

1 Parameters of water jet cutting

1.1 General

Due to the cutting process the shape and position deviation, cutting angle, edge geometry, entry and exit points as well as roughness are influenced.

1.2 Shape and position deviation

Machine capability and cutting process influence the shape and position deviation. The results are measured based on profiles.

Shape and position tolerances according to SN EN ISO 9013 chapter 5.

1.3 Cutting angle errors

The cutting angle error u (perpendicularity or inclination) is mainly influenced by cutting speed, material type and thickness and to a small extent also by the diameter of the cutting media and the machine technology.

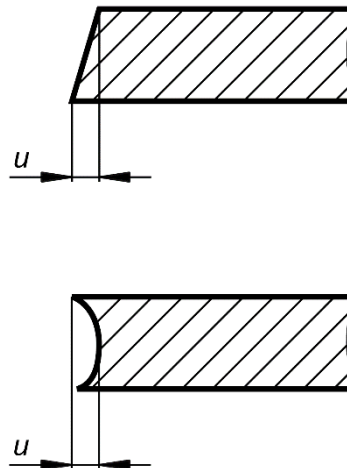


Figure 1 — Cross-sectional view of the workpiece

NOTE: The cutting angle error results from the process parameter change of the cutting gap top down. The profile is relevant for the workpiece contour (shape and position tolerance). The cutting angle error u is separately determined (figure 1).

1.4 Contour errors

Contour errors are the edge error j , corner radius r_E , cutting start and cutting end error t_1/t_2 . These are mainly influenced by cutting speed, material type and thickness, the diameter of the cutting media and to a small extent also by the machine technology.

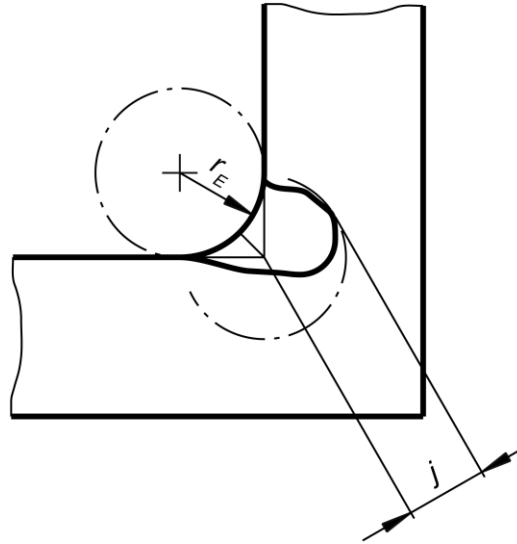


Figure 2 — Workpiece bottom view

NOTE: Contour errors mainly occur due to the cutting material flow.

1.4.1 Edge geometry

The corner error j defines contour deviations on the bottom side of the workpiece (figure 6).

1.4.2 Cutting start and end

The cutting start and end errors t_1/t_2 can be generally reduced by appropriate starting and ending strategies. Starting and end points should be positioned in areas where they aren't distracting (figure 7).

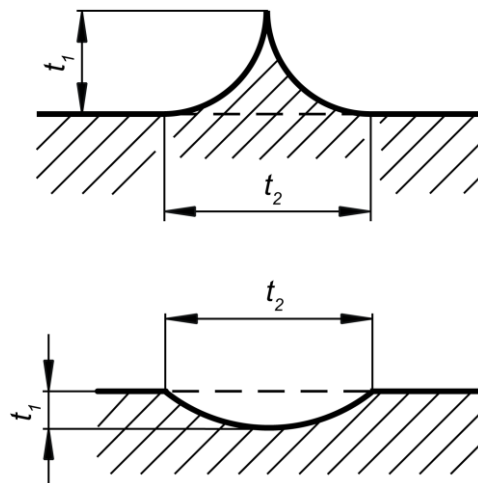
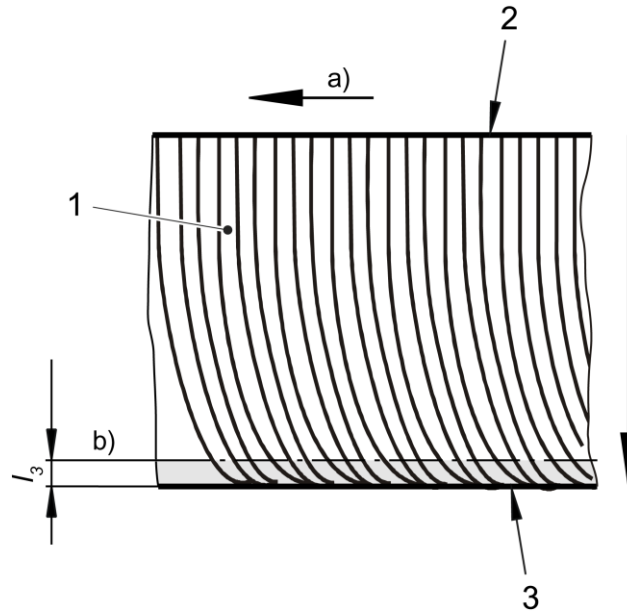


Figure 3 — Workpiece bottom view

1.5 Roughness

The roughness of the cutting surface is mainly influenced by the cutting speed, material type and thickness, and to a small extent by the cutting media and the process management.

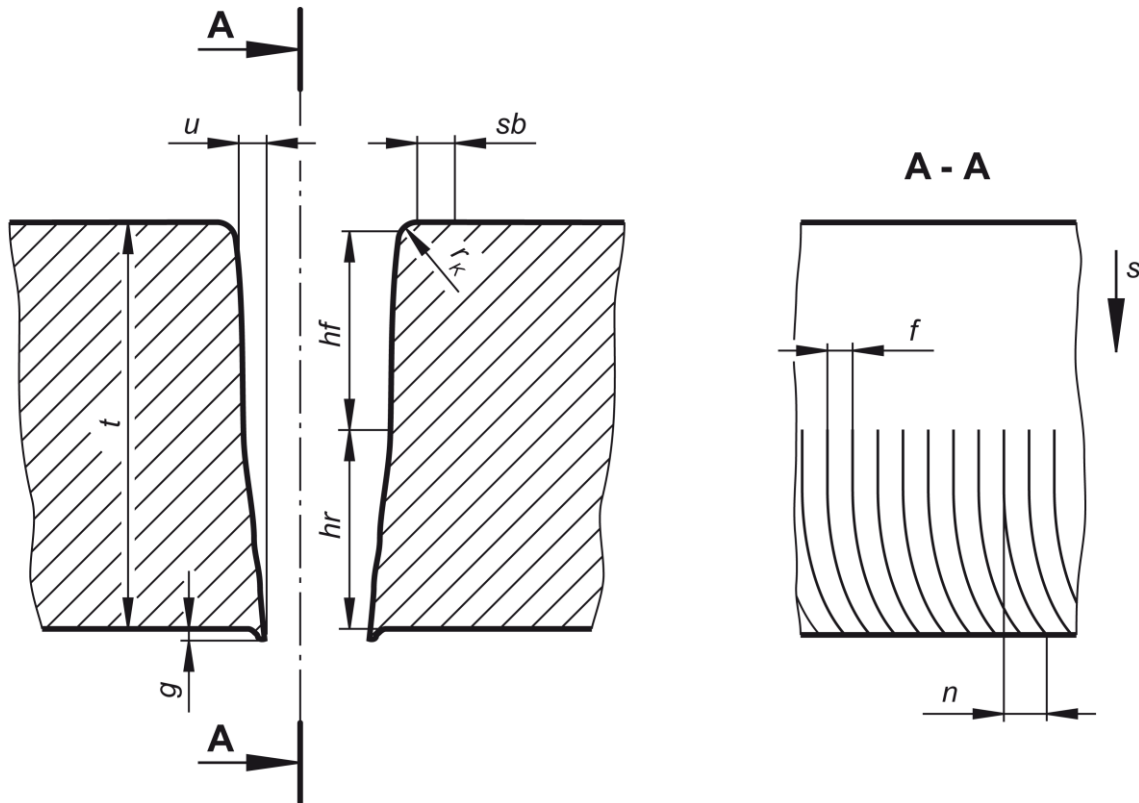


Key

- 1 Workpiece
- 2 Top side
- 3 Bottom side
- l_3 Area of greatest roughness
- a) Cutting direction
- b) Roughness measuring line

Figure 4 — View of cutting surface

NOTE: The greatest roughness is on the bottom side (figure 8).



1.6 Cutting gap of workpiece

Cross-sectional view of the workpiece

Cutting surface

Key

- g* Burr
- hf* Precision cut
- hr* Remaining area
- r_k* Edge radius
- sb* Area influenced by the jet
- t* Cutting thickness
- u* Cutting angle error
- f* Groove width
- n* Drag line separation
- s* Jet entry side

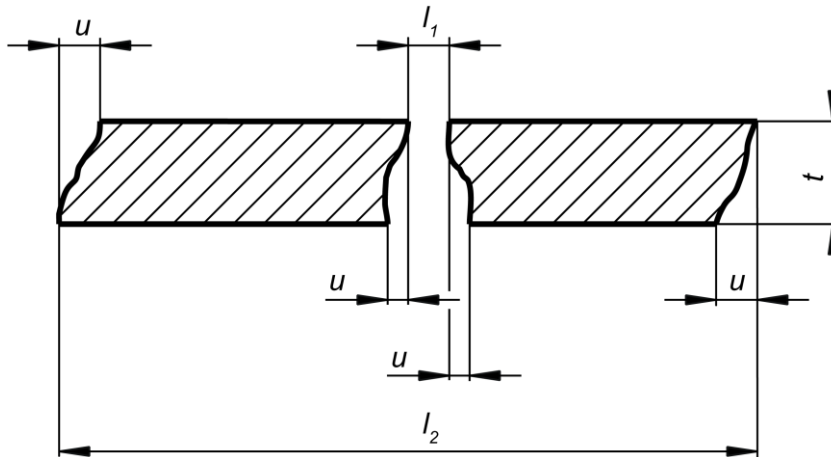
Figure 5 — Definitions at the cutting groove and the cutting surface

1.7 Profile

Profile measured over the edge that is created by vertical light projections of the workpiece.

The profile (nominal value) is relevant for cutting parts that have a cutting angle error u .

The profile of a cutting part corresponds to the maximum dimension for outer dimensions and the minimum dimension for inner dimensions.



Key

- l_1 Profile with inner dimensions
- l_2 Profile with outer dimensions
- t Cutting thickness
- u Cutting angle error

Figure 6 — Profiles

2 Symbols and measurement letters

For the application of this norm the following symbols for dimension specifications apply:

<i>f</i>	Groove width
<i>g</i>	Burr
<i>hf</i>	Precision cut
<i>hr</i>	Remaining area
<i>j</i>	Edge error
<i>n</i>	Groove flow
<i>Ra</i>	Roughness
<i>r_E</i>	Corner radius
<i>r_K</i>	Edge radius
<i>sb</i>	Area influenced by the jet
<i>t</i>	Cutting thickness
<i>t₁/t₂</i>	Cutting start and end errors
<i>u</i>	Cutting angle error

3 Quality of water jet cutting

3.1 Visual appearance of cutting surfaces

The appearance and quality of the cutting surface can vary heavily based on process parameters and materials.

The visual impression of abrasive water jet cut surfaces is similar to sandblasted surfaces.






3.2 Quality of cutting surfaces

With water jet cutting different cutting qualities and accuracies can be achieved that are categorised in five quality levels. They are defined by roughness, angle error, edge error, cutting start and end error. The cutting speed and the cutting media heavily influence the quality levels.

Table 1 — Quality levels (Example aluminium thickness 15 mm)

Q levels	Description	Cutting surface
Q5	This quality level results in highest shape accuracy of the workpiece and the lowest surface roughness. Q5 requires very low feed speeds. No visible grooving.	
Q4	This quality level stands out with the workpiece's high accuracy and the low surface roughness. Grooving is slightly visible.	
Q3	Typical process cut used in most cases for economical reasons. It offers a good quality with efficient feed speeds. Obvious grooving.	
Q2	Rough cut with obvious but periodic grooving without tears.	
Q1	The workpiece was divided with highest feed speed. The cutting surface shows clear irregularities (rough grooves, tears, cutting stop, releases etc.).	

Table2 — Quality levels for water jet cutting

Q levels	Roughness Ra [µm]	Angle error u [mm]	Edge error j [mm]	Cutting start and end errors t_1/t_2 [mm]	Thickness range [mm]					
					0	10	20	30	40	50.
Q5	3.2	< 0.05	< 0.25	< 0.1						
Q4	6.3	< 0.10	< 0.7	< 0.25						
Q3	12.5	< 0.20	< 1.5	< 0.5						
Q2	25	< 0.30	< 3.0	< 1.0						
Q1	50	> 0.30	> 3.0	> 1.0						

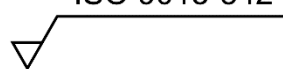
By adequate means the values can be individually influenced.

The listed limit values for thickness can vary based on the materials. Values deviating from the quality levels are to be agreed.

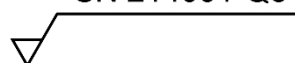
If individual criteria of quality levels aren't covered they need to be individually agreed and stated.

4 Details in technical documentation

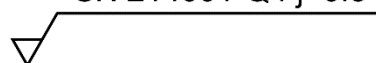
The requested quality levels and potential deviating individual criteria have to be stated on a symbol according SN EN ISO 1302 as follows:

ISO 9013-342


Example: Quality level 3 demanded, all values comply with table 2

SN 214001-Q3


Values deviating from the quality levels have to be agreed and stated as follows:

SN 214001-Q4 $j < 0.5$


Example: Quality level 4 demanded, the edge error j must not be higher than 0.5 mm.