

Optimization of knurling



The pitch corresponds to the workpiece circumference

In many cases the user does not notice the relationship between the pitch and the workpiece circumference, since the pitch already corresponds to the workpiece circumference.
The knurling wheel can compensate the distortion of the pitch to produce good knurling (see Figure 1).

The pitch does not optimally correspond to the workpiece circumference

The more unfavourable the pitch corresponds to the workpiece circumference, the more the knurling wheel has to compensate. This results in knurling of poor quality and reduces the tool life.

Effects on the knurling quality:

■ Form knurling:

The less favourable forming process (unnecessary strain on the material) results in a rough surface and reduced tool life. The sub-optimal penetration process causes material abrasion, which is formed into the knurling profile (indistinct profile flanks). This results in distortions of the knurling profile, which are evident in flattening of the profile and rounding of the tooth crest and tooth gullet (see Figure 2).

■ Cut knurling:

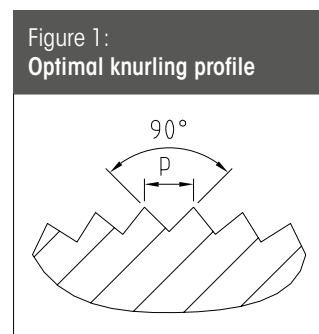
The sub-optimal penetration process of the knurling wheel results in indistinct profile flanks (shadowing). This results in distortions of the knurling profile, which are evident in flattening of the knurling profile and rounding of the tooth crest and tooth gullet (see Figure 2).

The pitch does not correspond to the workpiece circumference

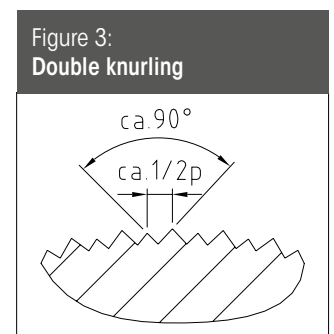
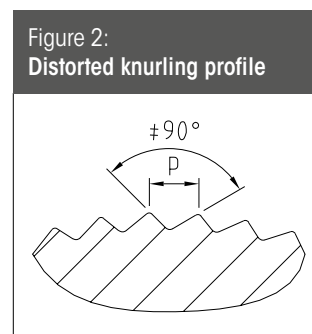
This is an extreme case. The knurling wheel cannot compensate the unfavourable relationship between the pitch and the workpiece circumference, or the profile is heavily distorted.

In the worst case this can result in "double knurling". The knurling wheel then no longer engages in the knurling profile after one workpiece rotation, but instead engages between the profile.

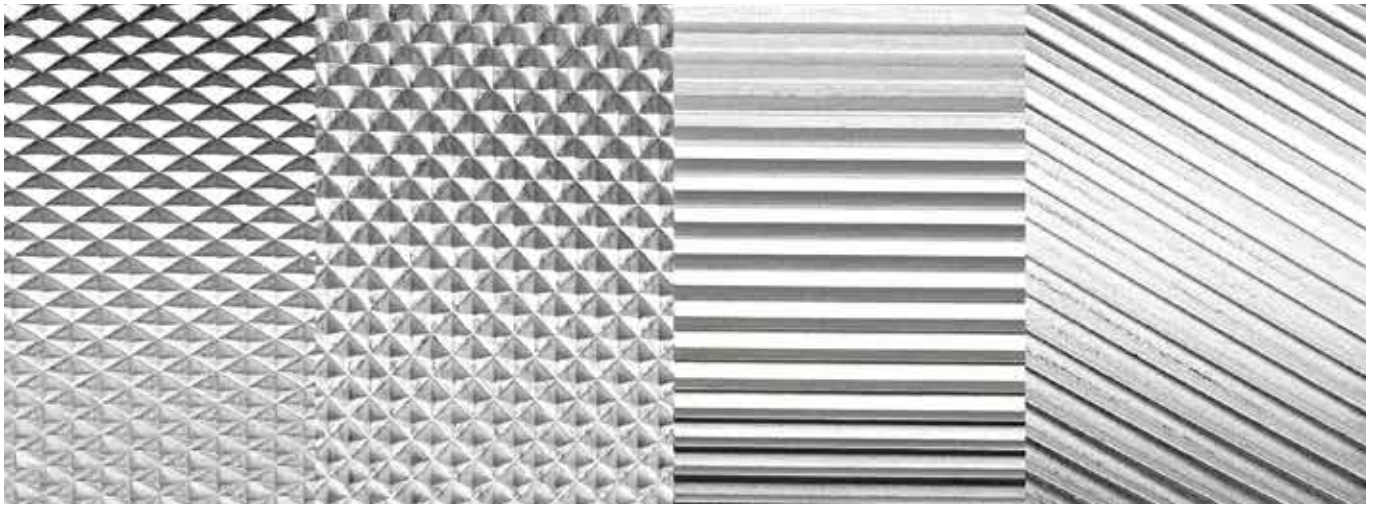
This is evident in the finer pitch of the knurling (see Figure 3).



p = pitch



Optimization of knurling



The knurling quality and the tool life can be improved substantially by optimising the knurling by changing the rough-turn diameter and/or the pitch.

The following procedure ensures systematic optimisation:

- **Correction of the rough-turn diameter until optimal knurling is achieved.**

Note:

Changing the rough-turn diameter by only a few hundredths of a millimetre has a substantial effect on the circumference {factor π (x 3.14...)} and can improve the knurling quality significantly.

If a correction is not possible (tolerances cannot be maintained; workpiece diameter should not be turned), then:

- **Check whether the pitch can be changed.**

If it is not possible to change the pitch, it is necessary to manufacture a special knurling wheel with optimised pitch (defined number of teeth/outer diameter of knurling wheel).

Consultation is provided by the Hommel+Keller application engineer on the basis of a workpiece drawing and information about the machine.

The calculation of the optimal pitch is conducted on the basis of approximate formulas. Due to influencing factors (such as differences in materials) further optimisation may be necessary.

Summary:

Customer requirements:

- Clear, distinct knurling profile
- Fully formed teeth
- No double knurling/no incomplete knurling

Solutions:

1) Optimisation measures by user:

- Correction of the rough-turn diameter
- Change of the pitch

2) Optimisation measures by Hommel+Keller:

- Optimisation by manufacturing a special knurling wheel:
- Calculation of the number of teeth allows development of a knurling wheel that is specially designed for the application based on the optimal relationship between the diameter and the number of teeth.