OPERATING MANUAL
CUT KNURLING TOOL C611

Please read this operating manual carefully. Correct assembly of the tool will save you set-up time and allow you to achieve optimal results.

KNURLING PROFILES AND PRODUCTION PROCESS

Series C611	
Machining direction	Knurling profiles on the workpiece: RAA; RBL 30° RBL 45°; RBR30° RBR45°
axial	Selection of knurling wheels: 1 x BR30° (right-hand use) 1 x BL30° (left-hand use); 1 x AA 1xBL15° (Left-hand use); 1 x AA 1xBR15° (Right-hand use)

Table 1: Knurling profiles

Ordering spare parts:

Please specify the tool number (including shank version) and the corresponding position number (see Figure 1).

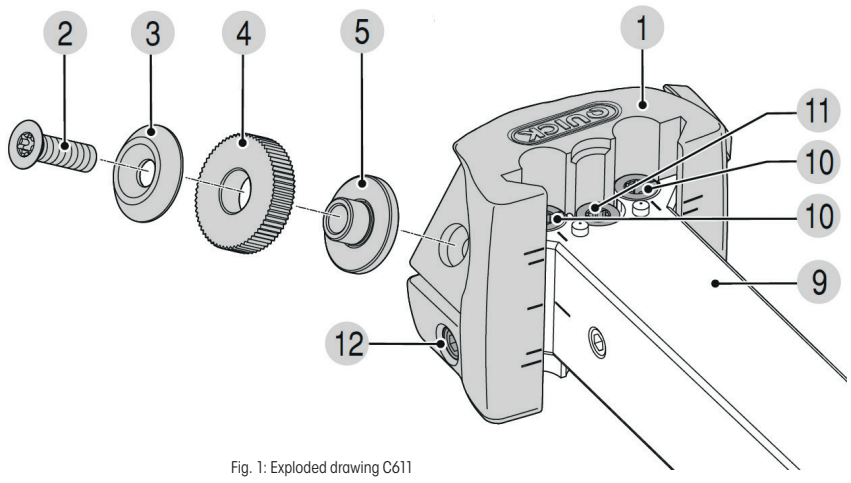


Fig. 1: Exploded drawing C611

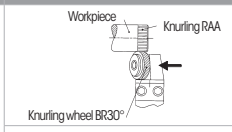
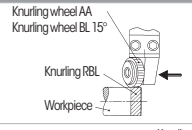
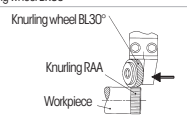
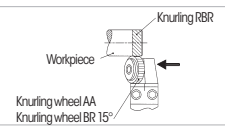
Knurling profile	Manufacturing process	Knurling profile	Manufacturing process
RAA knurl with straight pattern		RBL left-hand knurl 30° RBL left-hand knurl 45°	
		RBR right-hand knurl 30° RBR right-hand knurl 45°	

Table 2: Manufacturing process

1. General information

Produce a chamfer (30° – 45°) on the workpiece with a minimum width corresponding to half of the pitch of the knurling wheel on the start of the workpiece. The concentricity of the workpiece must be max. 0.03 mm.

2. Knurling wheel assem-

For assembling and/or changing the knurling wheel (Fig. 1, pos. 4), first loosen the countersunk screw (Fig. 1, pos. 2) completely and remove the knurling wheel and washer (Fig. 1, pos. 3). Then fit the knurling wheel and the washer on the bush (Fig. 1, pos. 5) and re-tighten with the countersunk screw.
Note: Torque specification in Table 3, chapter 8.
Ensure that the bearing surfaces of the knurl holders are free from chips and inspect regularly for damage.

TOOL ADJUSTMENT

3. Tool setting

① Clamping position
Clamp the tool at an angle of 90° to the workpiece.

② Centre height adjustment
For adjustment of the centre height, the mark on the shank (M) must be aligned with the marks on the tool head (Fig. 2).
It must be ensured that the appropriate mark is chosen for the relevant shank dimension.
For this purpose, loosen the eccentric pins (Fig. 3, pos. 10) inwards and adjust the tool head with the spindle (Fig. 3, pos. 11).
Note:
Variants with a shank measurement of 10/ 12/ 16 mm have only one eccentric pin!
Alternatively, the centre height can be adjusted with the accompanying adjustment gauge (refer to the accompanying supplementary information for this purpose).

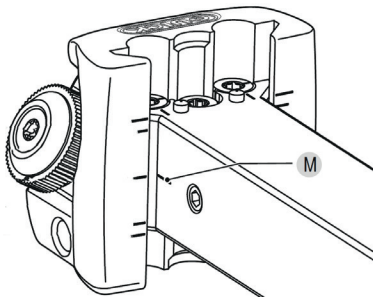


Fig. 2: Setting the centre height

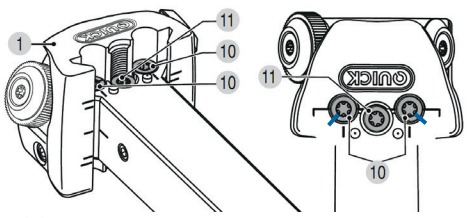


Fig. 3: Clamping the tool head

③ Clamping the tool head
After the centre height has been adjusted, clamp the eccentric pin (Fig. 3, pos. 10) outwards (Fig. 3, blue marks).
Note: Variants with a shank measurement of 10/ 12/ 16 have only one eccentric pin!
Attention: Eccentric pins must not be lubricated!

④ Clearance angle adjustment and checking the knurl impression
with correct use, the knurl impression is approx. 1/3 of the width of the knurling wheel (Fig. 4, ref. A).
The maximum knurl depth should only be a few hundredths.
Ensure that the front cut of the knurling wheel immerses in the material.
If there is a knurl impression as shown in Figure 4, ref. B, a correction of the tool must be carried out. For this purpose, tilt the tool slightly in the tool holder until the correct knurl impression is provided.

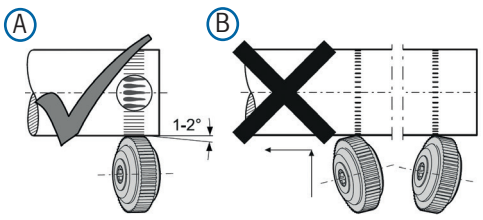


Fig. 4: Check of the knurl impression

⑤ Beginning of the knurling
The beginning of the knurling takes place approx. 1 mm after the beginning of the workpiece (Fig. 5, ref. A).
Attention: Do not start knurling in the middle/ in front of the component! (Fig. 5, ref. B)

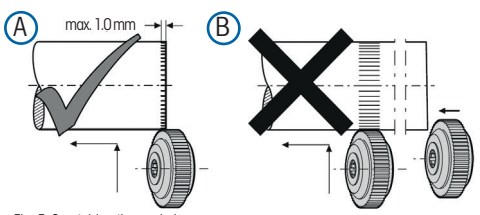


Fig. 5: Scratching the workpiece

4. Modularity of the knurl holder

This tool type can be used modularly in front of or behind the rotation centre. For this purpose, mount the countersunk screw (Fig. 1, pos. 2), washer (Fig. 1, pos. 3), knurling wheel (Fig. 1, pos. 4) and bush (Fig. 1, pos. 5) on the other side of the knurl holder. Refer also to the accompanying supplementary information.
Note: Use a knurling wheel with a different spiral angle, if necessary (cf. Table 1).

APPLICATION

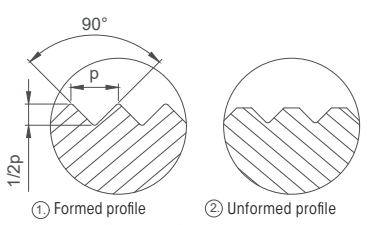
5. Setting of the profile depth and feed rate in X direction

The profile depth is set approx. 1mm behind the chamfer of the workpiece in the X direction and corresponds to approximately the half pitch p (with 90° flank angle), (cf. Fig. 6, ref. 1). After reaching the limit depth, the dwell time of the tool should be 3 – 10 revolutions of the workpiece. Then move in the Z-direction until the desired knurl width is achieved. Then disengage the tool while the spindle is rotating.

$$\text{Setting of the profile depth} = \frac{\text{Pitch}}{2}$$ With 90° flank angle

6. Checking the profile depth

The correct profile depth has been reached when the profile is knurled completely (Fig. 6, ref. 1). A new setting takes place when the profile is not completely formed
(Fig. 6, ref. 2). Re-adjustment in the profile is possible, because the knurling wheels catch in the existing profile.
For guideline values for feed rate and cutting speed, please refer to Table 5, chapter 10.



① Formed profile ② Unformed profile

Fig. 6: Different profile pattern

7. Correction of the knurl holder

If spiral formation occurs when producing an RAA profile (Fig. 7), it can be corrected by adjusting the knurl holder with the adjusting screws (Fig. 8, pos. 12a and 12b). For this purpose, unscrew screw 12a and adjust the inclination with screw 12b or vice versa. Then, re-tighten both screws.

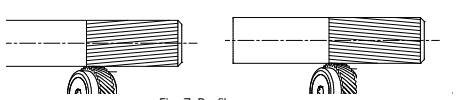


Fig. 7: Profile error

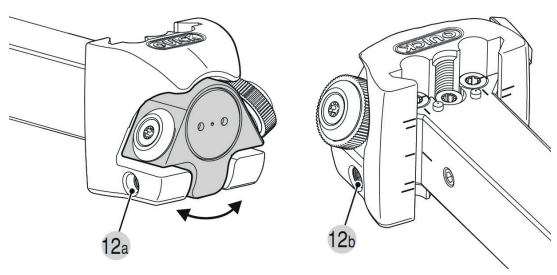


Fig. 8: Correction of the knurl holder

IMPORTANT

8. Manufacturer's recommendation

The countersunk screw (Fig. 1, pos. 2), bush (Fig. 1, pos. 5), washer (Fig. 1, pos. 3) and knurling wheel (Fig. 1, pos. 4) should be replaced after an appropriate number of cycles, no later than after appearance of considerable wear or deviating process parameters.
An adequate flow of coolant or cutting oil is recommended!
For this purpose, observe the correct use of the cooling unit and the instructions of the accompanying supplementary information.
Note: A material distortion of min. 0.03 mm and max. 0.1 mm can arise during the cut knurling.
If the countersunk screw (Fig. 1, pos. 2) loosens during the process, we recommend using LOCTITE® high-strength screw adhesive.
Ensure that the bearing surfaces of the knurl holders are free from chips and inspect regularly for damage.
Eccentric pins must be free from lubricant.
The optimal setting must be determined in the process.

Designation	Torque	Pos. no.
Countersunk screw M2.6	3.5 Nm	Fig. 1, pos. 2

Table 3: Torque specifications

9. Troubleshooting

Problem:	Reason / Cause:	Solution:
The knurled profile is not completely formed, surface on the tooth tip	The profile depth setting is not correct	Adjust the profile depth setting as specified in chapter 5
Knurled profile is uneven	– Deficient concentricity of the workpiece – Warpage of the workpiece due to excessive projection	– Over-turn workpiece diameter – Check extension length and clamping pressure – Support workpiece
Spirals are formed in the knurled profile	– Workpiece deflects – Incorrect setting or incorrect approach – Tilt of the cutting head incorrect	– Check extension length/support workpiece – Setting of the profile depth takes place in the component (cf. chapter 5) – Adjust the tilt of the cutting head (cf. chapter 7)
The finished diameter of the workpiece is not correct or has a cone	– The profile depth setting is not correct – Clearance angle adjustment of the tool is incorrect	– Adjust the profile depth setting as specified in chapter 5 – Correct the clearance angle as specified in chapter 3, reference 2

Table 4: Troubleshooting

10. Guidelines for cutting speed and feed rates

Material	Workpiece Ø [mm]	Knurling wheel Ø [mm]	Vc [m/min]		f [mm/rotation]					
					Radial		Axial			
							Pitch [mm]			
			from	to	from	to	> 0.3 < 0.5	> 0.5 < 1.0	> 1.0 < 1.5	> 1.5 < 2.0
Free-cutting steel	< 10	8.9 / 10 / 15	40	70	0.04	0.08	0.20	0.13	0.08	0.07
	10 – 40	15/25	50	90	0.05	0.10	0.28	0.18	0.14	0.10
	40 – 100	25 / 32 / 42	65	110	0.05	0.10	0.35	0.25	0.17	0.11
	100 – 250	25 / 32 / 42	65	110	0.05	0.10	0.42	0.28	0.18	0.13
	> 250	32/42	80	100	0.05	0.10	0.45	0.29	0.20	0.14
Stainless steel	< 10	8.9 / 10 / 15	22	40	0.04	0.08	0.14	0.09	0.06	0.05
	10 – 40	15/25	30	50	0.05	0.10	0.20	0.13	0.10	0.07
	40 – 100	25 / 32 / 42	35	60	0.05	0.10	0.25	0.18	0.12	0.08
	100 – 250	25 / 32 / 42	35	60	0.05	0.10	0.29	0.20	0.13	0.09
	> 250	32/42	45	55	0.05	0.10	0.31	0.21	0.14	0.10
Brass	< 10	8.9 / 10 / 15	55	100	0.04	0.08	0.22	0.14	0.09	0.08
	10 – 40	15/25	70	125	0.05	0.10	0.31	0.20	0.15	0.11
	40 – 100	25 / 32 / 42	90	155	0.05	0.10	0.39	0.28	0.18	0.12
	100 – 250	25 / 32 / 42	90	155	0.05	0.10	0.46	0.31	0.20	0.14
	> 250	32/42	115	140	0.05	0.10	0.49	0.32	0.22	0.15
Aluminium	< 10	8.9 / 10 / 15	70	120	0.04	0.08	0.12	0.08	0.05	0.04
	10 – 40	15/25	80	150	0.05	0.10	0.17	0.11	0.08	0.06
	40 – 100	25 / 32 / 42	110	160	0.05	0.10	0.21	0.15	0.10	0.07
	100 – 250	25 / 32 / 42	110	160	0.05	0.10	0.25	0.17	0.11	0.08
	> 250	32/42	130	150	0.05	0.10	0.27	0.18	0.12	0.08

Table 5: Cutting speed and feed rate

Art. no. 09PR0010 11/2019

Hommel+Keller Präzisionswerkzeuge GmbH
78554 Aldingen
www.hommel-keller.de