OPERATING MANUAL
CUT KNURLING TOOL C601 / C621

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

C601 / C621 series	
Machining direction	Knurling profiles on the workpiece: RAA / RBR30° RBR45°
axial	Selection of knurling wheels: 1x BR30° 1xAA 1xBR15°

Table 1: Knurling profiles

Ordering spare parts:

Please specify the tool number and the corresponding position number (see Figures 1 and 2).

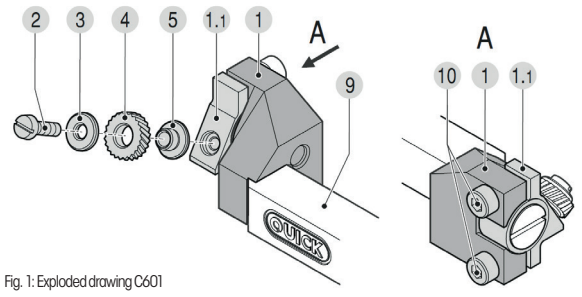


Fig. 1: Exploded drawing C601

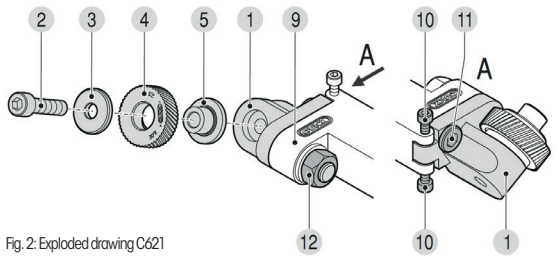


Fig. 2: Exploded drawing C621

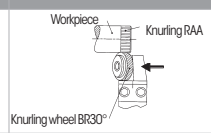
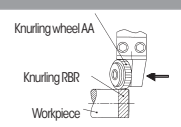
Knurling profile	Manufacturing process	Knurling profile	Manufacturing process
RAA knurl with straight pattern		RBR right-hand knurl 30°	

Table 2: Manufacturing process

TOOL ADJUSTMENT

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 centre height is integrated in the tool shank for version C601 and corresponds to the upper shank edge (Fig. 3).
With variant C621, the centre height corresponds to the centre of the screw (Fig. 4, ref. C).
The concentricity of the workpiece must be max. 0.03 mm.

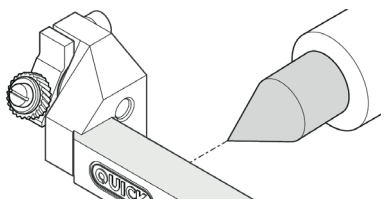


Fig. 3: C601 centre height

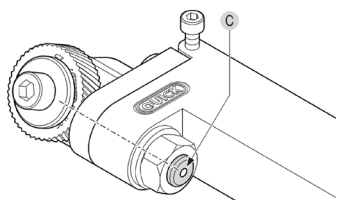


Fig. 4: C621 centre height

2. Knurling wheel assembly

For assembly and / or changing of the knurling wheel (Fig. 1 + Fig. 2, Pos. 4), first loosen the flat headed screw (Fig. 1, Pos. 2) or the cylinder head screw (Fig. 2, Pos. 2) completely and remove the knurling wheel and washer (Fig. 1, + Fig. 2, Pos. 3). Then fit the knurling wheel and the washer on the bearing bush (Fig. 1, + Fig. 2, Pos. 5) and re-tighten with the screw.
Observe the torque specification in Table 3, chapter 7.

3. Tool setting

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

② 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. 5, ref. A). The maximum immersion 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 5, ref. B, a correction of the tool must be carried out.
For this purpose, pivot the tool slightly in the tool holder until the correct knurl impression is provided.

③ Knurl beginning
The beginning of the knurling takes place approx. 1 mm after the beginning of the workpiece (Fig. 6, ref. A).
Caution: Do not start knurling in the middle/ in front of the work piece! (Fig. 6, ref. B)

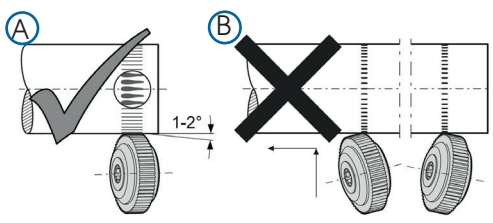


Fig. 5: Check of the knurl impression

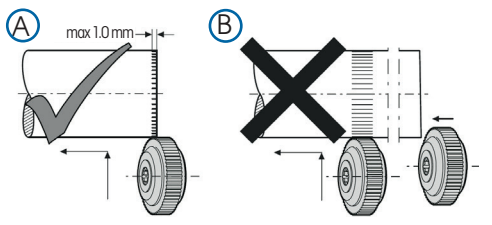


Fig. 6: Scratching the workpiece

APPLICATION

4. 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. 7). After reaching the limit depth, the residence 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.

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

5. Checking the profile depth

The correct profile depth has been reached when the profile is knurled completely (Fig. 7, ref. 1). A new setting takes place when the profile is not completely formed (Fig. 7, 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 9.

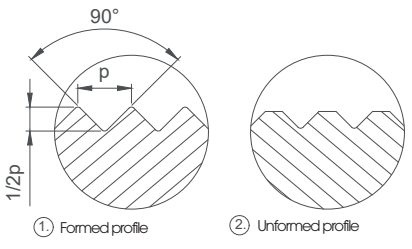


Fig. 7: Different profile pattern

6. Correction of the cutting head

If spirals form during production of a RAA profile (Fig. 8), it can be corrected by adjusting the knurling head with the adjusting screws (Fig. 9 + Fig. 10, Pos. 10).
Variant C601
Adjustment can take place directly with the two fine-adjusting screws (Fig. 9, Pos. 10). For this purpose, unscrew screw 10a and adjust the inclination with screw 10b or vice versa. After adjustment, tighten the opposite screw hand-tight.
Variant C621
For this tool type, the hexagonal nut must be loosened first (Fig. 10, Pos. 12). Then, loosen the clamping screw (Fig. 10, Pos. 11) and lightly tension again in order to achieve zero-play adjustment. For this purpose, unscrew screw 10a and adjust the inclination with screw 10b or vice versa. After adjustment, tighten the opposite screw hand-tight.
Re-tighten the clamping screw and hexagonal nut.

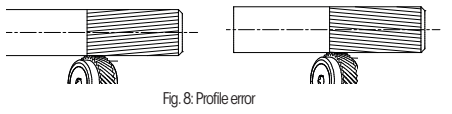


Fig. 8: Profile error

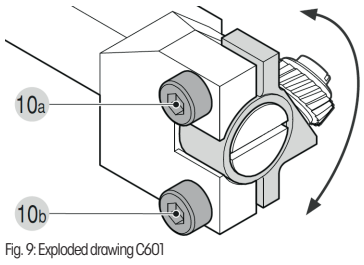


Fig. 9: Exploded drawing C601

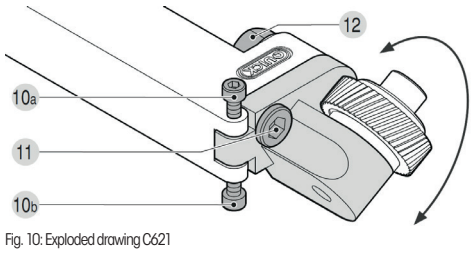


Fig. 10: Exploded drawing C621

IMPORTANT

7. Manufacturer's recommendation

The flat head screw (Fig. 1, Pos. 2) or cylinder screw (Fig. 2, Pos. 2), bearing bush (Fig. 1 + Fig. 2, Pos. 5) and washer (Fig. 1 + Fig. 2, Pos. 3) 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!
Note: A material displacement of min. 0.03 mm and max. 0.1 mm can arise during the cut knurling.
If the screws loosen (Fig. 1, Pos. 2; Fig. 2, Pos. 2) during the process, use of LOCTITE® threadlockers is highly recommended.
Ensure that the bearing surface of the knurl holder is free from chips and inspect it regularly for damage.
The optimal setting must be determined in the process.

Designation	Torque	Pos. no.
M2.6 flat head screw	0.85 Nm	Fig. 1, Pos. 2
M3 fine-adjusting screw	1.5 Nm	Fig. 1, Pos. 10
M10 Allen screw	5 Nm	Fig. 2, Pos. 2
M6 fine-adjusting screw	5 Nm	Fig. 2, Pos. 10
M10 cylinder head screw	5 Nm	Fig. 2, Pos. 11

Table 3: Torque specifications

8. 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 4
Knurled profile in knurled unevenly	– 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 4) – Adjust the tilt of the cutting head (cf. chapter 6)
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 4 – Correction with inclination of the tool holder

Table 4: Troubleshooting

9. Guidelines for cutting speed and feed rates

Material	Workpiece Ø [mm]	Knurling wheel Ø [mm]	Vc [m/min]		f [mm/U]					
					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 / 14.5 / 21.5	40	70	0.04	0.08	0.20	0.13	0.08	0.07
	10–40	8.9 / 14.5 / 21.5 / 32 / 42	50	90	0.05	0.10	0.28	0.18	0.14	0.10
	40–100	14.5 / 21.5 / 32 / 42	65	110	0.05	0.10	0.35	0.25	0.17	0.11
	100–250	21.5 / 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 / 14.5 / 21.5	22	40	0.04	0.08	0.14	0.09	0.06	0.05
	10–40	8.9 / 14.5 / 21.5 / 32 / 42	30	50	0.05	0.10	0.20	0.13	0.10	0.07
	40–100	14.5 / 21.5 / 32 / 42	35	60	0.05	0.10	0.25	0.18	0.12	0.08
	100–250	21.5 / 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 / 14.5 / 21.5	55	100	0.04	0.08	0.22	0.14	0.09	0.08
	10–40	8.9 / 14.5 / 21.5 / 32 / 42	70	125	0.05	0.10	0.31	0.20	0.15	0.11
	40–100	14.5 / 21.5 / 32 / 42	90	155	0.05	0.10	0.39	0.28	0.18	0.12
	100–250	21.5 / 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 / 14.5 / 21.5	70	120	0.04	0.08	0.12	0.08	0.05	0.04
	10–40	8.9 / 14.5 / 21.5 / 32 / 42	80	150	0.05	0.10	0.17	0.11	0.08	0.06
	40–100	14.5 / 21.5 / 32 / 42	110	160	0.05	0.10	0.21	0.15	0.10	0.07
	100–250	21.5 / 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. 09PRO0101/11/2018

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