OPERATING MANUAL
CUT KNURLING TOOL
C601

KNURLING PROFILES AND PRODUCTION PROCESS

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

Series C601	
Machining direction	Knurling profiles on the workpiece: RAA / RBR30° RBL45°
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)

Knurling profile	Manufacturing process	Knurling profile	Manufacturing process
RAA knurl with straight pattern	Workpiece, Knurling RAA, Knurling wheel BR30°	RBR right-hand knurl 30°	Knurling wheel AA, Knurling RBR, Workpiece

Table 2: Manufacturing process

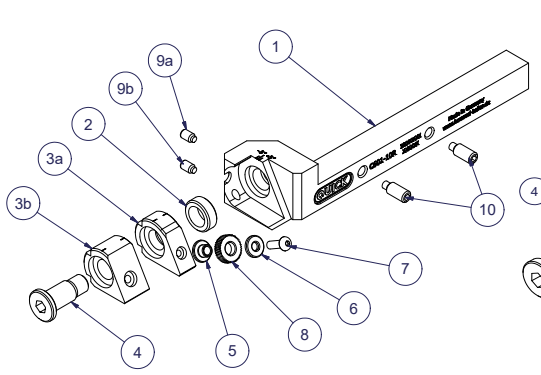

Fig. 1: Series C601-12R exploded drawing (swiss-type lathe)

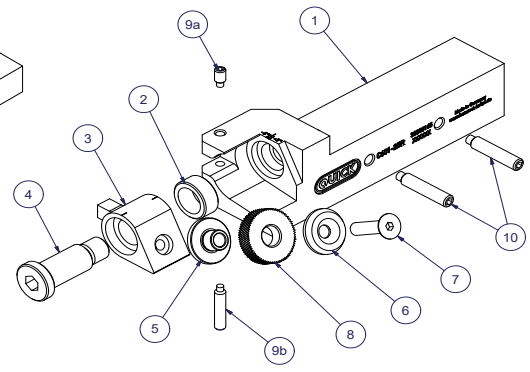

Fig. 2: Series C601-25R exploded drawing (CNC-lathe)

1. General

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 holder and corresponds to the upper shank edge (Fig. 1+2, Pos. 1)
The concentricity of the workpiece must be max. 0.03 mm.

TOOL SETTING

2. Knurling wheel assembly

For assembly and / or changing of the knurling wheel (Fig. 1 - Fig. 3, Pos. 8), first loosen the Countersunk screw (Abb. 1 - Fig. 3, Pos. 7) completely and remove the knurling wheel and washer (Fig. 1, - Fig. 3, Pos. 6). Then fit the knurling wheel and the washer on the bearing bush (Fig. 1 - Fig. 3, Pos. 5) and re-tighten with the screw (Fig. 1 - 3, Pos. 3).
Observe the torque specification in Table 3, chapter 7.
Ensure that the bearing surface of the knurl holder is free from chips and inspect regularly for damage.

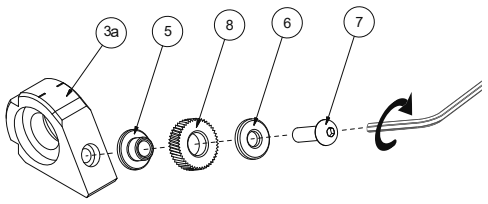

Fig. 3: Knurling wheel ssembly

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. 4, 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 4, 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.

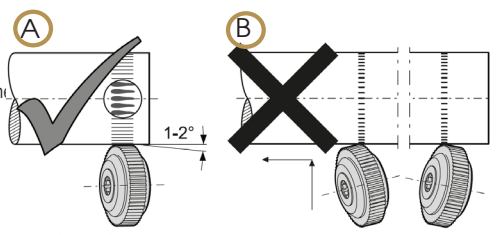

Fig. 4: Check of the knurl impression

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. 5, ref. B)

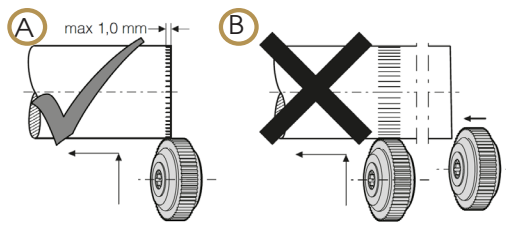

Fig. 5: Scratching the workpiece

④ Changing the Cutter holder
To use a different knurling wheel dimension the knurl carrier (Fig. 6, Pos. 3) can be replaced. To do this, loosen the axis (Fig. 6, Pos. 4) and replace the knurl carrier. Then mount the cutter holder and re-tighten with the axis (e.g. Fig. 6).

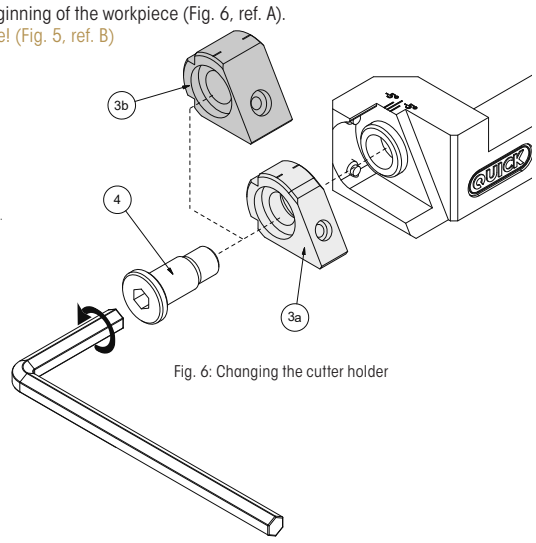

Fig. 6: Changing the cutter holder

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

Note: $\text{Setting of profile depth} = \frac{\text{Pitch}}{2}$

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.

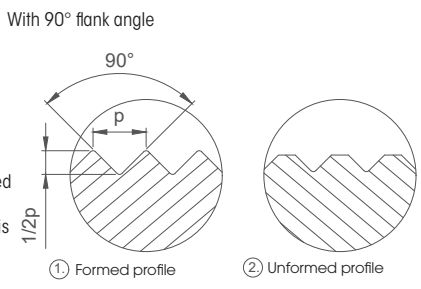

Fig. 7: Different profile pattern

6. Correction of the cutting head

If spirals form during production of an RAA profile (Fig. 8), it can be corrected by adjusting the knurling head with the adjusting screws (Fig. 9, Pos. 9a + 9b).
Adjustment can take place directly with the two fine-adjusting screws (Fig. 9, Pos. 9). For this purpose, unscrew screw 9a and adjust the inclination with screw 9b or vice versa. After adjustment, tighten the opposite screw hand-tight.

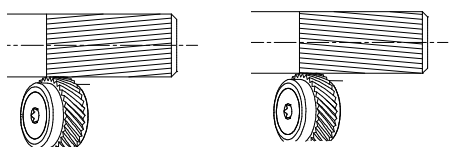

Fig. 8: Profile error

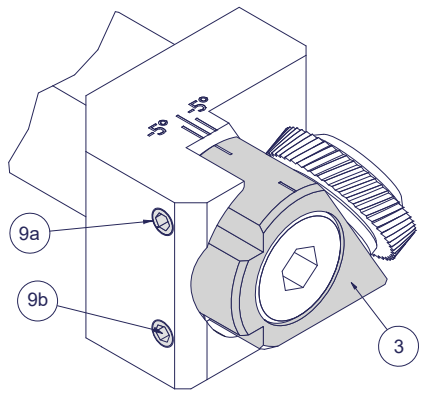

Fig. 9: Corretction of the tool head

7. Manufacturer's recommendation

Replace screw (Fig. 1+2, Pos. 7), bushing (Fig. 1+2, Pos. 5), knurling wheels (Fig. 1+2, Pos. 8) and washer (Abb. 1+2, Pos. 6) after a reasonable number of cycles. no later than upon appearance of significant wear or deviating process parameters.
An adequate flow of coolant 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.

Bezeichnung	Drehmoment	Pos. Nr.
M3 Countersunk screw	1,5 Nm	Fig. 1, Pos. 7
M Countersunk screw	6 Nm	Fig. 2, Pos. 7
M3 Cylindrical Pin	1,5 Nm	Fig. 1 + 2, Pos. 9

Table 3: Torque specifications

8. Troubleshooting

IMPORTANT

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 3) – 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: Trouble shooting

9 . 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

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