OPERATING MANUAL
FORM KNURLING TOOL F751

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

F751 series	
Machining direction	Knurling profiles on the workpiece: 
radial / radial and axial	Selection of knurling wheels: 2 x AA | 2 x BR | 2 x BL | 1 x BR 1 x BL

Table 1: Knurling profiles

Ordering spare parts:

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

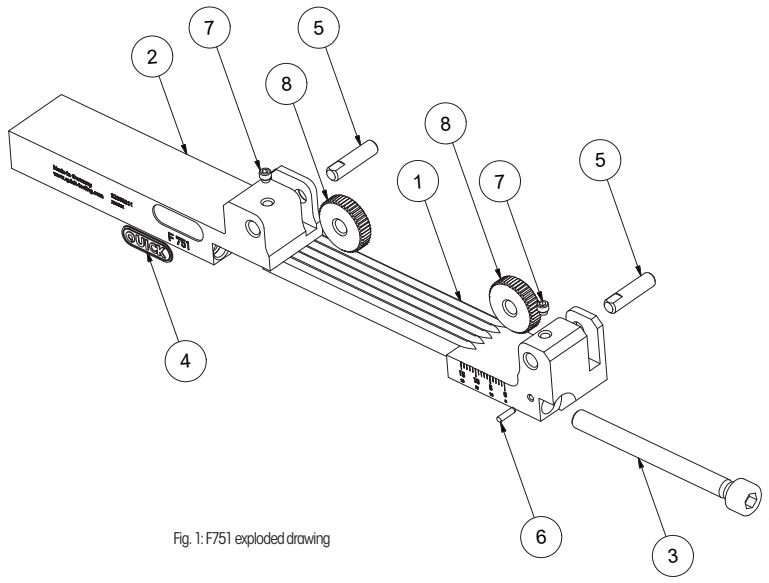


Fig. 1: F751 exploded drawing

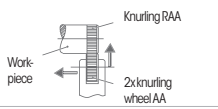
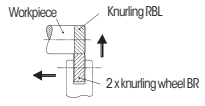
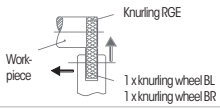
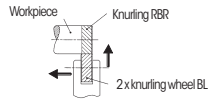
Knurling profile	Manufacturing process	Knurling profile	Manufacturing process
RAA knurl with straight pattern		RBL left-hand knurl 30°/45°	
RGE left / right-hand knurl, raised points, 30°/45°		RBR right-hand knurl 30°/45°	

Table 2: Manufacturing process

TOOL ADJUSTMENT

1. General information

This tool is designed exclusively for use in Swiss-type lathes.

2. Knurling wheel assembly

For installation or replacement of the knurling wheels, loosen the two threaded pins (Fig. 1, Pos. 7) and remove the axle pin (Fig. 1, Pos. 5) and knurling wheels (Fig. 1, Pos. 8). Then mount the new knurling wheels with the axle pins and clamp with the threaded pin. Ensure that the axle pin is clamped on the planar surface.

3. Tool setting

Working area adjustment:

For adjustment of the working area, distance A must be defined first (Fig. 2). This value is determined based on the following calculation:
Distance A = desired finished diameter of the workpiece – nominal pitch of the knurling wheel

Example: Desired finished diameter = 10 mm, pitch 1.2 mm
Distance A = 10 mm – 1.2 mm = 8.8 mm

Observe: This calculation only applies for a 90° flank angle

In order to be able to adjust this working area, adjust the front slider and knurling wheel by turning the spindles (Fig. 1, Pos. 3).
A calliper gauge is useful for measuring the distance.
Note: Observe the thread play!

4. Clamping position of tool

The clamping of the tool takes place by tensioning it in the toolholder.
Additional clamping with a clamping screw is not necessary.

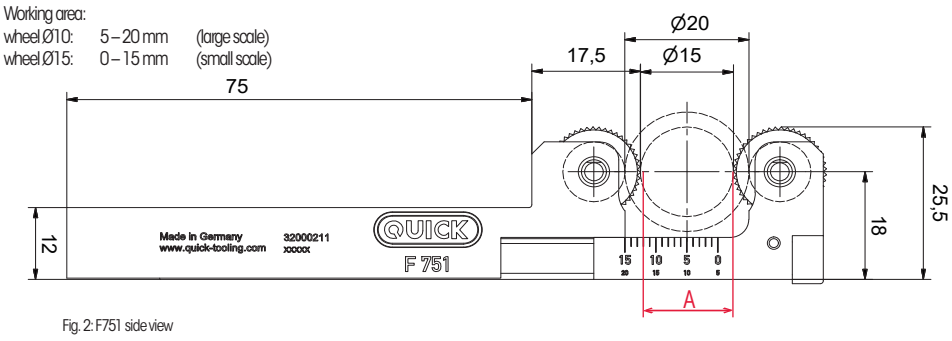


Fig. 2: F751 side view

Note: The centre height can be determined after use with the value 12, or 18 (Fig. 2)

5. Approach position of the tool

After the tool has been clamped in the toolholder, the approach of the workpiece can begin.
A rough guideline value for the approach position of the centre of rotation in the Y-direction depends on the knurling wheels which are used and the workpiece diameter to be machined (Fig. 2).

wheel Ø15 mm: 17.5 mm + radius of the workpiece
wheel Ø10 mm: 15 mm + radius of the workpiece

APPLICATION

6. Feed rate in workpiece direction

After the working area has been adjusted, the tool can approach the workpiece.
With the value calculated above (chapter 3), the centre point of the workpiece can be determined exactly in the Y-direction. For an optimal process, approach the workpiece gently and check the approach position.
Then move the tool to the workpiece zero point until the two knurling wheels are flush with the diameter of the workpiece (Fig. 3.).
Then the limit position of the setting is reached. The feed rate (Tab. 5, chapter 11) must be observed during the process. After reaching the limit position, the residence time of the tool should be between 3 and 10 revolutions of the workpiece.
Then disengage the tool while the spindle is rotating.
Note: The axis designation can deviate depending on the machine manufacturer.

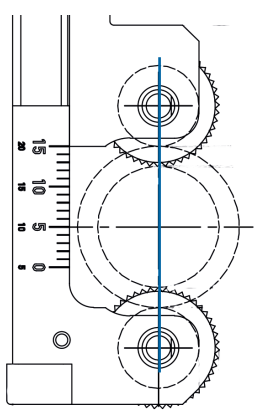


Fig. 3: Limit position during knurling

7. Feed rate in Z direction

In case of knurling in the axial direction, first move to the workpiece zero point and add a residence time of 3–10 rotations after reaching the limit position (see chapter 6).
Then move in the Z-direction in parallel to the axis until the desired knurl width is achieved. After the limit position is reached, the residence time should be approx. 3 to 10 revolutions.
Then disengage the tool while the spindle is rotating. For guideline values for feed rate and cutting speed, please refer to chapter 12.

8. Checking the profile depth

The profile is completely knurled when the tooth tips are closed (Fig. 4, ref. 1).
If the profile is not completely knurled (Fig. 4, ref. 2), reduce the working area and run over the component again. Running into the workpiece again is possible, because the knurling wheels catch in the existing profile.
Note: A guideline for calculation of the material displacement is provided in chapter 12, Tables 6 – 8.
This depends on the knurling profile, workpiece diameter and pitch.

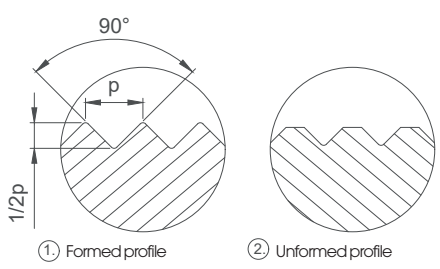


Fig. 4: Different profile pattern

9. Manufacturer's recommendation

The axis pins (Fig. 1, Pos. 5) and knurling wheels (Fig. 1, Pos. 8) should be replaced after an appropriate number of cycles, no later than after appearance of considerable wear or deviating process parameters. The slot of the jaws must also be inspected for wear or widening.
An adequate flow of coolant or cutting oil is recommended!
Note: Always use knurling wheels with the same pitch!

Designation	Torque	Pos. no.
M3 threaded pin	1.5 Nm	Fig. 1, Pos. 7

Table 3: Torque specifications

10. Troubleshooting

Problem:	Reason / Cause:	Solution:
The knurled profile is not completely formed, surface on the tooth tip	– The profile depth setting is not correct – Radial setting not down to limit depth	– Adjust distance A as specified in chapter 3 – Move in the workpiece direction to the workpiece zero point (see chapter 6)
The profile has a double knurling	– Feed rate incorrect – Profile depth too large – Residence time in the engagement too long	– Adjust feed rate according to chapter 11 (see Table 5) – Correct distance A as specified in chapter 3 – Residence time should be between 3 and 10 revolutions of the workpiece
Spangle collets on the profile	Residence time of the tool in the engagement too long	Residence time should be between 3 and 10 revolutions of the workpiece
Excessive material displacement at knurling end (axial)	– Feed rate value incorrect – Profile depth is not correct	– Adjust feed rate as specified in chapter 11 – Adjust distance A as specified in chapter 3
The finished diameter of the workpiece is too small	– Adjustment depth too large, overpressure on the profile	– Adjust distance A as specified in chapter 3 – Observe material displacement as specified in chapter 12
Overpressure on the profile	Depth adjustment too large	Correct distance A as specified in chapter 3

Table 4: Troubleshooting

IMPORTANT

11. 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	10/15/20	20	50	0.04	0.08	0.14	0.09	0.06	0.05
	10 – 40	10/15/20/25	25	55	0.05	0.10	0.20	0.13	0.10	0.07
	40 – 100	15/20/25	30	60	0.05	0.10	0.25	0.18	0.12	0.08
	100 – 250	20/25	30	60	0.05	0.10	0.30	0.20	0.13	0.09
	> 250	25	30	60	0.05	0.10	0.32	0.21	0.14	0.10
Stainless steel	< 10	10/15/20	15	40	0.04	0.08	0.12	0.08	0.05	0.04
	10 – 40	10/15/20/25	20	50	0.05	0.10	0.17	0.11	0.09	0.06
	40 – 100	15/20/25	25	50	0.05	0.10	0.21	0.15	0.10	0.07
	100 – 250	20/25	25	50	0.05	0.10	0.26	0.17	0.11	0.08
	> 250	25	25	50	0.05	0.10	0.27	0.18	0.12	0.09
Brass	< 10	10/15/20	30	75	0.04	0.08	0.15	0.09	0.06	0.05
	10 – 40	10/15/20/25	40	85	0.05	0.10	0.21	0.14	0.11	0.07
	40 – 100	15/20/25	45	90	0.05	0.10	0.26	0.19	0.13	0.08
	100 – 250	20/25	45	90	0.05	0.10	0.32	0.21	0.14	0.09
	> 250	25	45	90	0.05	0.10	0.34	0.22	0.15	0.11
Aluminium	< 10	10/15/20	25	60	0.04	0.08	0.18	0.11	0.08	0.06
	10 – 40	10/15/20/25	30	65	0.05	0.10	0.25	0.16	0.13	0.09
	40 – 100	10/20/25	35	70	0.05	0.10	0.31	0.23	0.15	0.10
	100 – 250	20/25	35	70	0.05	0.10	0.38	0.25	0.16	0.11
	> 250	25	35	70	0.05	0.10	0.40	0.26	0.18	0.13

Table 5: Cutting speed and feed rate

12. Material displacement

Pitch [mm]		0.3	0.4	0.5	0.6	0.7	0.8	1.0	1.2	1.5	1.6	2.0
Material	Workpiece Ø [mm]	Enlargement of workpiece diameter in mm										
Free-cutting steel	5	0.08	0.14	0.18	0.22	0.27	0.29	0.35	0.50	–	–	–
	15	0.08	0.14	0.18	0.23	0.30	0.40	0.44	0.50	0.60	0.65	0.70
	25	0.08	0.15	0.23	0.24	0.28	0.35	0.44	0.53	0.62	0.70	0.98
Stainless steel	5	0.10	0.15	0.20	0.25	0.28	0.30	0.42	0.41	–	–	–
	15	0.10	0.15	0.19	0.25	0.30	0.34	0.45	0.51	0.60	–	–
	25	0.10	0.14	0.20	0.26	0.31	0.33	0.43	0.50	0.62	–	–
Brass	5	0.08	0.12	0.18	0.20	0.21	0.22	0.25	0.28	–	–	–
	15	0.10	0.14	0.20	0.26	0.28	0.29	0.35	0.41	0.44	0.48	0.55
	25	0.10	0.15	0.20	0.25	0.28	0.30	0.36	0.43	0.46	0.50	0.53
Aluminium	5	0.09	0.15	0.19	0.23	0.28	0.30	0.41	0.40	–	–	–
	15	0.10	0.15	0.19	0.26	0.29	0.33	0.45	0.51	0.57	0.65	–
	25	0.09	0.15	0.19	0.26	0.29	0.32	0.45	0.52	0.59	0.65	0.75

Table 6: Knurling profile acc. to DIN82: RAA

Pitch [mm]		0.3	0.4	0.5	0.6	0.7	0.8	1.0	1.2	1.5	1.6	2.0
Material	Workpiece Ø [mm]	Enlargement of workpiece diameter in mm										
Free-cutting steel	5	0.11	0.15	0.20	0.24	0.28	0.34	0.45	0.55	–	–	–
	15	0.11	0.15	0.22	0.26	0.30	0.35	0.45	0.52	0.67	0.73	0.85
	25	0.11	0.14	0.23	0.25	0.28	0.36	0.45	0.56	0.70	0.72	0.90
Stainless steel	5	0.09	0.14	0.19	0.25	0.31	0.34	0.45	0.52	–	–	–
	15	0.12	0.20	0.23	0.31	0.35	0.40	0.51	0.62	0.66	0.73	0.97
	25	0.12	0.18	0.24	0.27	0.37	0.39	0.49	0.59	0.80	0.84	0.96
Brass	5	0.10	0.14	0.20	0.23	0.24	0.28	0.33	0.37	–	–	–
	15	0.10	0.15	0.21	0.23	0.24	0.31	0.41	0.47	0.53	0.55	0.63
	25	0.11	0.15	0.22	0.22	0.25	0.30	0.40	0.45	0.55	0.61	0.68
Aluminium	5	0.12	0.14	0.21	0.24	0.29	0.34	0.41	0.51	–	–	–
	15	0.12	0.18	0.23	0.26	0.36	0.40	0.50	0.56	0.56	0.61	0.75
	25	0.12	0.18	0.25	0.28	0.37	0.39	0.50	0.58	0.77	0.82	0.96

Table 7: Knurling profile acc. to DIN82: RBL30°/RBR30°

Pitch [mm]		0.3	0.4	0.5	0.6	0.7	0.8	1.0	1.2	1.5	1.6	2.0
Material	Workpiece Ø [mm]	Enlargement of workpiece diameter in mm										
Free-cutting steel	5	0.12	0.16	0.20	0.25	0.33	0.41	0.55	0.65	–	–	–
	15	0.13	0.22	0.30	0.32	0.35	0.41	0.52	0.62	0.67	0.81	0.95
	25	0.12	0.18	0.28	0.32	0.35	0.38	0.55	0.67	0.77	0.87	0.98
Stainless steel	5	0.11	0.20	0.25	0.30	0.36	0.39	0.55	0.55	–	–	–
	15	0.10	0.14	0.21	0.24	0.29	0.34	0.43	0.53	0.66	0.72	0.88
	25	0.11	0.13	0.20	0.25	0.28	0.32	0.44	0.52	0.67	0.70	0.83
Brass	5	0.12	0.13	0.16	0.20	0.24	0.28	0.32	0.38	–	–	–
	15	0.12	0.16	0.18	0.24	0.28	0.30	0.39	0.40	0.48	0.52	0.63
	25	0.12	0.17	0.22	0.23	0.27	0.30	0.38	0.41	0.48	0.50	0.63
Aluminium	5	0.10	0.15	0.21	0.25	0.33	0.36	0.50	0.57	–	–	–
	15	0.11	0.14	0.20	0.25	0.28	0.33	0.43	0.54	0.67	0.71	0.89
	25	0.11	0.15	0.22	0.25	0.29	0.34	0.44	0.53	0.68	0.69	0.88

Table 8: Knurling profile acc. to DIN82: RGE30°

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