Modular ballpoint pen with engraving

Ballpoint pen

This modular ballpoint pen fits well in the hand and can be manufactured in a material mix of aluminum, brass and/or plastic, in two lengths for different hand sizes, and with a personal engraving. The ballpoint pen was developed by the BBS-Burgdorf Vocational Schools in Burgdorf, Germany. It is custom made and awarded on special occasions.

The ballpoint pen, crafted from six individually turned parts, is a pleasure to use.

All information required for production, including drawing set, tool data, workplan and NC programs are compiled below.

www.siemens.com/cnc4you

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1. Safety note

The use of machinery always entails numerous hazards. The standard and statutory safety regulations must therefore also be complied with when manufacturing the ballpoint pen.

2. Preliminary remarks

The following description is intended for operators of CNC machines who have experience with or knowledge of the SINUMERIK CNC. All technology data listed here correspond to the machines, tools, materials, workplans and drawings used in the manufacture of the sample. For remanufacturing purposes, they only serve as a model, on account of the diverse conditions prevailing in other workshops. Trouble-free remanufacturing should nevertheless be possible in most cases.

The program was generated and tested on a CNC turning machine with a 12-position tool turret. The machine was equipped with a SINUMERIK 840D sl and a SINUMERIK Operate V4.05, SP02 HF2 user interface. As a rule, the program can be easily adapted to other SINUMERIK versions, such as other SINUMERIK Operate software versions. Simulations and necessary changes, such as zero point adjustments, should always be carried out.

All CAD drawings, programs and manufacturing descriptions for the workpieces can be downloaded for free at **www.siemens.com/cnc4you**

We offer you the following files and formats:
NC programs, PDF drawings, 3D data

3. Workpiece blanks/parts list

Depending on the specified material combination:

- Brass (CuZn39Pb3), round material Ø 20 mm, maximum length approx. 300 mm
- Aluminum (ALCuMgPb), round material Ø 20 mm, maximum length approx. 300 mm
- Plastic (PVCR20), round material Ø 20 mm, maximum length approx. 300 mm

The material required depends on the combination of materials out of which the ball-point pen is to be manufactured (one material only, two or three materials)

For the fixtures:

- Steel (11SMn30+C/+SH), round material Ø 35 mm

Purchased parts:

- 1 giant refill (recommended: Schneider Slider 755 XB)
- 1 M8 stud screw (10 mm long)
- 1 stud screw for the end stopper fixture (M5x25)

4. Turning machine and work plans

- DMG Ecoturn 310 CNC turning machine
  SINUMERIK 840 D with SINUMERIK Operate V4.05 + SP02

Part programs:

- Programs for manufacturing the fixtures required:
  - Kugelschreibervorr_01.MPF
  - Kugelschreibervorr_02.MPF
  - Kugelschreibervorr_03 _M.MPF
  - Kugelschreibervorr_03 _W.MPF
  - Kugelschreibervorr_04.MPF
  - Kugelschreibervorr_05.MPF


Programs for manufacturing the individual parts of the ballpoint pen:

- Kugelschrkappe01.MPF
- Kugelschrkappe02.MPF
- KugelschrSpitze_01.MPF
- KugelschrSpitze_02.MPF
- KugelschrSchaft1_01.MPF
- KugelschrSchaft1_02.MPF
- KugelschrSchaft2_01.MPF (with engraving)
- KugelschrSchaft2_02.MPF
- KugelschrSchaft3_01_M.MPF (for short version: KugelschrSchaft3_01_W.MPF)
- KugelschrSchaft3_02_M.MPF (for short version: KugelschrSchaft3_02_W.MPF)
- KugelschrEndstopfen_01.MPF
- KugelschrEndstopfen_02.MPF (with engraving)


5. Tools used

Turning, drilling and milling tools for machining the **ballpoint pen components:**

Tools for turning machine

Magazine location	Tool/short name	Description
1	BOHRER_K_VHM_7.0 (DRILL_K_VHM_7.0)	
2	GEWINDEBOHRER_M8 (TAPDRILL_M8)	
	GEWINDEBOHRER_M8 (TAPDRILL_M8)	Virtual second cutting edge as endstop
3	BOHRER_K_VHM_4.8 (DRILL_K_VHM_4.8)	
4	BOHRER_K_VHM_2.8 (DRILL_K_VHM_2.8)	
5	GRAVUR_STICHEL (ENGRAVING_BURIN)	Driven tool
6	GEWINDEB.HSS_M10x1 (TAPDRILL.HSS_M10x1)	
7	53_BOHRER_VHM_10.2 (53_DRILL_VHM_10.2)	
8	GRAVUR_STICHEL_8.0 (ENGRAVING_BURIN_8.0)	Driven tool
9	SCHLICHTER_ueberkopf (FINISHINGTOOL_inverse)	For two-sided machining in the opposite direction to the thread of the fixtures
10	Gewinde_Sandvik_1.0 (Thread_Sandvik_1.0)	
11	EINSTECHER_R1mm (PLUNGE_CUTTER_R1mm)	
12	BOHRER_K_VHM_9.0 (DRILL_K_VHM_9.0)	

Turning, drilling and milling tools for machining the **fixtures:**

Tools for turning machine

Magazine location	Tool/short name	Description
1	01_Schrupper_0.8 (01_Roughing_Tool_0.8)	
	01_Schrupper_0.8 (01_Roughing_Tool_0.8)	Virtual second cutting edge as endstop
2	Abstecher_HHW_4MM (PartingTool_HHW_4MM)	
3	52_BOHRER_VHM_4.2 (52_DRILL_VHM_4.2)	
4	70_Gewinde-HSS_M5 (70_Thread-HSS_M5)	
5	02_Schlichter_R0.4 (02_FinishingTool_R0.4)	
6	GEWINDEB.HSS_M10x1 (TAPDRILL.HSS_M10x1)	
7	53_BOHRER_VHM_10.2 (53_DRILL_VHM_10.2)	
8	GRAVUR_STICHEL_8.0 (ENGRAVING_BURIN_8.0)	Driven tool
9	SCHLICHTER_ueberkopf (FINISHINGTOOL_inverse)	For two-sided machining in the opposite direction to the thread of the fixtures
10	Gewinde_Sandvik_1.0 (Thread_Sandvik_1.0)	
11	EINSTECHER_R1mm (PLUNGE_CUTTER_R1mm)	
12	BOHRER_K_VHM_9.0 (DRILL_K_VHM_9.0)	

6. Turning individual parts

The ballpoint pen comprises six turned parts which are manufactured in a material mix of aluminum, brass and/or plastic.

- Cap
- Tip
- Shaft 1
- Shaft 2 (with engraving)
- Shaft 3 (short or long version)
- End stopper (with engraving)

The turned parts are machined using the part programs listed below.

The work plan comprises four production steps. After each section, a programmed stop is implemented (M0). The work plan is then continued with NC-START. The new zero point must be observed for each new production step.

Work steps on the turning machine (to be repeated for each workpiece):

1. Approach the reference point of the machine.
2. Read in the tool list or zero offsets KUGELSCHREIBER_TMZ.INI (only required once).
3. Measure tools and enter them in the tool list.
4. Insert tools in the magazine.

For each part program:

5. Read in the part program for the first-side machining.
6. Only with workpiece shaft 2: Modify the text to be engraved in the part program editor as required.
7. Clamp workpiece, initially using a short clamping length (approx. 10 mm).
8. Start the part program for first side machining, tap cutting edge is positioned as stop, programmed stop (M0).
9. Clamp the workpiece to set the workpiece zero to stop.
10. Start the manufacturing process / continue part program execution with NC-Start.
11. Turn the first side, cut off except for remaining core; the first side machining program ends. Break off the blank and screw it onto the fixture provided.


12. Clamp the fixture. The clamping length is defined by the contact between the flange of the fixture and the clamping jaw.
13. Read in the program for two-sided machining of the relevant part.
14. Start the two-sided machining process with NC-Start.
15. Before unclamping the workpiece, check the close fit of the ballpoint pen tip and end stopper by fitting the ballpoint pen cap (see description below).
16. Carefully unscrew the finished workpiece from the fixture (danger of deformation or surface damage).
17. Repeat the work sequence for the next workpiece from step no. 5

Work sequence when turning individual parts

First of all, turn the fixtures. The work sequence is the same as described above, with the exception that the partly worked fixtures are also directly clamped during the two-sided machining process, whereas for the ballpoint pen parts, two- sided machining is performed using special fixtures in order to protect the surface.

Regarding the ballpoint pen parts, we recommend that you first turn the cap to ensure that it is available when checking the close fit with the ballpoint pen tip and end stopper. You can thus immediately rework these parts if necessary without having to clamp them again.

Two machining programs are provided for each part of the ballpoint pen—one for machining the first side, and one for the second side.

First side machining of the clamping (fixtures and ballpoint pen parts)

Machining the first side: The raw material is clamped against the stop. Since the tool turret is fully assembled with 12 tools, a flat bottom tap drill is used as a stop, although it is also required during the manufacturing process. A second virtual cutting edge is programmed for the drill to measure the stop. In the first program section, each of the part programs for first side machining correctly positions this cutting edge for the relevant workpiece. The raw material must then be positioned and clamped at the stop using the cutting edge of the tap drill.

Cut-off process

All parts are programmed such that the cut-off process is performed as a grooving operation, except for some remaining core material. On completion of the first machining program, the blank is broken off from the raw material.


Second-side machining of the clamping (ballpoint pen parts)

In order to protect the surface, the parts required for machining the second side are screwed hand-tight onto the fixtures. To ensure the connection doesn't loosen during the machining process, tools with “cutting edge inverse” must be used in some cases (see tool list).

The holder for engraving the end stopper is equipped with an internal stud screw to lock it with the clamping. This is necessary because the direction of rotation of the workpiece changes during the engraving process. It does not suffice to simply screw the workpiece onto the holder. The lock screw prevents the end stopper from coming loose during engraving.

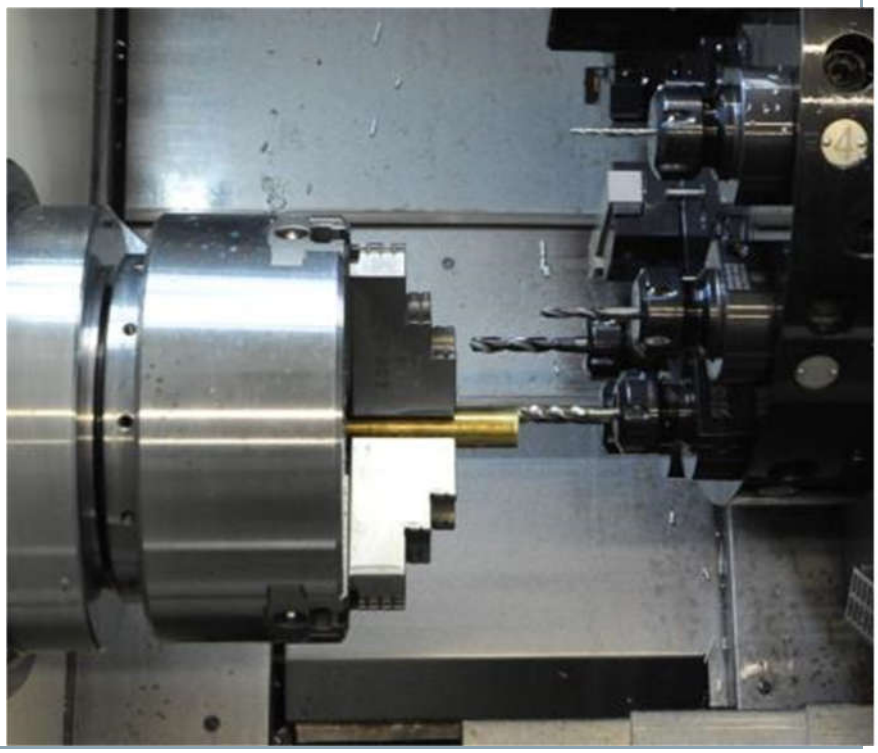
Very small feed values are used to machine the second side in the fixture. These values should be adhered to ensure that the cutting forces do not deform the thin-walled workpieces.

Surface quality and liquid cooling

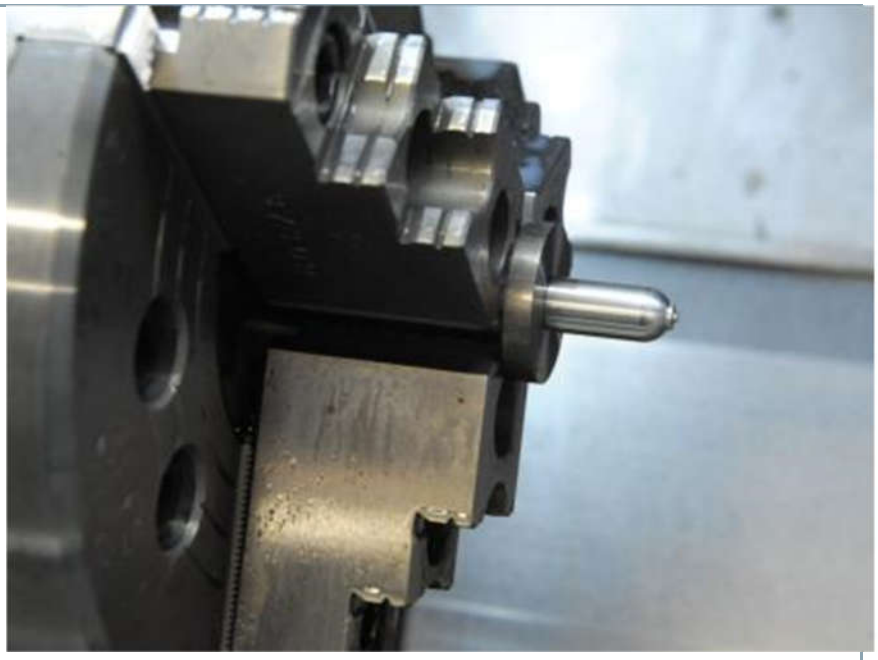
The surface is matt to ensure enhanced grip and greater resistance towards small scratches and bumps. We recommend that all parts undergo liquid cooling to achieve the envisaged surface quality. This also applies to parts made of plastic.

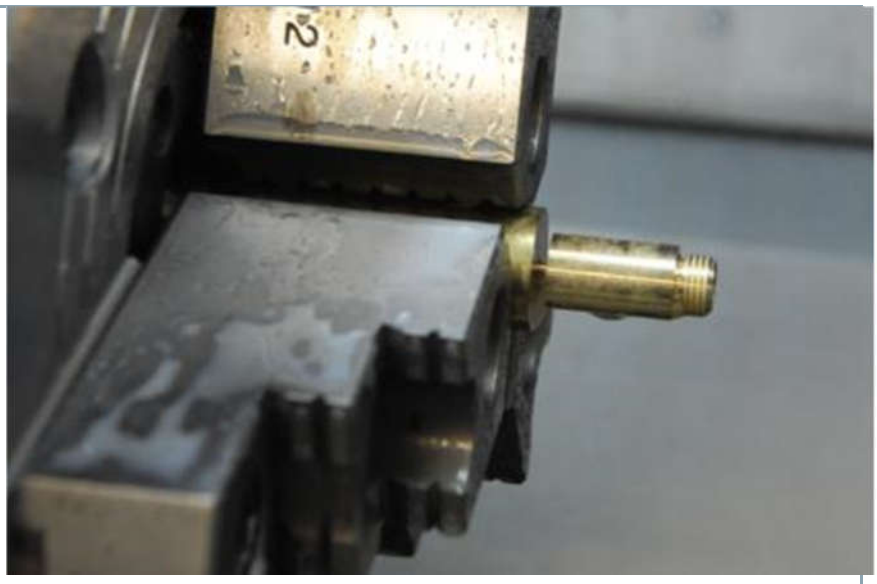

Machining sequence

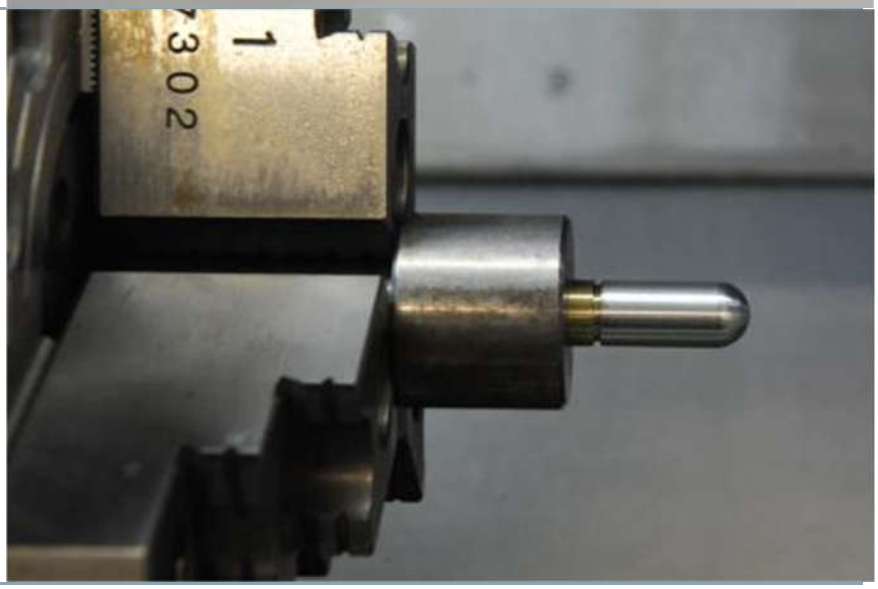
The parts are manufactured in several production steps. It is a precondition that all the necessary fixtures have already been manufactured.

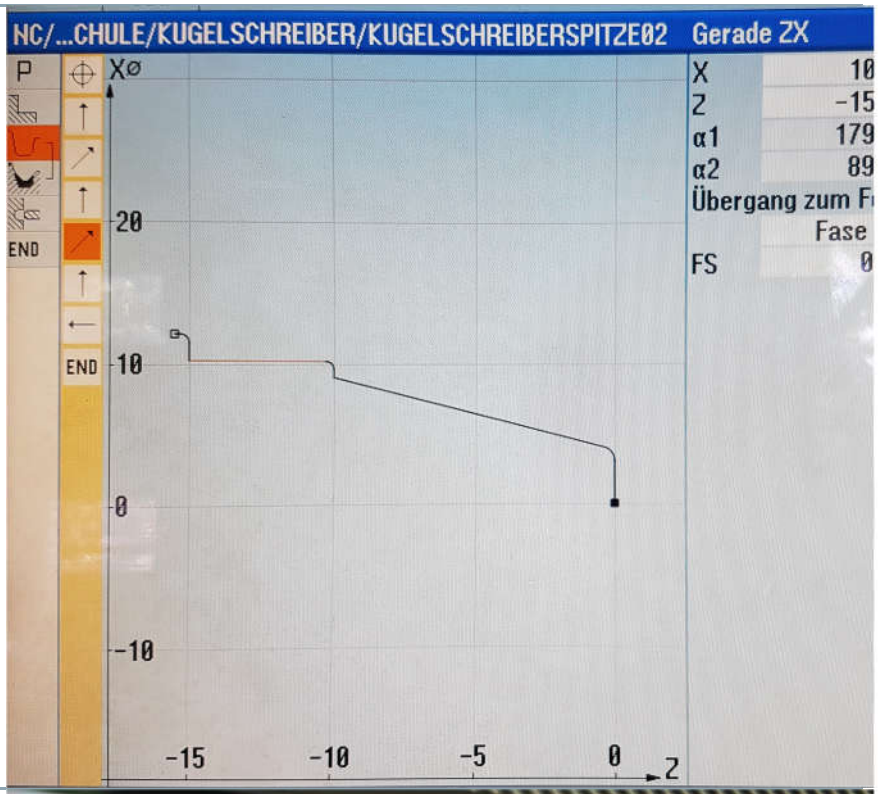
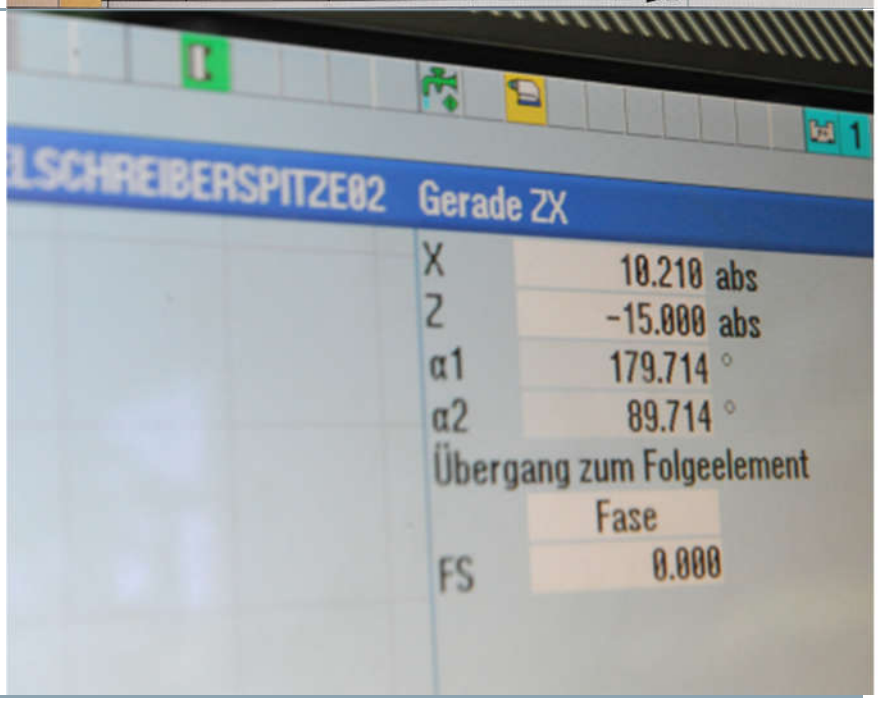
Machining step	Figure
Read in the part program Kugelschrkappe01 (first side machining). Briefly clamp the blank and start the firs-side machining part program to position tap drill cutting edge 2. Then clamp the raw material against the stop of the drill cutting edge and continue processing the part program with NC-Start. The cut-off process only leaves some remaining core material. Break off part after program completion ...	


... and screw it onto the first fixture	
	

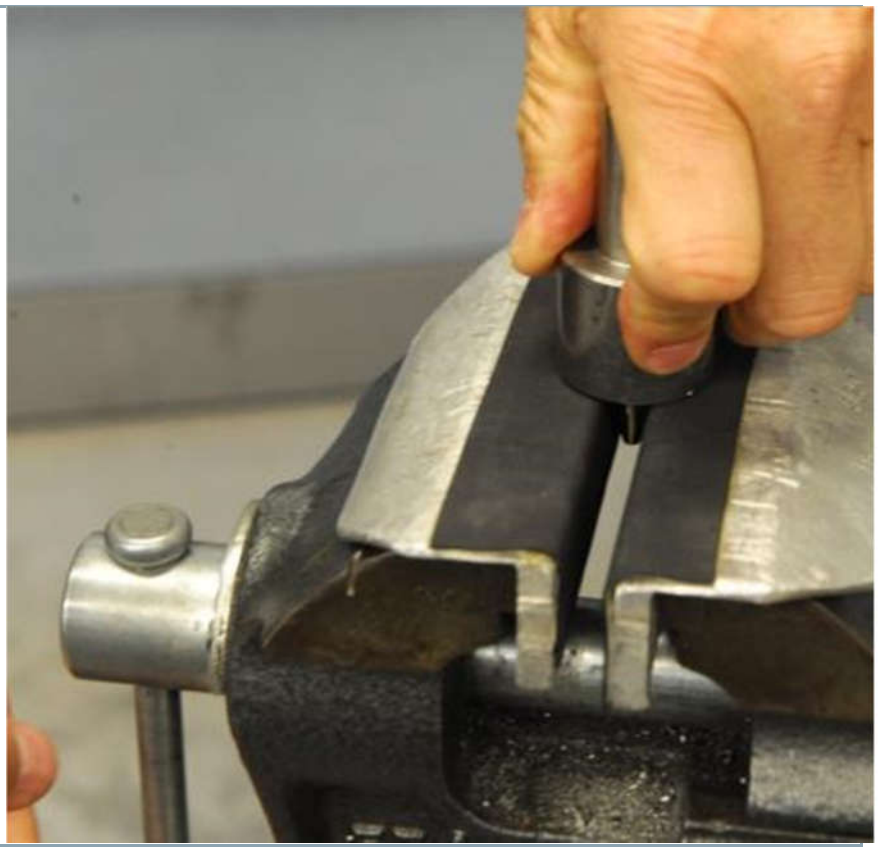

Read in part program Kugelschrkappe02 and clamp the fixture with the unilaterally machined blank of the cap to the left stop; start the part program. The feedrate and infeed have been programmed to prevent deformation of the thin-walled part.	
Unclamp the fixture with the cap and carefully unscrew the cap.	

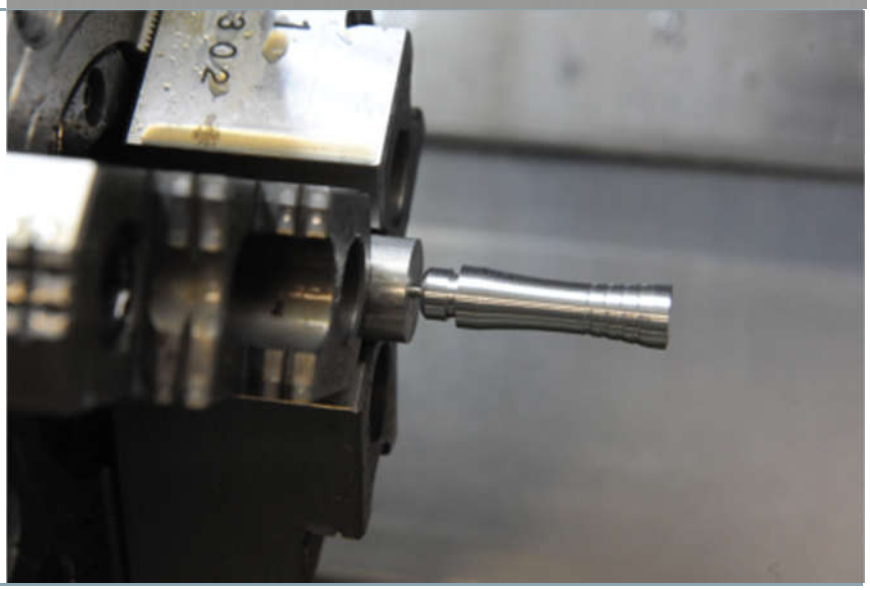
Clamp the raw material for the ballpoint pen tip according to the same principle and position it towards the tap drill stop; then machine the material, break off the workpiece from the raw material ...	
... and screw it into the clamping 2.	

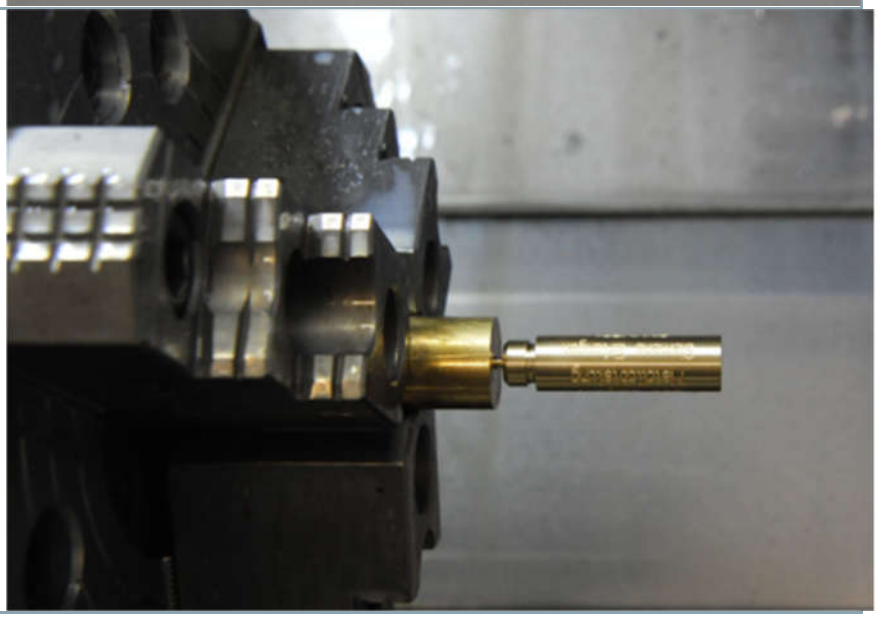
.	
Clamp in fixture towards the left stop and finish machining the ballpoint pen tip using part program KugelschrSpitze_02. Before unclamping the fixture, check that the cap fits firmly. If considerable force is required to attach the cap to the tip, slightly reduce the cone in the contour section of the part program minimally and repeat the step after first removing the cap.	


Only if required (excessively firm cap fit): Select the contour segment on which the cap is located ...	
... and reduce the X value for loose cap seat by some hundreds of a millimeter (e.g. to 10.160 abs). This work step can usually be omitted.	

Unclamp the fixture with the ballpoint pen tip and unscrew the tip from the fixture. If necessary, use a vise or tool with rubberized auxiliary jaws.



Intermediate result	
Execute the part program KugelschrSchaft1_01 with the same process: Pre-clamp the raw material, clamp it towards the stop when the program stops, machine the material, and break off the workpiece upon completion of the first side machining process.	

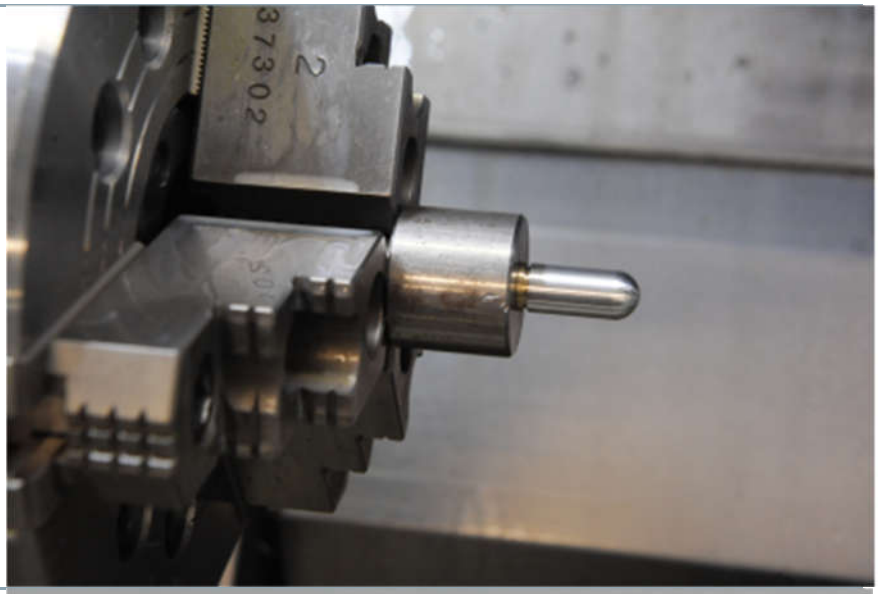
Screw prefabricated shaft 1 onto fixture 2, and clamp it for two sided machining. Read in and execute part program KugelschrSchaft1_02.	
Intermediate status: Cap and ballpoint pen tip screwed onto shaft 1	
Read in part program KugelschrSchaft2_01, open the program editor and modify the text to be engraved. Prepare the raw material, position it towards the stop following program stop and clamp it in place. Start the part program; break off the workpiece from the raw material upon completion of the machining process.	

Screw the workpiece hand-tight to fixture 1.	
Read in and execute part program KugelschrSchaft2_02. If necessary, use rubberized tools when unscrewing the workpiece from the fixture.	

Intermediate status of single parts	
Intermediate status of assembly	

Read in part program KugelschrSchaft3_01_M for the standard version of the pen, and part program KugelschrSchaft3_01_W for the short version of the pen. As in the previous work steps, clamp the material required for first side machining towards the stop, execute the part program, and break off the workpiece from the raw material. Depending on the shaft length, use either fixture 1 or fixture 3 (shorter support core) for the two-sided machining. Two-sided machining with KugelschrSchaft3_02_M or KugelschrSchaft3_02_W (short version).	
Intermediate status with alternative workpieces for shaft segment 3. Only one of these workpieces is required.	

The first-side machining operation for the end stopper is performed as for the previous workpieces; the relevant part program is KugelschrEndstopfen_01. After completing the first-side machining process, the workpiece is screwed into fixture 4 ...	
... and locked with its stud screw to prevent it from loosening from during the engraving cycle (the direction of rotation changes several times!).	


Before unclamping the end stopper, check the firm seat of the ballpoint pen cap and slightly rework, if necessary, the contour segment as described for the ballpoint pen tip.	
Ready for assembly: All workpieces of the pen, including purchased parts (M8 stud screw and giant refill)	


Assembly

Blow out again all parts, and apply a thin layer of Ballistol, weapon or sewing machine oil. Clean all parts thoroughly using a dry cloth.

Screw the tip, shaft 1 and shaft 2 together. Insert a giant refill and fix it using the M8 stud screw. Without exerting pressure, screw it in gently with your hand/fingernail until it touches the giant refill. Then screw on shaft 3 and the end stopper, and attach the cap.

7. Information on the Internet

Design of the parts, creation of drawings, development of work plans for machining:

BBS Burgdorf
Berliner Ring 28
31303 Burgdorf, Germany

Published by:

Digital Experience and Application Center (DEX)
Frauenauracher Str. 80
91056 Erlangen, Germany

Information on the machine tools/tools used:

DMG Ecoturn 310
On the Internet: http://www.dmgmori.com/

Manuals and information issued by Siemens AG

Manuals and detailed information about our products can be found on the following websites:

- DOConWEB (https://support.industry.siemens.com/cs/ww/de/view/109476679)
- Service & Support Portal (https://support.industry.siemens.com)
- SINUMERIK website (www.siemens.com/sinumerik)