

Rotating Dice



Rotating Dice

A dice without corners or edges – anybody who claims that a dice can't be round has clearly never seen this CNC workpiece! The rotating dice consists of a ball and plate manufactured on a CNC turning machine. Together with eight steel balls, one of which is of a different color, the dice is ready to use – just spin the larger ball and its colored miniature counterpart at the bottom indicates the number you have "rolled".

Siemens Professional Education in Nuremberg, Germany, uses this design as a practice workpiece as part of the training of industrial mechanics. It proves a highlight among the apprentices every year.

All information required for the reproduction, tool data and ShopTurn machining plans and NC programs are summarized in the following sections.

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Contents

1. Safety note	2
2. Preliminary remark	2
3. Workpiece blanks/parts list	3
4. Turning machine and machining plans	3
5. Tools used	4
6. Turning the parts	5
7. Informationen im Internet	9
8. Pictures	11

1. Safety note

The handling of machines brings many dangers. Consequently, the legal and general company safety regulations must always be observed for the production of the rotating dice.

2. Preliminary remark

The following description is oriented to technicians familiar with a CNC turning machine who have experience or knowledge of the SINUMERIK CNC with ShopTurn. All technology data listed here is appropriate for the machines, tools, materials and machining plans used to produce the chess pieces. Although the wide range of conditions prevailing in other workshops mean they are only exemplary for a reproduction, in most cases they should allow a problem-free reproduction.

The programs were created and tested using a CNC turning machine (with counter spindle) equipped with SINUMERIK Operate V4.7 SP1 and SINUMERIK Operate V2.6 SP2 HF2. It should be possible to easily adapt the program to other SINUMERIK versions (e.g. different SINUMERIK Operate SW versions). A simulation and necessary changes (e.g. zero points) should always be carried out.

You can download all the CAD drawings, programs and machining descriptions for the workpieces free of charge at www.siemens.com/cnc4you.

The following files and formats are available there:
NC programs ShopTurn, drawings PDF, 3d data

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3. Workpiece blanks/parts list

- AlCu4PbMg, round stock Ø 40 mm, length approximately 100 mm
- Brass CuZn3Pb3, round stock Ø 60 mm, length approximately 25 mm
- DIN 471 spring steel locking ring, 6 x 0.7
- Ball Ø8,731 mm (11/32 Zoll) chrome steel polished, material 1.3505 (7 pieces)
- Ball Ø8,731 mm (11/32 Zoll) ceramics (black/white) (1 piece); or color-coded ball of chromium steel (e.g. browned, tempered ...)

Note

Balls are available in model building shops as well as online from ball bearing manufacturers or via Ebay.

4. Turning machine and machining plans

- CNC turning machine DOOSAN PUMA 2600SY
SINUMERIK 828D with SINUMERIK Operate V4.7 SP1
- CNC turning machine Weiler DZ45, Siemens 840D sl - SINUMERIK Operate 2.7 SP2 HF 2
- ShopTurn machining plan ball: BALL_DICE.MPF
DIN/ISO program plate: PLATE_DICE.MPF
Tool list: BALL_DICE_TMZ.INI

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5. Tools used

Turning, drilling and milling tools for machining both sides of the parts.

Tools for turning machine

Tool name in the machining plan	Designation
HSP_SCHRUPPEN	Turning chisel for outside with one roughing disk, disk radius R0.8, corner angle 80°
HSP_SCHLICHTEN	Turning chisel for outside with one finishing disk, disk radius R0.4, corner angle 35°
EINSTECHER_2.1	Grooving tool HM, plate width 2,1 mm
ABSTECHER_3.1	Cutoff tool HM, plate width 3,1 mm
KUGELKOPF_ZYL_RAD_2	Ball milling cutter Ø2 mm
GSP_SCHRUPPEN	Counterspindle: Turning chisel for outside with one roughing disk, disk radius R0.8, corner angle 80°
GSP_SCHLICHTEN	Counterspindle: Turning chisel for outside with one finishing disk, disk radius R0.4, corner angle 35°
FRAESER_8	End mill VHM, ø8 mm
ZENTRIERER_12	NC spotdrill ø12 mm, 90°
BOHRER_6	Drill ø6 mm
EINSTECHER_RADIAL_4	Grooving tool, plate width 4 mm (Insert N123H2-0500-0002-GF 1125)
KUGELKOPF_ZYL_AX_1	Ball milling cutter Ø1 mm

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6. Turning the parts

The rotating dice consists of two parts, the ball and the plate.

Rotating dice - ball

For this machining operation, the Ø 40 mm blank is clamped into place. First, the contour of the bolt and ball are machine-lathed. A freely selectable engraving is then milled onto the ball surface. The workpiece is then transferred to the counter spindle and cut off. The remaining machining operations are performed on the ball here.



Work steps at the turning machine

1. Approach the reference point of the machine.
2. Read-in the workplan: BALL_DICE.MPF.
3. Read-in the tool list or zero offsets BALL_DICE_TMZ.INI.
4. Measure tools and enter them in the tool list.
5. Insert tools in magazine.
6. Clamp the workpiece (clamping length).
7. Set tool zero point, by scraping.
8. Program zero offsets.
9. Perform simulation.
10. Start production, process workplan.

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Rotating dice - plate

The Ø 60 mm round material is clamped into place. The plate is machine-lathed in two steps. First, the bottom is machined, and the NC program waits after the completion of this step until the workpiece is turned over before the upper side is machined. The contour of the plate is machine-lathed and the segments with the numbers are created.

Work steps at the turning machine

1. Approach the reference point of the machine.
2. Read-in the workplan: PLATE _DICE.MPF.
3. Read-in the tool list or zero offsets BALL_DICE_TMZ.INI.
4. Measure tools and enter them in the tool list.
5. Insert tools in magazine.
6. Clamp the workpiece (clamping length).
7. Set tool zero point, by scraping.
8. Program zero offsets.
9. Perform simulation.
10. Start production, process workplan.
11. Program WAIT, clamp the workpiece on the machined side.
12. Continue processing the upper side with NC start.

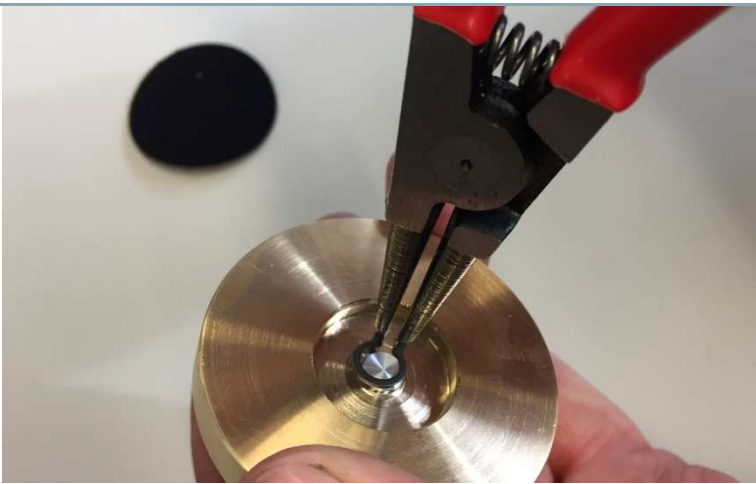
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Assembly

The rotating dice is very easy to assemble. First, the eight balls are placed into the circumferential groove in the plate. The large ball is inserted into the central hole by its bolt and fixed in place with the locking ring. Finally, a felt pad can be glued to the underside of the base.

Assembly	Picture
First, the eight balls are placed in the circumferential groove in the plate.	
The large ball with is then inserted into the central hole via the bolt and fixed in place with the locking ring.	

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Finally, a felt pad can be glued to the underside of the plate.



This is how the finished dice looks.



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7. Informationen im Internet

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

TAC Technology and Application Center
Frauenauracher Str. 80
91056 Erlangen

Siemens Professional Education
Nürnberg

Details of the tool machine and tools to be used

DOOSAN turning center
Internet: <http://www.doosan.com/>

WEILER PRECISION LATHES
Internet: <http://www.weiler.de>

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Manuals and information from the Siemens AG

Manuals and detailed information about our products, please visit the following websites:

- Documentation (<https://support.industry.siemens.com/cs/ww/en/view/109476679>)
- Service&Support Portal (www.support.industry.siemens.com)
- SINUMERIK Website (www.siemens.com/sinumerik)

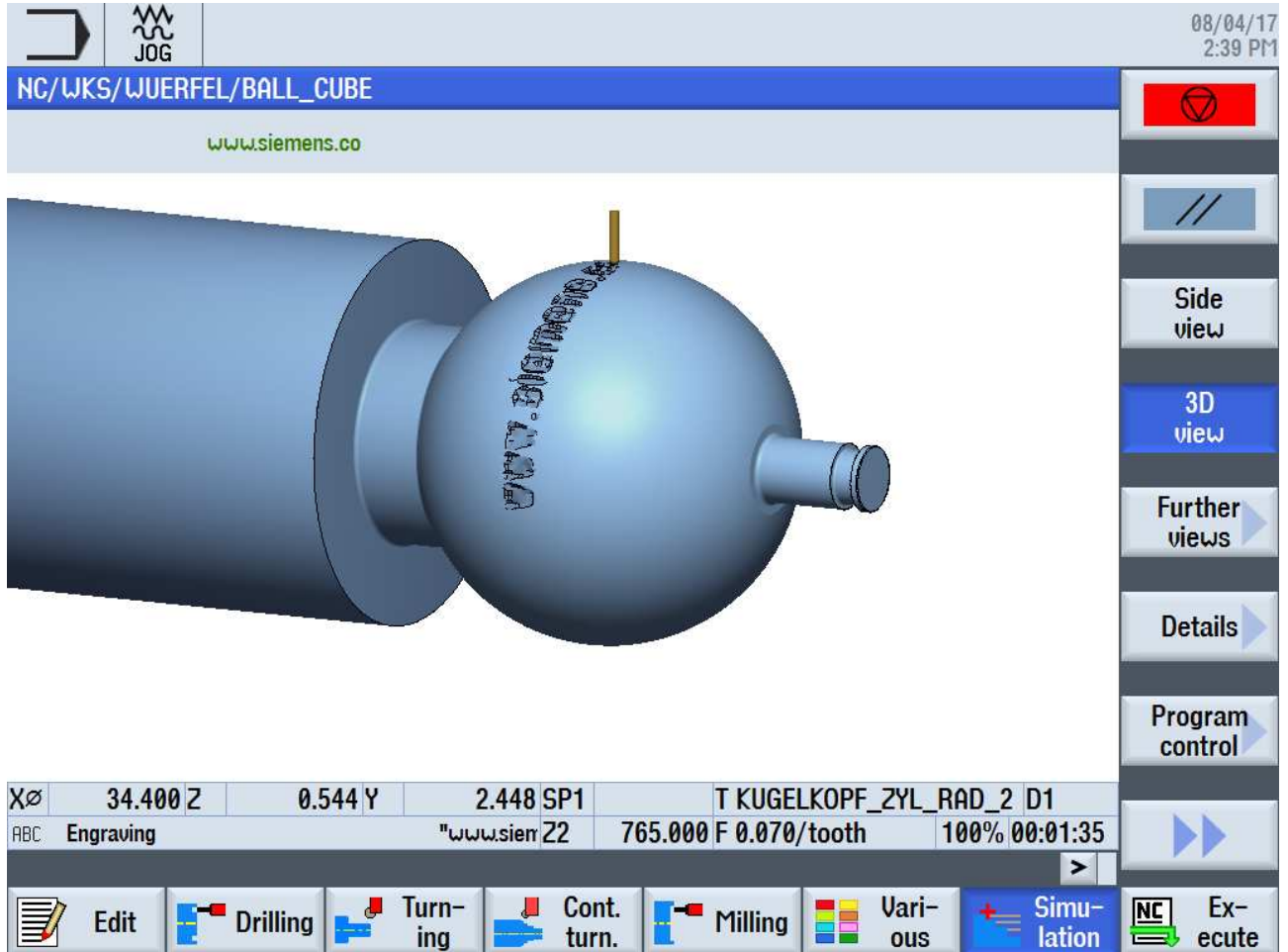
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8. Pictures

Simulation ball

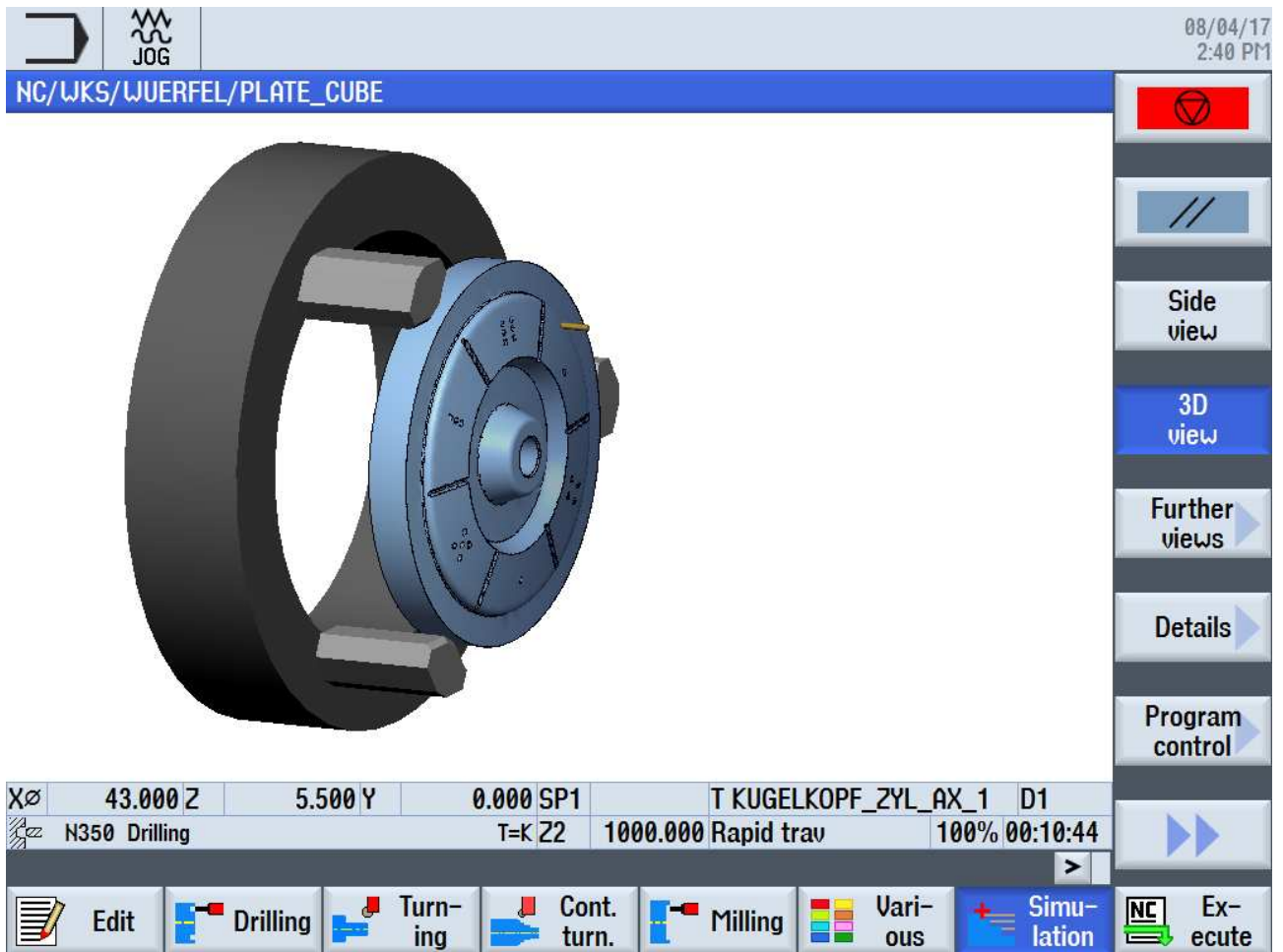


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Simulation plate



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Program ball

08/04/17
2:38 PM

NC/WKS/WUERFEL/BALL_CUBE			1
P	Program header	G54 Cylinder	[Right Arrow]
	Stock removal	▽▽▽ T=HSP_SCHRUPPEN F=0.2/rev U=500m Face X0=41	
	Contour	KONTUR_1	
	Stock removal	▽ T=HSP_SCHRUPPEN F=0.18/rev U=500m Longitudinal	
	Residual cutting	▽ T=HSP_SCHLICHTEN F=0.2/rev U=140m Longitudinal	
	Stock removal	▽▽▽ T=HSP_SCHLICHTEN F=0.08/rev U=500m Longitudinal	
	Groove	▽▽▽ T=EINSTECHER_2.1 F=0.05/rev S=100rev X0=6	
	C axis rotation	C=7	
ABC	Engraving	"www.siemens.com/cnc4you"	
	Counterspindle	Complete S1→S2 G55	
	Cutoff	T=ABSTECHER_3.1 F=0.2/rev U=250m X0=35 Z0=-45.5	
	Contour	KONTUR2	
	Stock removal	▽ T=GSP_SCHRUPPEN F=0.18/rev U=500m Face	
	Stock removal	▽▽▽ T=GSP_SCHLICHTEN F=0.08/rev U=500m Longitudinal	
END	End of program		

Edit

Drilling

Turn-
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Cont.
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Milling

Vari-
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Simu-
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Ex-
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Select
tool

Build
group

Search

Mark

Copy

Paste

Cut

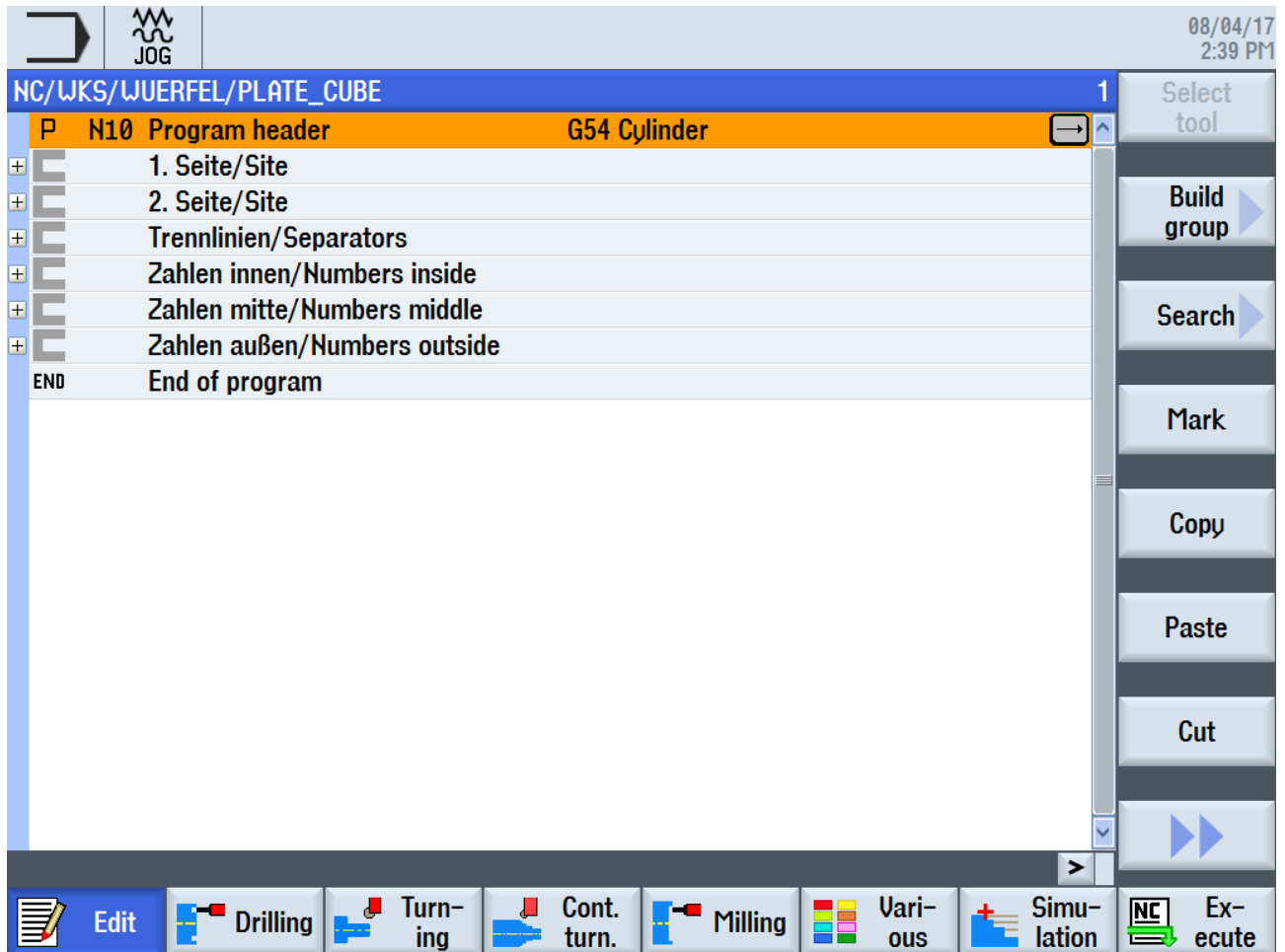
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Program plate



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