



HEIDENHAIN



TNC 320 / TNC 620 / TNC 640

Solutions
Additional Exercises

HIT Learning Package
Milling – 3+2-Axis Machining

English (en)
8/2019

Contents

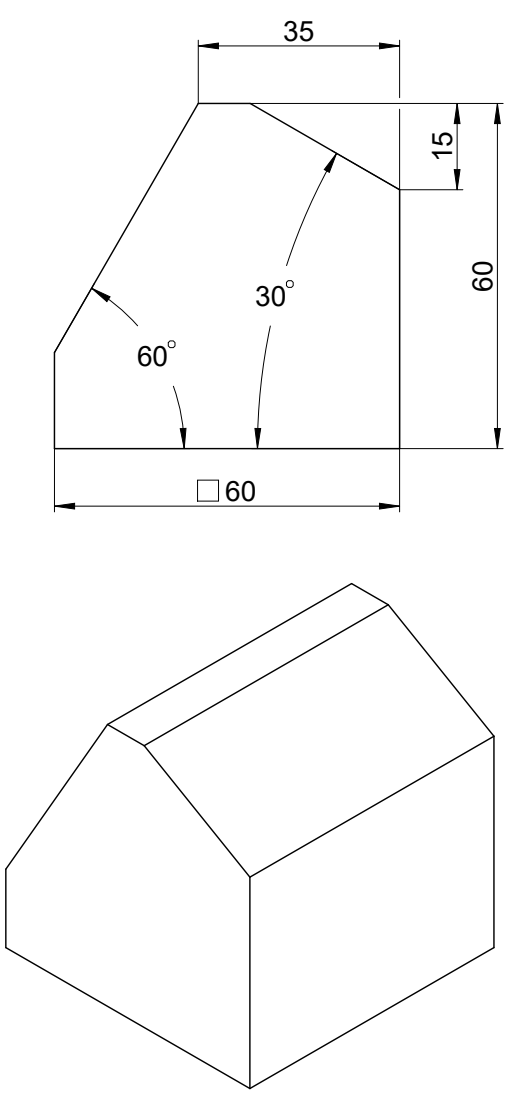
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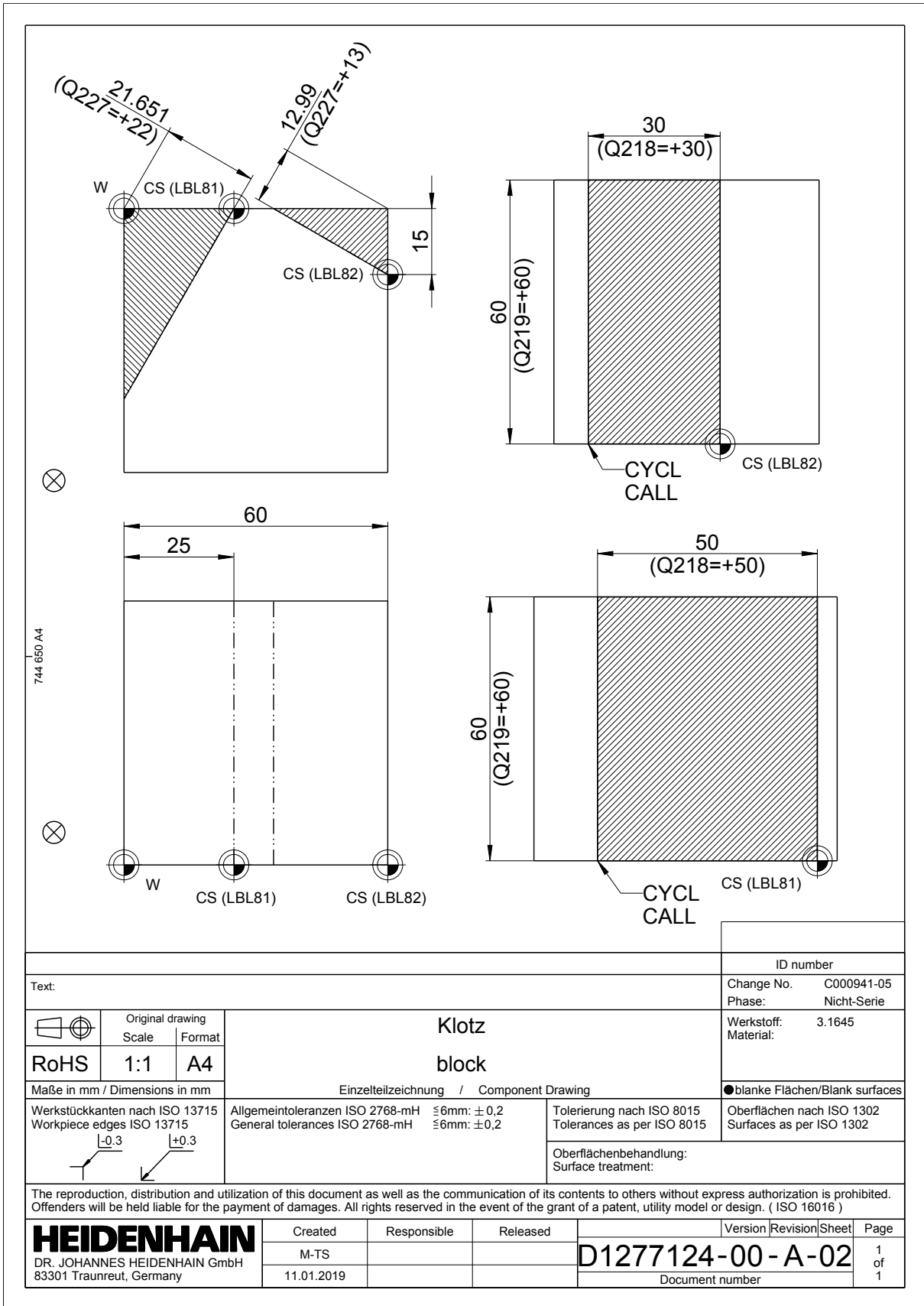
**Fundamentals of
tilted machining**

1.1 Programming one spatial angle – 1277124



Klotz
block

Text:		ID number							
Change No. C000941-05		Phase: Nicht-Serie							
Werkstoff: 3.1645		Material:							
<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th>Original drawing</th> <th>Scale</th> <th>Format</th> </tr> <tr> <td>RoHS</td> <td>1:1</td> <td>A4</td> </tr> </table>		Original drawing	Scale	Format	RoHS	1:1	A4	Einzelteilzeichnung / Component Drawing	
Original drawing	Scale	Format							
RoHS	1:1	A4							
Maße in mm / Dimensions in mm Werkstückkanten nach ISO 13715 Workpiece edges ISO 13715		●blanke Flächen/Blank surfaces							
<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center;">-0.3</td> <td style="text-align: center;">+0.3</td> </tr> </table>		-0.3	+0.3	Allgemeintoleranzen ISO 2768-mH $\leq 6\text{mm}: \pm 0,2$ General tolerances ISO 2768-mH $\leq 6\text{mm}: \pm 0,2$					
-0.3	+0.3								
		Tolerierung nach ISO 8015 Tolerances as per ISO 8015							
		Oberflächen nach ISO 1302 Surfaces as per ISO 1302							
Oberflächenbehandlung: Surface treatment:									
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		M-TS	Released						
		11.01.2019							
		Version	Revision						
		D1277124-00-A-01							
		Document number							
		Sheet	Page						
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Change No. C000941-05		Phase: Nicht-Serie																						
Werkstoff: 3.1645		Material:																						
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Working plan


- ▶ Workpiece blank definition
- ▶ Tool call
- ▶ Safe tilting position
- ▶ Shift datum to tilting edge
- ▶ Tilt the working plane
- ▶ Mill the inclined surface (60°)
- ▶ Reset transformations mathematically
- ▶ Shift datum to tilting edge
- ▶ Tilt the working plane
- ▶ Mill the inclined surface (30°)
- ▶ Reset tilting
- ▶ Reset datum shift

Program parameters

Face milling (roughing)	Parameters	X	Y	Z
Milling plan	2, climb milling			
Milling direction	2, parallel to Y axis			
Feed rate for pre-positioning	Maximum feed rate			

General parameters	Parameters	X	Y	Z
Safe position		-	-	+50
Safe tilting position	Relative to the machine datum	+300	-300	+300

Tool parameters

	Ø	T	S	F ₁	DZ	IZ
	20	10	5000	1000	-10	5

- Ø) Diameter
- T) Tool number
- S) Speed
- F₁) Machining feed rate
- DZ) Max. machining depth
- IZ) Infeed

Solution

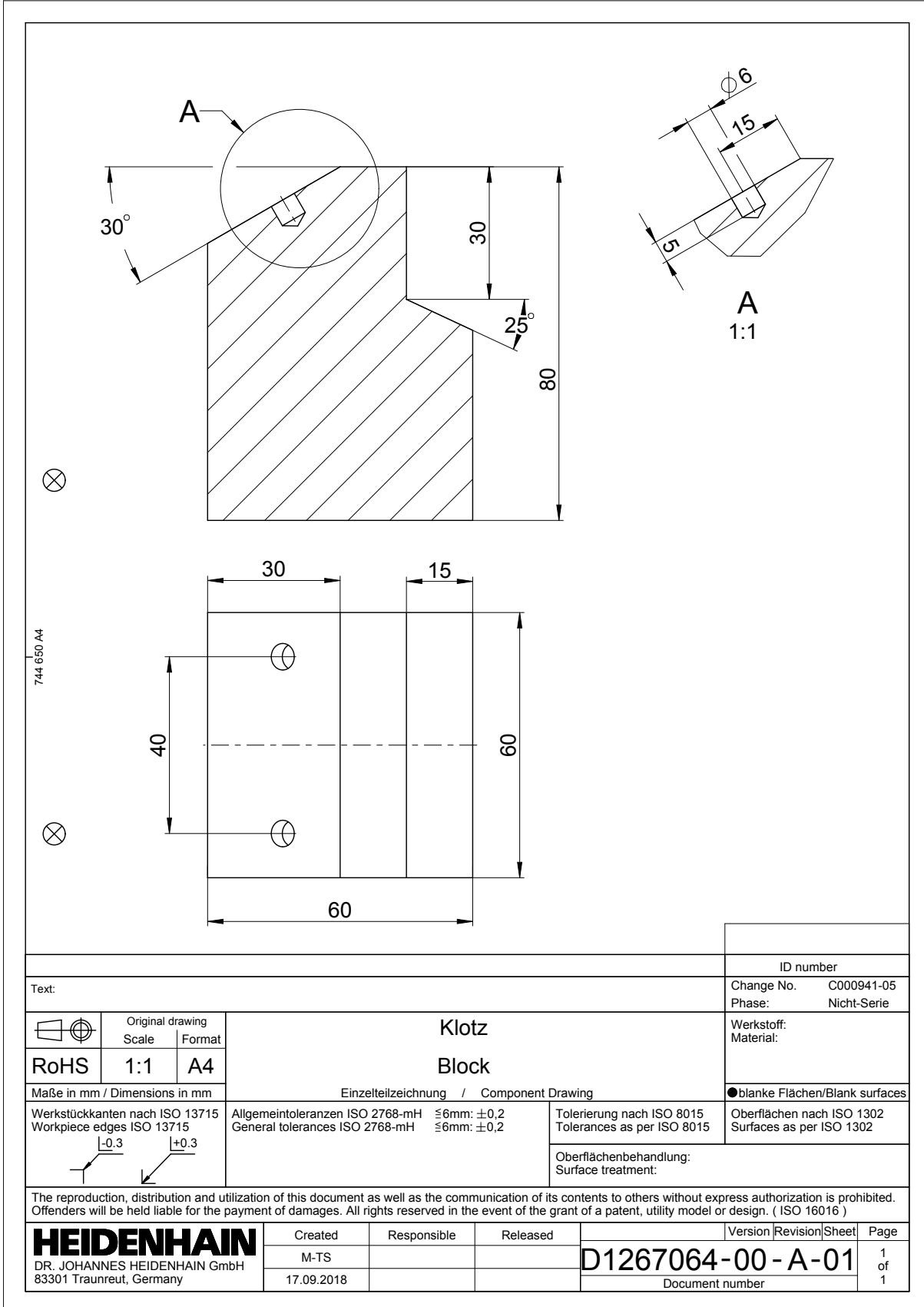
0	BEGIN PGM 1277124 MM
1	BLK FORM 0.1 Z X+0 Y+0 Z-60
2	BLK FORM 0.2 X+60 Y+60 Z+0
3	TOOL CALL 10 Z S5000 F1000
4	L Z+300 R0 FMAX M3 M91
5	L X+300 Y-300 R0 FMAX M91
6	CYCL DEF 7.0 DATUM SHIFT
7	CYCL DEF 7.1 X+25
8	PLANE SPATIAL SPA+0 SPB-60 SPC+0 TURN FMAX
9	CYCL DEF 233 FACE MILLING ~
	Q215=+1 ;MACHINING OPERATION ~
	Q389=+2 ;MILLING STRATEGY ~
	Q350=+2 ;MILLING DIRECTION ~
	Q218=+50 ;FIRST SIDE LENGTH ~
	Q219=+60 ;2ND SIDE LENGTH ~
	Q227=+22 ;STARTNG PNT 3RD AXIS ~
	Q386=+0 ;END POINT 3RD AXIS ~
	Q369=+0 ;ALLOWANCE FOR FLOOR ~
	Q202=+5 ;MAX. PLUNGING DEPTH ~
	Q370=+1 ;TOOL PATH OVERLAP ~
	Q207= AUTO ;FEED RATE MILLING ~
	Q385=+500 ;FINISHING FEED RATE ~
	Q253= MAX ;F PRE-POSITIONING ~
	Q357=+2 ;CLEARANCE TO SIDE ~
	Q200=+2 ;SET-UP CLEARANCE ~
	Q204=+50 ;2ND SET-UP CLEARANCE ~
	Q347=+0 ;1ST LIMIT ~
	Q348=+0 ;2ND LIMIT ~
	Q349=+0 ;3RD LIMIT ~
	Q220=+0 ;CORNER RADIUS ~
	Q368=+0 ;ALLOWANCE FOR SIDE ~
	Q338=+0 ;INFEEED FOR FINISHING ~
10	L X-50 Y+0 Z+50 R0 FMAX M99
11	PLANE RESET STAY
12	CYCL DEF 7.0 DATUM SHIFT
13	CYCL DEF 7.1 X+0
14	CYCL DEF 7.2 Y+0
15	CYCL DEF 7.3 Z+0
16	CYCL DEF 7.0 DATUM SHIFT
17	CYCL DEF 7.1 X+60
18	CYCL DEF 7.3 Z-15
19	PLANE SPATIAL SPA+0 SPB+30 SPC+0 TURN FMAX

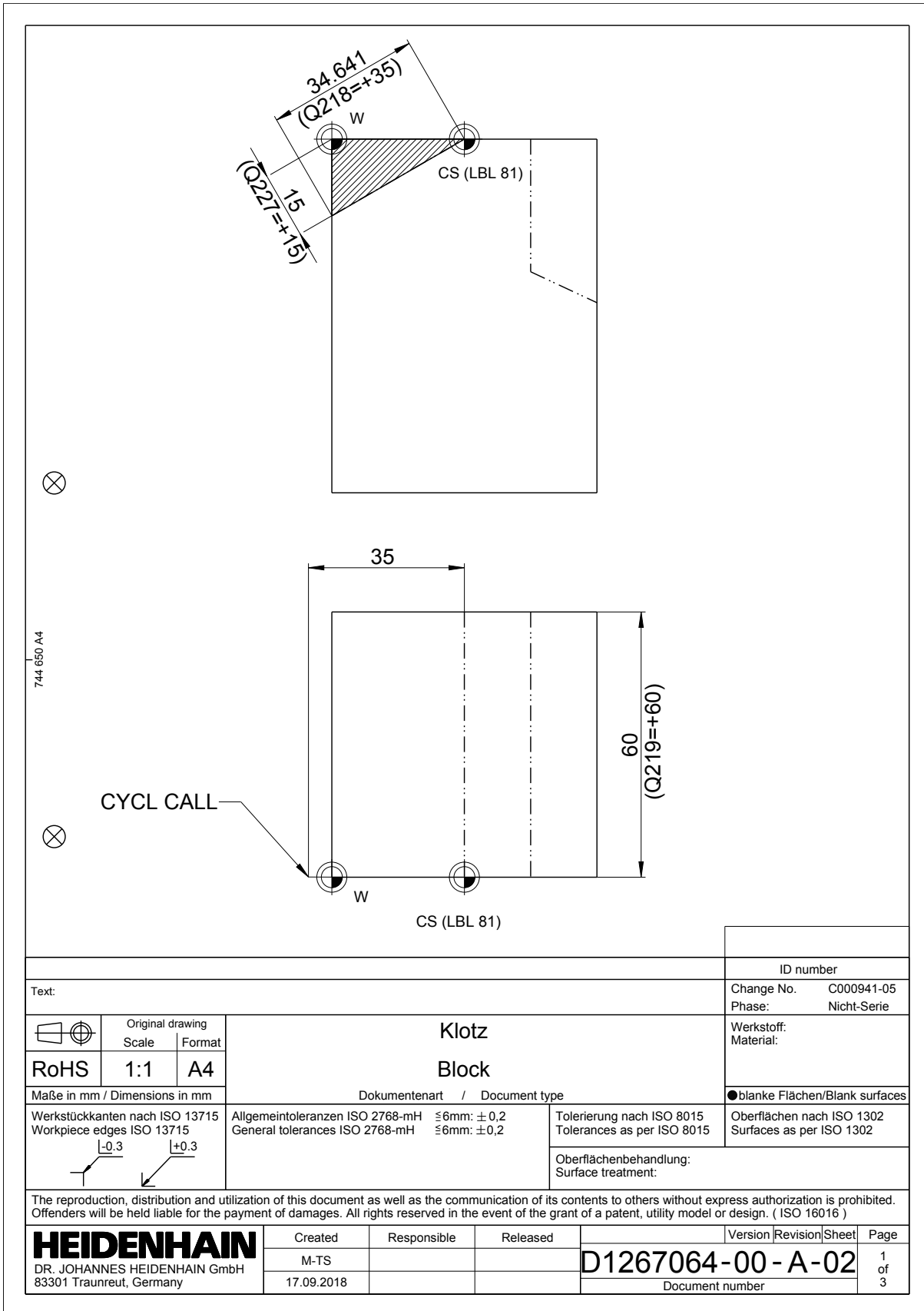
20 CYCL DEF 233	FACE MILLING	
~		
Q215=+1	;MACHINING OPERATION ~	
Q389=+2	;MILLING STRATEGY ~	
Q350=+2	;MILLING DIRECTION ~	
Q218=+30	;FIRST SIDE LENGTH ~	
Q219=+60	;2ND SIDE LENGTH ~	
Q227=+13	;STARTNG PNT 3RD AXIS ~	
Q386=+0	;END POINT 3RD AXIS ~	
Q369=+0	;ALLOWANCE FOR FLOOR ~	
Q202=+5	;MAX. PLUNGING DEPTH ~	
Q370=+1	;TOOL PATH OVERLAP ~	
Q207= AUTO	;FEED RATE MILLING ~	
Q385=+500	;FINISHING FEED RATE ~	
Q253= MAX	;F PRE-POSITIONING ~	
Q357=+2	;CLEARANCE TO SIDE ~	
Q200=+2	;SET-UP CLEARANCE ~	
Q204=+50	;2ND SET-UP CLEARANCE ~	
Q347=+0	;1ST LIMIT ~	
Q348=+0	;2ND LIMIT ~	
Q349=+0	;3RD LIMIT ~	
Q220=+0	;CORNER RADIUS ~	
Q368=+0	;ALLOWANCE FOR SIDE ~	
Q338=+0	;INFEED FOR FINISHING ~	
21 L X-30 Y+0 Z+50 R0 FMAX M99		
22 PLANE RESET TURN FMAX		
23 CYCL DEF 7.0	DATUM SHIFT	
24 CYCL DEF 7.1 X+0		
25 CYCL DEF 7.2 Y+0		
26 CYCL DEF 7.3 Z+0		
27 M30		
28 END PGM 1277124 MM		

2

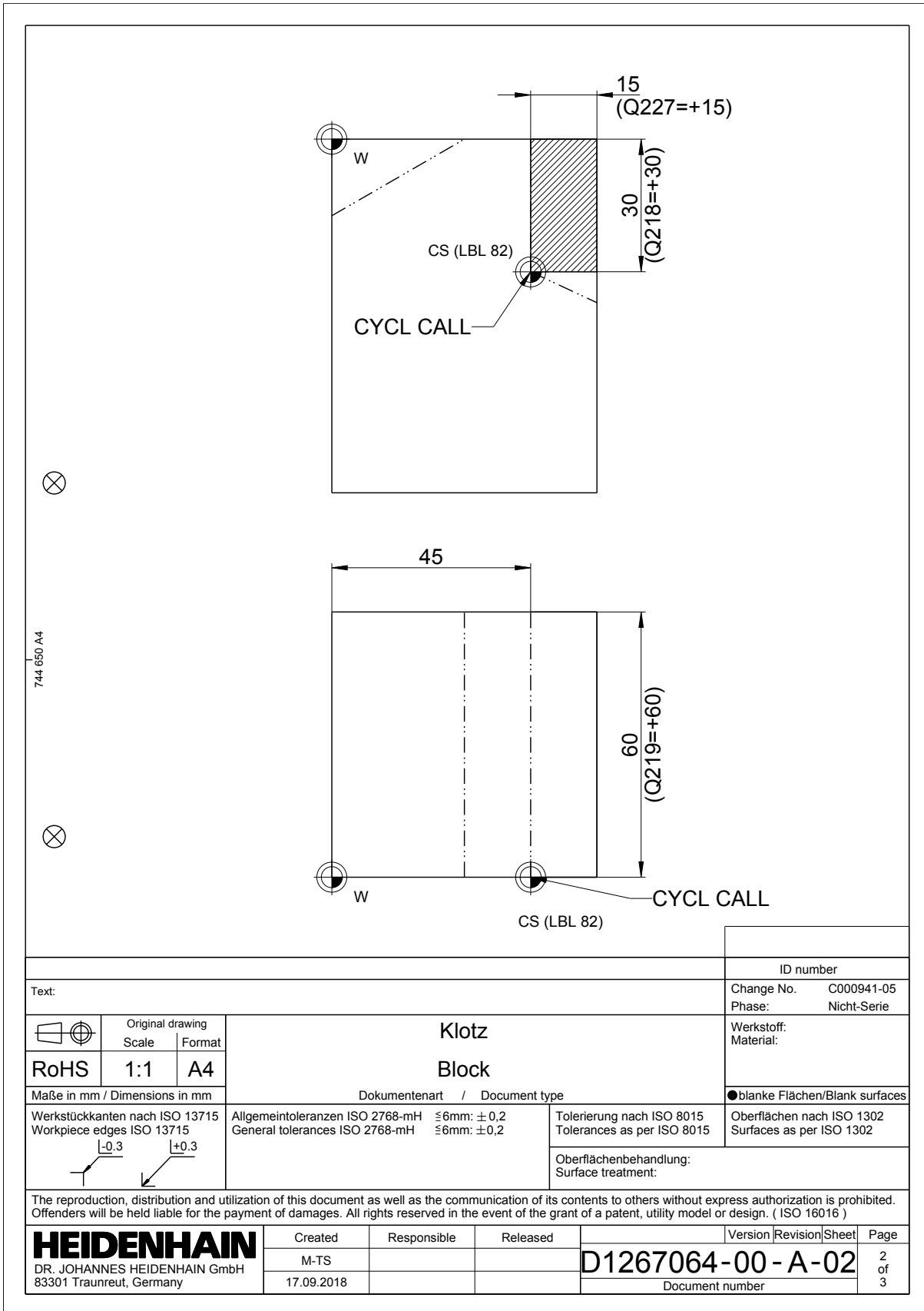
**Advanced topics of
tilted machining**

2.1 Programming one spatial angle – 1267064

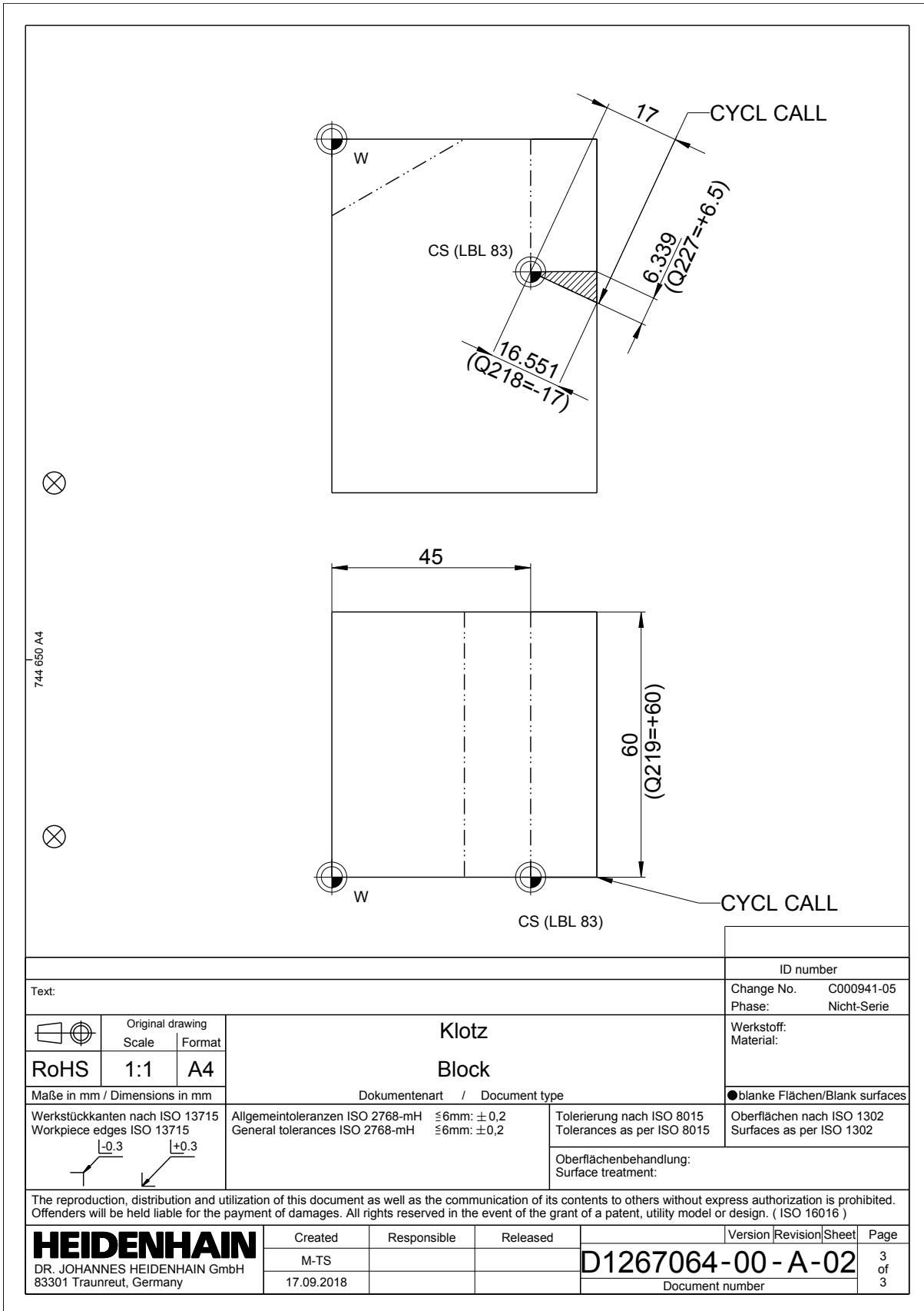




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Werkstoff: Material:		●blanke Flächen/Blank surfaces													
<table border="1"> <tr> <td></td> <td>Original drawing</td> <td colspan="2">Klotz</td> </tr> <tr> <td>Scale</td> <td>Format</td> <td colspan="2">Block</td> </tr> <tr> <td>1:1</td> <td>A4</td> <td colspan="2"></td> </tr> </table>		Original drawing	Klotz		Scale	Format	Block		1:1	A4			Dokumentenart / Document type		
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Maße in mm / Dimensions in mm	Allgemeintoleranzen ISO 2768-mH General tolerances ISO 2768-mH	≤6mm: ±0,2 ≤6mm: ±0,2	Tolerierung nach ISO 8015 Tolerances as per ISO 8015												
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	M-TS		
17.09.2018	D1267064-00-A-02		Version Revision Sheet Page
Document number			2 of 3



Working plan

- ▶ Workpiece blank definition
- ▶ Tool call
- ▶ Mill the inclined surface (30°)
- ▶ Mill the inclined surface (90°)
- ▶ Mill the inclined surface (25°)
- ▶ Tool call
- ▶ Drill the holes
- ▶ End the NC program
- ▶ Define subprograms



Program parameters

Face milling (roughing)	Parameters	X	Y	Z
Milling plan	2, climb milling			
Milling direction	2, parallel to Y axis			
Feed rate for pre-positioning	Maximum feed rate			
Limits				
■ 30°	■ -			
■ 90°	■ +1, positive principal axis			
■ 25°	■ -1, negative principal axis			

Drilling	Parameters	X	Y	Z
Plunging depth	5			
Depth reference	To cylindrical part of the drill (without tool tip)			

General parameters	Parameters	X	Y	Z
Safe position		-	-	+50
Safe tilting position	Relative to the machine datum	+300	-300	+300

Tool parameters

	Ø	T	S	F ₁	DZ	IZ
	20	10	5000	1000	-5	5
	6	228	6000	840	-5	5

- Ø) Diameter
- T) Tool number
- S) Speed
- F₁) Machining feed rate
- DZ) Max. machining / drilling depth
- IZ) Infeed

Solution

0 BEGIN PGM 1267064 MM	
1 BLK FORM 0.1 Z X+0 Y+0 Z-80	
2 BLK FORM 0.2 X+60 Y+60 Z+0	
3 TOOL CALL 10 Z S5000 F1000	
4 CALL LBL 99	RESET
5 CALL LBL 81	PLANE_1
6 CALL LBL 51	MACHINING_1
7 CALL LBL 99	RESET
8 CALL LBL 82	PLANE_2
9 CALL LBL 52	MACHINING_2
10 CALL LBL 99	RESET
11 CALL LBL 83	PLANE_3
12 CALL LBL 53	MACHINING_3
14 TOOL CALL 228 Z S6000 F840	
15 CALL LBL 99	RESET
16 CALL LBL 81	PLANE_1
17 CALL LBL 54	MACHINING_4
18 CALL LBL 99	RESET
19 M30	
20 LBL 51	MACHINING_1
21 CYCL DEF 233 FACE MILLING	
~	
Q215=+1 ;MACHINING OPERATION ~	
Q389=+2 ;MILLING STRATEGY ~	
Q350=+2 ;MILLING DIRECTION ~	
Q218=+35 ;FIRST SIDE LENGTH ~	
Q219=+60 ;2ND SIDE LENGTH ~	
Q227=+15 ;STARTNG PNT 3RD AXIS ~	
Q386=+0 ;END POINT 3RD AXIS ~	
Q369=+0 ;ALLOWANCE FOR FLOOR	
Q202=+5 ;MAX. PLUNGING DEPTH ~	
Q370=+1 ;MAX. OVERLAP ~	
Q207= AUTO ;FEED RATE MILLING ~	
Q385=+500 ;FINISHING FEED RATE ~	
Q253= MAX ;F PRE-POSITIONING ~	
Q357=+2 ;CLEARANCE TO SIDE	
Q200=+2 ;SET-UP CLEARANCE ~	
Q204=+50 ;2ND SET-UP CLEARANCE	
Q347=+0 ;1ST LIMIT	
Q348=+0 ;2ND LIMIT	
Q349=+0 ;3RD LIMIT	
Q220=+0 ;CORNER RADIUS	

Q368=+0	;ALLOWANCE FOR SIDE	
Q338=+0	;INFEED FOR FINISHING	
22 L X-35 Y+0 Z+50 R0 FMAX M99		
23 LBL 0		
24 LBL 52		MACHINING_2
25 CYCL DEF 233	FACE MILLING	
~		
Q215=+1	;MACHINING OPERATION ~	
Q389=+2	;MILLING STRATEGY ~	
Q350=+2	;MILLING DIRECTION ~	
Q218=+30	;FIRST SIDE LENGTH ~	
Q219=+60	;2ND SIDE LENGTH ~	
Q227=+15	;STARTNG PNT 3RD AXIS ~	
Q386=+0	;END POINT 3RD AXIS ~	
Q369=+0	;ALLOWANCE FOR FLOOR	
Q202=+5	;MAX. PLUNGING DEPTH ~	
Q370=+1	;MAX. OVERLAP ~	
Q207= AUTO	;FEED RATE MILLING ~	
Q385=+500	;FINISHING FEED RATE ~	
Q253= MAX	;F PRE-POSITIONING ~	
Q357=+2	;CLEARANCE TO SIDE	
Q200=+2	;SET-UP CLEARANCE ~	
Q204=+50	;2ND SET-UP CLEARANCE	
Q347=+1	;1ST LIMIT	
Q348=+0	;2ND LIMIT	
Q349=+0	;3RD LIMIT	
Q220=+0	;CORNER RADIUS	
Q368=+0	;ALLOWANCE FOR SIDE	
Q338=+0	;INFEED FOR FINISHING	
26 L X-30 Y+0 Z+50 R0 FMAX M99		
27 LBL 0		
28 LBL 53		MACHINING_3
29 CYCL DEF 233	FACE MILLING	
~		
Q215=+1	;MACHINING OPERATION ~	
Q389=+2	;MILLING STRATEGY ~	
Q350=+2	;MILLING DIRECTION ~	
Q218=-17	;FIRST SIDE LENGTH ~	
Q219=+60	;2ND SIDE LENGTH ~	
Q227=+6.5	;STARTNG PNT 3RD AXIS ~	
Q386=+0	;END POINT 3RD AXIS ~	
Q369=+0	;ALLOWANCE FOR FLOOR	
Q202=+5	;MAX. PLUNGING DEPTH ~	

Q370=+1	;MAX. OVERLAP ~	
Q207= AUTO	;FEED RATE MILLING ~	
Q385=+500	;FINISHING FEED RATE ~	
Q253= MAX	;F PRE-POSITIONING ~	
Q357=+2	;CLEARANCE TO SIDE	
Q200=+2	;SET-UP CLEARANCE ~	
Q204=+50	;2ND SET-UP CLEARANCE	
Q347=-1	;1ST LIMIT	
Q348=+0	;2ND LIMIT	
Q349=+0	;3RD LIMIT	
Q220=+0	;CORNER RADIUS	
Q368=+0	;ALLOWANCE FOR SIDE	
Q338=+0	;INFEED FOR FINISHING	
30 L X+17 Y+0 Z+50 R0 FMAX M99		
31 LBL 0		
32 LBL 54		MACHINING_4
33 CYCL DEF 200	DRILLING ~	
Q200=+2	;SET-UP CLEARANCE ~	
Q201=-5	;DEPTH ~	
Q206= AUTO	;FEED RATE FOR PLNGNG ~	
Q202=+5	;PLUNGING DEPTH ~	
Q210=+0	;DWELL TIME AT TOP ~	
Q203=+0	;SURFACE COORDINATE ~	
Q204=+50	;2ND SET-UP CLEARANCE ~	
Q211=+0	;DWELL TIME AT DEPTH ~	
Q395=+1	;DEPTH REFERENCE	
34 L X-15 Y+10 Z+50 R0 FMAX M99		
35 L IY+40 R0 FMAX M99		
36 LBL 0		
37 LBL 81		PLANE_1
38 CALL LBL 100		SAFE
39 CYCL DEF 7.0	DATUM SHIFT	
40 CYCL DEF 7.1 X+30		
41 PLANE SPATIAL SPA+0 SPB-30 SPC+0 TURN FMAX		
42 LBL 0		
43 LBL 82		PLANE_2
44 CALL LBL 100		SAFE
45 CYCL DEF 7.0	DATUM SHIFT	
46 CYCL DEF 7.1 X+45		
47 CYCL DEF 7.3 Z-30		
48 PLANE SPATIAL SPA+0 SPB+90 SPC+0 TURN FMAX		
49 LBL 0		
50 LBL 83		PLANE_3

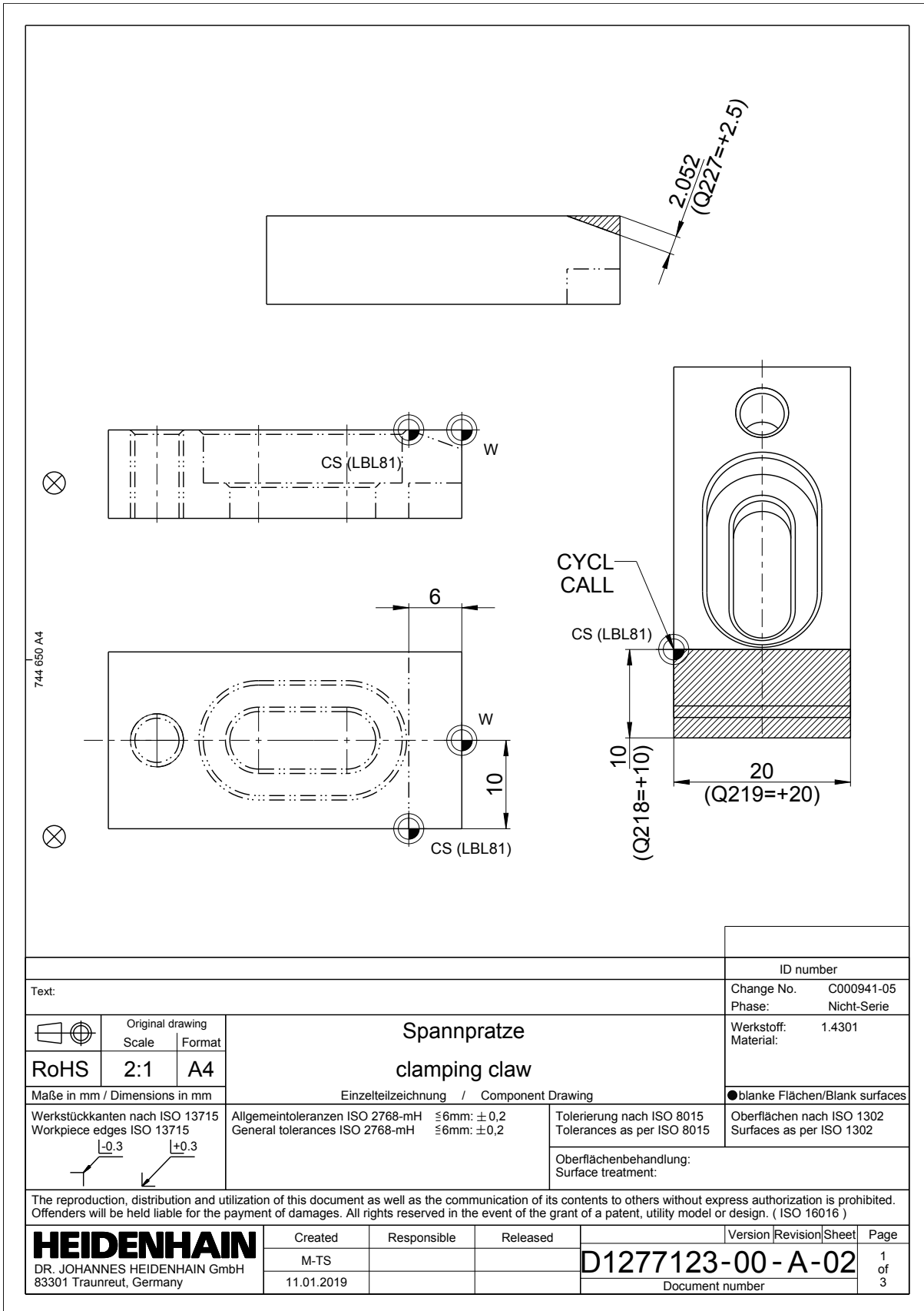
51 CALL LBL 100	SAFE
52 CYCL DEF 7.0 DATUM SHIFT	
53 CYCL DEF 7.1 X+45	
54 CYCL DEF 7.3 Z-30	
55 PLANE SPATIAL SPA+0 SPB+25 SPC+0 TURN FMAX	
56 LBL 0	
57 LBL 99	RESET
58 CALL LBL 100	SAFE
59 PLANE RESET TURN FMAX	
60 CYCL DEF 7.0 DATUM SHIFT	
61 CYCL DEF 7.1 X+0	
62 CYCL DEF 7.2 Y+0	
63 CYCL DEF 7.3 Z+0	
64 LBL 0	
65 LBL 100	SAFE
66 L Z+300 R0 FMAX M3 M91	
67 L X+300 Y-300 R0 FMAX M91	
68 LBL 0	
69 END PGM 1267064 MM	

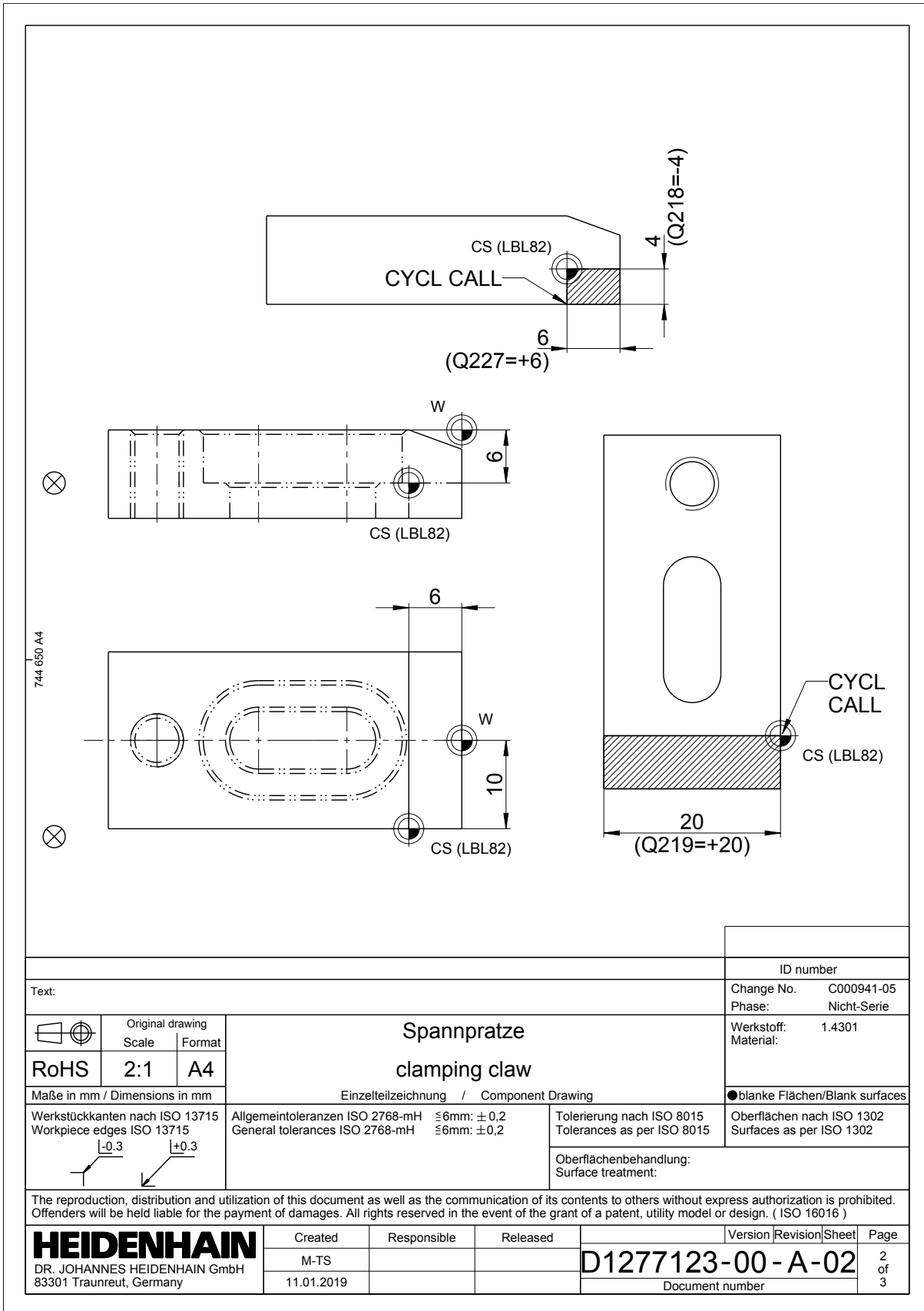
2.2 Programming one spatial angle – 1277123

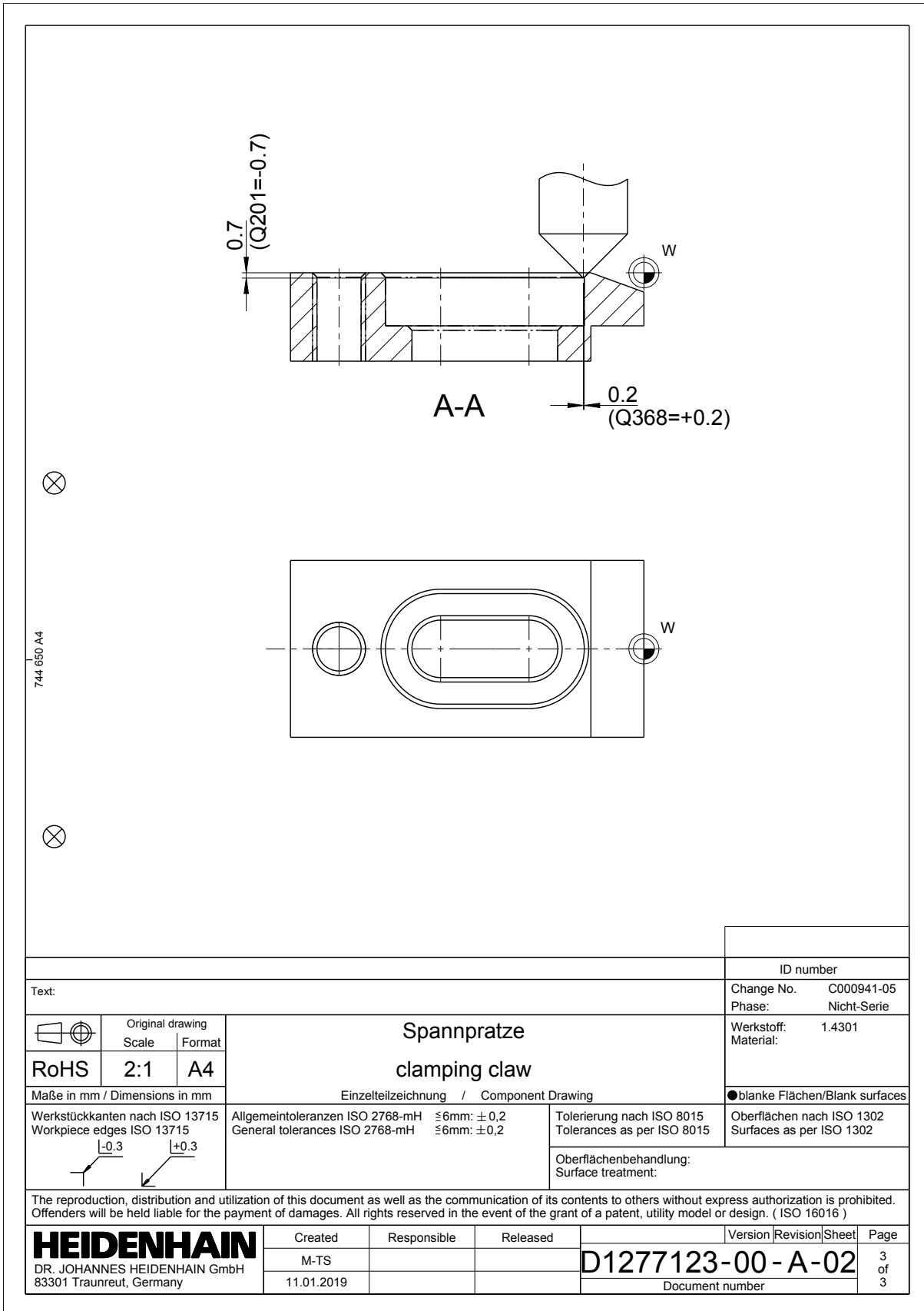
Spannpratze
clamping claw

1:1

Text:		ID number	
		Change No.:	C000941-05
		Phase:	Nicht-Serie
		Werkstoff:	1.4301
		Material:	
		●blanke Flächen/Blank surfaces	
Maße in mm / Dimensions in mm		Einzelteilzeichnung / Component Drawing	
Werkstückkanten nach ISO 13715 Workpiece edges ISO 13715		Allgemeintoleranzen ISO 2768-mH General tolerances ISO 2768-mH	Tolerierung nach ISO 8015 Tolerances as per ISO 8015
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		11.01.2019	
		Released	
		Version	Revision
		D1277123-00-A-01	
		Document number	
		Sheet	Page
			1 of 1












Working plan

- ▶ Workpiece blank definition
- ▶ Tool call
- ▶ Mill the inclined surface (20°)
- ▶ Mill the inclined surface (90°)
- ▶ Tool call
- ▶ Mill the slots
- ▶ Mill the chamfer on the slots
- ▶ Tool call
- ▶ Machine the holes
- ▶ End the NC program
- ▶ Define subprograms

Program parameters

Face milling (roughing)	Parameters	X	Y	Z
Milling plan	2, climb milling			
Milling direction	2, parallel to Y axis			
Feed rate for pre-positioning	Maximum feed rate			
Limitation at B+90°	-1, negative principal axis			
Slot milling (roughing)	Parameters	X	Y	Z
Machining direction	Climb milling			
Plunging motion	Reciprocating			
Surface coordinate	-6			
Slot milling (finishing)	Parameters	X	Y	Z
Machining direction	Climb milling			
Plunging motion	Reciprocating			
Centering / drilling / thread cutting	Parameters	X	Y	Z
Diameter of counterbore	-7			
Depth reference	To cylindrical part of the drill (without tool tip)			
Thread pitch	1			
General parameters	Parameters	X	Y	Z
Safe position		-	-	+50
Safe tilting position	Relative to the machine datum	+300	-300	+300

Tool parameters

	\emptyset	T	S	F ₁	DZ	IZ
	10	5	89000	1100	-10	5
	6	3	12000	950	-10	5
	10	172	43000	730	-10	5
	5	227	6000	840	-11	5
	6	263	1000	-	-11	11

∅) Diameter

T) Tool number

S) Speed

F₁) Machining feed rate

DZ) Max. machining / drilling depth

IZ) Infeed

Solution

0 BEGIN PGM 1277123 MM	
1 BLK FORM 0.1 Z X-40 Y-10 Z-10	
2 BLK FORM 0.2 X+0 Y+10 Z+0	
3 TOOL CALL 5 Z S5000 F1000	
4 CALL LBL 99	RESET
5 CALL LBL 81	PLANE_1
6 CALL LBL 51	MACHINING_1
7 CALL LBL 98	RESET_COORD. TRANS.
8 CALL LBL 82	PLANE_2
9 CALL LBL 52	MACHINING_2
10 CALL LBL 99	RESET
11 CALL LBL 53	MACHINING_3
12 TOOL CALL 3 Z S8900 F1100	
13 CALL LBL 99	RESET
14 CALL LBL 54	MACHINING_4
15 TOOL CALL 172 Z S12000 F9500	
16 CALL LBL 99	RESET
17 CALL LBL 55	MACHINING_5
18 TOOL CALL 172 Z S4300 F730 DL-2.5 DR-2.5	
19 CALL LBL 56	MACHINING_6
20 CALL LBL 57	MACHINING_7
21 TOOL CALL 227 Z S4300 F730	
22 CALL LBL 99	RESET
23 CALL LBL 58	MACHINING_8
24 TOOL CALL 263 Z S1000	
25 CALL LBL 99	RESET
26 CALL LBL 59	MACHINING_9
27 CALL LBL 99	RESET
28 M30	
29 LBL 51	MACHINING_1
30 CYCL DEF 233	FACE MILLING
~	
Q215=+1	;MACHINING OPERATION ~
Q389=+2	;MILLING STRATEGY ~
Q350=+2	;MILLING DIRECTION ~
Q218=+10	;FIRST SIDE LENGTH ~
Q219=+20	;2ND SIDE LENGTH ~
Q227=+2.5	;STARTNG PNT 3RD AXIS ~
Q386=+0	;END POINT 3RD AXIS ~
Q369=+0	;ALLOWANCE FOR FLOOR ~
Q202=+5	;MAX. PLUNGING DEPTH ~
Q370=+1	;TOOL PATH OVERLAP ~

Q207= AUTO	;FEED RATE MILLING ~	
Q385=+500	;FINISHING FEED RATE ~	
Q253= MAX	;F PRE-POSITIONING ~	
Q357=+2	;CLEARANCE TO SIDE ~	
Q200=+2	;SET-UP CLEARANCE ~	
Q204=+50	;2ND SET-UP CLEARANCE ~	
Q347=+0	;1ST LIMIT ~	
Q348=+0	;2ND LIMIT ~	
Q349=+0	;3RD LIMIT ~	
Q220=+0	;CORNER RADIUS ~	
Q368=+0	;ALLOWANCE FOR SIDE ~	
Q338=+0	;INFEEED FOR FINISHING ~	
31 L X+0 Y+0 Z+50 R0 FMAX M99		
32 LBL 0		
33 LBL 52		MACHINING_2
34 CYCL DEF 233	FACE MILLING	
~		
Q215=+1	;MACHINING OPERATION ~	
Q389=+2	;MILLING STRATEGY ~	
Q350=+2	;MILLING DIRECTION ~	
Q218=-4	;FIRST SIDE LENGTH ~	
Q219=+20	;2ND SIDE LENGTH ~	
Q227=+6	;STARTNG PNT 3RD AXIS ~	
Q386=+0	;END POINT 3RD AXIS ~	
Q369=+0	;ALLOWANCE FOR FLOOR ~	
Q202=+5	;MAX. PLUNGING DEPTH ~	
Q370=+1	;TOOL PATH OVERLAP ~	
Q207= AUTO	;FEED RATE MILLING ~	
Q385=+500	;FINISHING FEED RATE ~	
Q253= MAX	;F PRE-POSITIONING ~	
Q357=+2	;CLEARANCE TO SIDE ~	
Q200=+2	;SET-UP CLEARANCE ~	
Q204=+50	;2ND SET-UP CLEARANCE ~	
Q347=-1	;1ST LIMIT ~	
Q348=+0	;2ND LIMIT ~	
Q349=+0	;3RD LIMIT ~	
Q220=+0	;CORNER RADIUS ~	
Q368=+0	;ALLOWANCE FOR SIDE ~	
Q338=+0	;INFEEED FOR FINISHING ~	
35 L X+4 Y+0 Z+50 R0 FMAX M99		
36 LBL 0		
37 LBL 53		MACHINING_3

38 CYCL DEF 253	SLOT MILLING	
~		
Q215=+1	;MACHINING OPERATION ~	
Q218=+22.5	;SLOT LENGTH ~	
Q219=+12.5	;SLOT WIDTH ~	
Q368=+0	;ALLOWANCE FOR SIDE ~	
Q374=+0	;ANGLE OF ROTATION ~	
Q367=+3	;SLOT POSITION ~	
Q207= AUTO	;FEED RATE MILLING ~	
Q351=+1	;CLIMB OR UP-CUT ~	
Q201=-6	;DEPTH ~	
Q202=+5	;PLUNGING DEPTH ~	
Q369=+0	;ALLOWANCE FOR FLOOR ~	
Q206= AUTO	;FEED RATE FOR PLNGNG ~	
Q338=+0	;INFEEED FOR FINISHING ~	
Q200=+2	;SET-UP CLEARANCE ~	
Q203=+0	;SURFACE COORDINATE ~	
Q204=+50	;2ND SET-UP CLEARANCE ~	
Q366=+2	;PLUNGE ~	
Q385=+500	;FINISHING FEED RATE ~	
Q439=+3	;FEED RATE REFERENCE	
39 L X-13 Y+0 Z+50 R0 FMAX M99		
40 LBL 0		
41 LBL 54		MACHINING_4
42 CYCL DEF 253	SLOT MILLING	
~		
Q215=+1	;MACHINING OPERATION ~	
Q218=+16.5	;SLOT LENGTH ~	
Q219=+6.5	;SLOT WIDTH ~	
Q368=+0	;ALLOWANCE FOR SIDE ~	
Q374=+0	;ANGLE OF ROTATION ~	
Q367=+3	;SLOT POSITION ~	
Q207= AUTO	;FEED RATE MILLING ~	
Q351=+1	;CLIMB OR UP-CUT ~	
Q201=-5	;DEPTH ~	
Q202=+5	;PLUNGING DEPTH ~	
Q369=+0	;ALLOWANCE FOR FLOOR ~	
Q206= AUTO	;FEED RATE FOR PLNGNG ~	
Q338=+0	;INFEEED FOR FINISHING ~	
Q200=+2	;SET-UP CLEARANCE ~	
Q203=-6	;SURFACE COORDINATE ~	
Q204=+50	;2ND SET-UP CLEARANCE ~	
Q366=+2	;PLUNGE ~	

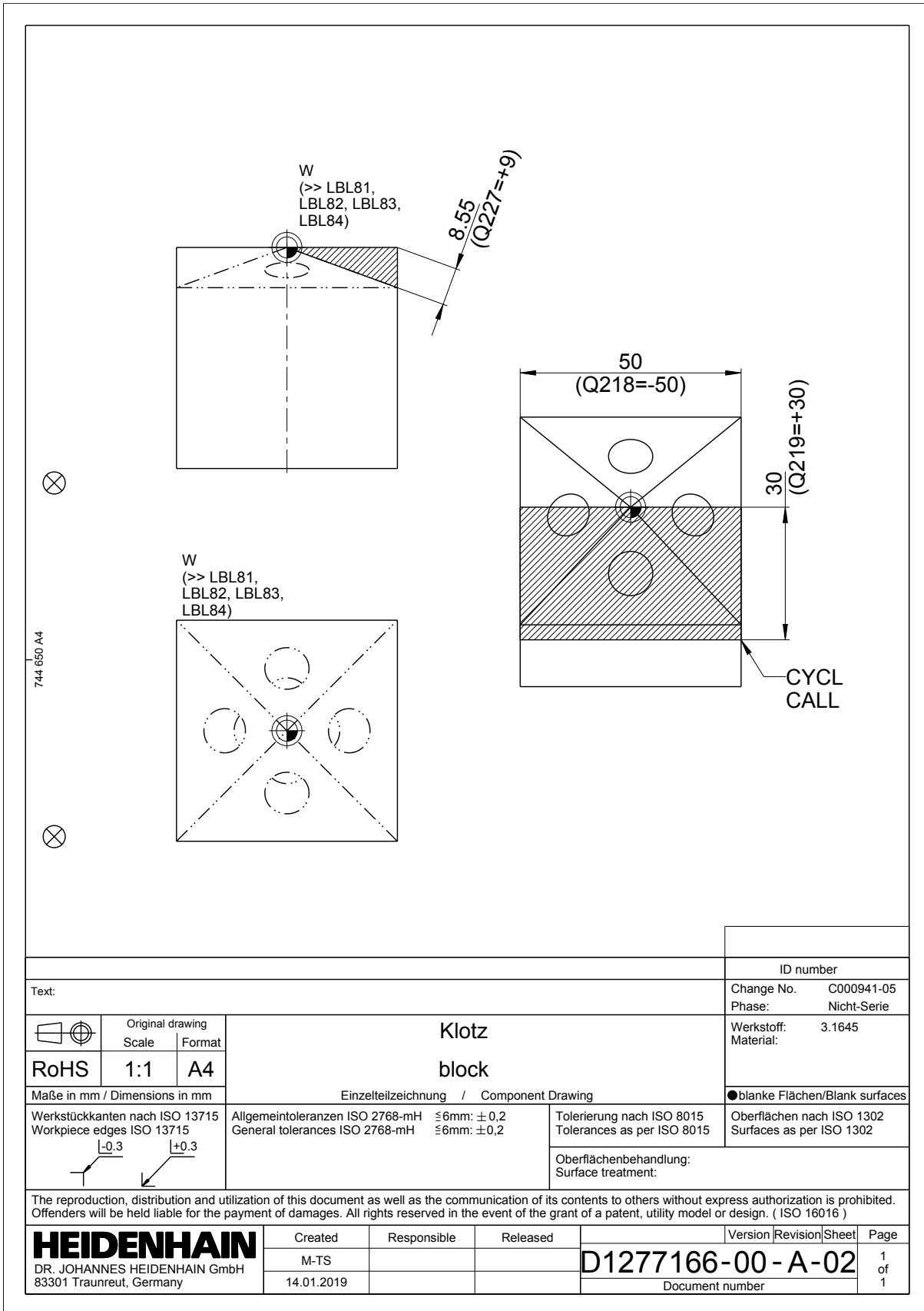
Q385=+500	;FINISHING FEED RATE ~	
Q439=+3	;FEED RATE REFERENCE	
43 L X-13 Y+0 Z+50 R0 FMAX M99		
44 LBL 0		
45 LBL 55		MACHINING_5
46 CYCL DEF 240	CENTERING ~	
Q200=+2	;SET-UP CLEARANCE ~	
Q343=+1	;SELECT DIA./DEPTH ~	
Q201=-2	;DEPTH ~	
Q344=-7	;DIAMETER ~	
Q206= AUTO	;FEED RATE FOR PLNGNG ~	
Q211=+0	;DWELL TIME AT DEPTH ~	
Q203=+0	;SURFACE COORDINATE ~	
Q204=+50	;2ND SET-UP CLEARANCE	
47 L X-34.5 Y+0 Z+50 R0 FMAX M99		
48 LBL 0		
49 LBL 56		MACHINING_6
50 CYCL DEF 253	SLOT MILLING ~	
Q215=+2	;MACHINING OPERATION ~	
Q218=+22.5	;SLOT LENGTH ~	
Q219=+12.5	;SLOT WIDTH ~	
Q368=+0.2	;ALLOWANCE FOR SIDE ~	
Q374=+0	;ANGLE OF ROTATION ~	
Q367=+3	;SLOT POSITION ~	
Q207= AUTO	;FEED RATE MILLING ~	
Q351=+1	;CLIMB OR UP-CUT ~	
Q201=-0.5	;DEPTH ~	
Q202=+5	;PLUNGING DEPTH ~	
Q369=+0	;ALLOWANCE FOR FLOOR ~	
Q206= AUTO	;FEED RATE FOR PLNGNG ~	
Q338=+0	;INFEEED FOR FINISHING ~	
Q200=+2	;SET-UP CLEARANCE ~	
Q203=+0	;SURFACE COORDINATE ~	
Q204=+50	;2ND SET-UP CLEARANCE ~	
Q366=+0	;PLUNGE ~	
Q385=+500	;FINISHING FEED RATE ~	
Q439=+3	;FEED RATE REFERENCE	
51 L X-13 Y+0 Z+50 R0 FMAX M99		
52 LBL 0		
53 LBL 57		MACHINING_7
54 CYCL DEF 253	SLOT MILLING ~	

Q215=+2	;MACHINING OPERATION ~	
Q218=+16.5	;SLOT LENGTH ~	
Q219=+6.5	;SLOT WIDTH ~	
Q368=+0.2	;ALLOWANCE FOR SIDE ~	
Q374=+0	;ANGLE OF ROTATION ~	
Q367=+3	;SLOT POSITION ~	
Q207= AUTO	;FEED RATE MILLING ~	
Q351=+1	;CLIMB OR UP-CUT ~	
Q201=-0.5	;DEPTH ~	
Q202=+5	;PLUNGING DEPTH ~	
Q369=+0	;ALLOWANCE FOR FLOOR ~	
Q206= AUTO	;FEED RATE FOR PLNGNG ~	
Q338=+0	;INFEEED FOR FINISHING ~	
Q200=+2	;SET-UP CLEARANCE ~	
Q203=-6	;SURFACE COORDINATE ~	
Q204=+50	;2ND SET-UP CLEARANCE ~	
Q366=+0	;PLUNGE ~	
Q385=+500	;FINISHING FEED RATE ~	
Q439=+3	;FEED RATE REFERENCE	
55 L X-13 Y+0 Z+50 R0 FMAX M99		
56 LBL 0		
57 LBL 58		MACHINING_8
58 CYCL DEF 200	DRILLING	~
Q200=+2	;SET-UP CLEARANCE ~	
Q201=-11	;DEPTH ~	
Q206= AUTO	;FEED RATE FOR PLNGNG ~	
Q202=+5	;PLUNGING DEPTH ~	
Q210=+0	;DWELL TIME AT TOP ~	
Q203=+0	;SURFACE COORDINATE ~	
Q204=+50	;2ND SET-UP CLEARANCE ~	
Q211=+0	;DWELL TIME AT DEPTH ~	
Q395=+1	;DEPTH REFERENCE	
59 L X-34.5 Y+0 Z+50 R0 FMAX M99		
60 LBL 0		
61 LBL 59		MACHINING_9
62 CYCL DEF 207	RIGID TAPPING	
~		
Q200=+2	;SET-UP CLEARANCE ~	
Q201=-11	;DEPTH OF THREAD ~	
Q239=+1	;THREAD PITCH ~	
Q203=+0	;SURFACE COORDINATE ~	
Q204=+50	;2ND SET-UP CLEARANCE	
63 L X-34.5 Y+0 Z+50 R0 FMAX M99		

64 LBL 0	
65 LBL 81	PLANE_1
66 CALL LBL 100	SAFE
67 CYCL DEF 7.0 DATUM SHIFT	
68 CYCL DEF 7.1 X-6	
69 CYCL DEF 7.2 Y-10	
70 PLANE SPATIAL SPA+0 SPB+20 SPC+0 TURN FMAX	
71 LBL 0	
72 LBL 82	PLANE_2
73 CALL LBL 100	SAFE
74 CYCL DEF 7.0 DATUM SHIFT	
75 CYCL DEF 7.1 X-6	
76 CYCL DEF 7.2 Y-10	
77 CYCL DEF 7.3 Z-6	
78 PLANE SPATIAL SPA+0 SPB+90 SPC+0 TURN FMAX	
79 LBL 0	
80 LBL 98	RESET_COORD. TRANS.
81 PLANE RESET STAY	
82 CYCL DEF 7.0 DATUM SHIFT	
83 CYCL DEF 7.1 X+0	
84 CYCL DEF 7.2 Y+0	
85 CYCL DEF 7.3 Z+0	
86 LBL 0	
87 LBL 99	RESET
88 CALL LBL 100	SAFE
89 PLANE RESET TURN FMAX	
90 CYCL DEF 7.0 DATUM SHIFT	
91 CYCL DEF 7.1 X+0	
92 CYCL DEF 7.2 Y+0	
93 CYCL DEF 7.3 Z+0	
94 LBL 0	
95 LBL 100	SAFE
96 L Z+300 R0 FMAX M3 M91	
97 L X+300 Y-300 R0 FMAX M91	
98 LBL 0	
99 END PGM 1277123 MM	

2.3 Programming more than one spatial angle – 1277166

ID number										
Text:	Change No. C000941-05 Phase: Nicht-Serie									
<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center;"> RoHS </td> <td style="text-align: center;"> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="font-size: 8px;">Original drawing</td> <td style="font-size: 8px;">Scale</td> <td style="font-size: 8px;">Format</td> </tr> <tr> <td style="text-align: center;">1:1</td> <td style="text-align: center;">A4</td> <td></td> </tr> </table> </td> </tr> </table>	 RoHS	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="font-size: 8px;">Original drawing</td> <td style="font-size: 8px;">Scale</td> <td style="font-size: 8px;">Format</td> </tr> <tr> <td style="text-align: center;">1:1</td> <td style="text-align: center;">A4</td> <td></td> </tr> </table>	Original drawing	Scale	Format	1:1	A4		Klotz block	Werkstoff: 3.1645 Material:
 RoHS	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="font-size: 8px;">Original drawing</td> <td style="font-size: 8px;">Scale</td> <td style="font-size: 8px;">Format</td> </tr> <tr> <td style="text-align: center;">1:1</td> <td style="text-align: center;">A4</td> <td></td> </tr> </table>	Original drawing	Scale	Format	1:1	A4				
Original drawing	Scale	Format								
1:1	A4									
Maße in mm / Dimensions in mm		Einzelteilzeichnung / Component Drawing	●blanke Flächen/Blank surfaces							
Werkstückkanten nach ISO 13715 Workpiece edges ISO 13715	Allgemeintoleranzen ISO 2768-mH General tolerances ISO 2768-mH	Tolerierung nach ISO 8015 Tolerances as per ISO 8015	Oberflächen nach ISO 1302 Surfaces as per ISO 1302							
		Oberflächenbehandlung: Surface treatment:								
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HEIDENHAIN	Created	Responsible	Released	Version	Revision	Sheet	Page			
	M-TS			D1277166-00-A-01			1 of 1			
	14.01.2019			Document number						
DR. JOHANNES HEIDENHAIN GmbH 83301 Traunreut, Germany										



Working plan

- ▶ Workpiece blank definition
- ▶ Tool call
- ▶ Mill the inclined surfaces
- ▶ Tool call
- ▶ Drill the holes
- ▶ End the NC program
- ▶ Define subprograms



Program parameters

Face milling (roughing)	Parameters	X	Y	Z
Milling plan	2, climb milling			
Milling direction	2, parallel to Y axis			
Feed rate for pre-positioning	Maximum feed rate			

Drilling	Parameters	X	Y	Z
Plunging depth	5			
Depth reference	To cylindrical part of the drill (without tool tip)			

General parameters	Parameters	X	Y	Z
Safe position		-	-	+50
Safe tilting position	Relative to the machine datum	+300	-300	+300

Tool parameters

	Ø	T	S	F ₁	DZ	IZ
	20	10	1000	5000	-10	5
	10	232	3200	800	-20	5

- Ø) Diameter
- T) Tool number
- S) Speed
- F₁) Machining feed rate
- DZ) Max. machining / drilling depth
- IZ) Infeed

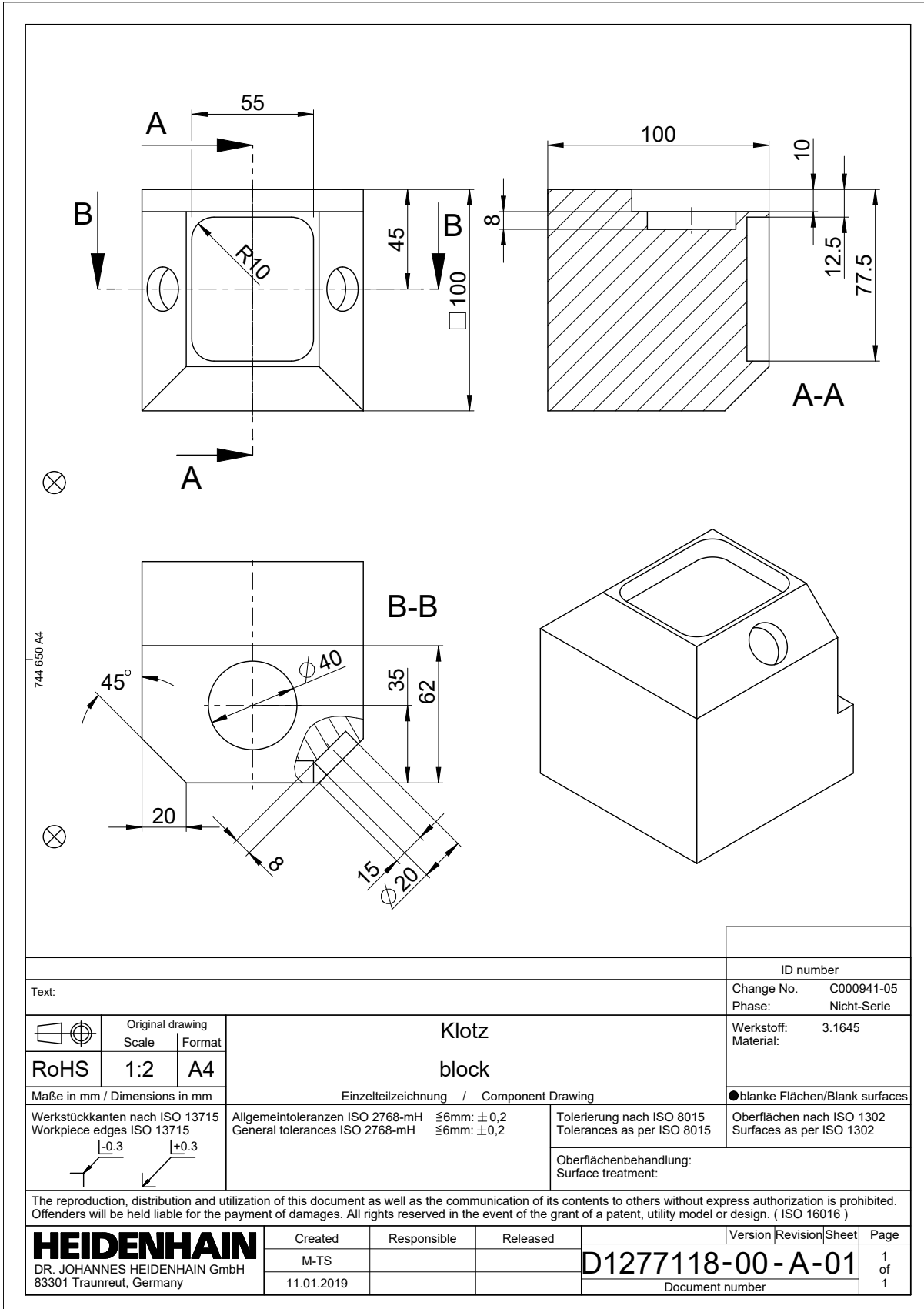
Solution

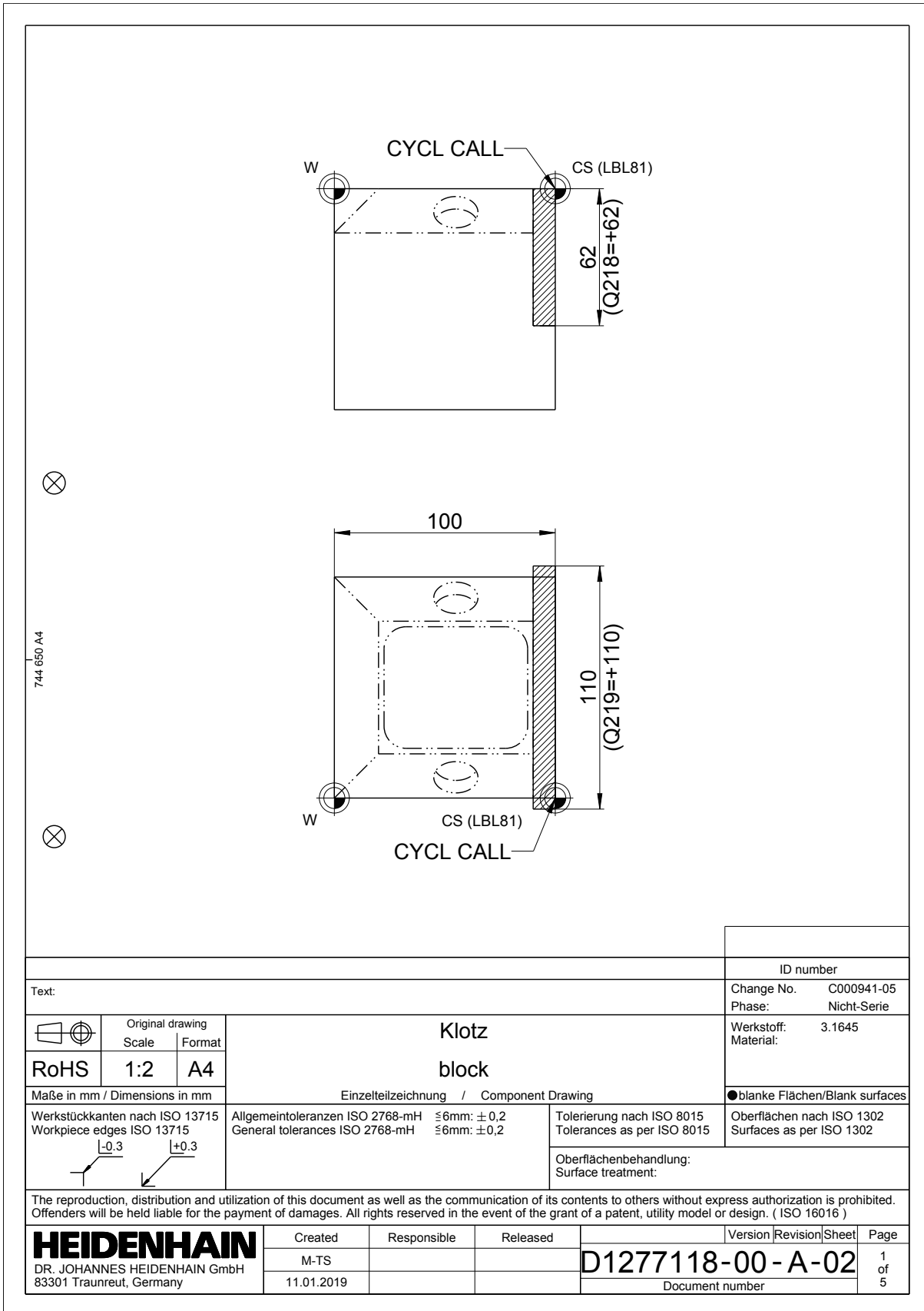
0 BEGIN PGM 1277166 MM	
1 BLK FORM 0.1 Z X-25 Y-25 Z-50	
2 BLK FORM 0.2 X+25 Y+25 Z+0	
3 TOOL CALL 10 Z S5000 F1000	
4 CALL LBL 99	RESET
5 CALL LBL 81	PLANE_1
6 CALL LBL 51	MACHINING_1
7 CALL LBL 82	PLANE_2
8 CALL LBL 51	MACHINING_1
9 CALL LBL 83	PLANE_3
10 CALL LBL 51	MACHINING_1
11 CALL LBL 84	PLANE_4
12 CALL LBL 51	MACHINING_1
13 CALL LBL 99	RESET
14 TOOL CALL 232 Z S3200 F800	
15 CALL LBL 99	RESET
16 CALL LBL 81	PLANE_1
17 CALL LBL 52	MACHINING_2
18 CALL LBL 82	PLANE_2
19 CALL LBL 52	MACHINING_2
20 CALL LBL 83	PLANE_3
21 CALL LBL 52	MACHINING_2
22 CALL LBL 84	PLANE_4
23 CALL LBL 52	MACHINING_2
24 CALL LBL 99	RESET
25 M30	
26 LBL 51	MACHINING_1
27 CYCL DEF 233	FACE MILLING
~	
Q215=+1	;MACHINING OPERATION ~
Q389=+2	;MILLING STRATEGY ~
Q350=+2	;MILLING DIRECTION ~
Q218=-50	;FIRST SIDE LENGTH ~
Q219=+30	;2ND SIDE LENGTH ~
Q227=+9	;STARTNG PNT 3RD AXIS ~
Q386=+0	;END POINT 3RD AXIS ~
Q369=+0	;ALLOWANCE FOR FLOOR ~
Q202=+5	;MAX. PLUNGING DEPTH ~
Q370=+1	;TOOL PATH OVERLAP ~
Q207= AUTO	;FEED RATE MILLING ~
Q385=+500	;FINISHING FEED RATE ~
Q253= MAX	;F PRE-POSITIONING ~

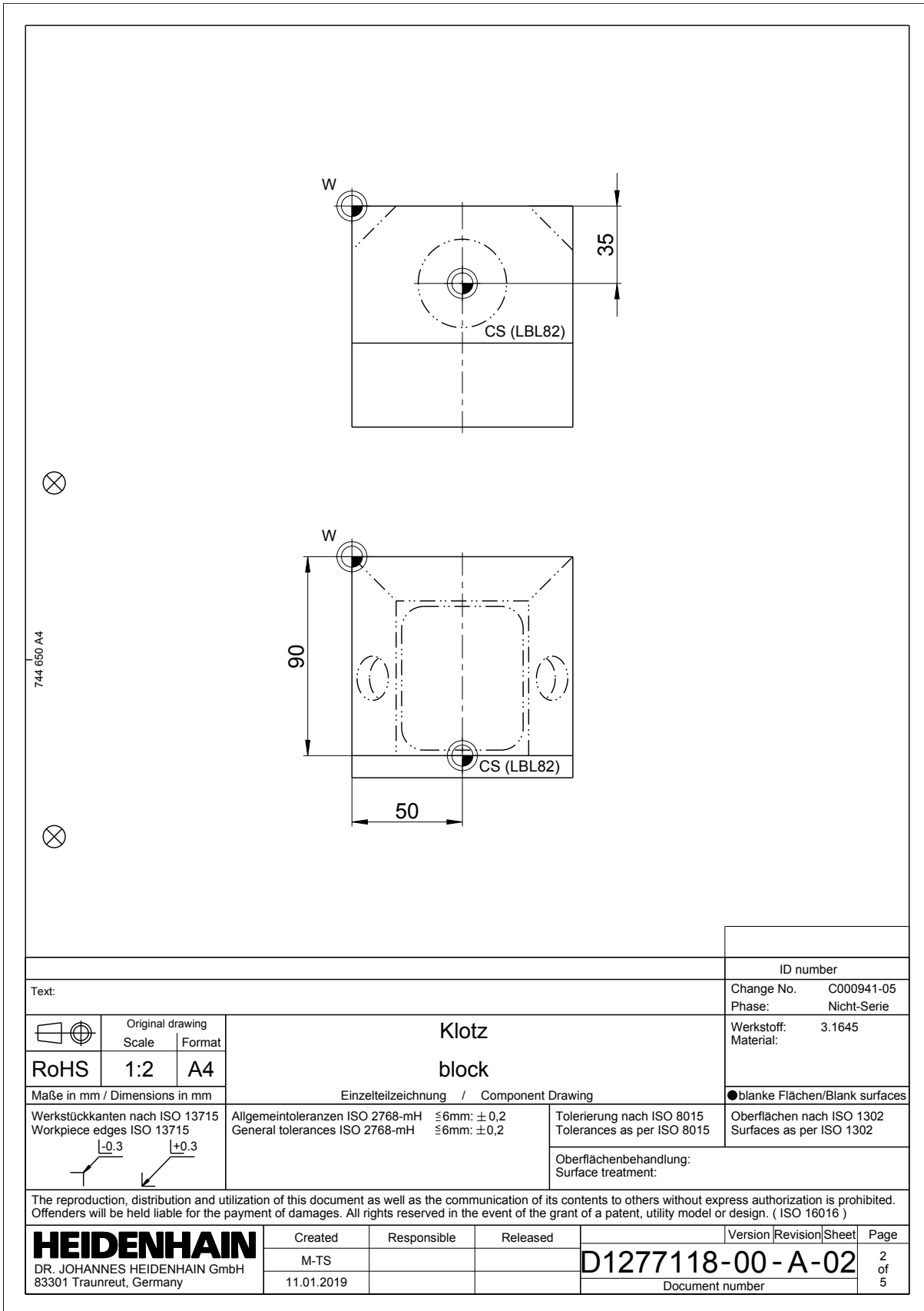
Q357=+2	;CLEARANCE TO SIDE ~	
Q200=+2	;SET-UP CLEARANCE ~	
Q204=+50	;2ND SET-UP CLEARANCE ~	
Q347=+0	;1ST LIMIT ~	
Q348=+0	;2ND LIMIT ~	
Q349=+0	;3RD LIMIT ~	
Q220=+0	;CORNER RADIUS ~	
Q368=+0	;ALLOWANCE FOR SIDE ~	
Q338=+0	;INFEEED FOR FINISHING ~	
28 L X+25 Y-30 Z+50 R0 FMAX M99		
29 LBL 0		
30 LBL 52		MACHINING_2
31 CYCL DEF 200 DRILLING ~		
Q200=+2	;SET-UP CLEARANCE ~	
Q201=-20	;DEPTH ~	
Q206= AUTO	;FEED RATE FOR PLNGNG ~	
Q202=+5	;PLUNGING DEPTH ~	
Q210=+0	;DWELL TIME AT TOP ~	
Q203=+0	;SURFACE COORDINATE ~	
Q204=+50	;2ND SET-UP CLEARANCE ~	
Q211=+0	;DWELL TIME AT DEPTH ~	
Q395=+1	;DEPTH REFERENCE	
32 L X+0 Y-15 Z+50 R0 FMAX M99		
33 LBL 0		
34 LBL 81		PLANE_1
35 CALL LBL 100		SAFE
36 PLANE SPATIAL SPA+20 SPB+0 SPC+0 TURN FMAX		
37 LBL 0		
38 LBL 82		PLANE_2
39 CALL LBL 100		SAFE
40 PLANE SPATIAL SPA+20 SPB+0 SPC+90 TURN FMAX		
41 LBL 0		
42 LBL 83		PLANE_3
43 CALL LBL 100		SAFE
44 PLANE SPATIAL SPA+20 SPB+0 SPC+180 TURN FMAX		
45 LBL 0		
46 LBL 84		PLANE_4
47 CALL LBL 100		SAFE
48 PLANE SPATIAL SPA+20 SPB+0 SPC+270 TURN FMAX		
49 LBL 0		
50 LBL 99		RESET
51 CALL LBL 100		SAFE
52 PLANE RESET TURN FMAX		

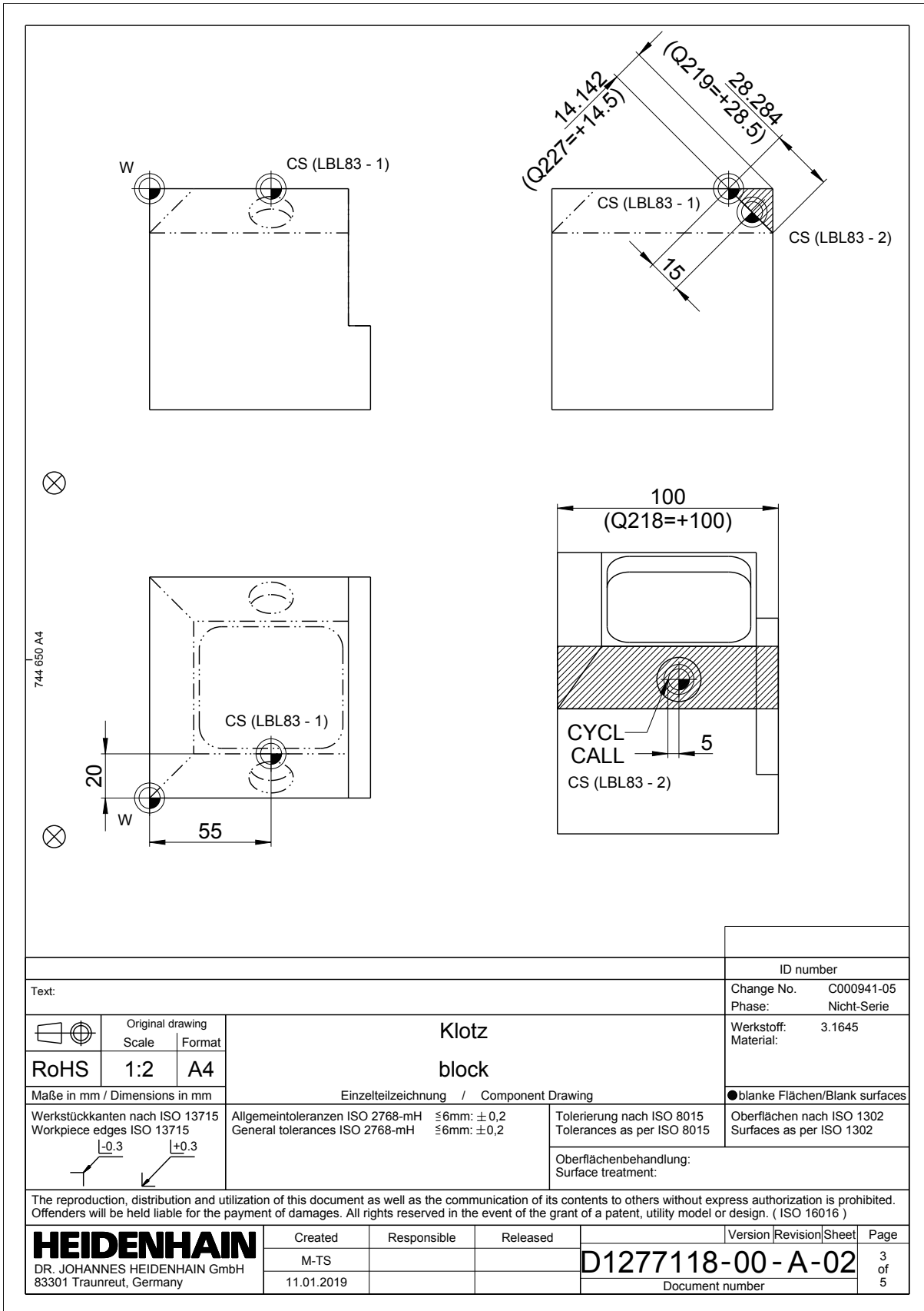
53 CYCL DEF 7.0 NULLPUNKT	
54 CYCL DEF 7.1 X+0	
55 CYCL DEF 7.2 Y+0	
56 CYCL DEF 7.3 Z+0	
57 LBL 0	
58 LBL 100	SAFE
59 L Z+300 R0 FMAX M3 M91	
60 L X+300 Y-300 R0 FMAX M91	
61 LBL 0	
62 END PGM 1277166 MM	

2.4 Programming more than one spatial angle – 1277118

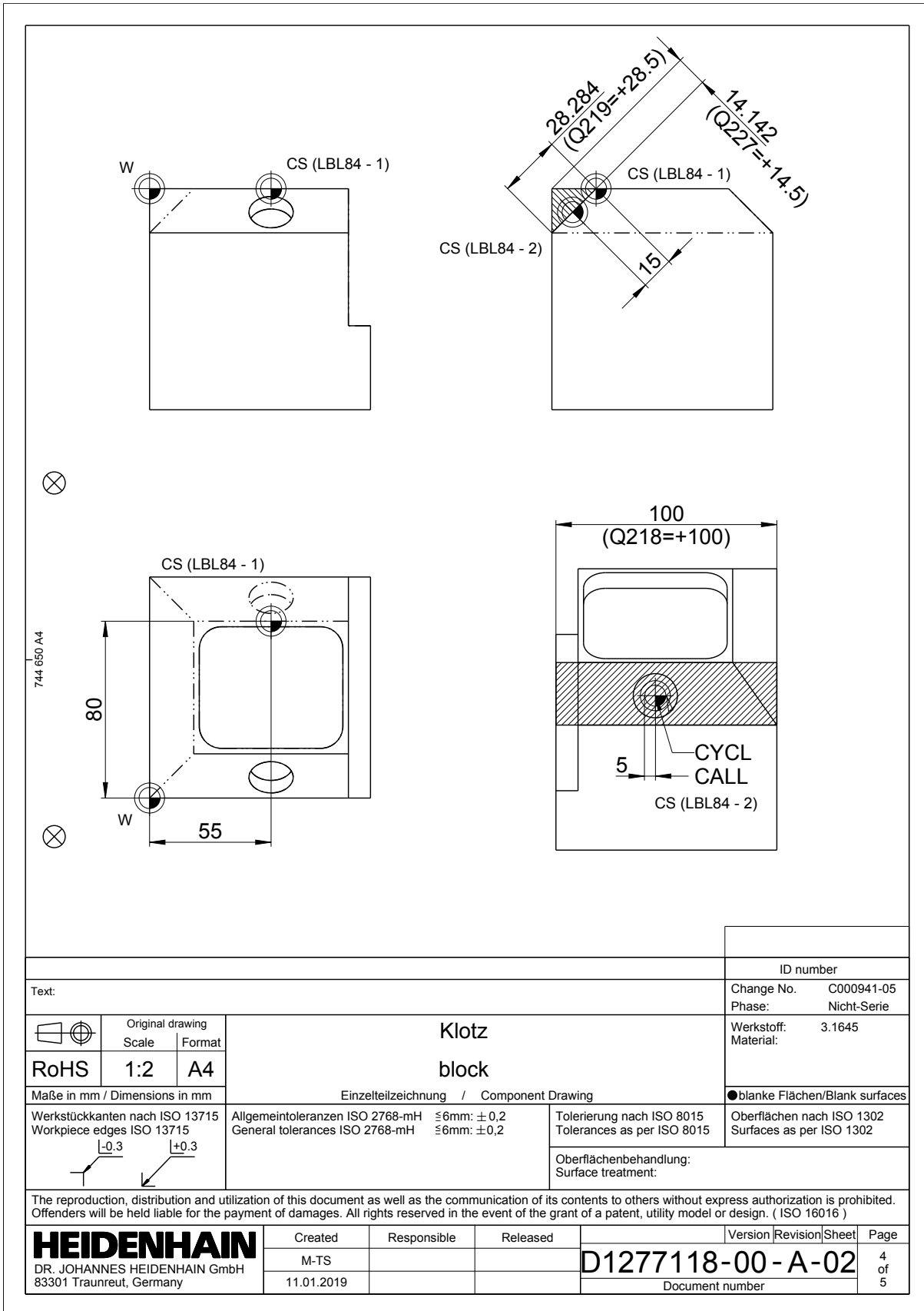


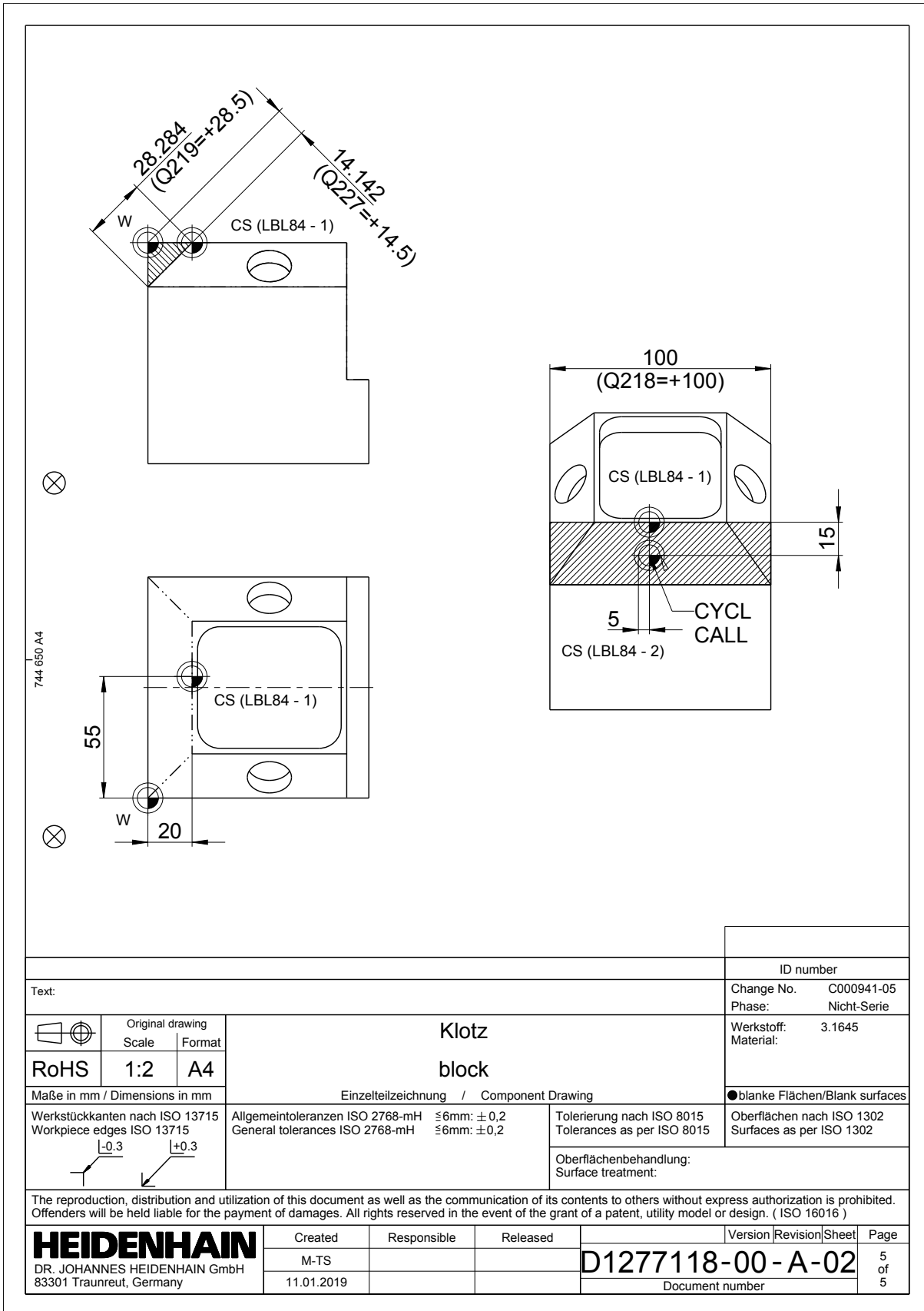






Text:		ID number							
Change No. C000941-05		Phase: Nicht-Serie							
Werkstoff: 3.1645		Material:							
<table border="1"> <tr> <th>Original drawing</th> <th>Scale</th> <th>Format</th> </tr> <tr> <td></td> <td>1:2</td> <td>A4</td> </tr> </table>		Original drawing	Scale	Format		1:2	A4	<p>Klotz block</p>	
Original drawing	Scale	Format							
	1:2	A4							
Maße in mm / Dimensions in mm		Einzelteilzeichnung / Component Drawing							
<p>Werkstückkanten nach ISO 13715 Workpiece edges ISO 13715</p> <p>± 0.3 ± 0.3</p>		<p>Allgemeintoleranzen ISO 2768-mH $\leq 6\text{mm}$: $\pm 0,2$ General tolerances ISO 2768-mH $\leq 6\text{mm}$: $\pm 0,2$</p>							
<p>Tolerierung nach ISO 8015 Tolerances as per ISO 8015</p>		<p>Oberflächen nach ISO 1302 Surfaces as per ISO 1302</p>							
<p>Oberflächenbehandlung: Surface treatment:</p>									
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<p>HEIDENHAIN DR. JOHANNES HEIDENHAIN GmbH 83301 Traunreut, Germany</p>	Created	Responsible	Released						
	M-TS								
	11.01.2019								
Version		Revision	Sheet						
D1277118-00-A-02			Page						
Document number			3 of 5						





Working plan

- ▶ Workpiece blank definition
- ▶ Tool call
- ▶ Mill the inclined surface (B+90°)
- ▶ Mill the circle (Ø 40)
- ▶ Mill the rectangular pocket
- ▶ Mill the inclined surface (A+45°) and circle (Ø 20)
- ▶ Mill the inclined surface (A+45°, B+180°) and circle (Ø 20)
- ▶ Mill the inclined surface (A+45°, B+90°)
- ▶ End the NC program
- ▶ Define subprograms

Program parameters


Face milling (roughing)	Parameters	X	Y	Z
Milling plan	2, climb milling			
Milling direction	1, parallel to X axis			
Feed rate for pre-positioning	Maximum feed rate			
Limitation at B+90°	+1, positive principal axis			

Rectangular pocket milling (roughing)	Parameters	X	Y	Z
Machining direction	Climb milling			
Plunging motion	Helical			

Bore milling	Parameters	X	Y	Z
Machining direction	Climb milling			
Plunging depth	1			

General parameters	Parameters	X	Y	Z
Safe position		-	-	+50
Safe tilting position	Relative to the machine datum	+300	-300	+300

Tool parameters

	Ø	T	S	F ₁	DZ	IZ
	20	10	5000	1000	-10	5

- Ø) Diameter
- T) Tool number
- S) Speed
- F₁) Machining feed rate
- DZ) Max. machining / drilling depth
- IZ) Infeed

Solution

0 BEGIN PGM 1277118 MM	
1 BLK FORM 0.1 Z X+0 Y+0 Z-100	
2 BLK FORM 0.2 X+100 Y+100 Z+0	
3 TOOL CALL 10 Z S5000 F1000	
4 CALL LBL 99	RESET
5 CALL LBL 81	PLANE_1
6 CALL LBL 51	MACHINING_1
7 CALL LBL 99	RESET
8 CALL LBL 82	PLANE_2
9 CALL LBL 52	MACHINING_2
10 CALL LBL 99	RESET
11 CALL LBL 53	MACHINING_3
12 CALL LBL 83	PLANE_3
13 CALL LBL 54	MACHINING_4
14 CALL LBL 55	MACHINING_5
15 CALL LBL 99	RESET
16 CALL LBL 84	PLANE_4
17 CALL LBL 54	MACHINING_4
18 CALL LBL 55	MACHINING_5
19 CALL LBL 99	RESET
20 CALL LBL 85	PLANE_5
21 CALL LBL 54	MACHINING_4
22 CALL LBL 99	RESET
23 M30	
24 LBL 51	MACHINING_1
25 CYCL DEF 233 FACE MILLING	
~	
Q215=+1 ;MACHINING OPERATION ~	
Q389=+2 ;MILLING STRATEGY ~	
Q350=+1 ;MILLING DIRECTION ~	
Q218=+62 ;FIRST SIDE LENGTH ~	
Q219=+110 ;2ND SIDE LENGTH ~	
Q227=+0 ;STARTNG PNT 3RD AXIS ~	
Q386=-10 ;END POINT 3RD AXIS ~	
Q369=+0 ;ALLOWANCE FOR FLOOR ~	
Q202=+5 ;MAX. PLUNGING DEPTH ~	
Q370=+1 ;TOOL PATH OVERLAP ~	
Q207= AUTO ;FEED RATE MILLING ~	
Q385=+500 ;FINISHING FEED RATE ~	
Q253= MAX ;F PRE-POSITIONING ~	
Q357=+2 ;CLEARANCE TO SIDE ~	
Q200=+2 ;SET-UP CLEARANCE ~	

Q204=+50	;2ND SET-UP CLEARANCE ~	
Q347=+1	;1ST LIMIT ~	
Q348=+0	;2ND LIMIT ~	
Q349=+0	;3RD LIMIT ~	
Q220=+0	;CORNER RADIUS ~	
Q368=+0	;ALLOWANCE FOR SIDE ~	
Q338=+0	;INFEEED FOR FINISHING ~	
26 L X+0 Y+0 Z+50 R0 FMAX M99		
27 LBL 0		
28 LBL 52		MACHINING_2
29 CYCL DEF 208	BORE MILLING	
~		
Q200=+2	;SET-UP CLEARANCE ~	
Q201=-8	;DEPTH ~	
Q206= AUTO	;FEED RATE FOR PLNGNG ~	
Q334=+1	;PLUNGING DEPTH ~	
Q203=+0	;SURFACE COORDINATE ~	
Q204=+50	;2ND SET-UP CLEARANCE ~	
Q335=+40	;NOMINAL DIAMETER ~	
Q342=+0	;ROUGHING DIAMETER ~	
Q351=+1	;CLIMB OR UP-CUT	
30 L X+0 Y+0 Z+50 R0 FMAX M99		
31 LBL 0		
32 LBL 53		MACHINING_3
33 CYCL DEF 251	RECTANGULAR POCKET	
~		
Q215=+1	;MACHINING OPERATION ~	
Q218=+65	;FIRST SIDE LENGTH ~	
Q219=+55	;2ND SIDE LENGTH ~	
Q220=+10	;CORNER RADIUS ~	
Q368=+0	;ALLOWANCE FOR SIDE ~	
Q224=+0	;ANGLE OF ROTATION ~	
Q367=+0	;POCKET POSITION ~	
Q207= AUTO	;FEED RATE MILLING ~	
Q351=+1	;CLIMB OR UP-CUT ~	
Q201=-8	;DEPTH ~	
Q202=+5	;PLUNGING DEPTH ~	
Q369=+0	;ALLOWANCE FOR FLOOR ~	
Q206= AUTO	;FEED RATE FOR PLNGNG ~	
Q338=+0	;INFEEED FOR FINISHING ~	
Q200=+2	;SET-UP CLEARANCE ~	
Q203=+0	;SURFACE COORDINATE ~	
Q204=+50	;2ND SET-UP CLEARANCE ~	

Q370=+1	;TOOL PATH OVERLAP ~	
Q366=+1	;PLUNGE ~	
Q385=+500	;FINISHING FEED RATE ~	
Q439=+0	;FEED RATE REFERENCE	
34 L X+55 Y+50 Z+50 R0 FMAX M99		
35 LBL 0		
36 LBL 54		MACHINING_4
37 CYCL DEF 233	FACE MILLING	
~		
Q215=+1	;MACHINING OPERATION ~	
Q389=+2	;MILLING STRATEGY ~	
Q350=+1	;MILLING DIRECTION ~	
Q218=+100	;FIRST SIDE LENGTH ~	
Q219=+28.5	;2ND SIDE LENGTH ~	
Q227=+14.5	;STARTNG PNT 3RD AXIS ~	
Q386=+0	;END POINT 3RD AXIS ~	
Q369=+0	;ALLOWANCE FOR FLOOR ~	
Q202=+5	;MAX. PLUNGING DEPTH ~	
Q370=+1	;TOOL PATH OVERLAP ~	
Q207= AUTO	;FEED RATE MILLING ~	
Q385=+500	;FINISHING FEED RATE ~	
Q253= MAX	;F PRE-POSITIONING ~	
Q357=+2	;CLEARANCE TO SIDE ~	
Q200=+2	;SET-UP CLEARANCE ~	
Q204=+50	;2ND SET-UP CLEARANCE ~	
Q347=+0	;1ST LIMIT ~	
Q348=+0	;2ND LIMIT ~	
Q349=+0	;3RD LIMIT ~	
Q220=+0	;CORNER RADIUS ~	
Q368=+0	;ALLOWANCE FOR SIDE ~	
Q338=+0	;INFEEED FOR FINISHING ~	
38 L X-5 Y+0 Z+50 R0 FMAX M99		
39 LBL 0		
40 LBL 55		MACHINING_55
41 CYCL DEF 208	BORE MILLING	
~		
Q200=+2	;SET-UP CLEARANCE ~	
Q201=-8	;DEPTH ~	
Q206= AUTO	;FEED RATE FOR PLNGNG ~	
Q334=+1	;PLUNGING DEPTH ~	
Q203=+0	;SURFACE COORDINATE ~	
Q204=+50	;2ND SET-UP CLEARANCE ~	
Q335=+20	;NOMINAL DIAMETER ~	

Q342=+0	;ROUGHING DIAMETER ~	
Q351=+1	;CLIMB OR UP-CUT	
42 L	X+0 Y+0 Z+50 R0 FMAX M99	
43 LBL	0	
44 LBL	81	PLANE_1
45 CYCL DEF	7.0 DATUM SHIFT	
46 CYCL DEF	7.1 X+100	
47 CYCL DEF	7.2 Y+0	
48 PLANE SPATIAL	SPA+0 SPB+90 SPC+0 TURN FMAX	
49 LBL	0	
50 LBL	82	PLANE_2
51 CALL	LBL 100	SAFE
52 CYCL DEF	7.0 DATUM SHIFT	
53 CYCL DEF	7.1 X+90	
54 CYCL DEF	7.2 Y+50	
55 CYCL DEF	7.3 Z-35	
56 PLANE SPATIAL	SPA+0 SPB+90 SPC+0 TURN FMAX	
57 LBL	0	
58 LBL	83	PLANE_3
59 CALL	LBL 100	SAFE
60 CYCL DEF	7.0 DATUM SHIFT	
61 CYCL DEF	7.1 X+55	
62 CYCL DEF	7.2 Y+20	
63 PLANE SPATIAL	SPA+48.18 SPB+0 SPC+0 TURN FMAX	
64 CYCL DEF	7.0 DATUM SHIFT	
65 CYCL DEF	7.1 IY-15	
66 LBL	0	
67 LBL	84	PLANE_4
68 CALL	LBL 100	SAFE
69 CYCL DEF	7.0 DATUM SHIFT	
70 CYCL DEF	7.1 X+55	
71 CYCL DEF	7.2 Y+80	
72 PLANE SPATIAL	SPA+48.18 SPB+0 SPC+180 TURN FMAX	
73 CYCL DEF	7.0 DATUM SHIFT	
74 CYCL DEF	7.1 IY-15	
75 LBL	0	
76 LBL	85	PLANE_5
77 CALL	LBL 100	SAFE
78 CYCL DEF	7.0 DATUM SHIFT	
79 CYCL DEF	7.1 X+20	
80 CYCL DEF	7.2 Y+55	
81 PLANE SPATIAL	SPA-48.18 SPB+0 SPC+90 TURN FMAX	
82 CYCL DEF	7.0 DATUM SHIFT	

83 CYCL DEF 7.1 IY+15	
84 LBL 0	
85 LBL 99	RESET
86 CALL LBL 100	SAFE
87 PLANE RESET TURN FMAX	
88 CYCL DEF 7.0 DATUM SHIFT	
89 CYCL DEF 7.1 X+0	
90 CYCL DEF 7.2 Y+0	
91 CYCL DEF 7.3 Z+0	
92 LBL 0	
93 LBL 100	SAFE
94 L Z+300 R0 FMAX M3 M91	
95 L X+300 Y-300 R0 FMAX M91	
96 LBL 0	
97 END PGM 1277118 MM	

3

**Related and further
topics**

3.1 Programming more than one transformation – 1267093

744 650 A4

Text:

Original drawing		Klotz Block	ID number
Scale	Format		Change No. C000941-05 Phase: Nicht-Serie
RoHS	1:1	A4	Werkstoff: Material:
Maße in mm / Dimensions in mm		Einzelteilzeichnung / Component Drawing	●blanke Flächen/Blank surfaces
Werkstückkanten nach ISO 13715 Workpiece edges ISO 13715		Allgemeintoleranzen ISO 2768-mH $\leq 6\text{mm}: \pm 0,2$ General tolerances ISO 2768-mH $\leq 6\text{mm}: \pm 0,2$	Tolerierung nach ISO 8015 Tolerances as per ISO 8015
		Oberflächenbehandlung: Surface treatment:	

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	M-TS			D1267093-00-A-01			1 of 1
	17.09.2018			Document number			

ID number							
Text:							
	Original drawing Scale: 1:1 Format: A4						
Klotz Block							
Maße in mm / Dimensions in mm							
Dokumentenart / Document type							
Werkstückkanten nach ISO 13715 Workpiece edges ISO 13715 	Allgmeintoleranzen ISO 2768-mH ≤6mm: ±0,2 General tolerances ISO 2768-mH ≤6mm: ±0,2						
Tolerierung nach ISO 8015 Tolerances as per ISO 8015							
Oberflächen nach ISO 1302 Surfaces as per ISO 1302							
Oberflächenbehandlung: Surface treatment:							
●blanke Flächen/Blank surfaces							
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	M-TS			D1267093-00 - A-02			1 of 1
	17.09.2018			Document number			

Working plan

- ▶ Workpiece blank definition
- ▶ Tool call
- ▶ Mill the first side of the hexagon
 - Cycle 19 **WORKING PLANE**
- ▶ Mill the other sides of the hexagon
 - Program section repeat
- ▶ Tool call
- ▶ Drill the holes
- ▶ End the NC program
- ▶ Define subprograms



Program parameters

Rectangular pocket (roughing)	Parameters	X	Y	Z
Corner radius	10, cutter radius			
Machining direction	Climb milling			
Surface coordinate	+20			
Plunging motion	Helical			

Drilling	Parameters	X	Y	Z
Plunging depth	5			
Depth reference	To cylindrical part of the drill (without tool tip)			

General parameters	Parameters	X	Y	Z
Safe position		-	-	+50
Safe tilting position	Relative to the machine datum	+300	-300	+300

Tool parameters

	Ø	T	S	F₁	DZ	IZ
	20	10	5000	1000	-5	5
	6	228	6000	840	-5	5

- Ø) Diameter
- T) Tool number
- S) Speed
- F₁) Machining feed rate
- DZ) Max. machining / drilling depth
- IZ) Infeed

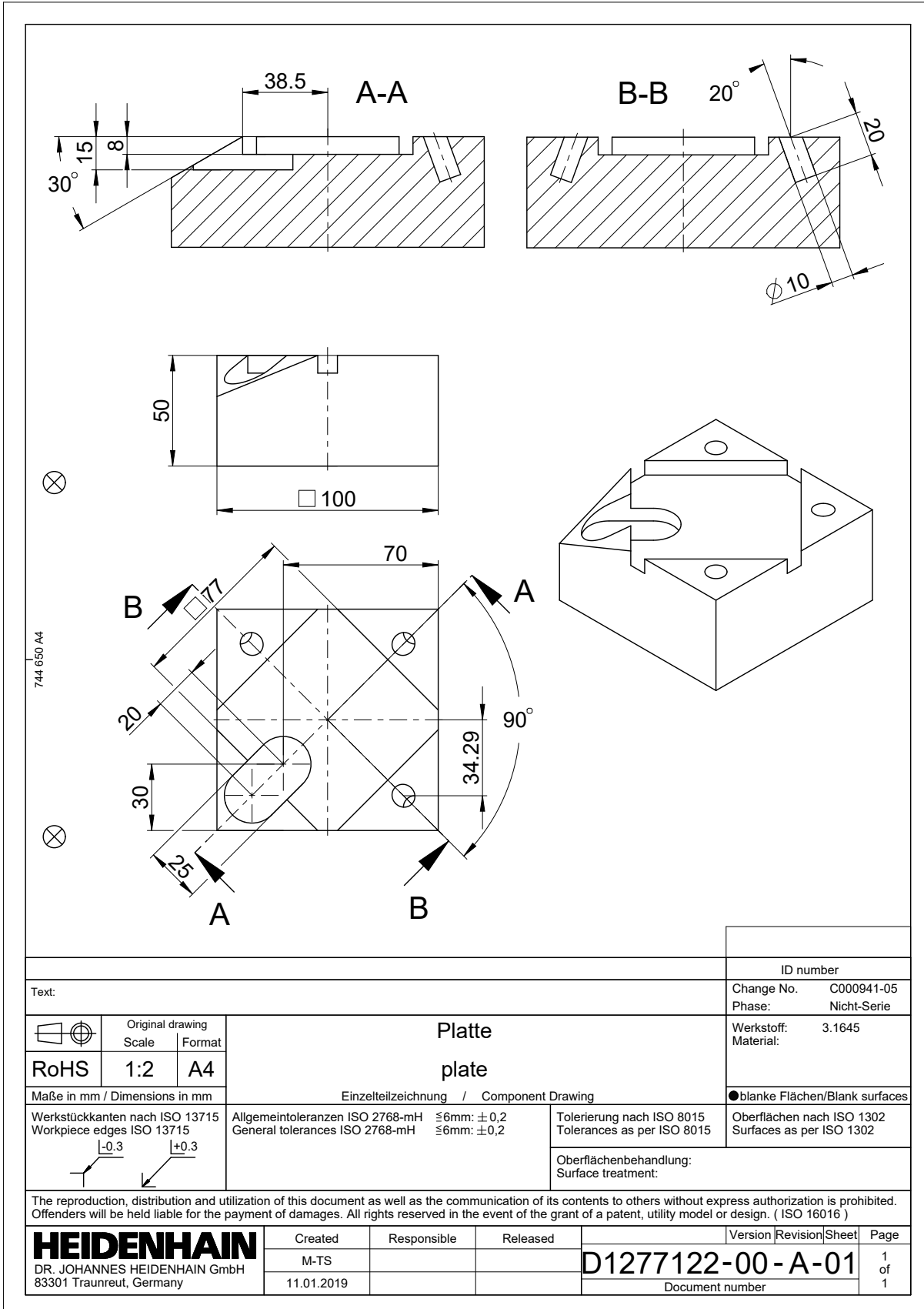
Solution

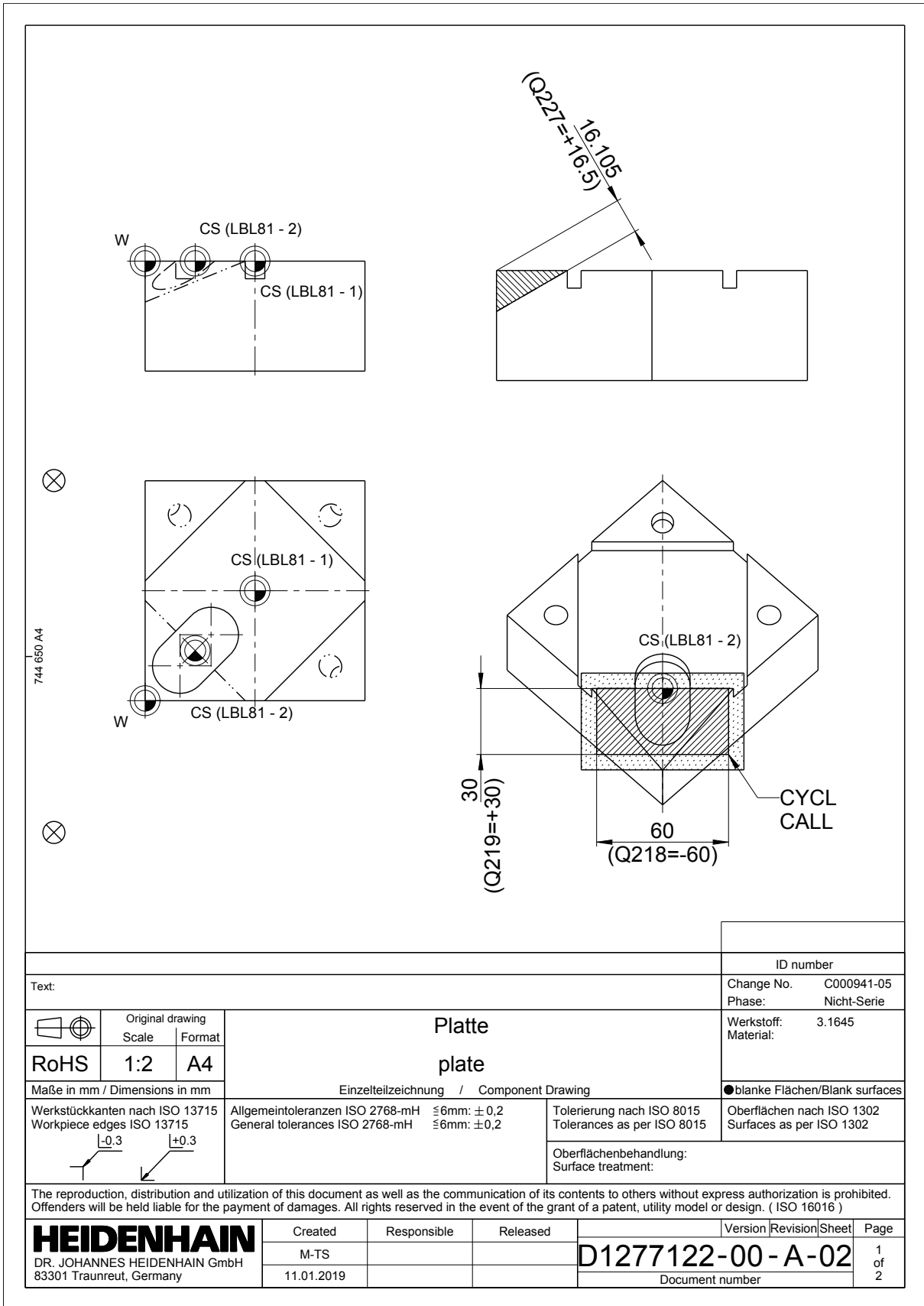
0	BEGIN PGM 1267093 MM	
1	BLK FORM 0.1 Z X-30 Y-30 Z-80	
2	BLK FORM 0.2 X+30 Y+30 Z+0	
3	TOOL CALL 10 Z S5000 F1000	
4	CALL LBL 99	RESET
5	CALL LBL 81	PLANE_1
6	CALL LBL 51	MACHINING_1
7	LBL 1	
8	CALL LBL 82	PLANE_INC.
9	CALL LBL 51	MACHINING_1
10	CALL LBL 1 REP4	
11	CALL LBL 99	RESET
12	TOOL CALL 228 Z S6000 F840	
13	CALL LBL 99	RESET
14	CALL LBL 81	PLANE_1
15	CALL LBL 52	MACHINING_2
16	LBL 2	
17	CALL LBL 82	PLANE_INC.
18	CALL LBL 52	MACHINING_2
19	CALL LBL 2 REP4	
20	CALL LBL 99	RESET
21	M30	
22	LBL 51	MACHINING_1
23	CYCL DEF 251 RECTANGULAR POCKET	
	~	
	Q215=+1 ;MACHINING OPERATION ~	
	Q218=+60 ;FIRST SIDE LENGTH ~	
	Q219=+30 ;2ND SIDE LENGTH ~	
	Q220=+10 ;CORNER RADIUS ~	
	Q368=+0 ;ALLOWANCE FOR SIDE ~	
	Q224=+0 ;ANGLE OF ROTATION ~	
	Q367=+0 ;POCKET POSITION ~	
	Q207= AUTO ;FEED RATE MILLING ~	
	Q351=+1 ;CLIMB OR UP-CUT ~	
	Q201=-16 ;DEPTH ~	
	Q202=+5 ;PLUNGING DEPTH ~	
	Q369=+0 ;ALLOWANCE FOR FLOOR ~	
	Q206= AUTO ;FEED RATE FOR PLNGNG ~	
	Q338=+0 ;INFEED FOR FINISHING ~	
	Q200=+2 ;SET-UP CLEARANCE ~	
	Q203=+20 ;SURFACE COORDINATE ~	
	Q204=+50 ;2ND SET-UP CLEARANCE ~	

Q370=+1	;TOOL PATH OVERLAP ~	
Q366=+1	;PLUNGE ~	
Q385=+500	;FINISHING FEED RATE	
Q439=+0	;FEED RATE REFERENCE	
24 L X+0 Y-15 Z+50 R0 FMAX M99		
25 LBL 0		
26 LBL 52		MACHINING_2
27 CYCL DEF 200	DRILLING ~	
Q200=+2	;SET-UP CLEARANCE ~	
Q201=-5	;DEPTH ~	
Q206= AUTO	;FEED RATE FOR PLNGNG ~	
Q202=+5	;PLUNGING DEPTH ~	
Q210=+0	;DWELL TIME AT TOP ~	
Q203=+0	;SURFACE COORDINATE ~	
Q204=+50	;2ND SET-UP CLEARANCE ~	
Q211=+0	;DWELL TIME AT DEPTH ~	
Q395=+1	;DEPTH REFERENCE	
28 L X+0 Y-15 Z+50 R0 FMAX M99		
29 LBL 0		
30 LBL 81		PLANE_1
31 CALL LBL 100		SAFE
32 CALL LBL 98		RESET_COORD. TRANS.
33 CYCL DEF 19.0	WORKING PLANE	
34 CYCL DEF 19.1 A+90 B+0 IC+0		
35 L A+Q120 B+Q121 C+Q122 R0 FMAX		
36 CYCL DEF 7.0	DATUM SHIFT	
37 CYCL DEF 7.3 IZ+25		
38 LBL 0		
39 LBL 82		PLANE_INC.
40 CALL LBL 100		SAFE
41 CYCL DEF 7.0	DATUM SHIFT	
42 CYCL DEF 7.1 Z+0		
43 CYCL DEF 19.0	WORKING PLANE	
44 CYCL DEF 19.1 A+90 B+0 IC+60		
45 L A+Q120 B+Q121 C+Q122 R0 FMAX		
46 CYCL DEF 7.0	DATUM SHIFT	
47 CYCL DEF 7.3 IZ+25		
48 LBL 0		
49 LBL 98		RESET_COORD. TRANS.
50 CYCL DEF 19.0	WORKING PLANE	
51 CYCL DEF 19.1 A+0 B+0 C+0		
52 CYCL DEF 7.0	DATUM SHIFT	
53 CYCL DEF 7.1 X+0		

54 CYCL DEF 7.2 Y+0	
55 CYCL DEF 7.3 Z+0	
56 LBL 0	
57 LBL 99	RESET
58 CALL LBL 100	SAFE
59 CYCL DEF 19.0 WORKING PLANE	
60 CYCL DEF 19.1 A+0 B+0 C+0	
61 CYCL DEF 19.0 WORKING PLANE	
62 CYCL DEF 19.1	
63 L A+Q120 B+Q121 C+Q122 R0 FMAX	
64 CYCL DEF 7.0 DATUM SHIFT	
65 CYCL DEF 7.1 X+0	
66 CYCL DEF 7.2 Y+0	
67 CYCL DEF 7.3 Z+0	
68 LBL 0	
69 LBL 100	SAFE
70 L Z+300 R0 FMAX M3 M91	
71 L X+300 Y-300 R0 FMAX M91	
72 LBL 0	
73 END PGM 1267093 MM	

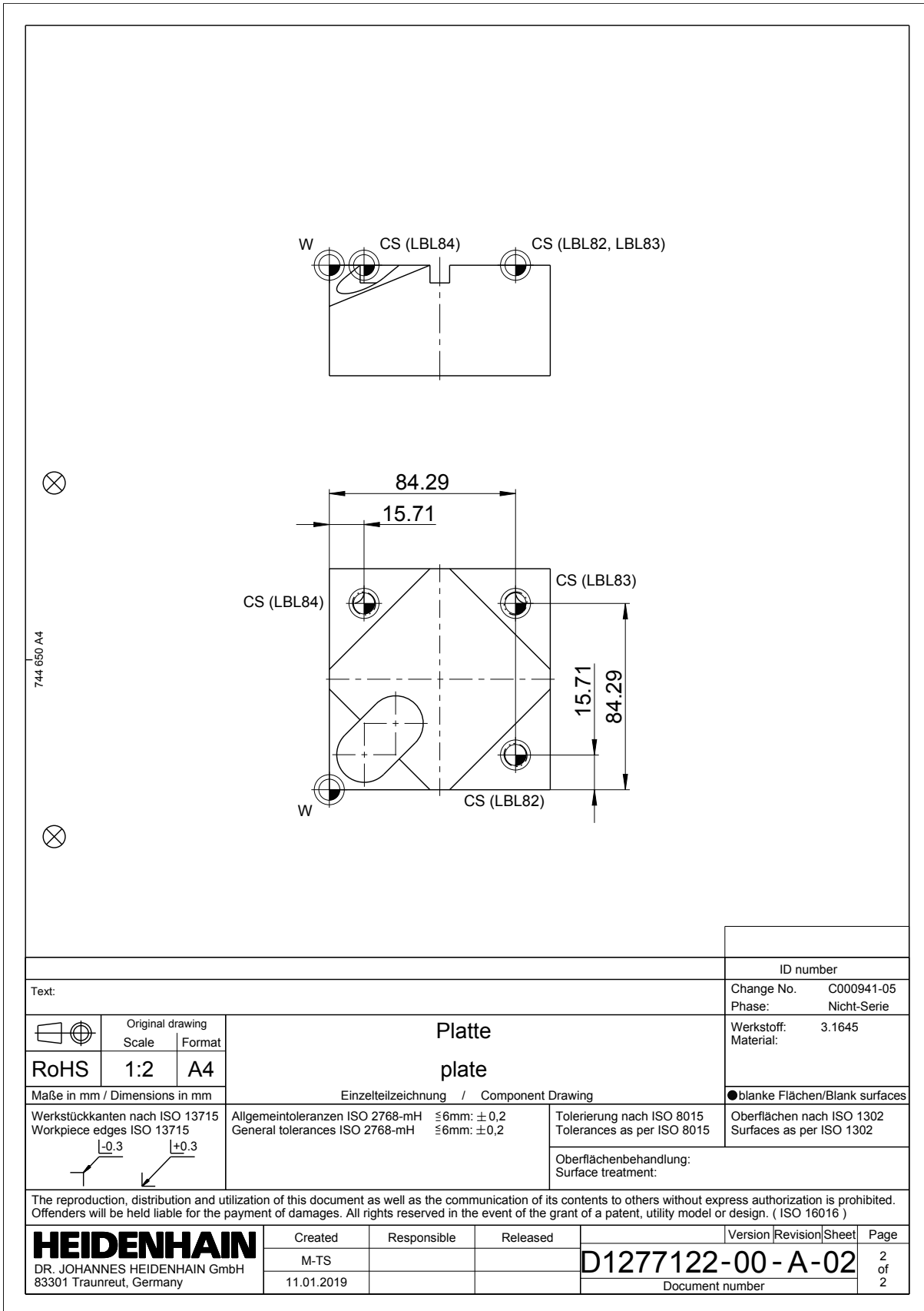
3.2 Programming more than one transformation – 1277122





744 650 A4

Text:		ID number																						
Change No. C000941-05		Phase: Nicht-Serie																						
Werkstoff: 3.1645		Material:																						
<table border="1"> <tr> <th>Original drawing</th> <th>Scale</th> <th>Format</th> </tr> <tr> <td>RoHS</td> <td>1:2</td> <td>A4</td> </tr> </table>		Original drawing	Scale	Format	RoHS	1:2	A4	<p>Platte plate</p> <p>Einzelteilzeichnung / Component Drawing</p>																
Original drawing	Scale	Format																						
RoHS	1:2	A4																						
Maße in mm / Dimensions in mm		●blanke Flächen/Blank surfaces																						
<p>Werkstückkanten nach ISO 13715 Workpiece edges ISO 13715</p> <p>± 0.3 ± 0.3</p>		<p>Allgemeintoleranzen ISO 2768-mH $\leq 6\text{mm}$: $\pm 0,2$ General tolerances ISO 2768-mH $\leq 6\text{mm}$: $\pm 0,2$</p> <p>Tolerierung nach ISO 8015 Tolerances as per ISO 8015</p> <p>Oberflächenbehandlung: Surface treatment:</p>																						
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Created	Responsible	Released																						
M-TS																								
11.01.2019																								
Version	Revision	Sheet	Page																					
D1277122-00-A-02			1 of 2																					
Document number																								



Text:		ID number
		Change No. C000941-05
		Phase: Nicht-Serie
		Werkstoff: 3.1645
		Material:
		●blanke Flächen/Blank surfaces
Maße in mm / Dimensions in mm		Einzelteilzeichnung / Component Drawing
Werkstückkanten nach ISO 13715 Workpiece edges ISO 13715		Allgemeintoleranzen ISO 2768-mH $\leq 6\text{mm}: \pm 0,2$ General tolerances ISO 2768-mH $\leq 6\text{mm}: \pm 0,2$
		Tolerierung nach ISO 8015 Tolerances as per ISO 8015
		Oberflächenbehandlung: Surface treatment:
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	11.01.2019	
Released		
Version		Revision
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Document number		Page
		2 of 2



Working plan

- ▶ Workpiece blank definition
- ▶ Tool call
- ▶ Mill the rectangular pocket
- ▶ Mill the slot
- ▶ Mill the inclined surface
 - PLANE SPATIAL
 - PLANE RELATIV
- ▶ Tool call
- ▶ Drill the holes
 - PLANE SPATIAL
- ▶ End the NC program
- ▶ Define subprograms

Program parameters

Milling of rectangular pocket and slot (roughing)	Parameters	X	Y	Z
Machining direction	Climb milling			
Plunging motion	Helical			
Face milling (roughing)	Parameters	X	Y	Z
Milling plan	2, climb milling			
Milling direction	1, parallel to X axis			
Feed rate for pre-positioning	Maximum feed rate			
Drilling	Parameters	X	Y	Z
Plunging depth	5			
Depth reference	To cylindrical part of the drill (without tool tip)			
General parameters	Parameters	X	Y	Z
Safe position		-	-	+50
Safe tilting position	Relative to the machine datum	+300	-300	+300

Tool parameters

	Ø	T	S	F₁	DZ	IZ
	14	7	5500	1200	-10	5
	10	232	6000	900	-20	5

- Ø) Diameter
- T) Tool number
- S) Speed
- F₁) Machining feed rate
- DZ) Max. machining / drilling depth
- IZ) Infeed

Solution

0	BEGIN PGM 1277122 MM	
1	BLK FORM 0.1 Z X+0 Y+0 Z-50	
2	BLK FORM 0.2 X+100 Y+100 Z+0	
3	TOOL CALL 7 Z S5500 F1200	
4	CALL LBL 99	RESET
5	CALL LBL 51	MACHINING_1
6	CALL LBL 52	MACHINING_2
7	CALL LBL 81	PLANE_1
8	CALL LBL 53	MACHINING_3
9	CALL LBL 99	RESET
10	TOOL CALL 232 Z S6000 F900	
11	CALL LBL 99	RESET
12	CALL LBL 82	PLANE_2
13	CALL LBL 54	MACHINING_4
14	CALL LBL 98	RESET_COORD. TRANS.
15	CALL LBL 83	PLANE_3
16	CALL LBL 54	MACHINING_4
17	CALL LBL 98	RESET_COORD. TRANS.
18	CALL LBL 84	PLANE_4
19	CALL LBL 54	MACHINING_4
20	CALL LBL 99	RESET
21	M30	
22	LBL 51	MACHINING_1
23	CYCL DEF 251 RECTANGULAR POCKET	
	~	
	Q215=+1 ;MACHINING OPERATION ~	
	Q218=+77 ;FIRST SIDE LENGTH ~	
	Q219=+77 ;2ND SIDE LENGTH ~	
	Q220=+0 ;CORNER RADIUS ~	
	Q368=+0 ;ALLOWANCE FOR SIDE ~	
	Q224=+45 ;ANGLE OF ROTATION ~	
	Q367=+0 ;POCKET POSITION ~	
	Q207= AUTO ;FEED RATE MILLING ~	
	Q351=+1 ;CLIMB OR UP-CUT ~	
	Q201=-8 ;DEPTH ~	
	Q202=+5 ;PLUNGING DEPTH ~	
	Q369=+0 ;ALLOWANCE FOR FLOOR ~	
	Q206= AUTO ;FEED RATE FOR PLNGNG ~	
	Q338=+0 ;INFEEED FOR FINISHING ~	
	Q200=+2 ;SET-UP CLEARANCE ~	
	Q203=+0 ;SURFACE COORDINATE ~	
	Q204=+50 ;2ND SET-UP CLEARANCE ~	

Q370=+1	;TOOL PATH OVERLAP ~	
Q366=+1	;PLUNGE ~	
Q385=+500	;FINISHING FEED RATE ~	
Q439=+0	;FEED RATE REFERENCE	
24 L X+50 Y+50 Z+50 R0 FMAX M99		
25 LBL 0		
26 LBL 52		MACHINING_2
27 CYCL DEF 253	SLOT MILLING	
~		
Q215=+1	;MACHINING OPERATION ~	
Q218=+45	;SLOT LENGTH ~	
Q219=+25	;SLOT WIDTH ~	
Q368=+0	;ALLOWANCE FOR SIDE ~	
Q374=+45	;ANGLE OF ROTATION ~	
Q367=+3	;SLOT POSITION ~	
Q207= AUTO	;FEED RATE MILLING ~	
Q351=+1	;CLIMB OR UP-CUT ~	
Q201=-15	;DEPTH ~	
Q202=+5	;PLUNGING DEPTH ~	
Q369=+0	;ALLOWANCE FOR FLOOR ~	
Q206= AUTO	;FEED RATE FOR PLNGNG ~	
Q338=+0	;INFEEED FOR FINISHING ~	
Q200=+2	;SET-UP CLEARANCE ~	
Q203=+0	;SURFACE COORDINATE ~	
Q204=+50	;2ND SET-UP CLEARANCE ~	
Q366=+2	;PLUNGE ~	
Q385=+500	;FINISHING FEED RATE ~	
Q439=+3	;FEED RATE REFERENCE	
28 L X+30 Y+30 Z+50 R0 FMAX M99		
29 LBL 0		
30 LBL 53		MACHINING_3
31 CYCL DEF 233	FACE MILLING	
~		
Q215=+1	;MACHINING OPERATION ~	
Q389=+2	;MILLING STRATEGY ~	
Q350=+1	;MILLING DIRECTION ~	
Q218=-60	;FIRST SIDE LENGTH ~	
Q219=+30	;2ND SIDE LENGTH ~	
Q227=+16.5	;STARTNG PNT 3RD AXIS ~	
Q386=+0	;END POINT 3RD AXIS ~	
Q369=+0	;ALLOWANCE FOR FLOOR ~	
Q202=+5	;MAX. PLUNGING DEPTH ~	
Q370=+1	;TOOL PATH OVERLAP ~	

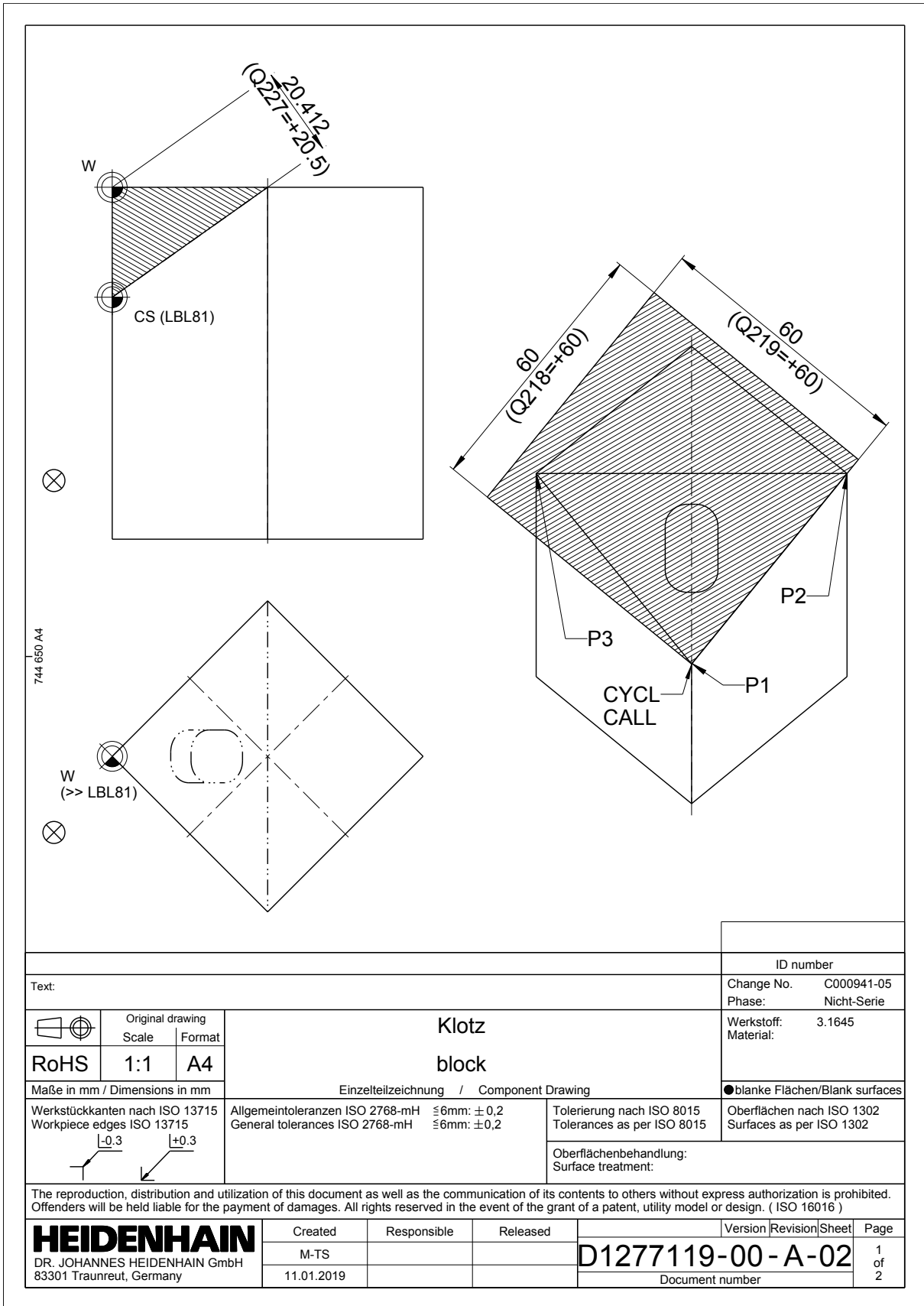
Q207= AUTO	;FEED RATE MILLING ~	
Q385=+500	;FINISHING FEED RATE ~	
Q253= MAX	;F PRE-POSITIONING ~	
Q357=+2	;CLEARANCE TO SIDE ~	
Q200=+2	;SET-UP CLEARANCE ~	
Q204=+50	;2ND SET-UP CLEARANCE ~	
Q347=+0	;1ST LIMIT ~	
Q348=+0	;2ND LIMIT ~	
Q349=+0	;3RD LIMIT ~	
Q220=+0	;CORNER RADIUS ~	
Q368=+0	;ALLOWANCE FOR SIDE ~	
Q338=+0	;INFEEED FOR FINISHING ~	
32 L X+30 Y-30 Z+50 R0 FMAX M99		
33 LBL 0		
34 LBL 54		MACHINING_4
35 CYCL DEF 200	DRILLING ~	
Q200=+2	;SET-UP CLEARANCE ~	
Q201=-20	;DEPTH ~	
Q206= AUTO	;FEED RATE FOR PLNGNG ~	
Q202=+5	;PLUNGING DEPTH ~	
Q210=+0	;DWELL TIME AT TOP ~	
Q203=+0	;SURFACE COORDINATE ~	
Q204=+50	;2ND SET-UP CLEARANCE ~	
Q211=+0	;DWELL TIME AT DEPTH ~	
Q395=+1	;DEPTH REFERENCE	
36 L X+0 Y+0 Z+50 R0 FMAX M99		
37 LBL 0		
38 LBL 81		PLANE_1
39 CALL LBL 100		SAFE
40 CYCL DEF 7.0	DATUM SHIFT	
41 CYCL DEF 7.1 X+50		
42 CYCL DEF 7.2 Y+50		
43 PLANE SPATIAL SPA+0 SPB+0 SPC-45 STAY		
44 CYCL DEF 7.0	DATUM SHIFT	
45 CYCL DEF 7.2 IY-38.5		
46 PLANE RELATIV SPA+30 TURN FMAX		
47 LBL 0		
48 LBL 82		PLANE_2
49 CALL LBL 100		SAFE
50 CYCL DEF 7.0	DATUM SHIFT	
51 CYCL DEF 7.1 X+84.29		
52 CYCL DEF 7.2 Y+15.71		
53 PLANE SPATIAL SPA-20 SPB+0 SPC+45 TURN FMAX		

54 LBL 0	
55 LBL 83	PLANE_3
56 CALL LBL 100	SAFE
57 CYCL DEF 7.0 DATUM SHIFT	
58 CYCL DEF 7.1 X+84.29	
59 CYCL DEF 7.2 Y+84.29	
60 PLANE SPATIAL SPA-20 SPB+0 SPC+135 TURN FMAX	
61 LBL 0	
62 LBL 84	PLANE_4
63 CALL LBL 100	SAFE
64 CYCL DEF 7.0 DATUM SHIFT	
65 CYCL DEF 7.1 X+15.71	
66 CYCL DEF 7.2 Y+84.29	
67 PLANE SPATIAL SPA-20 SPB+0 SPC+225 TURN FMAX	
68 LBL 0	
69 LBL 98	RESET_COORD. TRANS.
70 PLANE RESET STAY	
71 CYCL DEF 7.0 DATUM SHIFT	
72 CYCL DEF 7.1 X+0	
73 CYCL DEF 7.2 Y+0	
74 CYCL DEF 7.3 Z+0	
75 LBL 0	
76 LBL 99	RESET
77 CALL LBL 100	SAFE
78 PLANE RESET TURN FMAX	
79 CYCL DEF 7.0 DATUM SHIFT	
80 CYCL DEF 7.1 X+0	
81 CYCL DEF 7.2 Y+0	
82 CYCL DEF 7.3 Z+0	
83 LBL 0	
84 LBL 100	SAFE
85 L Z+300 R0 FMAX M3 M91	
86 L X+300 Y-300 R0 FMAX M91	
87 LBL 0	
88 END PGM 1277122 MM	

3.3 Programming more than one transformation – 1277119

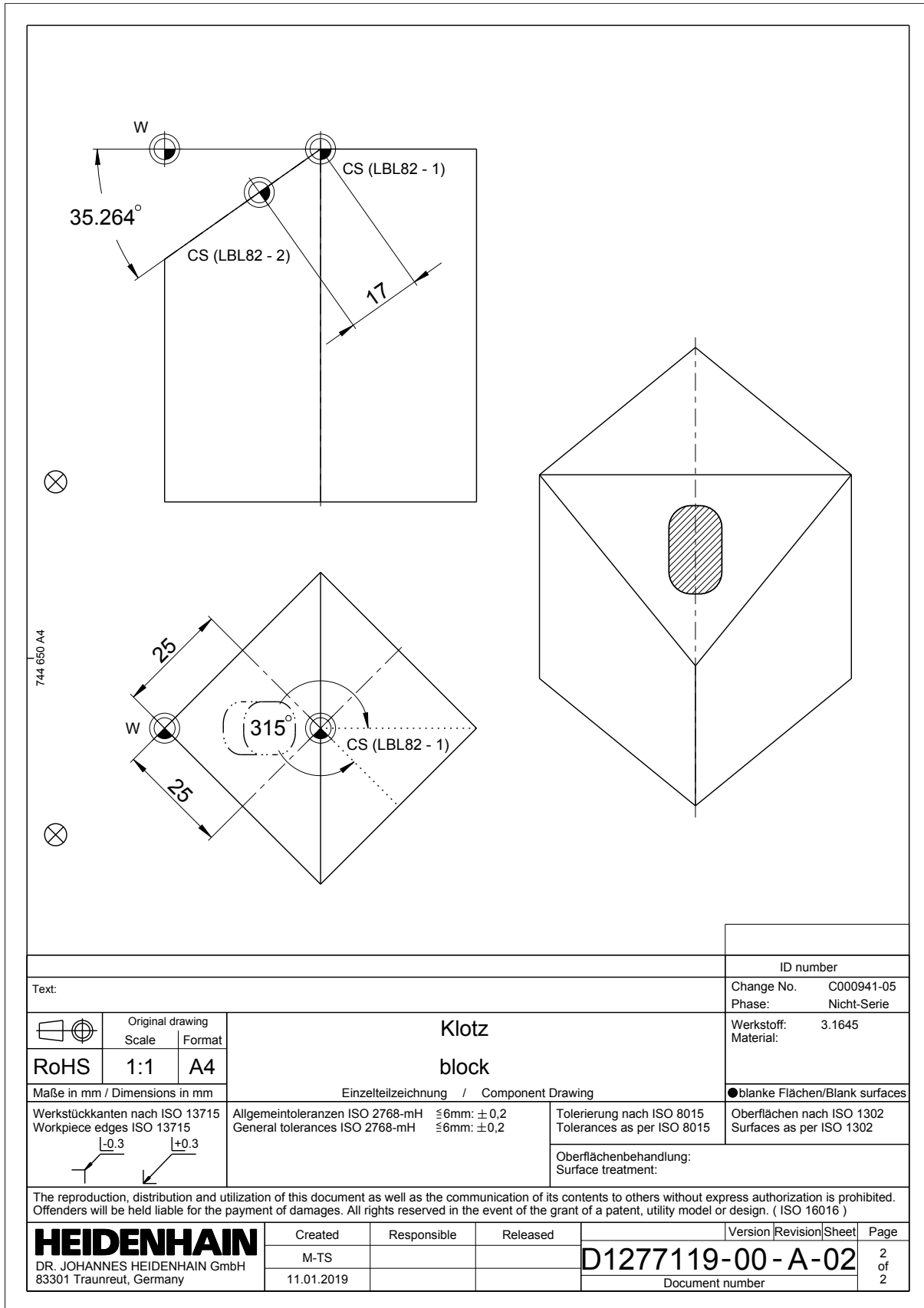
744 650 A4

Text:		ID number							
Change No. C000941-05		Phase: Nicht-Serie							
Werkstoff: 3.1645		Material:							
<table border="1"> <tr> <th>Original drawing</th> <th>Scale</th> <th>Format</th> </tr> <tr> <td>RoHS</td> <td>1:1</td> <td>A4</td> </tr> </table>		Original drawing	Scale	Format	RoHS	1:1	A4	<p>Klotz block</p> <p>Einzelteilzeichnung / Component Drawing</p>	
Original drawing	Scale	Format							
RoHS	1:1	A4							
<p>Maße in mm / Dimensions in mm</p> <p>Werkstückkanten nach ISO 13715 Workpiece edges ISO 13715</p> <p>± 0.3 ± 0.3</p>		<p>Allgemeintoleranzen ISO 2768-mH $\leq 6\text{mm}$: ± 0.2 General tolerances ISO 2768-mH $\leq 6\text{mm}$: ± 0.2</p> <p>Tolerierung nach ISO 8015 Tolerances as per ISO 8015</p> <p>Oberflächenbehandlung: Surface treatment:</p>							
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<p>HEIDENHAIN DR. JOHANNES HEIDENHAIN GmbH 83301 Traunreut, Germany</p>		<p>Created</p> <p>M-TS</p> <p>11.01.2019</p>	<p>Responsible</p>	<p>Released</p>	<p>Version</p> <p>D1277119-00-A-01</p> <p>Document number</p>	<p>Revision</p>	<p>Sheet</p> <p>1</p>	<p>Page</p> <p>1</p>	



744 650 A4

Text:		ID number	
		Change No. C000941-05	
		Phase: Nicht-Serie	
		Werkstoff: 3.1645	
		Material:	
		●blanke Flächen/Blank surfaces	
Maße in mm / Dimensions in mm		Einzelteilzeichnung / Component Drawing	
Werkstückkanten nach ISO 13715 Workpiece edges ISO 13715 		Allgmeintoleranzen ISO 2768-mH ≤6mm: ±0,2 General tolerances ISO 2768-mH ≤6mm: ±0,2	Tolerierung nach ISO 8015 Tolerances as per ISO 8015 Oberflächenbehandlung: Surface treatment:
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HEIDENHAIN DR. JOHANNES HEIDENHAIN GmbH 83301 Traunreut, Germany	Created	Responsible	Released
	M-TS		
	11.01.2019		
		Version	Revision
		D1277119-00-A-02	
		Sheet	Page
		1	1
		2	2
		Document number	



Working plan

- ▶ Workpiece blank definition
- ▶ Tool call
- ▶ Mill the inclined surface
 - **PLANE POINTS**
- ▶ Tool call
- ▶ Mill the rectangular pocket
 - **PLANE RELATIV**
- ▶ End the NC program
- ▶ Define subprograms



Program parameters

Face milling (roughing)	Parameters	X	Y	Z
Milling plan	2, climb milling			
Milling direction	2, parallel to Y axis			
Feed rate for pre-positioning	Maximum feed rate			

Rectangular pocket milling (roughing)	Parameters	X	Y	Z
Machining direction	Climb milling			
Plunging motion	Helical			

General parameters	Parameters	X	Y	Z
Safe position		-	-	+50
Safe tilting position	Relative to the machine datum	+300	-300	+300

Tool parameters

	Ø	T	S	F ₁	DZ	IZ
	20	10	5000	1000	-10	5
	6	3	14000	900	-10	5

- Ø) Diameter
- T) Tool number
- S) Speed
- F₁) Machining feed rate
- DZ) Max. machining depth
- IZ) Infeed

Solution

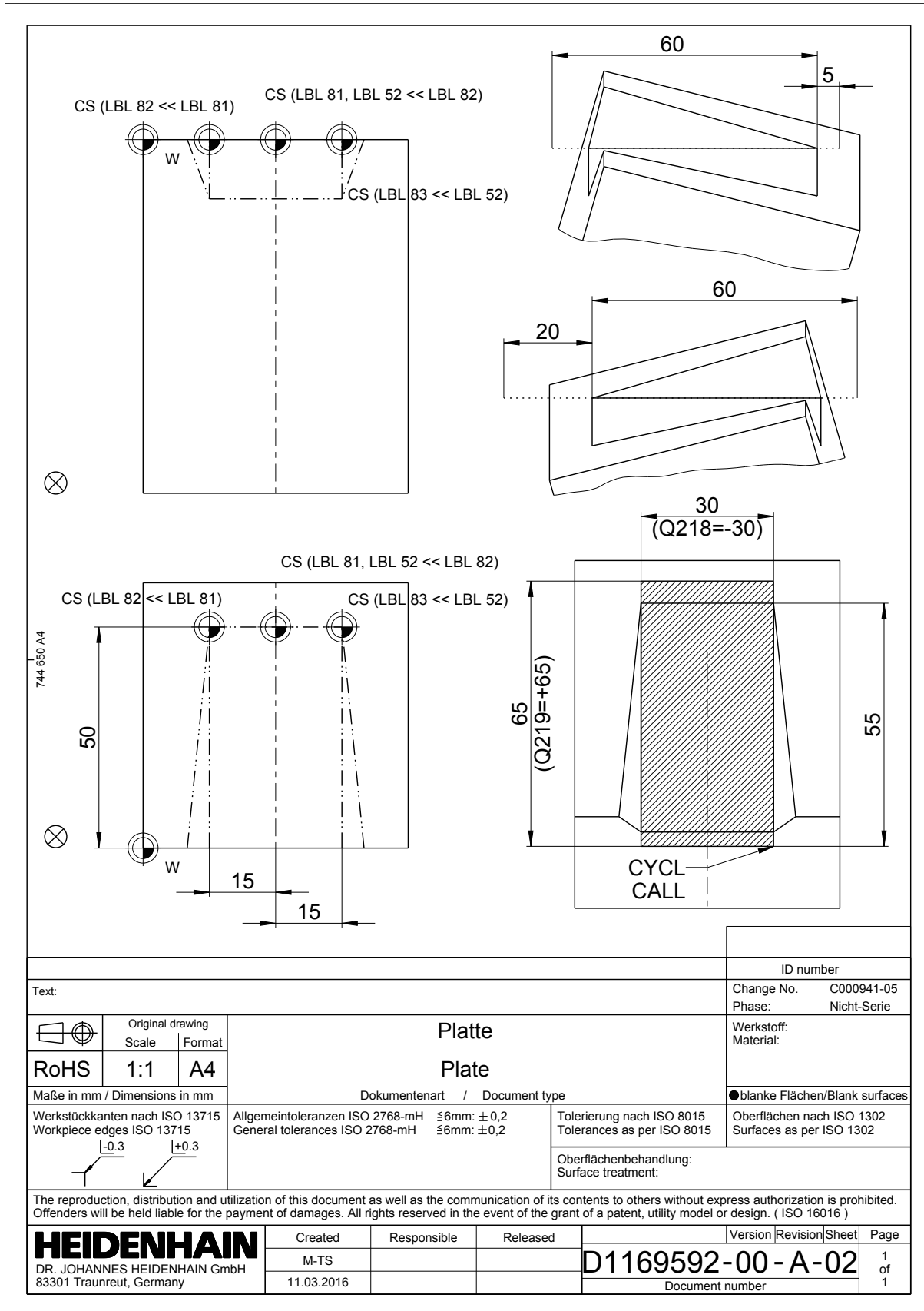
0	BEGIN PGM 1277119 MM	
1	BLK FORM 0.1 Z X+0 Y+0 Z-50	
2	BLK FORM 0.2 X+50 Y+50 Z+0	
3	TOOL CALL 10 Z S5000 F1000	
4	CALL LBL 99	RESET
5	CALL LBL 81	PLANE_1
6	CALL LBL 51	MACHINING_1
7	CALL LBL 99	RESET
8	TOOL CALL 3 Z S14000 F900	
9	CALL LBL 99	RESET
10	CALL LBL 82	PLANE_2
11	CALL LBL 52	MACHINING_2
12	CALL LBL 99	RESET
13	M30	
14	LBL 51	MACHINING_1
15	CYCL DEF 233 FACE MILLING	
	~	
	Q215=+1 ;MACHINING OPERATION ~	
	Q389=+2 ;MILLING STRATEGY ~	
	Q350=+1 ;MILLING DIRECTION ~	
	Q218=+60 ;FIRST SIDE LENGTH ~	
	Q219=+60 ;2ND SIDE LENGTH ~	
	Q227=+20.5 ;STARTNG PNT 3RD AXIS ~	
	Q386=+0 ;END POINT 3RD AXIS ~	
	Q369=+0 ;ALLOWANCE FOR FLOOR ~	
	Q202=+5 ;MAX. PLUNGING DEPTH ~	
	Q370=+1 ;TOOL PATH OVERLAP ~	
	Q207= AUTO ;FEED RATE MILLING ~	
	Q385=+500 ;FINISHING FEED RATE ~	
	Q253= MAX ;F PRE-POSITIONING ~	
	Q357=+2 ;CLEARANCE TO SIDE ~	
	Q200=+2 ;SET-UP CLEARANCE ~	
	Q204=+50 ;2ND SET-UP CLEARANCE ~	
	Q347=+0 ;1ST LIMIT ~	
	Q348=+0 ;2ND LIMIT ~	
	Q349=+0 ;3RD LIMIT ~	
	Q220=+0 ;CORNER RADIUS ~	
	Q368=+0 ;ALLOWANCE FOR SIDE ~	
	Q338=+0 ;INFEEED FOR FINISHING ~	
16	L X+0 Y+0 Z+50 R0 FMAX M99	
17	LBL 0	
18	LBL 52	MACHINING_2

19 CYCL DEF 251	RECTANGULAR POCKET	
~		
Q215=+1	;MACHINING OPERATION ~	
Q218=+12	;FIRST SIDE LENGTH ~	
Q219=+20	;2ND SIDE LENGTH ~	
Q220=+5	;CORNER RADIUS ~	
Q368=+0	;ALLOWANCE FOR SIDE ~	
Q224=+90	;ANGLE OF ROTATION ~	
Q367=+0	;POCKET POSITION ~	
Q207= AUTO	;FEED RATE MILLING ~	
Q351=+1	;CLIMB OR UP-CUT ~	
Q201=-8	;DEPTH ~	
Q202=+5	;PLUNGING DEPTH ~	
Q369=+0	;ALLOWANCE FOR FLOOR ~	
Q206= AUTO	;FEED RATE FOR PLNGNG ~	
Q338=+0	;INFEEED FOR FINISHING ~	
Q200=+2	;SET-UP CLEARANCE ~	
Q203=+0	;SURFACE COORDINATE ~	
Q204=+50	;2ND SET-UP CLEARANCE ~	
Q370=+1	;TOOL PATH OVERLAP ~	
Q366=+1	;PLUNGE ~	
Q385=+500	;FINISHING FEED RATE ~	
Q439=+0	;FEED RATE REFERENCE	
20 L X+0 Y+0 Z+50 R0 FMAX M99		
21 LBL 0		
22 LBL 81		PLANE_1
23 CYCL DEF 7.0	DATUM SHIFT	
24 CYCL DEF 7.1 Z-25		
25 PLANE POINTS P1X+0 P1Y+0 P1Z-25 P2X+50 P2Y+0 P2Z+0 P3X+0 P3Y+50 P3Z+0 TURN FMAX		
26 LBL 0		
27 LBL 82		PLANE_2
28 CYCL DEF 7.0	DATUM SHIFT	
29 CYCL DEF 7.1 X+25		
30 CYCL DEF 7.2 Y+25		
31 PLANE RELATIV SPC-315 TURN FMAX		
32 PLANE RELATIV SPB-45 TURN FMAX		
33 CYCL DEF 7.0	DATUM SHIFT	
34 CYCL DEF 7.1 IX-17		
35 LBL 0		
36 LBL 99		RESET
37 CALL LBL 100		SAFE
38 PLANE RESET TURN FMAX		

39 CYCL DEF 7.0	DATUM SHIFT	
40 CYCL DEF 7.1	X+0	
41 CYCL DEF 7.2	Y+0	
42 CYCL DEF 7.3	Z+0	
43 LBL 0		
44 LBL 100		SAFE
45 L	Z+300 R0 FMAX M3 M91	
46 L	X+300 Y-300 R0 FMAX M91	
47 LBL 0		
48 END PGM 1277119	MM	

3.4 Programming more than one transformation – 1169592

Text:		ID number								
Change No. -		Phase: Nicht-Serie								
<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center;"> </td> <td style="text-align: center;">Original drawing</td> <td colspan="2" rowspan="2" style="text-align: center; vertical-align: middle;"> Platte Plate </td> </tr> <tr> <td style="text-align: center;">RoHS</td> <td style="text-align: center;">Scale 1:1</td> <td style="text-align: center;">Format A4</td> </tr> </table>		Original drawing	Platte Plate		RoHS	Scale 1:1	Format A4	Einzelteilzeichnung / Component Drawing		
	Original drawing	Platte Plate								
RoHS	Scale 1:1			Format A4						
Maße in mm / Dimensions in mm Werkstückkanten nach ISO 13715 Workpiece edges ISO 13715		●blanke Flächen/Blank surfaces								
<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center;"> </td> <td style="text-align: center;"> </td> </tr> </table>				Tolerierung nach ISO 8015 Tolerances as per ISO 8015						
Allgemeintoleranzen ISO 2768-mH General tolerances ISO 2768-mH		Oberflächen nach ISO 1302 Surfaces as per ISO 1302								
Oberflächenbehandlung: Surface treatment:										
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HEIDENHAIN DR. JOHANNES HEIDENHAIN GmbH 83301 Traunreut, Germany		Created	Responsible							
		Released	Version Revision Sheet Page							
11.03.2016 Baumgartner		D1169592-00-A-01 Document number								
		1	1							



Working plan


- ▶ Workpiece blank definition
- ▶ Tool call
- ▶ Mill the inclined surface (15°)
 - **PLANE SPATIAL**
- ▶ Mill the left-hand chamfer
 - **PLANE RELATIV**
- ▶ Mill the right-hand chamfer
- ▶ End the NC program
- ▶ Define subprograms

Program parameters

Face milling (roughing)	Parameters	X	Y	Z
Milling plan	2, climb milling			
Milling direction	1, parallel to X axis			
Feed rate for pre-positioning	Maximum feed rate			
Limits	+1, positive principal axis -1, negative principal axis			

General parameters	Parameters	X	Y	Z
Set-up clearance		-	-	+5
Safe position		-	-	+50
Safe tilting position	Relative to the machine datum	+300	-300	+300

Tool parameters

	Ø	T	S	F ₁	DZ	IZ
	20	10	5000	1000	-5	5

- Ø) Diameter
- T) Tool number
- S) Speed
- F₁) Machining feed rate
- DZ) Max. machining depth
- IZ) Infeed

Solution

0 BEGIN PGM 1169592 MM	
1 BLK FORM 0.1 Z X+0 Y+0 Z-80	
2 BLK FORM 0.2 X+60 Y+60 Z+0	
3 TOOL CALL 10 Z S5000 F1000	
4 CALL LBL 99	RESET
5 CALL LBL 81	PLANE_1
6 CALL LBL 51	MACHINING_1
7 CALL LBL 82	PLANE_2
8 CALL LBL 52	MACHINING_2
9 CALL LBL 83	PLANE_3
10 CALL LBL 53	MACHINING_3
11 CALL LBL 99	RESET
12 M30	
13 LBL 51	MACHINING_1
14 CYCL DEF 233 FACE MILLING	
~	
Q215=+1 ;MACHINING OPERATION ~	
Q389=+2 ;MILLING STRATEGY ~	
Q350=+1 ;MILLING DIRECTION ~	
Q218=-30 ;FIRST SIDE LENGTH ~	
Q219=+65 ;2ND SIDE LENGTH ~	
Q227=+5 ;STARTNG PNT 3RD AXIS ~	
Q386=+0 ;END POINT 3RD AXIS ~	
Q369=+0 ;ALLOWANCE FOR FLOOR ~	
Q202=+5 ;MAX. PLUNGING DEPTH ~	
Q370=+1 ;TOOL PATH OVERLAP ~	
Q207= AUTO ;FEED RATE MILLING ~	
Q385=+500 ;FINISHING FEED RATE ~	
Q253= MAX ;F PRE-POSITIONING ~	
Q357=+2 ;CLEARANCE TO SIDE ~	
Q200=+2 ;SET-UP CLEARANCE ~	
Q204=+50 ;2ND SET-UP CLEARANCE ~	
Q347=+1 ;1ST LIMIT ~	
Q348=-1 ;2ND LIMIT ~	
Q349=+0 ;3RD LIMIT ~	
Q220=+0 ;CORNER RADIUS ~	
Q368=+0 ;ALLOWANCE FOR SIDE ~	
Q338=+0 ;INFEED FOR FINISHING ~	
15 L X+15 Y-55 Z+50 R0 FMAX M99	
16 LBL 0	
17 LBL 52	MACHINING_2
18 L X+10 Y+30 Z+50 R0 FMAX	

19 L Z+5 R0 FMAX	
20 L Z+0 R0 F AUTO	
21 L Y+5 X+0 RL	
22 L Y-60	
23 L Z+50 R0 FMAX	
24 PLANE RELATIV SPB+20.466 TURN FMAX	
25 CYCL DEF 7.0 DATUM SHIFT	
26 CYCL DEF 7.1 IX+15	
27 LBL 0	
28 LBL 53	MACHINING_3
29 L X-5 Y-60 Z+50 R0 FMAX	
30 L Z+5 R0 FMAX	
31 L Z+0 R0 F AUTO	
32 L X+0 Y-60 RL	
33 L Y+20	
34 L Z+50 R0 FMAX	
35 LBL 0	
36 LBL 81	PLANE_1
37 CALL LBL 100	SAFE
38 CYCL DEF 7.0 DATUM SHIFT	
39 CYCL DEF 7.1 X+30	
40 CYCL DEF 7.2 Y+50	
41 PLANE SPATIAL SPA+15 SPB+0 SPC+0 TURN FMAX	
42 LBL 0	
43 LBL 82	PLANE_2
44 CALL LBL 100	SAFE
45 CYCL DEF 7.0 DATUM SHIFT	
46 CYCL DEF 7.1 IX-15	
47 PLANE RELATIV SPB-20.466 TURN FMAX	
48 LBL 0	
49 LBL 83	PLANE_3
50 CALL LBL 100	SAFE
51 CYCL DEF 7.0 DATUM SHIFT	
52 CYCL DEF 7.1 IX+15	
53 PLANE RELATIV SPB+20.466 TURN FMAX	
54 LBL 0	
55 LBL 99	RESET
56 CALL LBL 100	SAFE
57 PLANE RESET TURN FMAX	
58 CYCL DEF 7.0 DATUM SHIFT	
59 CYCL DEF 7.1 X+0	
60 CYCL DEF 7.2 Y+0	
61 CYCL DEF 7.3 Z+0	

62 LBL 0	
63 LBL 100	SAFE
64 L Z+300 R0 FMAX M3 M91	
65 L X+300 Y-300 R0 FMAX M91	
66 LBL 0	
67 END PGM 1169592 MM	