



HEIDENHAIN



TNC 320 / TNC 620 / TNC 640

Solutions
Programming Station Exercises

HIT Learning Package
Milling – 3-Axis Machining

English (en)
6/2018



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1

**Contour
programming**

1.1 Slot milling – 1226651

744 650 A4

16
5

108°

20
30
70
100

10


3:10

Text:		ID number	
Change No. C000941-05		Phase: Nicht-Serie	
Werkstoff: 3.1645		Material:	
●blanke Flächen/Blank surfaces			
Werkstückkanten nach ISO 13715 Workpiece edges ISO 13715 		Allgemeintoleranzen 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:			
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	05.09.2017		
Version		Revision	Sheet
D1226651-00-A-01			1 of 1
Document number			

Program parameters

Milling of a slot	Requirements	X	Y	Z
Safe position		+150	+150	+100
Safety clearance		-	-	+5
Pre-position		+50	+20	+100
Start/End point of the contour		+50	+20	-
Machining direction	Clockwise			

Tool parameters

	Ø	T	S	F₁	F₂	DZ	IZ
	10	5	8900	1100	2000	-5	5

Ø) Diameter

T) Tool number

S) Speed

F₁) Machining feed rateF₂) Retraction feed rate

DZ) Max. machining / drilling depth

IZ) Infeed

Solution

0 BEGIN PGM 1226651 MM	
1 BLK FORM 0.1 Z X+0 Y+0 Z-16	
2 BLK FORM 0.2 X+100 Y+100 Z+0	
3 TOOL CALL 5 Z S8900 F1100	
4 L Z+100 R0 FMAX M3	
5 L X+50 Y+20 Z+5 R0 FMAX M8	
6 L Z-5 R0 F AUTO	
7 L X+30	
8 CC	
9 LP PR+40 PA+108	
10 CC	
11 LP PR+40 PA+36	
12 CC	
13 LP PR+40 PA-36	
14 CC	
15 LP PR+40 PA-108	
16 L X+50	
17 L Z+5 R0 F2000	
18 L X+150 Y+150 Z+100 R0 FMAX	
19 M30	
20 END PGM 1226651 MM	

1.2 Contour milling – 1206129


1:5

ID number																						
Text:	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 style="text-align: center;"> </td> <td style="text-align: center;">1:1</td> <td style="text-align: center;">A4</td> </tr> </table>	Original drawing	Scale	Format		1:1	A4	Platte Plate															
Original drawing	Scale	Format																				
	1:1	A4																				
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:																					
●blanke Flächen/Blank surfaces Oberflächen nach ISO 1302 Surfaces as per ISO 1302																						
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Created	Responsible	Released	Version	Revision	Sheet	Page																
M-TS			D1206129-00-A-01			1																
14.02.2017			Document number			1																

Program parameters

Milling an external contour	Requirements	X	Y	Z
Safe position		+150	+150	+100
Safety clearance		-	-	+5
Pre-position		-20	+20	+100
Start/End point of the contour		+0	+25	-
Approach/Departure path	LEN20			
Machining direction	Climb milling			

Tool parameters

	Ø	T	S	F₁	F₂	DZ	IZ
	20	10	4500	1100	2000	-5	5

- Ø) Diameter
- T) Tool number
- S) Speed
- F₁) Machining feed rate
- F₂) Retraction feed rate
- DZ) Max. machining / drilling depth
- IZ) Infeed

Solution

0 BEGIN PGM 1206129 MM	
1 BLK FORM 0.1 Z X+0 Y+0 Z-20	
2 BLK FORM 0.2 X+100 Y+100 Z+0	
3 TOOL CALL 10 Z S4500 F1100	
4 L Z+100 R0 FMAX M3	
5 L X-20 Y+20 Z+5 R0 FMAX M8	
6 L Z-5 R0 F AUTO	
7 APPR LT X+0 Y+25 LEN20 RL	
8 L X+25 Y+100	
9 L X+100 Y+75	
10 L X+75 Y+0	
11 L X+0 Y+25	
12 DEP LT LEN20	
13 L Z+5 R0 F2000	
14 L X+150 Y+150 Z+100 R0 FMAX	
15 M30	
16 END PGM 1206129 MM	

1.3 Contour milling – 1214098

744 650 A4

10

16

5

36

25

14

25

□ 100


1:5

Text:		ID number	
Change No. C000941-05		Phase: Nicht-Serie	
	Original drawing	Platte Plate	
Scale	Format		
RoHS	1:1	A4	Werkstoff: 3.1645 Material:
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	●blanke Flächen/Blank surfaces Oberflächen nach ISO 1302 Surfaces as per ISO 1302
Oberflächenbehandlung: Surface treatment:			
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	M-TS		
	11.04.2017		
Version		Revision	Sheet
D1214098-00-A-01			Page
Document number			1 of 1

Program parameters

Milling a contour	Requirements	X	Y	Z
Safe position		+150	+150	+100
Safety clearance		-	-	+5
Pre-position		-20	-20	+100
Start/End point of the contour		+10	+0	-
Approach/Departure path	LEN20			
Machining direction	Climb milling			

Tool parameters

	Ø	T	S	F₁	F₂	DZ	IZ
	16	8	5600	1600	2000	-5	5

Ø) Diameter

T) Tool number

S) Speed

F₁) Machining feed rateF₂) Retraction feed rate

DZ) Max. machining / drilling depth

IZ) Infeed

Solution

0 BEGIN PGM 1214098 MM	
1 BLK FORM 0.1 Z X+0 Y+0 Z-16	
2 BLK FORM 0.2 X+100 Y+100 Z+0	
3 TOOL CALL 8 Z S5600 F1600	
4 L Z+100 R0 FMAX M3	
5 L X-20 Y-20 Z+5 R0 FMAX M8	
6 L Z-5 R0 F AUTO	
7 APPR LT X+10 Y+0 LEN20 RL	
8 L Y+14	
9 CC X+25 Y+25	
10 C X+10 Y+36 DR+	
11 L Y+100	
12 DEP LT LEN20	
13 L Z+5 R0 F2000	
14 L X+150 Y+150 Z+100 R0 FMAX	
15 M30	
16 END PGM 1214098 MM	


1.4 Contour milling – 1226664

ID number													
Text:													
Change No.	C000941-05												
Phase:	Nicht-Serie												
Werkstoff:	3.1645												
Material:													
Platte Plate													
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:													
●blanke Flächen/Blank surfaces													
Oberflächen nach ISO 1302 Surfaces as per ISO 1302													
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M-TS													
05.09.2017													
Version Revision Sheet Page													
D1226664-00-A-01													
Document number													
1 of 1													

Program parameters

Milling an external contour	Requirements	X	Y	Z
Safe position		+150	+150	+100
Safety clearance		-	-	+5
Pre-position		+0	+70	+100
Start/End point of the contour		+0	+30	-
Approach/Departure strategy	Circular arc with tangential connection to the contour and a straight line			
Approach/Departure radius	R10			
Machining direction	Climb milling			

Tool parameters

	Ø	T	S	F ₁	F ₂	DZ	IZ
	20	10	4500	1700	2000	-5	5

- Ø) Diameter
- T) Tool number
- S) Speed
- F₁) Machining feed rate
- F₂) Retraction feed rate
- DZ) Max. machining / drilling depth
- IZ) Infeed

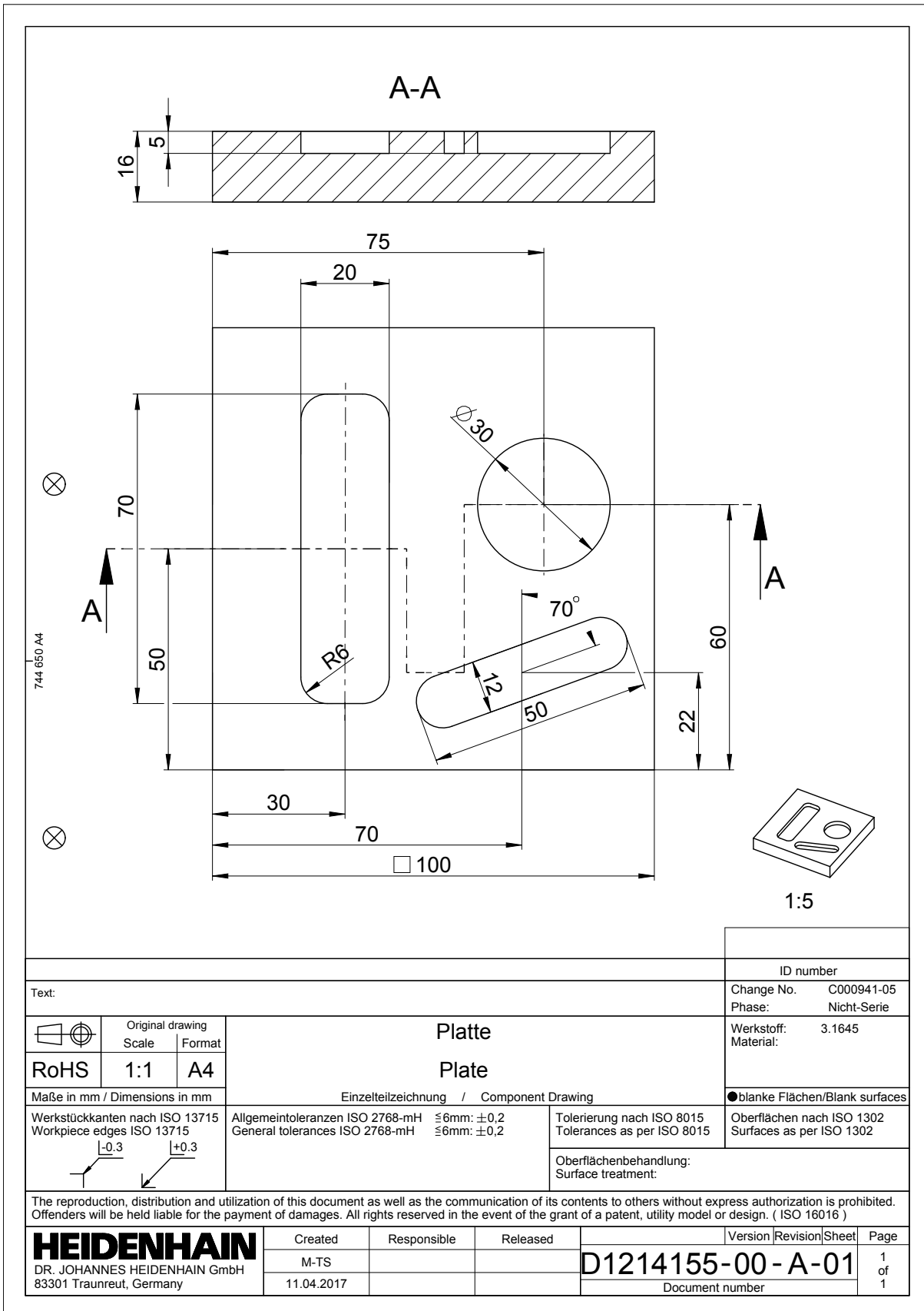
Solution

0 BEGIN PGM 1226664 MM	
1 BLK FORM 0.1 Z X-50 Y-50 Z-16	
2 BLK FORM 0.2 X+50 Y+50 Z+0	
3 TOOL CALL 10 Z S4500 F1700	
4 L Z+100 R0 FMAX M3	
5 L X+0 Y+70 Z+5 R0 FMAX M8	
6 L Z-5 R0 F AUTO	
7 APPR LCT X+0 Y+30 R10 RL	
8 FL Y+30 AN+0	
9 FC Y+30 DR- R42.5 CCX+0 CCY+0	
10 FSELECT2	
11 L X+0	
12 DEP LCT X+0 Y+70 R10	
13 L Z+5 R0 F2000	
14 L X+150 Y+150 Z+100 R0 FMAX	
15 M30	
16 END PGM 1226664 MM	

2

**Cycle
Programming**


2.1 Milling pockets and slots – 1214155



Program parameters

Pockets / Slots (roughing + finishing)	Requirements	X	Y	Z
Safe position		+150	+150	+100
Safety clearance		-	-	+5
2nd set-up clearance		-	-	+50
Allowance for side	0.2			
Allowance for floor	0.1			
Path overlap	0.7			
Climb/Up-cut	Climb milling			

Tool parameters

	Ø	T	S	F₁	F₂	DZ	IZ
	10	5	8900	1100	2000	-5	5

- Ø) Diameter
- T) Tool number
- S) Speed
- F₁) Machining feed rate
- F₂) Retraction feed rate
- DZ) Max. machining / drilling depth
- IZ) Infeed

Solution

0 BEGIN PGM 1214155 MM	
1 BLK FORM 0.1 Z X+0 Y+0 Z-16	
2 BLK FORM 0.2 X+100 Y+100 Z+0	
3 TOOL CALL 5 Z S8900 F1100	
4 L Z+100 R0 FMAX M3	
5 CYCL DEF 251 RECTANGULAR POCKET ~	
Q215=+0 ;MACHINING OPERATION ~	
Q218=+20 ;FIRST SIDE LENGTH ~	
Q219=+70 ;2ND SIDE LENGTH ~	
Q220=+6 ;CORNER RADIUS ~	
Q368=+0.2 ;ALLOWANCE FOR SIDE ~	
Q224=+0 ;ANGLE OF ROTATION ~	
Q367=+0 ;POCKET POSITION ~	
Q207= AUTO ;FEED RATE FOR MILLNG ~	
Q351=+1 ;CLIMB OR UP-CUT ~	
Q201=-5 ;DEPTH ~	
Q202=+5 ;PLUNGING DEPTH ~	
Q369=+0.1 ;ALLOWANCE FOR FLOOR ~	
Q206= AUTO ;FEED RATE FOR PLNGNG ~	
Q338=+0 ;INFEEED FOR FINISHING ~	
Q200=+5 ;SET-UP CLEARANCE ~	
Q203=+0 ;SURFACE COORDINATE ~	
Q204=+50 ;2ND SET-UP CLEARANCE ~	
Q370=+0.7 ;TOOL PATH OVERLAP ~	
Q366=+2 ;PLUNGE ~	
Q385= AUTO ;FINISHING FEED RATE ~	
Q439=+3 ;FEED RATE REFERENCE	
6 L X+30 Y+50 R0 FMAX M99	
7 CYCL DEF 252 CIRCULAR POCKET ~	
Q215=+0 ;MACHINING OPERATION ~	
Q223=+30 ;CIRCLE DIAMETER ~	
Q368=+0.2 ;ALLOWANCE FOR SIDE ~	
Q207= AUTO ;FEED RATE FOR MILLNG ~	
Q351=+1 ;CLIMB OR UP-CUT ~	
Q201=-5 ;DEPTH ~	
Q202=+5 ;PLUNGING DEPTH ~	
Q369=+0.1 ;ALLOWANCE FOR FLOOR ~	
Q206= AUTO ;FEED RATE FOR PLNGNG ~	
Q338=+0 ;INFEEED FOR FINISHING ~	
Q200=+5 ;SET-UP CLEARANCE ~	
Q203=+0 ;SURFACE COORDINATE ~	
Q204=+50 ;2ND SET-UP CLEARANCE ~	

Q370=+0.7	;TOOL PATH OVERLAP ~
Q366=+1	;PLUNGE ~
Q385= AUTO	;FINISHING FEED RATE ~
Q439=+3	;FEED RATE REFERENCE
8 L X+75 Y+60 R0 FMAX M99	
9 CYCL DEF 253 SLOT MILLING ~	
Q215=+0	;MACHINING OPERATION ~
Q218=+50	;SLOT LENGTH ~
Q219=+12	;SLOT WIDTH ~
Q368=+0.2	;ALLOWANCE FOR SIDE ~
Q374=+20	;ANGLE OF ROTATION ~
Q367=+0	;SLOT POSITION ~
Q207= AUTO	;FEED RATE FOR MILLNG ~
Q351=+1	;CLIMB OR UP-CUT ~
Q201=-5	;DEPTH ~
Q202=+5	;PLUNGING DEPTH ~
Q369=+0.1	;ALLOWANCE FOR FLOOR ~
Q206= AUTO	;FEED RATE FOR PLNGNG ~
Q338=+0	;INFEEED FOR FINISHING ~
Q200=+5	;SET-UP CLEARANCE ~
Q203=+0	;SURFACE COORDINATE ~
Q204=+50	;2ND SET-UP CLEARANCE ~
Q366=+2	;PLUNGE ~
Q385= AUTO	;FINISHING FEED RATE ~
Q439=+3	;FEED RATE REFERENCE
10 L X+70 Y+22 R0 FMAX M99	
11 L X+150 Y+150 Z+100 R0 FMAX	
12 M30	
13 END PGM 1214155 MM	

3

**Programming
techniques**



3.1 Drilling and tapping – 1226642

Text:		ID number	
Change No. C000941-05		Phase: Nicht-Serie	
Werkstoff: 3.1645		Material:	
●blanke Flächen/Blank surfaces			
Oberflächen nach ISO 1302		Surfaces as per ISO 1302	
Oberflächenbehandlung: Surface treatment:			
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Program parameters

Drilling / Thread	Requirements	X	Y	Z
Safe position		+150	+150	+100
Safety clearance		-	-	+5
2nd set-up clearance		-	-	+50

Tool parameters

	Ø	T	S	F ₁	F ₂	DZ	IZ
	6.8	229	6000	840	2000	-17	17
	M8	264	200	-	-	-17	17

- Ø) Diameter
- T) Tool number
- S) Speed
- F₁) Machining feed rate
- F₂) Retraction feed rate
- DZ) Max. machining / drilling depth
- IZ) Infeed

Solution

0	BEGIN PGM 1226642 MM
1	BLK FORM 0.1 Z X+0 Y+0 Z-16
2	BLK FORM 0.2 X+100 Y+100 Z+0
3	TOOL CALL 229 Z S6000 F840
4	L Z+100 R0 FMAX M3
5	CYCL DEF 200 DRILLING ~
	Q200=+5 ;SET-UP CLEARANCE ~
	Q201=-17 ;DEPTH ~
	Q206= AUTO ;FEED RATE FOR PLNGNG ~
	Q202=+17 ;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
6	CALL LBL 1
7	CALL LBL 2
8	L Z+100 R0 FMAX
9	TOOL CALL 264 Z S200
10	L Z+100 R0 FMAX M3
11	CYCL DEF 207 RIGID TAPPING ~
	Q200=+5 ;SET-UP CLEARANCE ~
	Q201=-17 ;DEPTH OF THREAD ~
	Q239=+1.25 ;THREAD PITCH ~
	Q203=+0 ;SURFACE COORDINATE ~
	Q204=+50 ;2ND SET-UP CLEARANCE
12	CALL LBL 1
13	L X+150 Y+150 Z+100 R0 FMAX
14	M30
15	LBL 1
16	CYCL DEF 221 CARTESIAN PATTERN ~
	Q225=+30 ;STARTNG PNT 1ST AXIS ~
	Q226=+15 ;STARTNG PNT 2ND AXIS ~
	Q237=+10 ;SPACING IN 1ST AXIS ~
	Q238=+20 ;SPACING IN 2ND AXIS ~
	Q242=+8 ;NUMBER OF COLUMNS ~
	Q243=+2 ;NUMBER OF LINES ~
	Q224=+70 ;ANGLE OF ROTATION ~
	Q200=+5 ;SET-UP CLEARANCE ~
	Q203=+0 ;SURFACE COORDINATE ~
	Q204=+50 ;2ND SET-UP CLEARANCE ~
	Q301=+1 ;MOVE TO CLEARANCE

17 LBL 0	
18 LBL 2	
19 CYCL DEF 220 POLAR PATTERN ~	
Q216=+70 ;CENTER IN 1ST AXIS ~	
Q217=+30 ;CENTER IN 2ND AXIS ~	
Q244=+30 ;PITCH CIRCLE DIAMETR ~	
Q245=+30 ;STARTING ANGLE ~	
Q246=+360 ;STOPPING ANGLE ~	
Q247=+60 ;STEPPING ANGLE ~	
Q241=+6 ;NR OF REPETITIONS ~	
Q200=+5 ;SET-UP CLEARANCE ~	
Q203=+0 ;SURFACE COORDINATE ~	
Q204=+50 ;2ND SET-UP CLEARANCE ~	
Q301=+1 ;MOVE TO CLEARANCE ~	
Q365=+0 ;TYPE OF TRAVERSE	
20 LBL 0	
21 END PGM 1226642 MM	