SHAPER DUO

■Hexalobular Socket

■Hexagon Socket

■Square Socket

- Now available for Hexalobular(6-lobe) Socket
- Perfect fit for back spindle of Swiss machine
- Achieves good corner edge sharpness
- Less tool pressure than Rotary-Broaching
- Easy to adjust for correct dimension
- Economical double-ended insert bar (Except for Hexalobular)

Comparison Chart of Hexalobular Socket Machining

	Tool Pressure	Cycle Time	Tool Cost	High speed spindle	Program	
Shaper Duo 	◎	◎	◎	Not necessary	Simple	●No high speed spindle needed ●A lot less cycle time
End milling	○	×	△	Necessary	Complicated	●Need high speed spindle ●Time consuming process

- Small diameter endmill driven by high-speed spindle is popular way to create Hexalobular(6-lobe) socket. It has some flexibility but needs high speed spindle unit and it is a time consuming process.
- SHAPER DUO can make Hexalobular(6-lobe) socket faster and simpler.

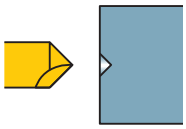
Comparison Chart of HEX Socket Machining

	Tool Pressure	Cycle Time	Flexibility	Tool Cost	
Shaper Duo 	◎	△ ＊Can be off-set by over-wrapping operation	○	◎	●Less tool pressure-especially on small diameter parts ●One size can cover several socket sizes
Broach Tool	△	○	×	△	●Need to have tools for each socket size

- Rotary-broach is an efficient way for Hexagon socket. But tool pressure is high and often it pushes part too hard.
- SHAPER DUO system enables less tool pressure and provides better tolerance with less cost.

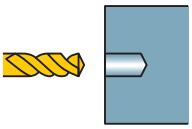
Process Chart

① Center drilling



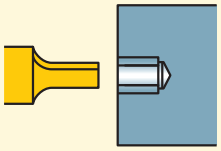
Make a center hole which is smaller than pilot hole drill.

② Drilling (Pilot hole)



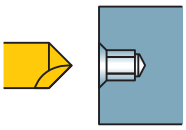
Select a drill with same or smaller (0 ~ -0.1mm) dia. as AF and machine a bit deeper because burrs may cause chipping on shaper insert

③ Shaper tool



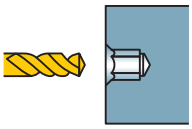
Machine socket rotating 60 degrees 6 times

④ Chamfering



Chamfer with the same pilot hole drill as ①

⑤ Deburring



Finish and deburr with the same drill as in process②
☆Reduce cutting conditions due to heavy interruption

SHAPER DUO Process Chart -Hexalobular-

Holder => K9

Socket Size	Tool	Pilot bore Dia. (mm)	Starting "X" position (mm)	Number of passes: Final "X" position (mm)	Roughing pass 0.025mm	Finishing pass 0.005mm	Estimated cycle time *: ISO10664 Stadard depth of Hexalobular hole (mm)	Whole process ①-⑤	Process④ Shaper
T6	**SSP050N25T06**	1.15	1.14	1.75	13	1	1.82	51 sec	23.2 sec
T7	**SSP050N31T07**	1.38	1.35	2.06	15	1	2.44	59 sec	28.2 sec
T8	**SSP050N36T08**	1.62	1.59	2.40	17	1	3.05	67 sec	33.8 sec
T10	**SSP050N41T10**	1.92	1.89	2.80	19	1	3.56	75 sec	39.5 sec
T15	**SSP050N43T15**	2.30	2.29	3.35	22	1	3.81	84 sec	46.2 sec
T20	**SSP050N46T20**	2.71	2.69	3.95	26	1	4.07	94 sec	55.4 sec
T25	**SSP050N50T25**	3.13	3.09	4.50	29	1	4.45	105 sec	63.8 sec
T27	**SSP050N55T27**	3.52	3.51	5.07	32	1	4.70	115 sec	71.8 sec
T30	**SSP050N55T30**	3.91	3.89	5.60	35	1	4.95	125 sec	80.2 sec

＊Using Carbide drill

＊Shaper cutting conditions

Feed : 3000 mm/min
DOC : 0.025 mm (Roughing), 0.005 mm (Finishing)

SHAPER DUO Process Chart -Hexagonal-

Holder => K9

HEX Standard	Tool	Pilot bore Dia. (mm)	Starting "X" position (mm)	Number of passes: Final "X" position (mm)	Roughing pass 0.025mm	Finishing pass 0.005mm	Estimated cycle time *: ISO 2936 standard depth of Hex hole (mm)	Whole process ①-⑤	Process④ Shaper
HEX 1.5	**SSP020N1130H**	1.5	1.47	1.73	6	1	2	39 sec	14 sec
HEX 2.0	**SSP020N1430H**	2.0	1.95	2.31	8	1	2.5	44 sec	16 sec
HEX 2.5	**SSP030N1940H**	2.5	2.48	2.89	9	1	3	50 sec	20 sec
HEX 3.0	**SSP030N1940H**	3.0	2.95	3.46	11	1	3.5	55 sec	23 sec
HEX 4.0	**SSP040N2450H**	4.0	3.96	4.62	14	1	5	73 sec	33 sec
HEX 5.0	**SSP050N3260H**	5.0	4.96	5.77	17	1	6	90 sec	46 sec
HEX 6.0	**SSP060N42120H**	6.0	5.97	6.93	20	1	8	117 sec	63 sec
HEX 8.0	**SSP080N62160H**	8.0	7.98	9.24	26	1	10	155 sec	92 sec

＊Pilot bore diameter is same or smaller(0-0.1mm) as AF.
＊Using Carbide drill

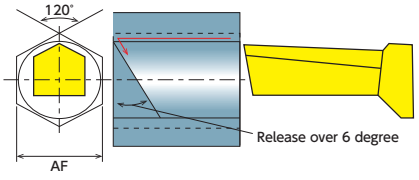
＊Shaper cutting conditions

Feed : 3000 mm/min
DOC : 0.025 mm (Roughing), 0.005 mm (Finishing)

Recommended Cutting Conditions

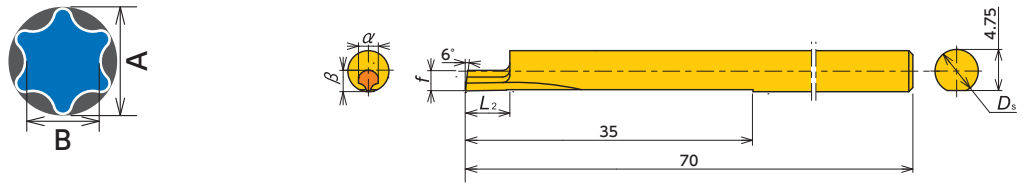
Feed : 3000 mm/min
DOC : Roughing ··· 0.025 mm + Finishing ··· 0.005 mm

Program Example ➡J6 • J7



Sleeves ➡K8 • K9

Insert Bar -Hexalobular-



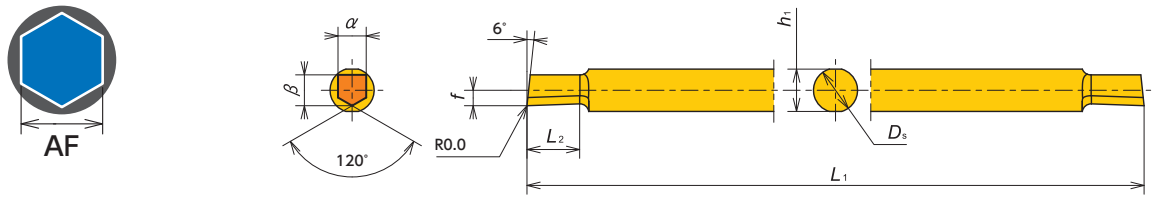
Single-sided

Item Number	Socket Size	Hexalobular Socket #	A (mm)	B (mm)	Ds (mm)	L2 (mm)	α (mm)	β (mm)	f (mm)	Pilot Bore Dia (mm)	Coated Carbide TM4
SSP050N25T06	T6	6	1.75	1.27	ϕ5	2.5	1.08	1.09	2.4	ϕ1.15	●
SSP050N31T07	T7	–	–	–	ϕ5	3.1	1.27	1.29	2.4	ϕ1.38	●
SSP050N36T08	T8	8	2.4	1.75	ϕ5	3.6	1.48	1.50	2.4	ϕ1.62	●
SSP050N41T10	T10	10	2.8	2.05	ϕ5	4.1	1.67	1.70	2.4	ϕ1.92	●
SSP050N43T15	T15	15	3.35	2.4	ϕ5	4.3	2.04	2.10	2.4	ϕ2.30	●
SSP050N46T20	T20	20	3.95	2.85	ϕ5	4.6	2.41	2.50	2.4	ϕ2.71	●
SSP050N50T25	T25	25	4.5	3.25	ϕ5	5.0	2.78	2.90	2.4	ϕ3.13	●
SSP050N55T27	T27	–	–	–	ϕ5	5.5	3.15	3.30	2.4	ϕ3.52	●
SSP050N55T30	T30	30	5.6	4.05	ϕ5	5.5	3.52	3.70	2.4	ϕ3.91	●

※Caution: Due to the tolerance, it might not fit into the holder which is made by other company.

Sleeves ➡K8 • K9

Insert Bar -Hexagon-



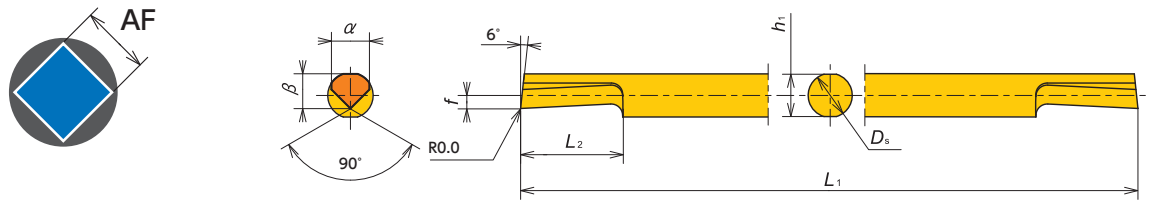
Double-sided

Item Number	Base AF (mm)	HEX Standard size range (mm)	AF range (mm)	Ds (mm)	L1 (mm)	L2 (mm)	h1 (mm)	α (mm)	β (mm)	f (mm)	Coated Carbide TM4
SSP020N1130H	HEX 1.5	HEX 1.5 – 2.0	1.4 – 2.0	ϕ2	50	3.0	1.8	1.1	0.8	0.40	●
SSP020N1430H	HEX 2.0	HEX 2.0 – 2.5	1.9 – 2.6	ϕ2	50	3.0	1.8	1.4	1.1	0.55	●
SSP030N1940H	HEX 3.0	HEX 2.5 – 3.5	2.4 – 3.6	ϕ3	50	4.0	2.8	1.9	1.6	0.8	●
SSP040N2450H	HEX 4.0	HEX 3.5 – 4.5	3.4 – 4.6	ϕ4	60	5.0	3.8	2.4	2.6	1.3	●
SSP050N3260H	HEX 5.0	HEX 4.5 – 6.0	4.4 – 6.2	ϕ5	70	6.0	4.8	3.2	3.4	1.70	●
SSP060N42120H	HEX 6.0	HEX 6.0 – 8.0	5.9 – 8.2	ϕ6	80	12.0	5.6	4.2	4.0	2.00	●
SSP080N62160H	HEX 8.0	HEX 8.0 – 12.0	7.9 – 12.2	ϕ8	80	16.0	7.6	6.2	4.7	2.35	●

※Caution: Due to the tolerance, it might not fit into the holder which is made by other company.

Sleeves ➡K8 • K9

Insert Bar -Square-



Double-sided

Item Number	Base AF (mm)	AF range (mm)	Ds (mm)	L1 (mm)	L2 (mm)	h1 (mm)	α (mm)	β (mm)	f (mm)	Coated Carbide TM4
SSP020N1740S	2.0	1.9 – 2.3	ϕ2.0	50	4.0	1.8	1.70	1.60	0.70	●
SSP025N1940S	2.5	2.2 – 2.6	ϕ2.5	50	4.0	2.3	1.95	1.80	0.65	●
SSP030N2260S	3.0	2.5 – 3.0	ϕ3.0	50	6.0	2.8	2.20	2.05	0.65	●
SSP035N2760S	3.5	2.9 – 3.7	ϕ3.5	60	6.0	3.3	2.70	2.25	0.60	●
SSP040N3380S	4.0	3.6 – 4.6	ϕ4.0	60	8.0	3.8	3.35	3.05	1.15	●
SSP050N39100S	5.0	4.5 – 5.4	ϕ5.0	70	10.0	4.8	3.90	3.95	1.55	●
SSP060N47120S	6.0	5.3 – 6.6	ϕ6.0	80	12.0	5.6	4.75	4.50	1.70	●
SSP080N58160S	8.0	6.5 – 8.1	ϕ8.0	80	16.0	7.6	5.80	5.50	1.70	●

※Caution: Due to the tolerance, it might not fit into the holder which is made by other company.

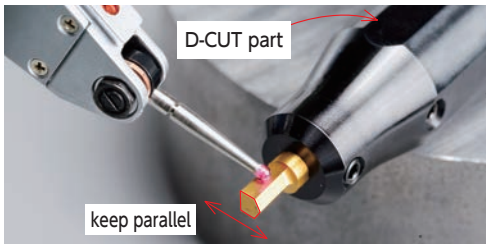
Sleeves ➡K8 • K9

● : Stock

SHAPER DUO Set-up Instructions -Hexagonal

■Outside machine

①



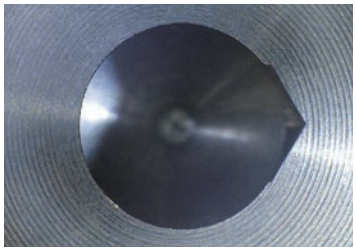
- Set the insert bar in the sleeve and check the parallelism of the flat portion of the sleeve and the insert bar.
- Minimize the overhang of the insert.

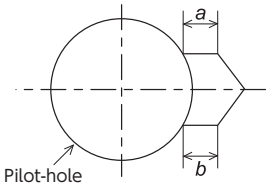
■Inside machine

②

- Set the sleeve into the tool post and make sure the sleeve is set parallel.
- Minimize sleeve overhang.

③

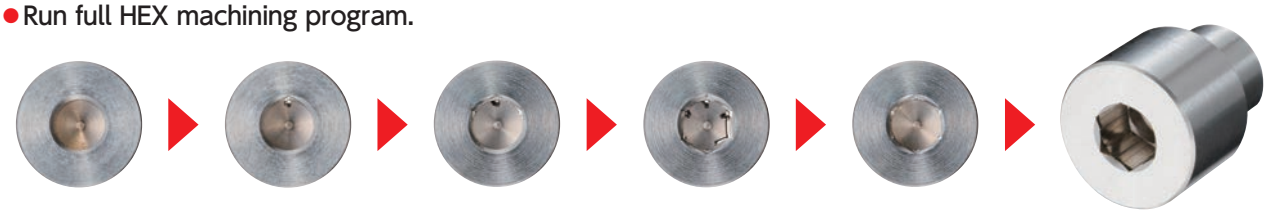




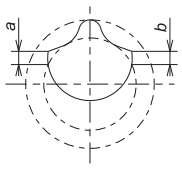
- Increase the number of machining passes with smaller depth of cut if the insert chips with large depth of cut. (0.025mm×5pass is recommended)
  No chamfering process is required for measuring purpose.
- Measure the length of both [a] and [b] with comparator or magnifier.
- Adjust centerline height by rotating the sleeve until you get the same length for [a] and [b].(The difference should be less than 0.02mm)
  *If the straight is not seen with increased passes, please reset the insert and the sleeve.
  Please make sure both the insert and the sleeve are set up correctly.

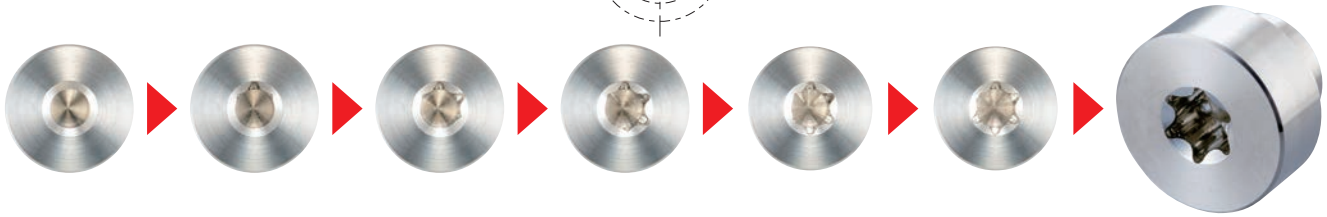
④ **Machine Hexagonal shape**

- Run full HEX machining program.



■For Hexalobular machining
Basically same as Hexagonal socket





Hexagon Socket Programming Code Examples from Machine Builders in Metric

Hex socket size : Hex 3.0mm, AF(Final "X" position) 3.46mm, Depth 3.5mm
Pilot drill diameter : 3.0mm **Starting "X" position : 2.95mm (see chart on J3)**
Insert : SSP030N1940N TM4
Parameters : Feed 3000mm/min, DOC(Roughing) 0.025mm, (Finishing) 0.005mm

Programming tips

● **Make a program considering final " X "position.**

#1 Final "X"position : 3.46mm (AF)
#2 Finishing position of roughing : 3.46−0.01 (Finishing) =3.45mm
#3 Calculate total DOC for roughing : 3.45−3.0 (Pilot hole) =0.45mm
#4 Determine number of cuts : 0.45÷0.05 (DOC for Dia.)= 9.0 + **2** (round down to whole number and add "**2**" for program adjustment)
→ Roughing sequence runs 11 times
#5 Set starting point : 3.45−(0.05×(11−**1**)) = 2.95mm : must subtract by "**1**" for program adjustment

CITIZEN

Main Program Sequence

```
M25
M78 S0 ·····I
Shaper T****
G50 U1.6 ·····II
G0 X2.95 Z-2.0 T** ·····III
M98 P2100 L11 ·····IV
M98 P2200 ·····V

M78 S60 ·····I
G0 X2.95 Z-2.0
M98 P2100 L11
M98 P2200
```

<a>

Repeat <a> program sequence 4 more times to complete the cuts at S120, S180, S240, S300 (represents 120°, 180°, 240°, 300°).

```
M20
G0 Z-2.0
G50 U-1.6
G0 U0 W0 T0
M1
```

Sub-Program Sequence #1 for Roughing

```
N2100
G4 U0.02 ·····A
G98 G1 Z3.5 F3000 ·····B
G4 U0.02
U-0.2 W-0.018 ·····C
G4 U0.02
G0 Z-2.0
G4 U0.02
U0.25 ·····D
M99
```

Sub-Program Sequence #2 for Finishing

```
N2200
G98 G1 X3.46 Z-2.0 F1000 ·····E
G4 U0.02
Z3.5 F3000
G4 U0.02
U-0.2 W-0.018
G4 U0.02
G0 Z-2.0
M99
```

STAR

Main Program Sequence

```
M25
Shaper T****
G50 U1.6 ·····II
M8
G0 X2.95 Z-2.0 C0 T** ·····I, III
M98 P2100 L11 ·····IV
M98 P2200 ·····V

G0 C60.0 ·····I
G0 X2.95 Z-2.0
M98 P2100 L11
M98 P2200
```

<a>

Repeat <a> program sequence 4 more times to complete the cuts at C120.0, C180.0, C240.0, C300.0 (represents 120°, 180°, 240°, 300°).

```
G0 Z-2.0
G50 U-1.6
G0 T0
G28 W0
M1
```

Sub-Program Sequence #1 for Roughing

```
O2100
G4 U0.02 ·····A
G98 G1 Z3.5 F3000 ·····B
G4 U0.02
U-0.2 W-0.018 ·····C
G4 U0.02
G0 Z-2.0
G4 U0.02
U0.25 ·····D
M99
```

Sub-Program Sequence #2 for Finishing

```
O2200
G98 G1 X3.46 Z-2.0 F1000 ·····E
G4 U0.02
Z3.5 F3000
G4 U0.02
U-0.2 W-0.018
G4 U0.02
G0 Z-2.0
M99
```

TSUGAMI

Main Program Sequence

```
M105
M150
G28 H0 ·····I
M182
Shaper T****
G50 U1.6 ·····II
G0 X2.95 Z2.0 T** ·····III
M98 P2100 L11 ·····IV
M98 P2200 ·····V
M183

G0 C60 ·····I
M182
G0 X2.95 Z2.0
M98 P2100 L11
M98 P2200
M183
```

<a>

Repeat <a> program sequence 4 more times to complete the cuts at C120, C180, C240, C300 (represents 120°, 180°, 240°, 300°).

```
M151
G0 Z2.0
G50 U-1.6
G0 U0 W0 T0
M1
```

Sub-Program Sequence #1 for Roughing

```
O2100
G4 U0.02 ·····A
G98 G1 Z-3.5 F3000 ·····B
G4 U0.02
U-0.2 W0.018 ·····C
G4 U0.02
G0 Z2.0
G4 U0.02
U0.25 ·····D
M99
```

Sub-Program Sequence #2 for Finishing

```
O2200
G98 G1 X3.46 Z2.0 F1000 ·····E
G4 U0.02
Z-3.5 F3000
G4 U0.02
U-0.2 W0.018
G4 U0.02
G0 Z2.0
M99
```

I. Index the sub-spindle 6 times in 60 degree increments.
II. Specify the coordinate system shift command (in X axis direction) for the tool. [2 x f, where f is tool dimension located in catalog].
  • A positive direction shift is recommended for easier programming.
III. Execute the positioning of the tool.
  • X position should be smaller than pilot drill diameter.
  • Z position should be offset 2.0 mm from material to achieve program feed rate.
IV. Go to the Sub-Program #1.
  • Sequence runs 11 times. First cutting point X2.95 and final cutting point X3.45, with 0.05 DOC (for diameter) each time.
A. Specify dwell time. This allows the program and machine to stay synchronized.
B. Cut into part 3.5mm. F3000 is recommended feed to be used for most materials; including Titanium Alloy and Stainless Steel.
C. This code backs off the tool with an angle greater than 6 degrees (10 degrees used in example). See page J3.
D. Return to the X position + 0.05mm (the DOC for diameter).
V. Go to the Sub-Program #2, for finishing sequence.
E. Finishing operation with 0.005mm DOC (X 3.46) is recommended for better surface finish.

Hexalobular Socket Programming Code Examples from Machine Builders in Metric

Hexalobular socket size : Hexalobular T15 (depth : 3.81mm)
Pilot drill diameter : 2.3mm
Insert : SSP050N43T15 TM4
Parameters : Feed 3000mm/min, DOC(Roughing) 0.025mm, (Finishing) 0.005mm

Programming tips

● **Make a program considering final " X "position.**

#1 Final " X "position : 3.35mm(A)
#2 Finishing position of roughing : 3.35−0.01 (Finishing) =3.34mm
#3 Calculate total DOC for roughing : 3.34−2.3 (Pilot hole) =1.04mm
#4 Determine number of cuts : 1.04÷0.05 (DOC for Dia)=20.8 + **2** (round down to whole number and add "**2**" for program adjustment)
→ Roughing sequence runs 22 times
#5 Set starting point : 3.34−(0.05×(22−**1**)) = 2.29mm : must subtract by "**1**" for program adjustment

CITIZEN

Main Program Sequence

```
M25
M78 S0  ·····I
Shaper   T****
G50 U4.8  ·····II
G0 X2.29 Z-2.0 T**  ·····III
M98 P2100 L22  ·····IV
M98 P2200  ·····V

M78 S60  ·····I
G0 X2.29 Z-2.0
M98 P2100 L22
M98 P2200
```
<a>

Repeat <a> program sequence 4 more times to complete the cuts at S120, S180, S240, S300 (represents 120°, 180°, 240°, 300°).

```
M20
G0 Z-2.0
G50 U-4.8
G0 U0 W0 T0
M1
```

Sub-Program Sequence #1 for Roughing

```
N2100
G4 U0.02  ·····A
G98 G1 Z3.81 F3000  ·····B
G4 U0.02
U-0.2 W-0.018  ·····C
G4 U0.02
G0 Z-2.0
G4 U0.02
U0.25  ·····D
M99
```

Sub-Program Sequence #2 for Finishing

```
N2200
G98 G1 X3.35 Z-2.0 F1000  ·····E
G4 U0.02
Z3.81 F3000
G4 U0.02
U-0.2 W-0.018
G4 U0.02
G0 Z-2.0
M99
```

STAR

Main Program Sequence

```
M25
Shaper   T****
G50 U4.8  ·····II
M8
G0 X2.29 Z-2.0 C0 T**  ·····I, III
M98 P2100 L22  ·····IV
M98 P2200  ·····V

G0 C60.0  ·····I
G0 X2.29 Z-2.0
M98 P2100 L22
M98 P2200
```
<a>

Repeat <a> program sequence 4 more times to complete the cuts at C120.0, C180.0, C240.0, C300.0 (represents 120°, 180°, 240°, 300°).

```
G0 Z-2.0
G50 U-4.8
G0 T0
G28 W0
M1
```

Sub-Program Sequence #1 for Roughing

```
O2100
G4 U0.02  ·····A
G98 G1 Z3.81 F3000  ·····B
G4 U0.02
U-0.2 W-0.018  ·····C
G4 U0.02
G0 Z-2.0
G4 U0.02
U0.25  ·····D
M99
```

Sub-Program Sequence #2 for Finishing

```
O2200
G98 G1 X3.35 Z-2.0 F1000  ·····E
G4 U0.02
Z3.81 F3000
G4 U0.02
U-0.2 W-0.018
G4 U0.02
G0 Z-2.0
M99
```

TSUGAMI

Main Program Sequence

```
M105
M150
G28 H0  ·····I
M182
Shaper   T****
G50 U4.8  ·····II
G0 X2.29 Z2.0 T**  ·····III
M98 P2100 L22  ·····IV
M98 P2200  ·····V
M183

G0 C60  ·····I
M182
G0 X2.29 Z2.0
M98 P2100 L22
M98 P2200
M183
```
<a>

Repeat <a> program sequence 4 more times to complete the cuts at C120, C180, C240, C300 (represents 120°, 180°, 240°, 300°).

```
M151
G0 Z2.0
G50 U-4.8
G0 U0 W0 T0
M1
```

Sub-Program Sequence #1 for Roughing

```
O2100
G4 U0.02  ·····A
G98 G1 Z-3.81 F3000  ·····B
G4 U0.02
U-0.2 W0.018  ·····C
G4 U0.02
G0 Z2.0
G4 U0.02
U0.25  ·····D
M99
```

Sub-Program Sequence #2 for Finishing

```
O2200
G98 G1 X3.35 Z2.0 F1000  ·····E
G4 U0.02
Z-3.81 F3000
G4 U0.02
U-0.2 W0.018
G4 U0.02
G0 Z2.0
M99
```

I. Index the sub-spindle 6 times in 60 degree increments.
II. Specify the coordinate system shift command (in X axis direction) for the tool. [2 x f, where f is tool dimension located in catalog].
  • A positive direction shift is recommended for easier programming.
III. Execute the positioning of the tool.
  • X position should be smaller than pilot drill diameter.
  • Z position should be offset 2.0 mm from material to achieve program feed rate.
IV. Go to the Sub-Program #1.
  • Sequence runs 22 times. First cutting point X2.29 and final cutting point X3.34, with 0.05 DOC (for diameter) each time.
A. Specify dwell time. This allows the program and machine to stay synchronized.
B. Cut into part 3.81mm. F3000 is recommended feed to be used for most materials; including Titanium Alloy and Stainless Steel.
C. This code backs off the tool with an angle greater than 6 degrees (10 degrees used in example). See page J3.
D. Return to the X position + 0.05mm (the DOC for diameter).
V. Go to the Sub-Program #2, for finishing sequence.
E. Finishing operation with 0.005mm DOC (X 3.35) is recommended for better surface finish.