Nine9®

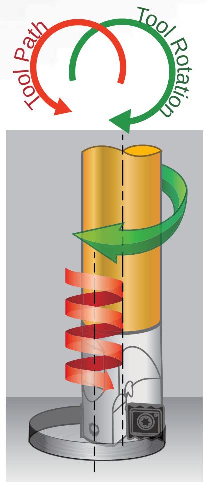
NC Helix Drill

One Tool Performs Multiple Applications

2

NC Helix Drill

Rough Milling, Drilling & Slotting



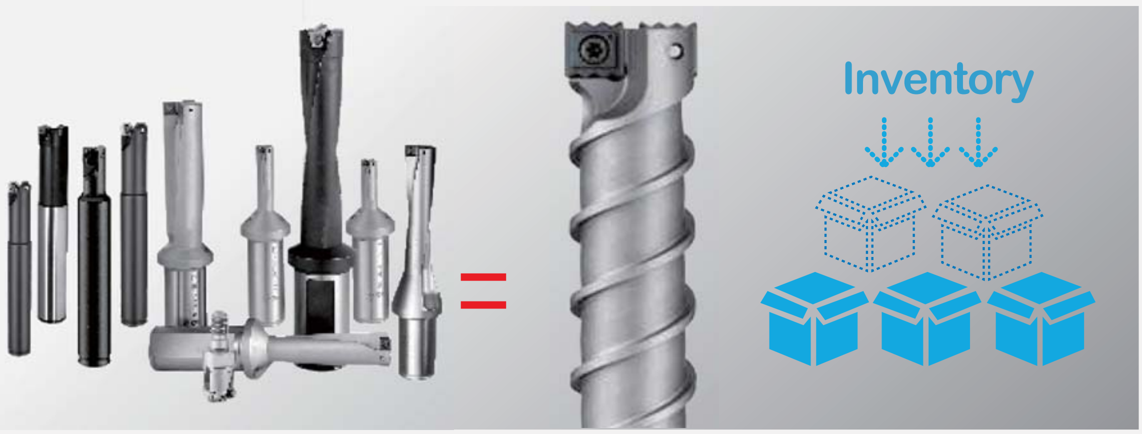
All NC Helix Drill must be programmed by helical interpolation

Reduce Your Tool Inventory

Only four tools for making Ø13~Ø65mm hole from solid.

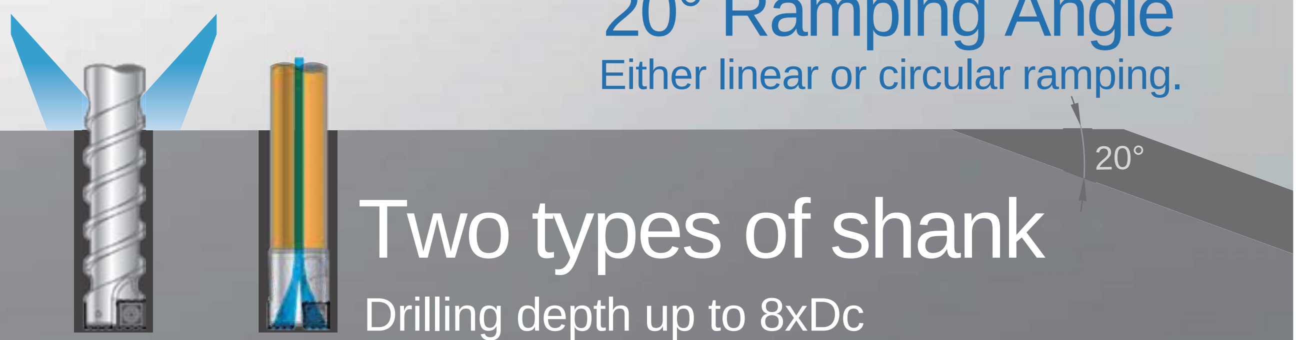
Each holder can machine different diameters and hole depths, saving your tool inventory and cost!
No need to peck drill or dwell in operation even machine without internal coolant.

Low Cost! Economy!



20° Ramping Angle

Either linear or circular ramping.

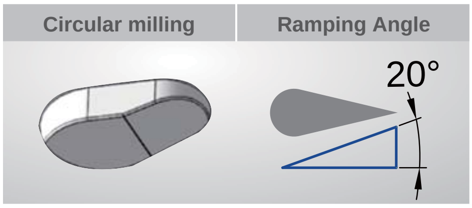


Two types of shank

Drilling depth up to 8xDc

01 Feature

Lower spindle power consumption Easy to cut!



- Thanks to the small cutting load of the serrated cutting edge and helical interpolation lower power consumption. Work quicker, smarter and achieve better results.
- Circular ramping milling, maximum ramping angle is 20°.
  For example: tool HD27 machining Ø50 mm hole, 9 mm pitch for aluminum, 6 mm pitch for carbon steel.

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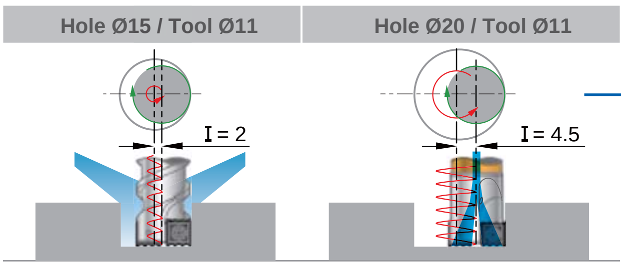
NC Helix Drill

02 Feature

Just four tools for drilling Ø13~Ø65 mm or larger

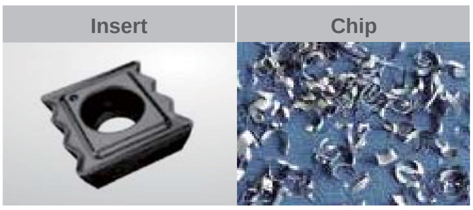
Example :



- Cuts by helical interpolation.
- Each holder can machine different diameters and hole depths.
- Enlarger hole is adaptable by using 99323 internal coolant cutter.

03 Feature

Special insert geometry - exceptional swarfs control.



- Serrated cutting edge makes the chips short and small, and easier to evacuate.
- Eliminate swarf and vibration problems while drilling difficult material or deeper holes.
- Excellent swarfs control for providing safe and rational chip removal for morden automation.

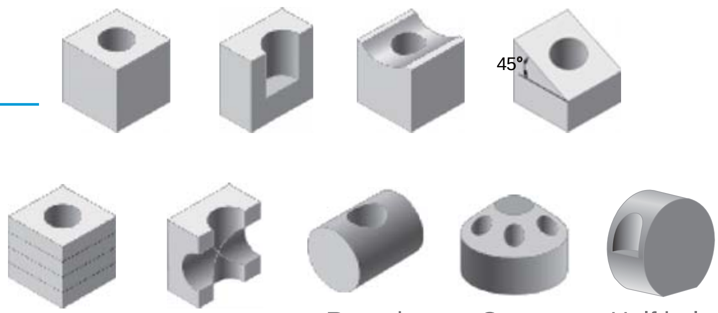
04
Feature

"One tool" performs multiple applications

- Not only a drill, but an end mill too.
- Small radius path to cut a hole or step hole, various curved cavity shapes on different materials, reduce tool number and cutting time.

05
Feature

Functions in variable conditions It's so easy!



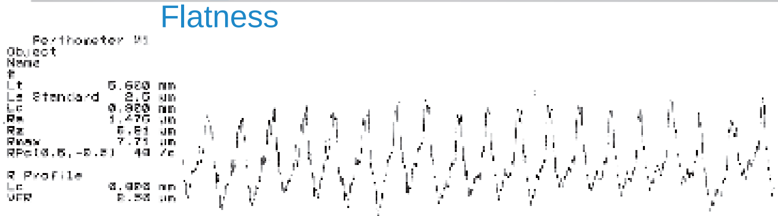
Roughness Measuring

Feature
06

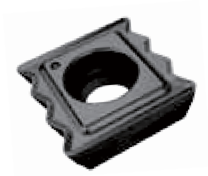
- Making a flatness at bottom just by NC program, easy and smart!

Workpiece	
	Make " One more turn" after reached the depth. Ex : : G03 I-1.5 Z-30 P5 G03 I-1.5 <make one more turn > G01 X0 Y0 < afterward, let tool back to center of hole >

Flatness



Inserts

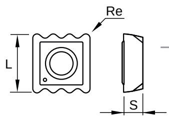


NC5072 : P40, TiAlN coating.
General purpose, suitable for almost all kind of steel, stainless steel and Titanium.
Recommended while clamping devices is unstable or deep hole drilling or apply on low power machines .

NC2032 : K20F, TiAlN coating.
Design for high performance cutting, special good for cast iron and hardened material <HRC50°.

● Best ◎ Suit ○ Possible

	P Steel	M SS	K Cast Iron	N Aluminum	S Titanium	H Hardened
NC5072	●	●	◎	◎	◎	○
NC2032	◎	○	●	◎	○	◎

Code	Parts No.	Grade		Coating		Dimensions L	S	Re	Screw	Key
041021	01-N9MX04T002	NC5072	P40	TiAlN		4.75	1.8	0.2	*NS-18037 0.6Nm	NK-T6
041001		NC2032	K20F							
042021	01-N9MX05T103	NC5072	P40	TiAlN		5.75	2.0	0.3	*NS-20045 0.6Nm	NK-T6
042001		NC2032	K20F							
043021	01-N9MX070204	NC5072	P40	TiAlN		7.5	2.4	0.4	*NS-25045 0.9Nm	NK-T7
043001		NC2032	K20F							
044021	01-N9MX100306	NC5072	P40	TiAlN		10.0	3.18	0.6	NS-30072 2.0Nm	NK-T9
044001		NC2032	K20F							
045021	01-N9MX12T308	NC5072	P40	TiAlN		12.5	3.97	0.8	NS-35080 2.5Nm	NK-T15
045001		NC2032	K20F							

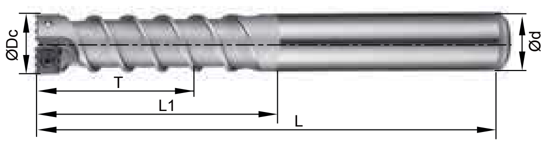
*Torque screwdriver is recommended, see page 6-4.

Holder

Cylindrical Shank (made from hardened high alloy steel)

▶ Helical chip-removing groove >>

- Designed for CNC machines with external coolant.
- Unique helical groove design generates chip removing coolant stream.
- The helical groove is designed for the coolant to remove swarf from the cutting zone.

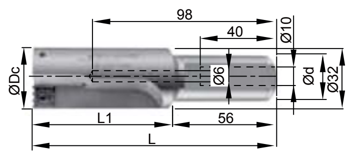


Code	Parts No.	Type	Capable of drill dia. mm Dmin.	Dmax.	ØDc	T	L1	L	Ød	Insert type	Max. ramping angle
401001	00-99321-010-1320	BC10-HD11-1320	**13**	**20**	11	30	40	80	10	N9MX04T002	20°
402001	00-99321-012-1525	BC12-HD13-1525	**15**	**25**	13	36	50	100	12	N9MX05T103	20°
403001	00-99321-016-2030	BC16-HD17-2030	**20**	**30**	17	50	60	110	16	N9MX070204	20°
404001	00-99321-020-2540	BC20-HD22-2540	**25**	**40**	22	60	70	125	20	N9MX100306	20°
405001	00-99321-025-3050	BC25-HD27-3050	**30**	**50**	27	75	85	165	25	N9MX12T308	20°

Side Lock Shank

▶ With Internal Coolant

- Special size is available on request.



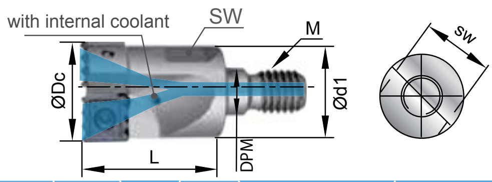
Code	Parts No.	Type	Capable of drill dia. mm Dmin.	Dmax.	ØDc	L	L1	Ød	Max. Depth	Insert type	Max. ramping angle
405002	00-99321-025-4265	SL25-HD33-4265	**42**	**65**	33	130	74	25	50	N9MX12T308	9°

Screw Fit Cutter

With Internal Coolant

- Designed for CNC machines with internal coolant.
- Standard screw-fit body adapts to almost any kind of the screw-fit tool holder or extension bar in the market.
- Possible apply for enlarge hole.

* Use open ended spanner to tighten the cutter.



Code	Part No.	Type	Capable of drill dia. mm		ØDc	L	M	DPM	Ød1	SW	Insert type	Max. ramping angle
			Dmin.	Dmax.								
421001	00-99323-010-1320	M05-HD11-1320	**13**	**20**	11	20	M5	5.5	10	8	N9MX04T002	20°
422001	00-99323-012-1525	M06-HD13-1525	**15**	**25**	13	25	M6	6.5	12	10	N9MX05T103	20°
423001	00-99323-016-2030	M08-HD17-2030	**20**	**30**	17	25	M8	8.5	16	14	N9MX070204	20°
424001	00-99323-020-2540	M10-HD22-2540	**25**	**40**	22	30	M10	10.5	20	18	N9MX100306	20°
425001	00-99323-025-3050	M12-HD27-3050	**30**	**50**	27	35	M12	12.5	25	23	N9MX12T308	20°

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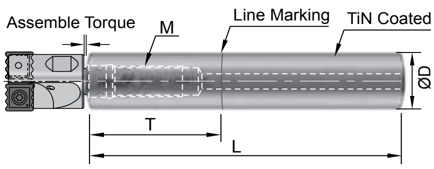
NC Helix Drill

Extension Bar

Steel Type

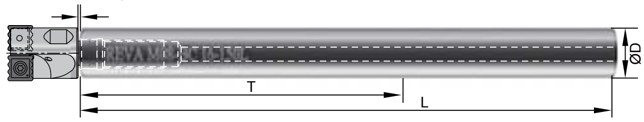
- T is the maximum overhang length.
- With internal coolant hole.



Code	Parts No.	Type	ØD	T	L	M	Assembled Torque
970100	00-99801-10S	BC10-075M05S	10	25	75	M5xP0.8	6.5 Nm
970122	00-99801-12S	BC12-075M06S	12	25	75	M6xP1.0	11.0 Nm
970161	00-99801-16S	BC16-090M08S	16	35	90	M8xP1.25	25.0 Nm
970202	00-99801-20S	BC20-100M10S	20	40	100	M10xP1.5	50.0 Nm
970253	00-99801-25S	BC25-120M12S	25	50	120	M12xP1.75	60.0 Nm

Solid Carbide Type (REVA)

- T is the maximum overhang length.
- With internal coolant hole.
- Carbide extension bar with longer tool length is available on request.



Parts No.	Type	ØD	T	L	M	Assembled Torque
0-398010-100M05	M05-BC10-100L	10	60	100	M5xP0.8	6.5 Nm
0-398012-100M06	M06-BC12-100L	12	60	100	M6xP1.0	11.0 Nm
0-398016-150M08	M08-BC16-150L	16	80	150	M8xP1.25	25.0 Nm
0-398020-200M10	M10-BC20-200L	20	100	200	M10xP1.5	50.0 Nm
0-398025-200M12	M12-BC25-200L	25	125	200	M12xP1.75	60.0 Nm

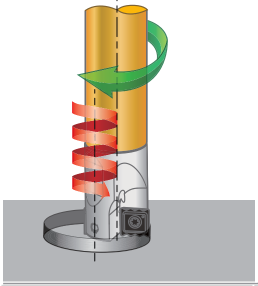
** Nine9 TiN coated extension bar is also available please refer to page 6-3.

Technical Guide

※ Before you start, please pay attention the following conditions >>

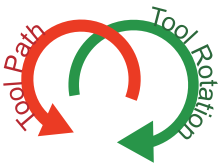
1 Programming

All NC Helix Drills must be programmed using helical interpolation



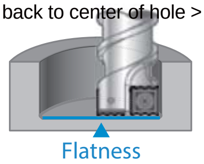
2 Recommend of Direction

Tool path of moving downward by CCW (G03) ,Tool Rotation by CW direction is recommended.



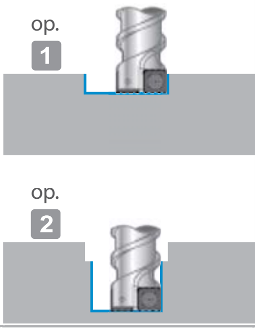
3 Flatness on blind hole bottom

Make one more turn after reaching depth.
Ex. :
⋮
G03 I-1.5 Z-30 P5
G03 I-1.5
<make one more turn >
G01 X0 Y0
< afterward return tool back to center of hole >



4 Step Hole

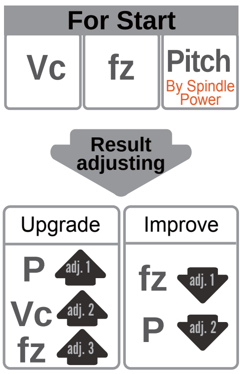
From solid is more safe and reduce the cutting time.



5 External coolant

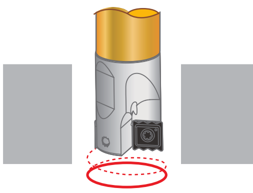
Lower pressure higher volume is recommended.
Minimum 5 bar.
Aim nozzle toward the tool body, let the coolant effectively enter the hole.

6



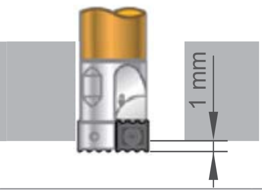
7 Through hole

Reduce Vc 50% at last cycle.



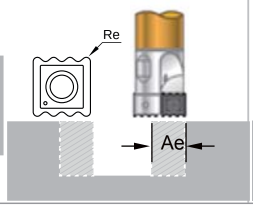
8 Through hole Add 1mm to the required depth (Z)

Failure to program beyond the through hole may result in insert breakage due to the force from circular interpolation.



9 Enlarge Hole

Choosing a 99323 drill body with internal coolant.
Max. Ae=Dc- (Rex2)
for enlarging hole.

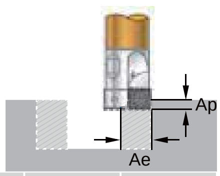


10 Internal coolant

High pressure is recommended.
Minimum 10 bar.
Recommended for 3xDc ~8xDc Use.

※ Choosing a suitable drill body.

- Required hole diameter is within the recommended range (**blue numbers**).
- Required hole diameters (more than one size), choose the drill can cover more different hole diameters.
- For 3xDc~8xDc drilling, 99323 series is recommended.



Drilling diameter	Coolant type	Max. drilling depth	Tool type	Dc	Insert type	Re	Max. Ae	Max. Ap
13-**15-20**	Internal	80 mm	00-99323-010-1320	11	N9MX04T002	0.2	10.6	3.5
	External	30 mm	00-99321-010-1320	11				
15-**20-25**	Internal	85 mm	00-99323-012-1525	13	N9MX05T103	0.3	12.4	4.3
	External	36 mm	00-99321-012-1525	13				
20-**25-30**	Internal	105 mm	00-99323-016-2030	17	N9MX070204	0.4	16.2	5.6
	External	50 mm	00-99321-016-2030	17				
25-**30-40**	Internal	130 mm	00-99323-020-2540	22	N9MX100306	0.6	20.8	7.5
	External	60 mm	00-99321-020-2540	22				
30-**40-50**	Internal	160 mm	00-99323-025-3050	27	N9MX12T308	0.8	25.4	9
	External	75 mm	00-99321-025-3050	27				
42-**50-65**	Internal	50 mm	00-99321-025-4265	33	N9MX12T308	0.8	31.4	9

Max. Ae = Dc- (Rex2)
Max. Ap < 3/4 of insert length

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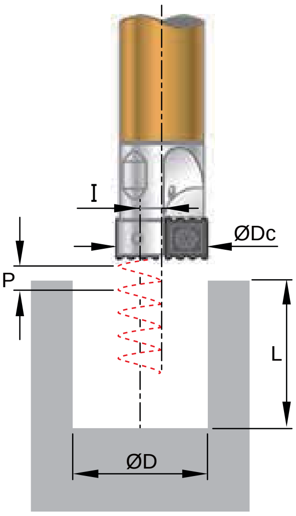
NC Helix Drill

※ The NC Helix Drill is programmed using "Helical interpolation" on CNC machine, CNC controller must have 3-axis simultaneously motion function.

NC Helix Drill	Cutting Parameters (S & F)	Formula



Cutting Parameters (S & F)

$$S = \frac{Vc \times 1000}{Dc \times \pi} \text{ r.p.m.}$$

$$F = S \times fz \times Z \quad \text{mm/min.}$$

$$d = D - Dc \text{ mm}$$

$$I = \frac{(D-Dc)}{2} \text{ mm}$$

Cutting time (T)

$$T = \frac{\pi \times d \times L \times 60}{F \times P} \text{ sec.}$$

Chip removal Volume rate (Q)

$$Q = \frac{\pi \times D^2 \times L \times 60}{4 \times 1000 \times T} \text{ cm}^3\text{/min.}$$

Formula

Dc	=	Dia. of drill	mm
D	=	Dia. of hole	mm
L	=	Depth of drilling	mm
Vc	=	Cutting speed	m/min.
S	=	Spindle speed	r.p.m.
I	=	Circular radius	mm
fz	=	Feed rate	mm/tooth
F	=	Table feed rate	mm/min.
d	=	Circular diameter (D-Dc)	mm
P	=	Pitch of helical interpolation	mm
T	=	Cutting time	sec.
Q	=	Chip removal volume rate	cm³ / min.
Z	=	Insert tooth	

Actual Feed Rate (fcut)

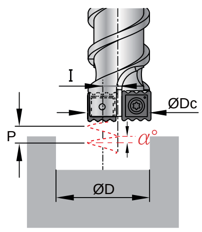
$$f_{cut} = f_z \times \eta \left(\sqrt[3]{1 + \frac{P}{I}} \right) \text{ mm/tooth}$$

η = Power factor

Power Factor (η) Suggestion Table

Spindle Power	Power Factor
< 12KW	0.7-0.8
12-20 KW	0.8-0.9
> 20KW	0.9-1.0

Ramping Angle

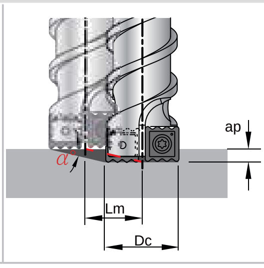


Circular ramping (α)

$$\alpha = \tan^{-1} \frac{P}{(D-Dc) \times \pi} \text{ degree}$$

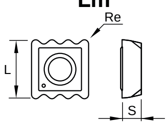
P < 2.2 x Circular radius (I)

α < 20°



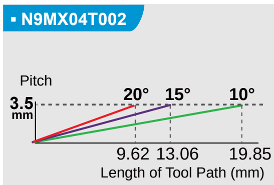
Linear ramping (α)

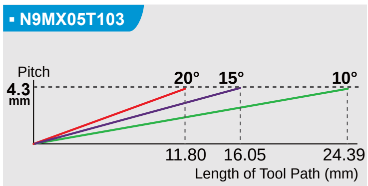
$$\alpha = \tan^{-1} \frac{ap}{Lm} \text{ degree}$$

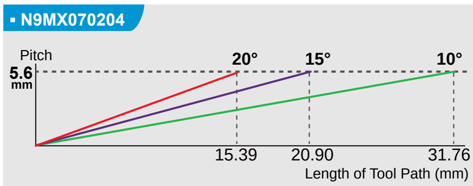


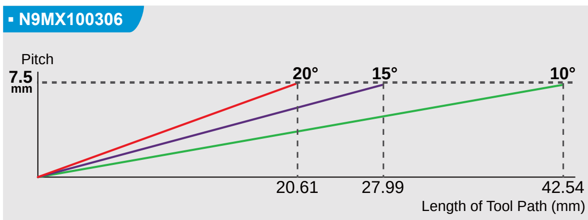
Max. ap < 3/4 of insert length

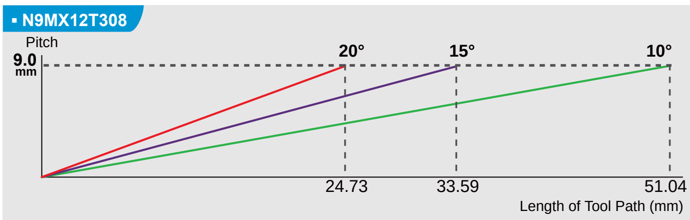
※ Length of tool path for linear ramping.
Length of tool path for Circular ramping= (D-Dc) x 3.14











Cutting Data

Suggestion Table			
Spindle Power	< 12 KW	12-20 KW	> 20 KW
Pitch	Lower Pitch	Median Pitch	Higher Pitch

00-99321-010-1320 / 00-99323-010-1320 >>

	Workpiece material	Vc m/min. 99321	Vc m/min. 99323	Ø13 fz mm/tooth	Ø13 Pitch mm			Ø16 fz mm/tooth	Ø16 Pitch mm			Ø20 fz mm/tooth	Ø20 Pitch mm		
P	Carbon steel 0.25%C	120	200	0.025	0.60	0.80	1.00	0.055	0.90	1.20	1.50	0.08	1.20	1.60	2.00
P	Carbon steel 0.45% C	120	200	0.025	0.60	0.80	1.00	0.055	0.90	1.20	1.50	0.08	1.20	1.60	2.00
P	Carbon steel 0.60%C	100	150	0.025	0.60	0.75	0.90	0.05	0.80	1.10	1.35	0.07	1.00	1.40	1.80
P	Low alloy steel	70	120	0.02	0.50	0.65	0.80	0.05	0.70	0.95	1.20	0.06	1.00	1.30	1.60
P	High alloy steel	60	90	0.02	0.50	0.65	0.80	0.05	0.70	0.95	1.20	0.06	1.00	1.30	1.60
M	Stainless steel	60	90	0.02	0.50	0.65	0.80	0.05	0.70	0.95	1.20	0.06	1.00	1.30	1.60
K	Cast iron	70	120	0.025	0.60	0.80	1.00	0.055	0.90	1.20	1.50	0.08	1.20	1.60	2.00
N	Al	345	500	0.025	0.90	1.20	1.50	0.055	1.30	1.80	2.25	0.08	1.80	2.40	3.00
N	Cu	200	400	0.025	0.70	0.95	1.20	0.055	1.00	1.40	1.80	0.08	1.40	1.90	2.40
S	Ni- alloy	20	28	0.01	0.50	0.65	0.80	0.015	0.70	0.95	1.20	0.03	0.90	1.30	1.60
S	Titanium	40	60	0.01	0.50	0.65	0.80	0.015	0.70	0.95	1.20	0.03	0.90	1.30	1.60
H	Hardened	60	90	0.02	0.50	0.65	0.80	0.05	0.70	0.95	1.20	0.06	1.00	1.30	1.60

00-99321-012-1525 / 00-99323-012-1525 >>

	Workpiece material	Vc m/min. 99321	Vc m/min. 99323	Ø15 fz mm/tooth	Ø15 Pitch mm			Ø20 fz mm/tooth	Ø20 Pitch mm			Ø25 fz mm/tooth	Ø25 Pitch mm		
P	Carbon steel 0.25%C	120	200	0.035	1.20	1.60	2.00	0.065	1.50	2.00	2.50	0.09	1.80	2.40	3.00
P	Carbon steel 0.45% C	120	200	0.035	1.20	1.60	2.00	0.065	1.50	2.00	2.50	0.09	1.80	2.40	3.00
P	Carbon steel 0.60%C	100	150	0.03	1.10	1.50	1.80	0.06	1.30	1.78	2.25	0.08	1.60	2.15	2.70
P	Low alloy steel	70	120	0.025	1.00	1.30	1.60	0.05	1.20	1.60	2.00	0.07	1.40	1.90	2.40
P	High alloy steel	60	90	0.025	1.00	1.30	1.60	0.05	1.20	1.60	2.00	0.07	1.40	1.90	2.40
M	Stainless steel	60	90	0.025	1.00	1.30	1.60	0.05	1.20	1.60	2.00	0.07	1.40	1.90	2.40
K	Cast iron	70	120	0.035	1.20	1.60	2.00	0.065	1.30	1.90	2.50	0.09	1.80	2.40	3.00
N	Al	345	500	0.035	1.80	2.00	2.20	0.065	2.20	2.98	3.75	0.09	2.70	3.60	4.30
N	Cu	200	400	0.035	1.40	1.90	2.20	0.065	1.80	2.40	3.00	0.09	2.10	2.85	3.60
S	Ni- alloy	20	28	0.0125	1.00	1.30	1.60	0.0225	1.20	1.60	2.00	0.03	1.40	1.90	2.40
S	Titanium	40	60	0.0125	1.00	1.30	1.60	0.0225	1.20	1.60	2.00	0.03	1.40	1.90	2.40
H	Hardened	60	90	0.025	1.00	1.30	1.60	0.05	1.20	1.60	2.00	0.07	1.40	1.90	2.40

Cutting Data

Suggestion Table			
Spindle Power	< 12 KW	12-20 KW	> 20 KW
Pitch	Lower Pitch	Median Pitch	Higher Pitch

▶ 00-99321-016-2030 / 00-99323-016-2030 >>

	Workpiece material	Vc m/min.		Ø20				Ø25				Ø30			
		99321	99323	fz mm/tooth	Pitch mm			fz mm/tooth	Pitch mm			fz mm/tooth	Pitch mm		
P	Carbon steel 0.25%C	120	200	0.04	1.80	2.40	3.00	0.08	2.10	2.80	3.50	0.105	2.40	3.20	4.00
P	Carbon steel 0.45% C	120	200	0.04	1.80	2.40	3.00	0.08	2.10	2.80	3.50	0.105	2.40	3.20	4.00
P	Carbon steel 0.60%C	100	150	0.035	1.60	2.15	2.70	0.07	1.90	2.55	3.20	0.09	2.10	2.85	3.60
P	Low alloy steel	70	120	0.03	1.40	1.90	2.40	0.065	1.60	2.20	2.80	0.08	1.90	2.55	3.20
P	High alloy steel	60	90	0.03	1.40	1.90	2.40	0.065	1.60	2.20	2.80	0.08	1.90	2.55	3.20
M	Stainless steel	60	90	0.03	1.40	1.90	2.40	0.065	1.60	2.20	2.80	0.08	1.90	2.55	3.20
K	Cast iron	70	120	0.04	1.80	2.40	3.00	0.08	2.10	2.80	3.50	0.105	2.40	3.20	4.00
N	Al	345	500	0.04	2.70	3.00	3.40	0.08	3.10	4.05	5.00	0.105	3.60	4.80	5.60
N	Cu	200	400	0.04	2.10	2.85	3.40	0.08	2.50	3.35	4.20	0.105	2.80	3.80	4.80
S	Ni- alloy	20	28	0.015	1.40	1.90	2.40	0.03	1.60	2.20	2.80	0.04	1.90	2.55	3.20
S	Titanium	40	60	0.015	1.40	1.90	2.40	0.03	1.60	2.20	2.80	0.04	1.90	2.55	3.20
H	Hardened	60	90	0.03	1.40	1.90	2.40	0.065	1.60	2.20	2.80	0.08	1.90	2.55	3.20

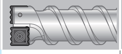
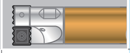
▶ 00-99321-020-2540 / 00-99323-020-2540 >>

	Workpiece material	Vc m/min.		Ø25				Ø32				Ø40			
		99321	99323	fz mm/tooth	Pitch mm			fz mm/tooth	Pitch mm			fz mm/tooth	Pitch mm		
P	Carbon steel 0.25%C	120	200	0.05	1.80	2.40	3.00	0.095	2.40	3.20	4.00	0.12	3.00	4.00	5.00
P	Carbon steel 0.45% C	120	200	0.05	1.80	2.40	3.00	0.095	2.40	3.20	4.00	0.12	3.00	4.00	5.00
P	Carbon steel 0.60%C	100	150	0.04	1.60	2.15	2.70	0.08	2.20	2.90	3.60	0.11	2.70	3.60	4.50
P	Low alloy steel	70	120	0.035	1.40	1.90	2.40	0.07	1.90	2.55	3.20	0.095	2.40	3.20	4.00
P	High alloy steel	60	90	0.035	1.40	1.90	2.40	0.07	1.90	2.55	3.20	0.095	2.40	3.20	4.00
M	Stainless steel	80	90	0.035	1.40	1.90	2.40	0.07	1.90	2.55	3.20	0.095	2.40	3.20	4.00
K	Cast iron	70	120	0.05	1.80	2.40	3.00	0.095	2.40	3.20	4.00	0.12	3.00	4.00	5.00
N	Al	345	500	0.05	2.70	3.00	3.40	0.095	3.60	4.80	6.00	0.12	4.50	6.00	7.50
N	Cu	200	400	0.05	2.10	2.85	3.40	0.095	2.90	3.85	4.80	0.12	3.60	4.80	6.00
S	Ni- alloy	40	50	0.02	1.40	1.90	2.40	0.035	1.90	2.55	3.20	0.045	2.40	3.20	4.00
S	Titanium	80	90	0.02	1.40	1.90	2.40	0.035	1.90	2.55	3.20	0.045	2.40	3.20	4.00
H	Hardened	80	90	0.035	1.40	1.90	2.40	0.07	1.90	2.55	3.20	0.095	2.40	3.20	4.00

Cutting Data

Suggestion Table			
Spindle Power	< 12 KW	12-20 KW	> 20 KW
Pitch	Lower Pitch	Median Pitch	Higher Pitch

▶ 00-99321-025-3050 / 00-99323-025-3050 >>

	Workpiece material	Vc m/min. 99321 	Vc m/min. 99323 	Ø30 fz mm/tooth	Ø30 Pitch mm			Ø40 fz mm/tooth	Ø40 Pitch mm			Ø50 fz mm/tooth	Ø50 Pitch mm		
P	Carbon steel 0.25%C	120	200	0.055	2.40	3.00	3.40	0.12	3.00	4.00	5.00	0.135	3.60	4.80	6.00
P	Carbon steel 0.45% C	120	200	0.055	2.40	3.00	3.40	0.12	3.00	4.00	5.00	0.135	3.60	4.80	6.00
P	Carbon steel 0.60%C	100	150	0.05	2.20	2.90	3.40	0.10	2.70	3.60	4.50	0.12	3.20	4.30	5.40
P	Low alloy steel	70	120	0.04	1.90	2.55	3.20	0.09	2.40	3.20	4.00	0.11	2.90	3.85	4.80
P	High alloy steel	60	90	0.04	1.90	2.55	3.20	0.09	2.40	3.20	4.00	0.11	2.90	3.85	4.80
M	Stainless steel	60	90	0.04	1.90	2.55	3.20	0.09	2.40	3.20	4.00	0.11	2.90	3.85	4.80
K	Cast iron	70	120	0.055	2.40	3.00	3.40	0.115	3.00	4.00	5.00	0.135	3.60	4.80	6.00
N	Al	345	500	0.055	2.50	3.00	3.40	0.115	4.50	6.00	7.50	0.135	5.40	7.20	9.00
N	Cu	200	400	0.055	2.50	3.00	3.40	0.115	3.60	4.80	6.00	0.135	4.30	5.75	7.20
S	Ni- alloy	20	28	0.02	1.90	2.55	3.20	0.045	2.40	3.20	4.00	0.055	2.90	3.85	4.80
S	Titanium	40	60	0.02	1.90	2.55	3.20	0.045	2.40	3.20	4.00	0.055	2.90	3.85	4.80
H	Hardened	60	90	0.04	1.90	2.55	3.20	0.09	2.40	3.20	4.00	0.11	2.90	3.85	4.80

▶ 00-99321-025-4265 >>

	Workpiece material	Vc m/min. 99321 	Ø42 fz mm/tooth	Ø42 Pitch mm			Ø55 fz mm/tooth	Ø55 Pitch mm			Ø65 fz mm/tooth	Ø65 Pitch mm		
P	Carbon steel 0.25%C	200	0.08	3.00	3.60	4.40	0.12	3.30	4.40	5.50	0.135	3.60	4.80	6.00
P	Carbon steel 0.45% C	150	0.08	3.00	3.60	4.40	0.12	3.30	4.40	5.50	0.135	3.60	4.80	6.00
P	Carbon steel 0.60%C	130	0.075	2.70	3.60	4.40	0.11	3.00	4.00	5.00	0.12	3.20	4.30	5.40
P	Low alloy steel	120	0.065	2.40	3.20	4.00	0.095	2.60	3.50	4.40	0.11	2.90	3.85	4.80
P	High alloy steel	90	0.065	2.40	3.20	4.00	0.095	2.60	3.50	4.40	0.11	2.90	3.85	4.80
M	Stainless steel	90	0.065	2.40	3.20	4.00	0.095	2.60	3.50	4.40	0.11	2.90	3.85	4.80
K	Cast iron	120	0.08	3.00	3.60	4.40	0.12	3.30	4.40	5.50	0.135	3.60	4.80	6.00
N	Al	500	0.08	4.00	4.20	4.40	0.12	4.90	6.55	8.20	0.135	5.40	7.20	9.00
N	Cu	200	0.08	3.60	4.00	4.40	0.12	4.00	5.30	6.60	0.135	4.30	5.75	7.20
S	Ni- alloy	28	0.03	2.40	3.20	4.00	0.045	2.60	3.50	4.40	0.055	2.90	3.85	4.80
S	Titanium	90	0.03	2.40	3.20	4.00	0.045	2.60	3.50	4.40	0.055	2.90	3.85	4.80
H	Hardened	90	0.065	2.40	3.20	4.00	0.095	2.60	3.50	4.40	0.11	2.90	3.85	4.80

Application Example

▶ Special insert geometry is able to cut different materials>>

- Serrated cutting edge makes the chips short and small, and easier to evacuate.
- Recommended for almost all material types, good for drilling material that generates long, soft chips.

Example 1

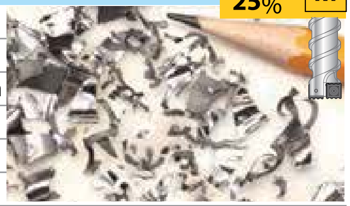
BT40, 22.5KW | Hole size: Ø25 x 50L mm | Tool: 00-99321-016-2030

Material: SAE8620 — Load 25% — P

Vc	=	120	m/min.
S	=	2250	r.p.m.
fz	=	0.08	mm/tooth
F	=	360	mm/min
P	=	5.6	mm
T	=	40	sec.

Material: SUS304 (Stainless steel 304) — Load 25% — M

Vc	=	80	m/min.
S	=	1500	r.p.m.
fz	=	0.04	mm/tooth
F	=	120	mm/min
P	=	5.6	mm
T	=	118	sec.

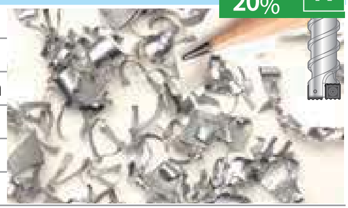


Material: C1100 — Load 25% — N

Vc	=	200	m/min.
S	=	3750	r.p.m.
fz	=	0.08	mm/tooth
F	=	600	mm/min
P	=	5.6	mm
T	=	23	sec.

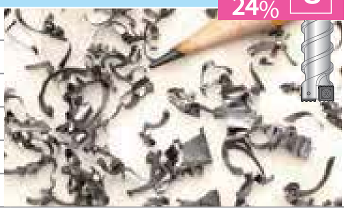
Material: AL6061T6 — Load 20% — N

Vc	=	345	m/min.
S	=	6500	r.p.m.
fz	=	0.10	mm/tooth
F	=	1300	mm/min
P	=	5.6	mm
T	=	11	sec.



Material: TiAl6V4 — Load 24% — S

Vc	=	80	m/min.
S	=	1500	r.p.m.
fz	=	0.04	mm/tooth
F	=	120	mm/min
P	=	5.6	mm
T	=	118	sec.



Material: Inconel 718 (Drill with internal coolant) — Load 24% — S

Vc	=	40	m/min.
S	=	750	r.p.m.
fz	=	0.15	mm/tooth
F	=	225	mm/min
P	=	2.0	mm
T	=	177	sec.

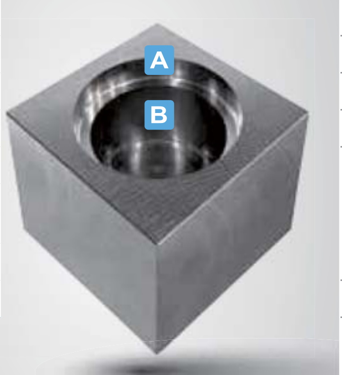
▶ Suggested insert grades for best result >>

Example 2

Diameter (mm)		25		
Depth (mm)		50		
Tool (Dc=17mm)		00-99321-016-2030 (external coolant)		
		P Carbon Steel	M Stainless Steel	H Tool Steel
Material	DIN	C45E	X5CrNi18-10	X40CrMoV5 1
	SAE	1045	304	H13
	JIS	S45C	SUS304	SKD61 (HRC50°)
Insert Grade		**NC5072** (P40, TiAlN)	**NC5072** (P40, TiAlN)	**NC2032** (K20F, TiAlN)
No. of Edges		2	2	2
Vc = (m/min.)		120	60	80
S = r.p.m.		2250	1120	1500
fz = (mm/tooth)		0.1	0.065	0.05
F = (mm/min.)		450	146	150
Pitch = (mm)		5.6	3	3
Machine Load = % (BT40, 22.5KW)		35%	20%	20%
Tool Life (hole)		150	108	18
Chip Removal Volume (cm³/min.)		52.66	8.55	8.77

▶ To produce step hole Ø53.5 & Ø45 by one tool >>

Example 3

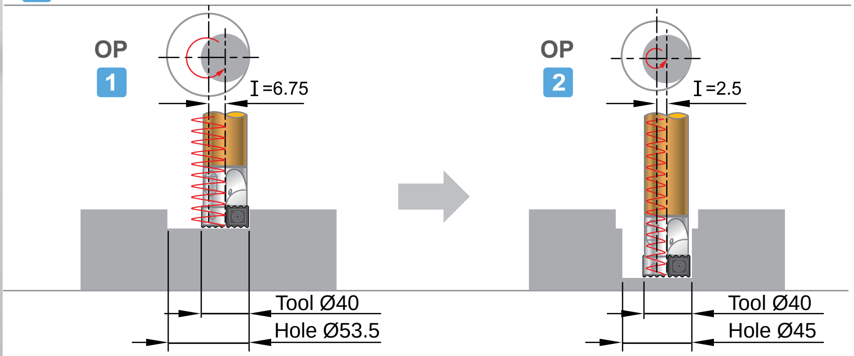


Application

- Hydraulic port for plug-in valve cylinders, counterbore for bolt, and more!

Material	S50C (JIS). High carbon steel
Tool	99323-LS32-HD40 (Non-standard size)
Insert	N9MX12T308-NC2032
Machine	BT40, 22.5 KW
Coolant	Internal

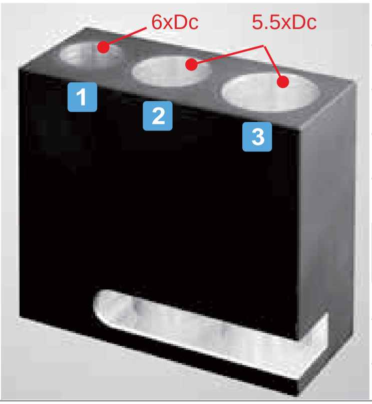
Hole	Dc mm	D mm	L mm	Vc m/min.	S r.p.m.	fz mm/tooth	F mm/min.	I mm	P mm	T sec.
A	Ø40	Ø53.5	10	300	2400	0.08	380	6.75	5.0	13.3
B		Ø45.0	32	300	2400	0.08	380	2.5	2.0	39.48



▶ **Just one "NC Helix Drill" can machine different diameters and hole depths.**

▶ Just one tool to drill different diameters and hole depth, possible up to 6xDc >>

Example 4



Material	AL6061T6
Tool	00-99323-016-2030
Insert	N9MX070204-NC5072
Machine	HAAS VM-3, BT40, 22.5KW (η=1)
Coolant	Internal coolant

Fig.	Dc mm	D mm	I mm	L mm	Vc m/min.	S r.p.m.	fz mm/tooth	fcut mm/tooth	F mm/min.	P mm	α deg
1	Ø17	20	1.5	100	500	9360	0.04	0.058	1090	3	17.67
2		25	4	95	500	9360	0.08	0.103	1930	4.5	10.16
3		30	6.5	95	500	9360	0.105	0.131	2450	5.6	7.81

▶ Low spindle power is not a problem! BT30 machine, Ø30 hole diameter, 3.3xDc drill depth >>

The main purpose of this example is to improve machining efficiency.

Example 5

Maximum drilling capacity of the 5.5 kw spindle is Ø16 mm

Material	S50C (JIS), High carbon steel
Tool	00-99321-020-2540 / BC20-HD22-2540
Insert	N9MX100306-NC2032
Machine	BT30, 5.5 KW (η =0.7)
Coolant	External coolant

Dc mm	D mm	L mm	Vc m/min.	S r.p.m.	fz mm/tooth	fcut mm/tooth	F mm/min.	I mm	P mm	T sec.
Ø22	Ø30	60	200	* 2893	0.12	0.1	600	4	2.8	62

* 3000 r.p.m. is used.

▶ **Calculation:**

$$fcut = 0.12 \times 0.7\left(\sqrt[3]{1 + \frac{2.8}{4}}\right) = 0.1 \text{ mm/tooth}$$

* calculation formula please refer to p 2-8

One tool performs multiple patterns >> (this is only programming example, no refer to cutting parameters)

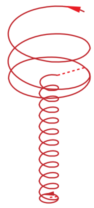
Example 6

Material	AL6061T6
Tool	00-99323-016-2030 M08-HD17-2030
Insert	N9MX070204-NC5072
Machine	HAAS VM-3, BT40, 22.5KW (η =1)
Coolant	Internal

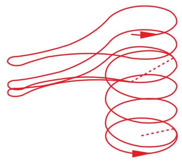
Fig.	Dc mm	Vc m/min.	S r.p.m.	fz mm/tooth	F mm/min.	P mm	T sec.
1	Ø17	200	3800	0.075	570	4	67
2		200	3800	0.075	570	4	95
3		200	3800	0.075	570	4	80

Tool Path

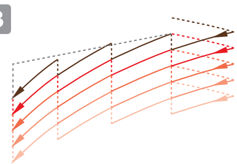
1



2



3



```
%
G40 G80 G69
G28 G91 Z0
G28 G91 X0 Y0
G00 G90
G126
G00 G90 X0. Y0.
G52 X18. Y-20.
G00 G90 X0. Y0.
T5
M06
#1= 6.5 (X1)
#11= -6.5 (X1=-I)
#6= 1.5 (X2)
#7= -1.5 (X2=-I)
#2= 0. (Y)
#3= 2.0 (Z1-1)
#13= -2.0 (Z1-2)
#16= -10.0 (Z1-1)
#17= -12.0 (Z1-2)
#4= 190.0 (F1-1)
#5= 570.0 (F1-2)
#14= 190.0 (F1-1)
#15= 380.0 (F1-2)
#8= 3 (L1=Deepth/P#9)
#9= 4.0 (P1=Z#3-DOWN Pitch)
#18= 7 (L2=Deepth/P#9)
#19= 2.0 (P2=Z#16-DOWN Pitch)
M88
G00 G90 X#1 Y#2
S3800 M03
G43 H05 Z30. (M08)
Z10.
Z5.
G01 Z#3 F#4
M97 P1000 L#8
G03 I#11 F#4
G01 X#6 Y#2 (Holes 2)
M97 P2000 L#18
G03 I#7 F#14
G01 X0. Y0.
G00 G90 Z10. M05
G00 G90 Z20. M89
G00 G90 Z30. M09
G28 G91 Z0. M05
M00
G28 G91 Y0.
M30
N1000
G03 I#11 Z#13 F#5
#13= #13 - #9
M99
N2000
G03 I#7 Z#17 F#15
#17= #17 - #19
M99

%
```

```
%
G40 G80 G69
G28 G91 Z0
G28 G91 X0 Y0
G00 G90
G126
G00 G90 X0. Y0.
G52 X0. Y0.
G00 G90 X0. Y0.
T5
M06
#12= 1.0 (Z-UP)
#13= 0.0 (Z1)
#14= -1.512 (Z2)
#15= -2.608 (Z3)
#16= -2.904 (Z4)
#17= -4.0 (Z5-1) (Z2-1)
#4= 190.0 (F1)
#5= 570.0 (F2)
#7= -6.5 (X2=-I)
#18= -12.0 (Z2-2)
#19= 4.0 (P2=Z#17-DOWN
PITCH)
G00 G90 X25. Y-51.
M88
S3800 M03
G43 H05 Z30. (M08)
Z10.
G01 Z#12 F#4
M97 P1000 L2
G01 X35.757 Y-55.924 F#4
G03 X35.757 Y-46.076 R-6.5
G02 X15.537 Y-49.599 R20.
G03 X15.537 Y-52.401 R-1.5
G02 X35.757 Y-55.924 R20.
G01 X46.5 Y-51.
M97 P2000 L3
G03 I#7 F#4
G01 X40. Y-51.
G00 G90 Z10. M05
G00 G90 Z20. M89
G00 G90 Z30. M09
G28 G91 Z0. M05
M00
G28 G91 Y0.
M30

N1000
G01 X35.757 Y-55.924 Z#13
F#4
G03 X35.757 Y-46.076 R-6.5
Z#14 F#5
G02 X15.537 Y-49.599 R20. Z#15
G03 X15.537 Y-52.401 R-1.5 Z#16
G02 X35.757 Y-55.924 R20. Z#17

#13= #13 - 4.0
#14= #14 - 4.0
#15= #15 - 4.0
#16= #16 - 4.0
#17= #17 - 4.0
M99

N2000
G03 I#7 Z#18 F#5
#18= #18 - #19
M99

%
```

```
%
G40 G80 G69
G28 G91 Z0
G28 G91 X0 Y0
G00 G90
G126
G00 G90 X0. Y0.
G52 X0. Y0.
G00 G90 X0. Y0.
T5
M06
#1= 4.0 (Z up)
#2= 0.0 (Z1)
#3= -4.0 (Z2)
#4= 210.0 (F1)
#5= 420.0 (F2)
#6= 4.0 (Z#13-Pitch)
G00 G90 X92.56 Y-14.507
M88
S2800 M03
G43 H05 Z30. (M08)
Z10.
Z5.
M97 P1000 L5 (Z-Pitch)
G00 G90 Z30. M05
M09
M89
G28 G91 Z0. M05
M00
G28 G91 Y0.
M30

N1000

G00 G90 X92.56 Y-14.507
G01 Z#1 F#4
G02 X108.5 Y-20.416 Z#2 R72.
F#5
G03 X92.56 Y-14.507 Z#3 R72.
F#5
G01 Z#2
G03 X75.679 Y-12.5 Z#3 R72. F#5
G01 Z#2
G03 X58.798 Y-14.507 Z#3 R72.
F#5
G01 Z#2
G03 X42.858 Y-20.416 Z#3 R72.
F#5
G01 Z#2
G00 G90 Z5.
#1= #1 - #6 (Z up)
#2= #2 - #6 (Z1.)
#3= #3 - #6 (Z2.)
M99

%
```

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NC Helix Drill