NEW

MOLDINO
The Edge To Innovation

ER5HS-PN

End mill for adaptive milling

Enables high-efficiency machining in conjunction with adaptive milling tool paths!

MOLDINO Tool Engineering, Ltd.
New Product News | No.2301E-2 | 2023-11

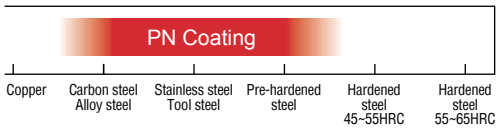
ER5HS-PN

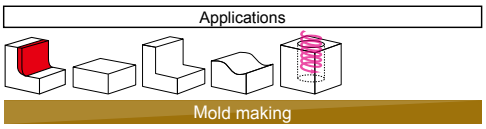
Another Option for Roughing

Reduced machining times and rationalized/downsized tool use

Ability to use a single tool for all roughing processes without high feed tools or tools for remaining allows rationalization of both processes and tools.

Watch machining video



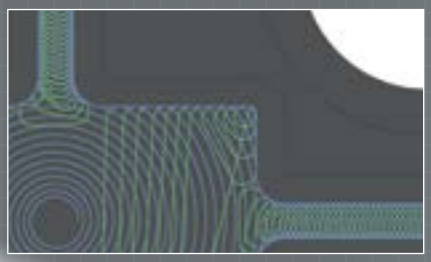


ER5HS-3.5DC-PN : ϕ6～ϕ20 [6 Items]

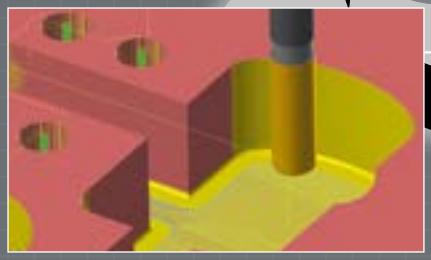
ER5HS-5DC-PN : ϕ6～ϕ20 [6 Items]

Base plate machining example: Work material: S50C carbon steel (250 mm × 200 mm × 30 mm)

Breaks the chips in fragments



Tool paths to minimize sudden load fluctuations



Maximum 3DC cutting depth

ER5HS-PN allows rationalization of multiple processes. High-efficiency machining is possible with a ϕ10 tool as with a ϕ20 high-feed tool.

Conventional machining
Contouring

Adaptive milling
(Adaptive milling tool path)

Roughing
High feed tool
ϕ20

n=2,710min^{-1} (*v*c=170m/min)
*v*f=8,130mm/min (*f*z=1.0mm/t)
*a*p=0.6mm *a*e=14.0mm *Q*=68cm^3/min

Remaining
Radius end mill
ϕ10

n=3,200min^{-1} (*v*c=100m/min)
*v*f=960mm/min (*f*z=0.075mm/t)
*a*p=10.0mm

Drilling
Drill
ϕ12 (for through hole)

n=3,200min^{-1} (*v*c=120m/min)
*v*f=700mm/min (*f*=0.22mm/rev)

3 processes using 3 tools
Actual machining time:
1 hour 8 minutes

Roughing
ER5HS-PN ϕ10

n=6,370min^{-1} (*v*c=200m/min)
*v*f=3,820mm/min (*f*z=0.12mm/t)
*a*p=25.0mm *a*e=1.0mm

***Q*=95cm^3/min**

ER5HS-PN

From roughing to helical milling completed in a single process using a single tool

1 process using 1 tool
Actual machining time:
33 minutes

Using a single ER5HS-PN ϕ10 tool reduces machining time by 52%.

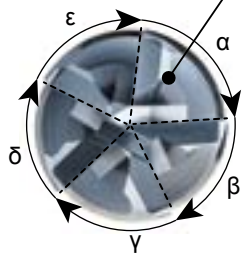
Features of ER5HS-PN

Three tool features required for adaptive milling

Minimizes chattering | **Reduces chip clogging** | **Minimizes edge chipping**

5 flutes & Unequal pitch ($\alpha \neq \beta \neq \gamma \neq \delta \neq \varepsilon$)

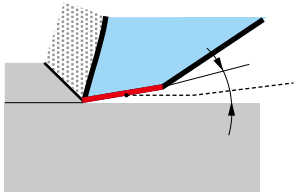
Vibration prevention Ensures consistent machining without chattering even under high-efficiency conditions.



Double relief profile

Vibration prevention

Small-angled relief face makes contact with work material to dampen vibrations.



Small angle relief face

Edge chipping resistance

Edge rigidity increased to minimize edge chipping even under high-efficiency conditions.

Chip breaker

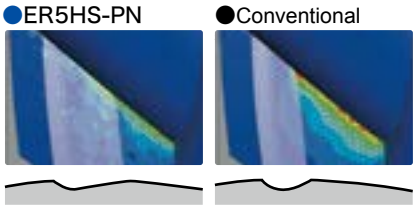
Chip discharge characteristics

Long chips are fragmented to reduce problems due to clogging, even in enclosed areas.

High-speed camera image

Edge chipping resistance

Original chip breaker profile disperses stress concentrations to minimize edge chipping.

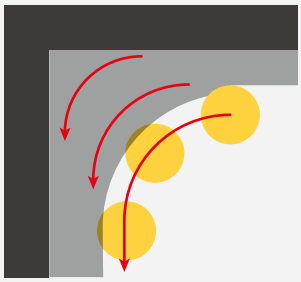


Comparison of machining methods

Adaptive milling tool paths with ER5HS-PN

Controlling radial cutting depth minimizes machining load.

Consistent machining



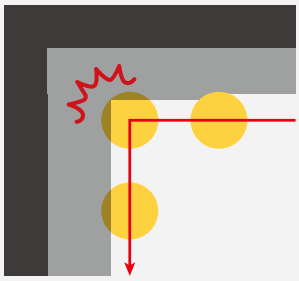
Using the entire tool flute length increases axial cutting depth.

Ultrahigh efficiency!

Contouring using conventional roughing tool

Machining load increases suddenly at corners or when starting touch on work.

Sudden tool damage



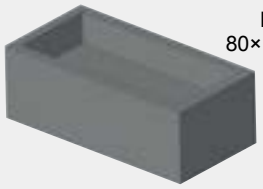
Since axial cutting depth is small, machining efficiency is maintained by high feed rate.

Field data

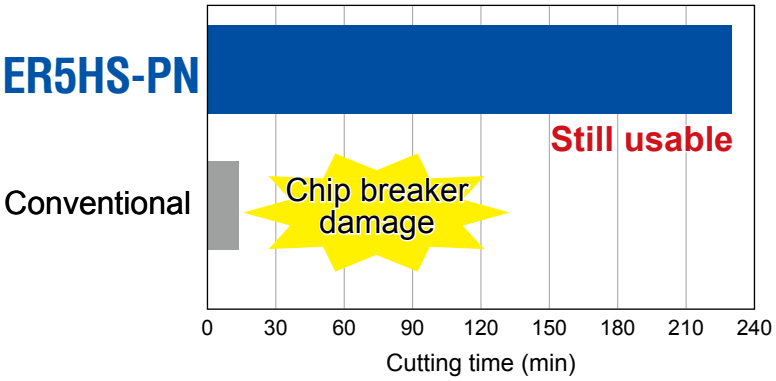
Pocketing

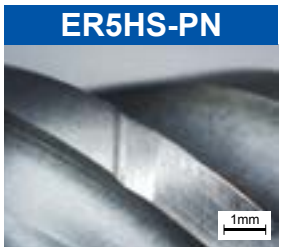
Work material：S50C　Machine：Vertical MC (BT40)
Coolant：Airblow　Overhang：40mm
Tool：ER5HS10-PN (ϕ10×5NT), Conventional (ϕ10×4NT)

Cutting conditions
n=4,775min^{-1} (v_c=150m/min)　v_f=2,865mm/min　$a_p \times a_e$=29×0.8mm　Q=66cm^3/min

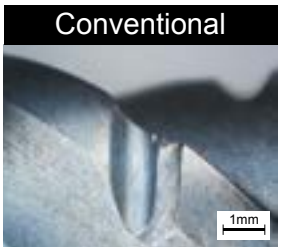


Pocket size
80×180×29mm





Chip breaker undamaged after 3 hours 50 minutes of machining

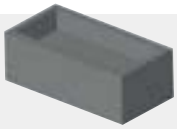


Chip breaker damaged after 14 minutes of machining

Capable of consistent machining over extended periods without suffering chip breaker damage.

Comparison of adaptive milling and contouring

Work material：S50C　Machine：Vertical MC (BT50)
Coolant：Airblow　Overhang：50mm
Tool：ER5HS10-50-PN (ϕ10×5NT), Conventional (ϕ10×4NT)



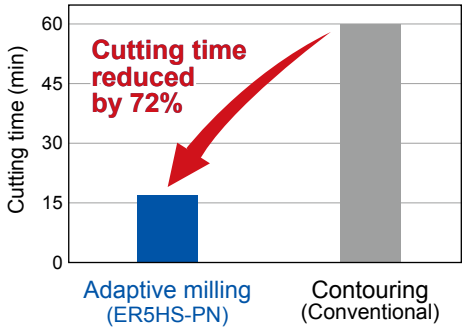
Pocket size
80×180×29mm

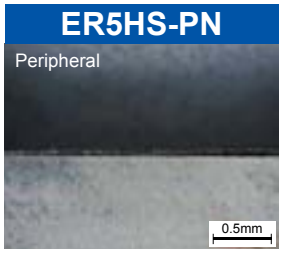
Cutting conditions：

Adaptive milling
n=4,775min^{-1} (v_c=150m/min)
v_f=2,865mm/min (f_z=0.12mm/t)
$a_p \times a_e$=29×0.5mm　Q=42cm^3/min

Contouring
n=2,400min^{-1} (v_c=75m/min)
v_f=6,720mm/min(f_z=0.09mm/t)
$a_p \times a_e$=0.6×3mm　Q=12cm^3/min

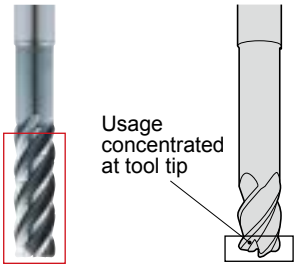
【Cutting time comparison for 1 pocket】





After 12 pockets (3 hours 24 minutes) machining

Adaptive milling (ER5HS-PN)　Contouring (Conventional)



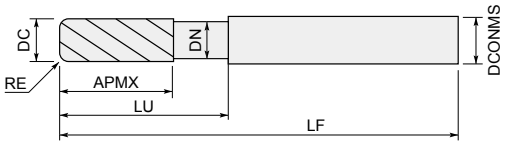
Relief face wear width after machining 4 pockets
0.35mm

Using the entire peripheral portion of flutes extends tool life.
➡ Minimizes wear.

Using the ER5HS-PN in conjunction with adaptive milling improves efficiency and tool life.

Line Up

Under neck 3.5DC type

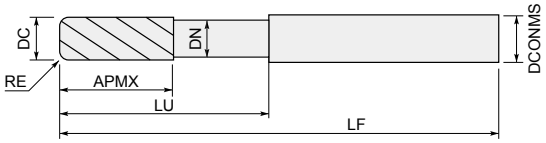


ER5HS○○-PN

Carbide PN Helix angle 40° 0 −0.015 (φ6) 0 −0.02 (φ8~φ20) h5 (φ6,8,10,12) h6 (φ16,20) Unequal Pitch

Item code	Stock	Size(mm)						
		Tool dia.	Corner radius	Flute length	Under neck length	Neck dia.	Overall length	Shank dia.
		DC	RE	APMX	LU	DN	LF	DCONMS
ER5HS06-PN	●	6	0.5	18	21	5.5	60	6
ER5HS08-PN	●	8	1.0	24	28	7.3	75	8
ER5HS10-PN	●	10	1.0	30	35	9.2	80	10
ER5HS12-PN	●	12	1.0	36	42	11	100	12
ER5HS16-PN	●	16	1.0	48	56	14.7	110	16
ER5HS20-PN	●	20	1.0	60	70	18.4	125	20

Under neck 5DC type



ER5HS○○-○○-PN

Carbide PN Helix angle 40° 0 −0.015 (φ6) 0 −0.02 (φ8~φ20) h5 (φ6,8,10,12) h6 (φ16,20) Unequal Pitch

Item code	Stock	Size(mm)						
		Tool dia.	Corner radius	Flute length	Under neck length	Neck dia.	Overall length	Shank dia.
		DC	RE	APMX	LU	DN	LF	DCONMS
ER5HS06-30-PN	●	6	0.5	18	30	5.5	70	6
ER5HS08-40-PN	●	8	1.0	24	40	7.3	80	8
ER5HS10-50-PN	●	10	1.0	30	50	9.2	100	10
ER5HS12-60-PN	●	12	1.0	36	60	11	120	12
ER5HS16-80-PN	●	16	1.0	48	80	14.7	135	16
ER5HS20-100-PN	●	20	1.0	60	100	18.4	155	20

● : Stocked items.

Regrinding compatibility range table

Item code	Product name	Line up tool dia. (mm)	Shape	Re-grinding compatibility range (mm)	
				Outer dia.	End
ER5HS-3.5DC-PN	End mill for adaptive milling -Under neck 3.5DC	6 ~20		6 ~20	6 ~20
ER5HS-5DC-PN	End mill for adaptive milling -Under neck 5DC	6 ~20		6 ~20	6 ~20

Recommended Cutting Conditions

Recommended cutting conditions

Work material	Carbon steels, Alloy steels (~30HRC)		Pre-hardened steels (30~40HRC)		Stainless steels	
Cutting speed	v_c=150m/min		v_c=100m/min		v_c=150m/min	
Depth of cut (mm)	a_p=3DC-1mm, a_e=0.08DC		a_p=3DC-1mm, a_e=0.08DC		a_p=3DC-1mm, a_e=0.06DC	
Tool dia.DC (mm)	Revolution n (min^{-1})	Feed rate v_f (mm/min)	Revolution n (min^{-1})	Feed rate v_f (mm/min)	Revolution n (min^{-1})	Feed rate v_f (mm/min)
6	7,960	3,980	5,310	2,655	7,960	3,180
8	5,970	2,985	3,980	1,990	5,970	2,390
10	4,775	2,865	3,185	1,910	4,775	2,390
12	3,980	2,390	2,660	1,600	3,980	1,990
16	2,990	1,500	1,990	1,000	2,990	1,200
20	2,390	1,200	1,600	800	2,390	960

Under neck 5DC cutting conditions (as percentage of recommended cutting conditions)

Work material	Carbon steels, Alloy steels (~30HRC)			Pre-hardened steels (30~40HRC)			Stainless steels		
Percentage	Revolution n (min^{-1})	Feed rate v_f (mm/min)	Radial depth of cut a_e (mm)	Revolution n (min^{-1})	Feed rate v_f (mm/min)	Radial depth of cut a_e (mm)	Revolution n (min^{-1})	Feed rate v_f (mm/min)	Radial depth of cut a_e (mm)
	100%	100%	60%	100%	50%	75%	100%	100%	50%

Adjust ap by referring to the recommended cutting conditions. Example of carbon steel : ϕ10 n=4,775min^{-1} v_f=2,865mm/min a_p=29mm a_e=0.48mm

High-speed cutting conditions (under neck 3.5DC only)

Work material	Carbon steels, Alloy steels (~30HRC)		Pre-hardened steels (30~40HRC)	
Cutting speed	v_c=200m/min		v_c=150m/min	
Depth of cut (mm)	a_p=3DC-1mm, a_e=0.08DC		a_p=3DC-1mm, a_e=0.08DC	
Tool dia.DC (mm)	Revolution n (min^{-1})	Feed rate v_f (mm/min)	Revolution n (min^{-1})	Feed rate v_f (mm/min)
6	10,610	5,300	7,960	3,980
8	7,960	4,000	5,970	2,985
10	6,370	3,820	4,775	2,865
12	5,310	3,190	3,980	2,390
16	3,980	2,000	2,990	1,500
20	3,185	1,600	2,390	1,200

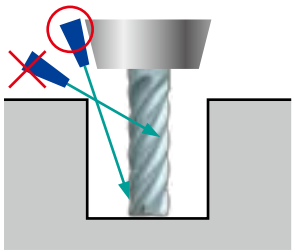
High-speed cutting is not recommended with stainless steel.

【Note】

① Use a highly rigid machine as possible.
※When using ϕ16 or larger tools, use a BT50-class or higher high-rigidity machine.
② Supply coolant from the holder end face (using a through-collet air supply, for example) when cutting work material with many enclosed areas.
③ Use the appropriate coolant for the work material and machining shape.
④ These Recommended Cutting Conditions indicate only the rule of a thumb for the cutting conditions. In actual machining, the condition should be adjusted according to the machining shape, purpose and the machine type.
⑤ If the rpm available is lower than that recommended please reduce the feed rate to the same ratio.
⑥ The recommended ramping angle for helical interpolation is 1°. Set the feed rate to between 50% and 60% of the values indicated above. Additionally, where this can be adjusted, set the rotation speed to around v_c = 100 m/min.

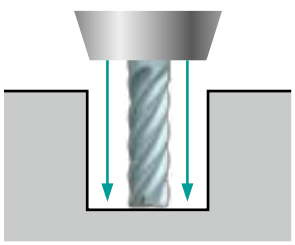
Coolant

Coolant nozzle



When using a coolant nozzle, arrange the coolant nozzle so that the coolant hits the end of the tool. Adjust the coolant pressure required to discharge the chips. Insufficient pressure may result in edge damage or tool breakage due to chip clogging.

End feed using through-collet supply



Using a through-collet coolant feed improves chip discharge and reduces edge damage and tool breakage.

MOLDINO

The Edge To Innovation

The diagrams and table data are examples of test results, and are not guaranteed values.
"MOLDINO" is a registered trademark of MOLDINO Tool Engineering, Ltd.

⚠ Attentions on Safety

1. Cautions regarding handling

(1) When removing the tool from its case (packaging), be careful that the tool does not pop out or is dropped. Be particularly careful regarding contact with the tool flutes.
(2) When handling tools with sharp cutting flutes, be careful not to touch the cutting flutes directly with your bare hands.

2. Cautions regarding mounting

(1) Before use, check the outside appearance of the tool for scratches, cracks, etc. and that it is firmly mounted in the collet chuck, etc.
(2) If abnormal chattering, etc. occurs during use, stop the machine immediately and remove the cause of the chattering.

3. Cautions during use

(1) Before use, confirm the dimensions and direction of rotation of the tool and milling work material.
(2) The numerical values in the standard cutting conditions table should be used as criteria when starting new work. The cutting conditions should be adjusted as appropriate when the cutting depth is large, the rigidity of the machine being used is low, or according to the conditions of the work material.
(3) Cutting tools are made of a hard material. During use, they may break and fly off. In addition, cutting chips may also fly off. Since there is a danger of injury to workers, fire, or eye damage from such flying pieces, a safety cover should be attached when work is performed and safety equipment such as safety goggles should be worn to create a safe environment for work.
(4) There is a risk of fire or inflammation due to sparks, heat due to breakage, and cutting chips. Do not use where there is a risk of fire or explosion. **Please caution of fire while using oil base coolant, fire prevention is necessary.**
(5) Do not use the tool for any purpose other than that for which it is intended.

4. Cautions regarding regrinding

(1) If regrinding is not performed at the proper time, there is a risk of the tool breaking. Replace the tool with one in good condition, or perform regrinding.
(2) Grinding dust will be created when regrinding a tool. When regrinding, be sure to attach a safety cover over the work area and wear safety clothes such as safety goggles, etc.
(3) This product contains the specified chemical substance cobalt and its inorganic compounds. When performing regrinding or similar processing, be sure to handle the processing in accordance with thelocal laws and regulations regarding prevention of hazards due to specified chemical substances.

MOLDINO Tool Engineering, Ltd.

Head Office
Hulic Ryogoku Bldg. 8F, 4-31-11, Ryogoku, Sumida-ku, Tokyo, Japan 130-0026
International Sales Dept. : TEL +81-3-6890-5103 FAX +81-3-6890-5128

Europe **MOLDINO Tool Engineering Europe GmbH**
Itterpark 12, 40724 Hilden,Germany.
Tel +49-(0)2103-24820 Fax +49-(0)2103-248230

America **MITSUBISHI MATERIALS U.S.A. CORPORATION**
DETROIT OFFICE Customer service
41700 Gardenbrook Road, Suite 120, Novi, MI 48375-1320 U.S.A.
Tel +1(248) 308-2620 Fax +1(248) 308-2627

Mexico **MMC METAL DE MEXICO, S.A. DE C.V.**
Av. La Cañada No.16, Parque Industrial Bernardo Quintana, El Marques, Querétaro, CP 76246, México
Tel +52-442-1926800

Brazil **MMC METAL DO BRASIL LTDA.**
Rua Cincinato Braga, 340 13° andar.Bela Vista – CEP 01333-010 São Paulo – SP ., Brasil
Tel +55(11)3506-5600 Fax +55(11)3506-5677

Thailand **MMC Hardmetal (Thailand) Co.,Ltd. MOLDINO Division**
622 Emporium Tower, Floor 22/1-4, Sukhumvit Road, Klong Tan, Klong Toei,
Bangkok 10110, Thailand
TEL:+66-(0)2-661-8175 FAX:+66-(0)2-661-8176

India **MMC Hardmetal India Pvt Ltd.**
H.O.: Prasad Enclave, #118/119, 1st Floor, 2nd Stage, 5th main, BBMP Ward #11, (New #38),
Industrial Suburb, Yeshwanthpura, Bengaluru, 560 022, Karnataka, India.
Tel +91-80-2204-3600

DISTRIBUTED BY:

Printed in JAPAN
2023-11 (K)
2023-1:FP