

**NEW**



# ***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-1 | 2023-4

# ER5HS-PN

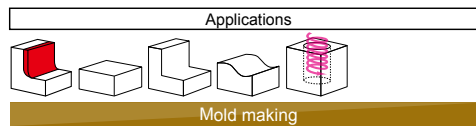
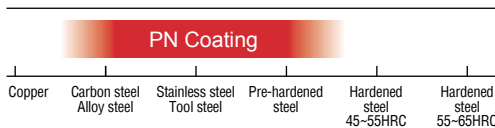
# Another Option for Roughing

## 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.



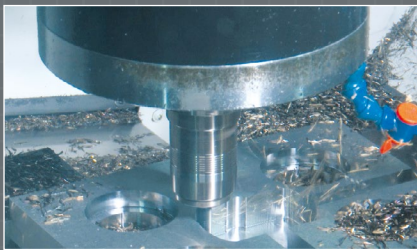
Watch machining video



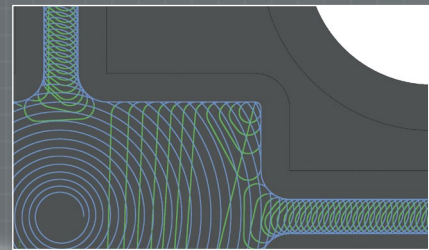
ER5HS-3.5DC-PN :  $\phi 6 \sim \phi 20$  [6 Items]

ER5HS-5DC-PN :  $\phi 6 \sim \phi 20$  [6 Items]

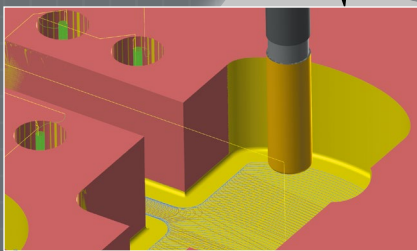
Base plate machining example: Work material: S50C carbon steel (250 mm × 200 mm × 30 mm)



Breaks the chips in fragments



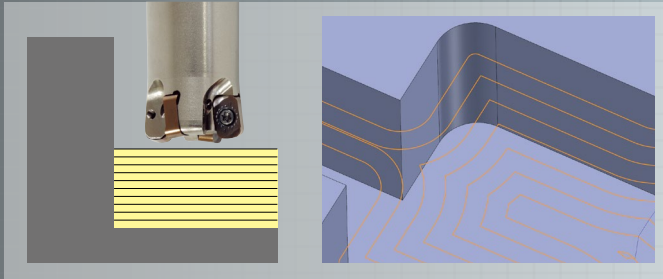
Tool paths to minimize sudden load fluctuations



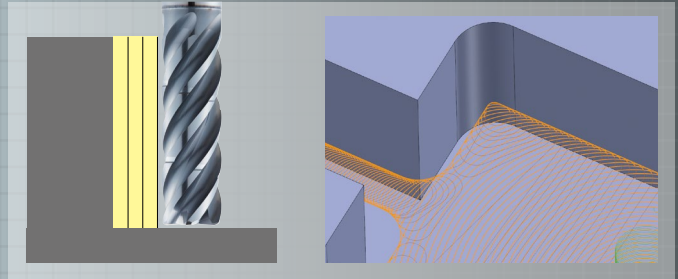
Maximum 3DC cutting depth

**ER5HS-PN allows rationalization of multiple processes. High-efficiency machining is possible with a  $\phi 10$  tool as with a  $\phi 20$  high-feed tool.**

## Conventional machining Contouring



## Adaptive milling (Adaptive milling tool path)



### Roughing

#### High feed tool φ20

$n=2,710\text{min}^{-1}$  ( $v_c=170\text{m/min}$ )  
 $v_f=8,130\text{mm/min}$  ( $f_z=1.0\text{mm/t}$ )  
 $a_p=0.6\text{mm}$   $a_e=14.0\text{mm}$   $Q=68\text{cm}^3/\text{min}$



### Roughing

#### ER5HS-PN φ10

$n=6,370\text{min}^{-1}$  ( $v_c=200\text{m/min}$ )  
 $v_f=3,820\text{mm/min}$  ( $f_z=0.12\text{mm/t}$ )  
 $a_p=25.0\text{mm}$   $a_e=1.0\text{mm}$

**Q=95cm<sup>3</sup>/min**

### Remaining

#### Radius end mill φ10

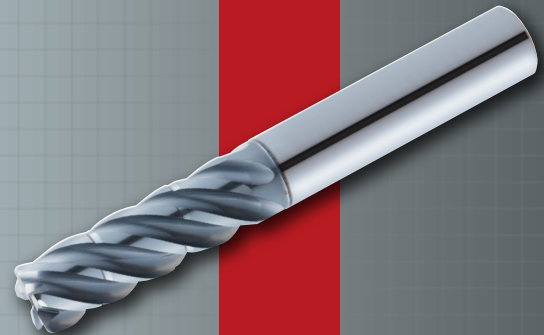
$n=3,200\text{min}^{-1}$  ( $v_c=100\text{m/min}$ )  
 $v_f=960\text{mm/min}$  ( $f_z=0.075\text{mm/t}$ )  
 $a_p=10.0\text{mm}$



### Drilling

#### Drill φ12 (for through hole)

$n=3,200\text{min}^{-1}$  ( $v_c=120\text{m/min}$ )  
 $v_f=700\text{mm/min}$  ( $f=0.22\text{mm/rev}$ )



### ER5HS-PN

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

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

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

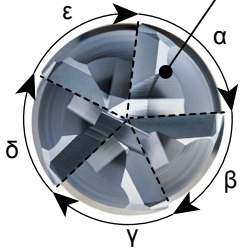
Reduces chip clogging

Minimizes edge chipping

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

**Vibration prevention**

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



Double relief profile

Chip breaker

**Vibration prevention**

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

**Edge chipping resistance**

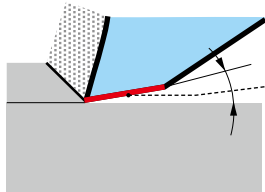
Edge rigidity increased to minimize edge chipping even under high-efficiency conditions.

**Chip discharge characteristics**

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

**Edge chipping resistance**

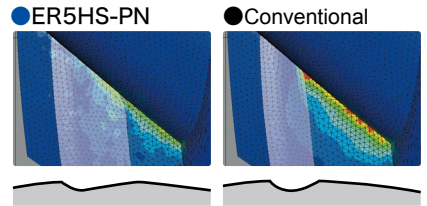
Original chip breaker profile disperses stress concentrations to minimize edge chipping.



Small angle relief face



High-speed camera image

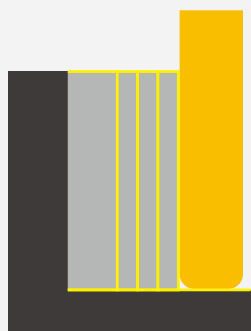
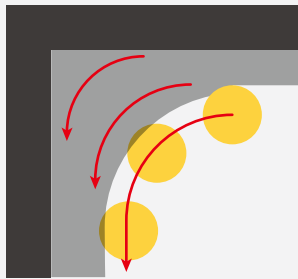


## Comparison of machining methods

### Adaptive milling tool paths with ER5HS-PN

Controlling radial cutting depth minimizes machining load.

Consistent machining



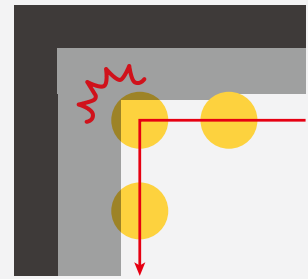
Using the entire tool flute length increases axial cutting depth.

Ultrahigh efficiency!

### Contouring using conventional roughing tool

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

Sudden tool damage

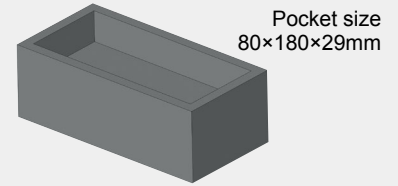


Since axial cutting depth is small, machining efficiency is maintained by high feed rate.

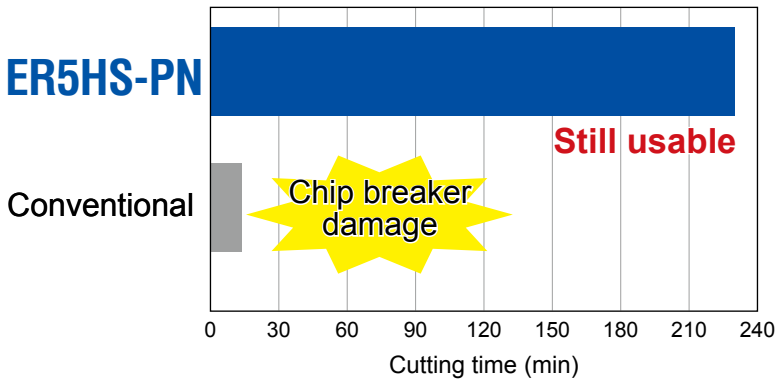
# Field data

## Pocketing

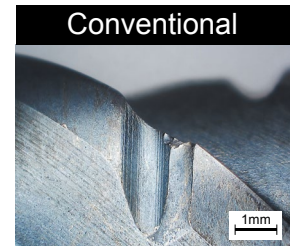
Work material : S50C Machine : Vertical MC (BT40)  
 Coolant : Airblow Overhang : 40mm  
 Tool : ER5HS10-PN ( $\phi 10 \times 5NT$ ), Conventional ( $\phi 10 \times 4NT$ )



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



Chip breaker undamaged after 3 hours 50 minutes of machining

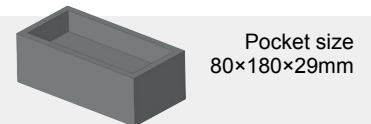


Chip breaker damaged after 14 minutes of machining

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 ( $\phi 10 \times 5NT$ ), Conventional ( $\phi 10 \times 4NT$ )



Cutting conditions :

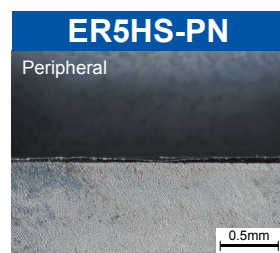
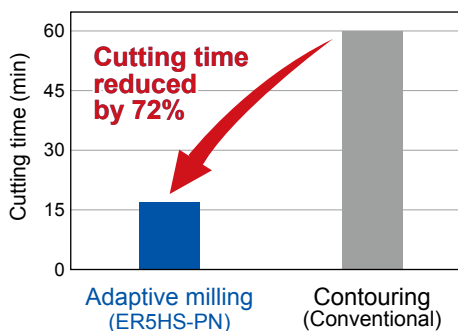
Adaptive milling  
 $n=4,775\text{min}^{-1}$  ( $v_c=150\text{m/min}$ )  
 $v_f=2,865\text{mm/min}$  ( $f_z=0.12\text{mm/t}$ )  
 $a_p \times a_e=29 \times 0.5\text{mm}$   $Q=42\text{cm}^3/\text{min}$



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



[Cutting time comparison for 1 pocket]



After 12 pockets (3 hours 24 minutes) machining

Adaptive milling (ER5HS-PN)



Using the entire peripheral portion of flutes extends tool life.

Contouring (Conventional)



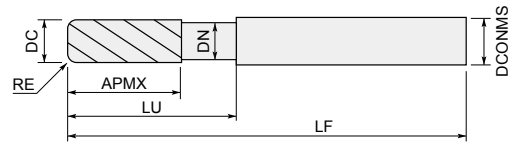
Relief face wear width after machining 4 pockets  
**0.35mm**

→ Minimizes wear.

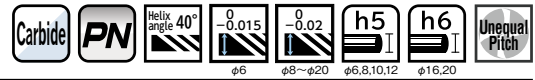
Using the ER5HS-PN in conjunction with adaptive milling improves efficiency and tool life.

# Line Up

## Under neck 3.5DC type

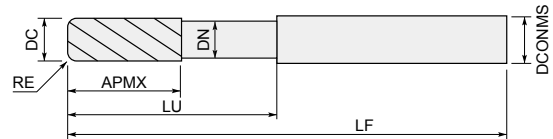


## ER5HS-3.5DC-PN

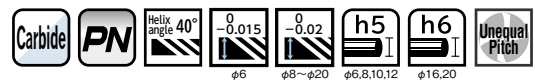


Item code	Stock	Size(mm)						
		Tool dia.	Corner radius	Flute length	Under neck length	Neck dia.	Overall length	Shank dia.
		DC	RE	APMX	LU	DN	LF	DCONMS
ER5HS06-PN	●	6	0.5	18	21	5.5	60	6
ER5HS08-PN	●	8	1.0	24	28	7.3	75	8
ER5HS10-PN	●	10	1.0	30	35	9.2	80	10
ER5HS12-PN	●	12	1.0	36	42	11	100	12
ER5HS16-PN	●	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-5DC-PN



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	$v_c=150\text{m/min}$		$v_c=100\text{m/min}$		$v_c=150\text{m/min}$	
Depth of cut (mm)	$a_p=3\text{DC}-1\text{mm}, a_e=0.08\text{DC}$		$a_p=3\text{DC}-1\text{mm}, a_e=0.08\text{DC}$		$a_p=3\text{DC}-1\text{mm}, a_e=0.06\text{DC}$	
Tool dia.DC (mm)	Revolution $n$ ( $\text{min}^{-1}$ )	Feed rate $v_f$ (mm/min)	Revolution $n$ ( $\text{min}^{-1}$ )	Feed rate $v_f$ (mm/min)	Revolution $n$ ( $\text{min}^{-1}$ )	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 $n$ ( $\text{min}^{-1}$ )	Feed rate $v_f$ (mm/min)	Radial depth of cut $a_e$ (mm)	Revolution $n$ ( $\text{min}^{-1}$ )	Feed rate $v_f$ (mm/min)	Radial depth of cut $a_e$ (mm)	Revolution $n$ ( $\text{min}^{-1}$ )	Feed rate $v_f$ (mm/min)	Radial depth of cut $a_e$ (mm)
	100%	100%	60%	100%	50%	75%	100%	100%	50%

Adjust  $a_p$  by referring to the recommended cutting conditions. Example of carbon steel :  $\phi 10$   $n=4,775\text{min}^{-1}$   $v_f=2,865\text{mm/min}$   $a_p=29\text{mm}$   $a_e=0.48\text{mm}$

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

Work material	Carbon steels, Alloy steels (~30HRC)		Pre-hardened steels (30~40HRC)	
Cutting speed	$v_c=200\text{m/min}$		$v_c=150\text{m/min}$	
Depth of cut (mm)	$a_p=3\text{DC}-1\text{mm}, a_e=0.08\text{DC}$		$a_p=3\text{DC}-1\text{mm}, a_e=0.08\text{DC}$	
Tool dia.DC (mm)	Revolution $n$ ( $\text{min}^{-1}$ )	Feed rate $v_f$ (mm/min)	Revolution $n$ ( $\text{min}^{-1}$ )	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

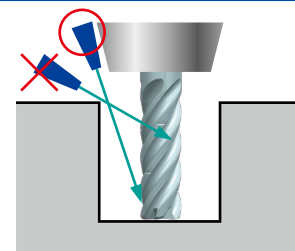
High-speed cutting is not recommended with stainless steel.

### [Note]

- Use a highly rigid machine as possible.  
※When using  $\phi 16$  or larger tools, use a BT50-class or higher high-rigidity machine.
- Supply coolant from the holder end face (using a through-collet air supply, for example) when cutting work material with many enclosed areas.
- Use the appropriate coolant for the work material and machining shape.
- 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.
- If the rpm available is lower than that recommended please reduce the feed rate to the same ratio.
- The recommended ramping angle for helical interpolation is  $1^\circ$ . 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.

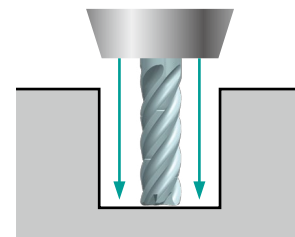
## Coolant

### 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.



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 the local laws and regulations regarding prevention of hazards due to specified chemical substances.

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