

# IABPFN/ABPFN



## High Precision Indexable Ball End Mills for Enhanced Efficiency



SHANK  
STYLE



MODULAR  
STYLE



### FEATURES

High helix shape on inserts reduces chattering and improved surface finish

Set up R accuracy of  $\pm 0.01\text{mm}$  (Insert R accuracy  $\pm 0.005\text{mm}$ )

Multiple coating grades for machining a variety of materials

Carbide and steel shank tools are available

# IABPFN/ABPFN

## Features



## INTRODUCTION

The IABPFN/ABPFN High Precision Indexable Balls End Mills are ideal for high precision finishing in a wide range of materials. With a set up tool R accuracy of  $\pm 0.01\text{mm}$  and insert R accuracy of  $\pm 0.005\text{mm}$  with a high helix shape on the inserts, chattering is reduced and improved surface finishes are delivered.



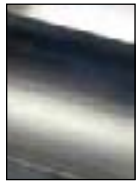
## FEATURES

### 1. The Effect of High Helix Insert Edge Shape



#### Typical Convention Problem

Chattering happens frequently while cutting a curved shape or similar. The greater the cutting force, the more the chattering which makes cutting marks on the work surface.



#### Reduced Cutting Force

The high helix edge shape suppresses rapid growth of cutting force. This relieves chattering and improves surface finish.

- Improved cutting surface finish.
- Less chattering on corner.

#### Improved Tool Life

Less cutting force reduces chipping due to wear and impact, and tool life is improved.

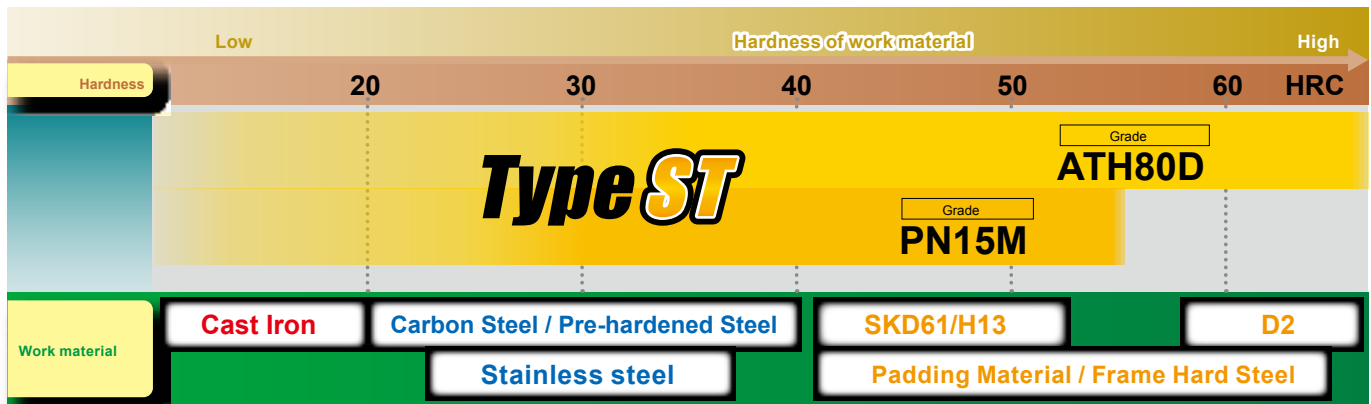


**LESS POST PROCESSING TIME RESULTS IN**

**COST REDUCTION**

**TIME SAVINGS**

### 2. Recommended Coating Grade Map

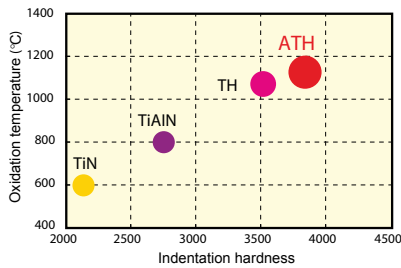


### 3. New PVD Nano Technology

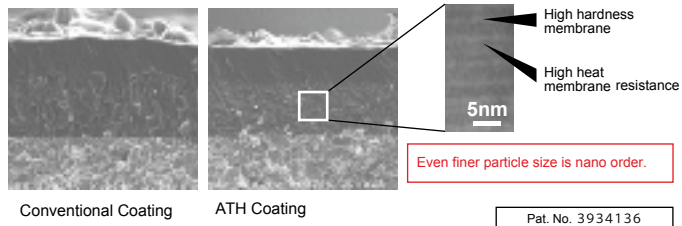
**Advanced TH (ATH) Coating:** The multi-layer structure provides improved adhesion strength, film hardness, and oxidation resistance.

**Strengths:** Shows an extraordinary performance for high speed cutting and highly efficient machining of hardened steels and pre-hardened steels (machining efficiency is double).

- Hardened steels (45HRC-65HRC); D2, H13, HSS, 420 Stainless Steel etc.
- Pre-hardened steels: CENA1, HPM-MAGIC, NAK80, etc.



Cross-section photograph of ATH coating layer structure



Pat. No. 3934136

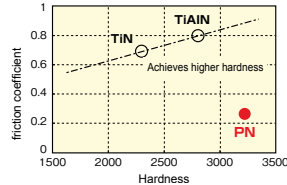
**PN Coating:** Industry's first multi-layer structure provides improved adhesion and surface hardness as well as improving the oxidation-resistance temperature. PN Coating improves the friction coefficient, reduces generation of heat while cutting.

**Strengths:** Exhibits stable tool life in cutting materials such as plastic injection molds etc. where tool seizure often occurs. Achieves longer tool life in cutting prehardened steel such as carbon steel, alloy steel, stainless steel, hot and cold tool steel, etc. PN15M adopts micro-grain substrate and PN coating. Improves the cutting performance for overhand cutting.

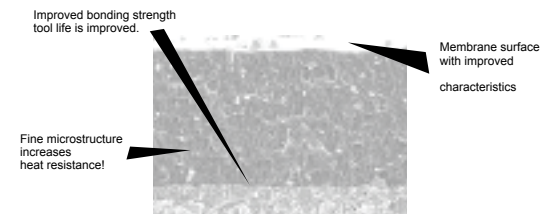
Comparison of Characteristics

Characteristics	Conventional	PN
Hardness	2800HV	3200HV
Friction coefficient	0,4	<0,3
Oxidation temperature	800°C	1100°C

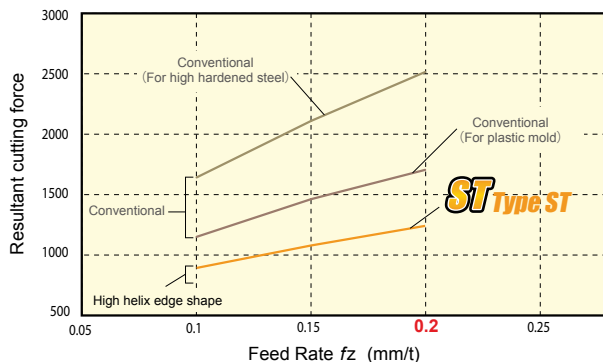
Friction Coefficient and Hardness of Coating



Cross-sectional structure and characteristics of PN coating membrane



### 4. Cutting Performance



#### Cutting Conditions

Work Material = Carbon Steel (220HB)

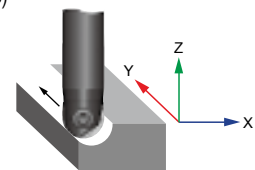
Cutter = Diameter  $\phi 30$

$V_c = 200\text{m/min}$

$f_z = 0.1, 0.15, 0.2\text{mm/t}$

Axial Depth of Cut ( $a_p$ ) = 15mm

Radial Depth of Cut ( $a_e$ ) = 0.5mm

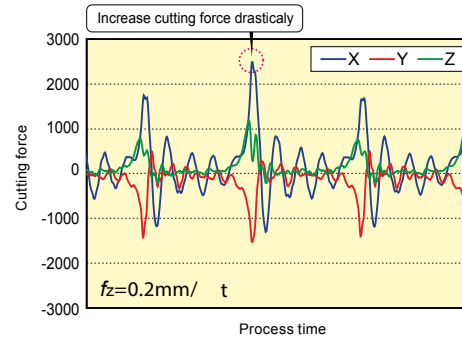
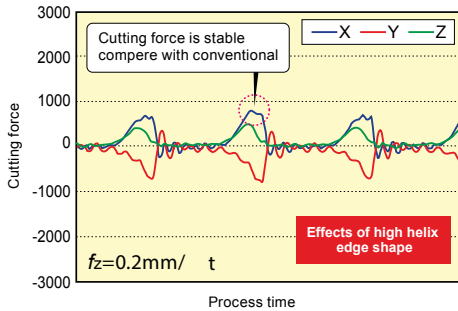


### Type ST

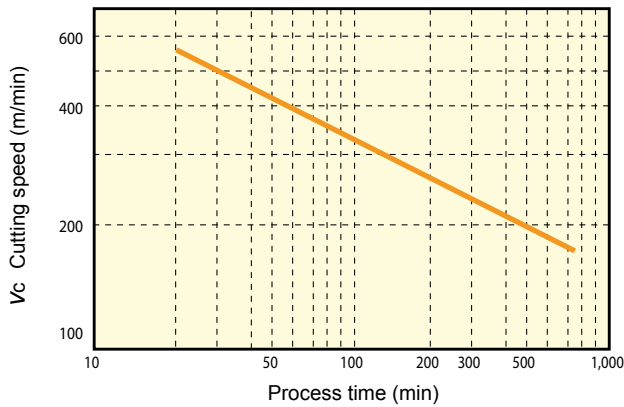
High Helix edge shape



Conventional (For high hardness)

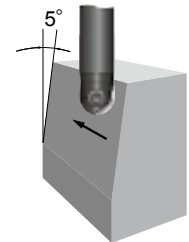


### 5. Field Data



#### Cutting Conditions

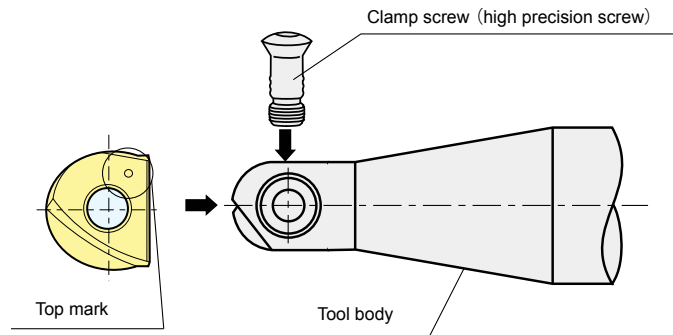
- Work Material = D2 (60HRC)
- Tool = ABPF30S32WL150
- Insert = ZDFG300-ST (ATH80D)
- Overhang = 150mm
- Feed Rate  $f_z = 0.3 \text{ mm/t}$
- Radial Depth of Cut  $a_{pxae} = 0.3 \times 0.1 \text{ mm}$
- Machine Vertical Type = BT50
- Cutting Shape = Contouring cutting on the sloped face  $5^\circ$



### 6. Insert Installation

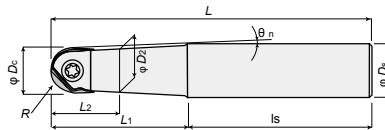
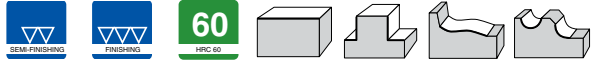
To meet the specification for precision of  $\pm 0.01 \text{ mm}$ , please follow this procedure:

1. Clean the insert seat: Using air-blow or alike, clean the seat.
2. Put in the insert with its top positioned to the screw-tightening side of the tool body.
3. Tighten the clamp screw with the special wrench. Please do not press down on the insert during this tightening process.
4. This is the end of insert set-up.

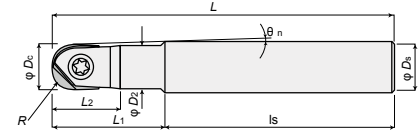


# IABPFN/ABPFN

## Shank Style Inch



Type A (Taper Neck)

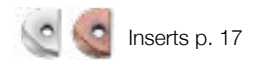


Type B (Straight Neck)

D ±0.01mm

### ABPFN-Inch (Shank Style)

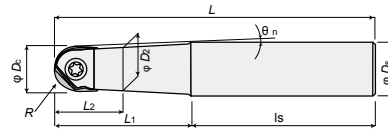
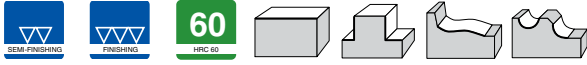
	Part No.	øDc	R	L	øDs	L2	L1	øD2	Is	θn	Type	Insert
Steel Shank	IABPFN04S06-4-1.25	0.250	0.125	4.0	0.375	0.591	1.250	0.213	2.750	3.18°	A	IZDFG040N-ST
	IABPFN05S08-4-1.25	0.313	0.156	4.0	0.500	0.591	1.250	0.295	2.750	4.87°	A	IZDFG050N-ST
	IABPFN06S06-4-1.25	0.375	0.188	4.0	0.375	0.709	1.250	0.354	2.750	-	B	IZDFG060N-ST
	IABPFN08S08-6-3	0.500	0.250	6.0	0.500	0.827	3.000	0.453	3.000	-	B	IZDFG080N-ST
	IABPFN10S10-6-3	0.625	0.313	6.0	0.625	1.063	3.000	0.583	3.000	-	B	IZDFG100N-ST
	IABPFN12S12-6-3	0.750	0.375	6.0	0.750	1.378	3.000	0.709	3.000	-	B	IZDFG120N-ST
	IABPFN16S16-6-3	1.000	0.500	6.0	1.000	1.693	3.000	0.945	3.000	-	B	IZDFG160N-ST
Carbide Shank	IABPFN04S04W-3.5-1	0.250	0.125	3.5	0.250	-	1.000	0.217	2.500	-	B	IZDFG040N-ST
	IABPFN04S06W-4-2	0.250	0.125	4.0	0.375	0.406	2.000	0.217	2.000	-	B	IZDFG040N-ST
	IABPFN05S05W-4-1.5	0.313	0.156	4.0	0.313	-	1.500	0.295	2.500	-	B	IZDFG050N-ST
	IABPFN05S08W-4-2	0.313	0.156	4.0	0.500	0.591	2.000	0.295	2.000	-	B	IZDFG050N-ST
	IABPFN06S06W-4-1.5	0.375	0.188	4.0	0.375	-	1.500	0.354	2.500	-	B	IZDFG060N-ST
	IABPFN06S08W-4-2	0.375	0.188	4.0	0.500	0.709	2.000	0.354	2.000	-	B	IZDFG060N-ST
	IABPFN08S08W-5-2	0.500	0.250	5.0	0.500	-	2.000	0.453	3.000	-	B	IZDFG080N-ST
	IABPFN08S10W-6-3	0.500	0.250	6.0	0.625	0.827	3.000	0.453	3.000	-	B	IZDFG080N-ST
	IABPFN10S10W-6-3	0.625	0.313	6.0	0.625	1.063	3.000	0.583	3.000	-	B	IZDFG100N-ST
	IABPFN12S12W-6-3	0.750	0.375	6.0	0.750	1.378	3.000	0.709	3.000	-	B	IZDFG120N-ST
	IABPFN12S12W-8-4	0.750	0.375	8.0	0.750	1.378	4.000	0.709	4.000	-	B	IZDFG120N-ST
	IABPFN16S16W-8-4	1.000	0.500	8.0	1.000	1.693	4.000	0.945	4.000	-	B	IZDFG160N-ST



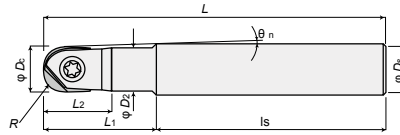
Inserts p. 17

# IABPFN/ABPFN

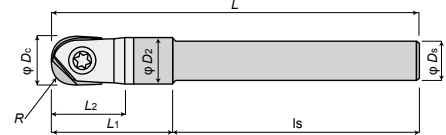
## Shank Style Metric



Type A (Taper Neck)



Type B (Straight Neck)



Type C

D ±0.01mm

### ABPFN-Metric (Shank Style)

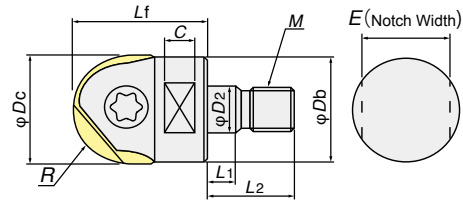
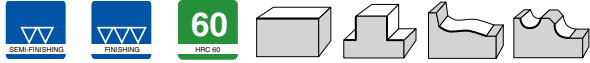
Part No.	øDc	R	L	øDs	L2	L1	øD2	Is	θn	Type	Insert	
Steel Shank	ABPFN06S08-90-30	6	3.0	90	8	15.0	30	5.4	60	2.12	A	ZDFG06N-ST
	ABPFN06S06-100-50	6	3.0	100	6	10.3	50	5.5	50	-	B	ZDFG06N-ST
	ABPFN08S10-100-30	8	4.0	100	10	15.0	30	7.5	70	2.20	A	ZDFG08N-ST
	ABPFN10S10-100-30	10	5.0	100	10	18.0	30	9.0	70	-	B	ZDFG10N-ST
	ABPFN12S12-110-40	12	6.0	110	12	21.0	40	11.5	70	-	B	ZDFG12N-ST
	ABPFN12S12-150-75	12	6.0	150	12	21.0	75	11.5	75	-	B	ZDFG12N-ST
	ABPFN16S16-130-50	16	8.0	130	16	27.0	50	14.8	80	-	B	ZDFG16N-ST
	ABPFN20S20-140-60	20	10.0	140	20	35.0	60	18.0	80	-	B	ZDFG20N-ST
	ABPFN25S25-150-75	25	12.5	150	25	43.0	75	24.0	75	-	B	ZDFG25N-ST
Carbide Shank	ABPFN06S06W-75-25	6	3.0	75	6	10.3	25	5.5	50	-	B	ZDFG06N-ST
	ABPFN06S06W-100-50	6	3.0	100	6	10.3	50	5.5	50	-	B	ZDFG06N-ST
	ABPFN08S08W-90-25	8	4.0	90	8	25.0	25	7.5	65	-	B	ZDFG08N-ST
	ABPFN08S08W-140-75	8	4.0	140	8	75.0	75	7.5	65	-	B	ZDFG08N-ST
	ABPFN10S10W-100-35	10	5.0	100	10	18.0	35	9.0	65	-	B	ZDFG10N-ST
	ABPFN10S10W-140-75	10	5.0	140	10	18.0	75	9.0	65	-	B	ZDFG10N-ST
	ABPFN12S12W-105-40	12	6.0	105	12	21.0	40	11.5	65	-	B	ZDFG12N-ST
	ABPFN12S12W-120-55	12	6.0	120	12	21.0	55	11.5	65	-	B	ZDFG12N-ST
	ABPFN12S12W-150-75	12	6.0	150	12	21.0	75	11.5	75	-	B	ZDFG12N-ST
	ABPFN16S16W-115-45	16	8.0	115	16	27.0	45	14.8	70	-	B	ZDFG16N-ST
	ABPFN16S16W-160-90	16	8.0	160	16	27.0	90	14.8	70	-	B	ZDFG16N-ST
	ABPFNU20S18W-200-51	20	10.0	200	18	35.0	51	18.3	149	-	C	ZDFG20N-ST
	ABPFN25S25W-140-65	25	12.5	140	25	43.0	65	24.0	75	-	B	ZDFG25N-ST
	ABPFN25S25W-165-90	25	12.5	165	25	43.0	90	24.0	75	-	B	ZDFG25N-ST
	ABPFN25S25W-200-100	25	12.5	200	25	43.0	100	24.0	100	-	B	ZDFG25N-ST



Inserts p. 17

# IABPFN/ABPFN

Modular Style  
Inch + Metric



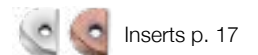
D ±0.01mm

## IABPFN-Inch (Modular Style)

Part No.	øDc	R	Lf	øD2	M	øDb	L1	L2	C	E	Insert
IABPFNM06	0.375	0.188	1.024	6.5mm	M6	0.386	5.5mm	14.5mm	5mm	7mm	IZDFG060N-ST ZDFG06N-ST
IABPFNM08	0.500	0.250	1.024	6.5mm	M6	0.386	5.5mm	14.5mm	5mm	7mm	IZDFG080N-ST ZDFG12N-ST
IABPFNM10	0.625	0.312	1.260	8.5mm	M8	0.504	5.5mm	17.0mm	8mm	10mm	IZDFG100N-ST ZDFG16N-ST
IABPFNM12	0.750	0.375	1.496	10.5mm	M10	0.701	5.5mm	19.0mm	10mm	15mm	IZDFG120N-ST ZDFG20N-ST
IABPFNM16	1.000	0.500	1.496	12.5mm	M12	0.819	5.5mm	22.0mm	10mm	17mm	IZDFG160N-ST ZDFG25N-ST

## ABPFN-Metric (Modular Style)

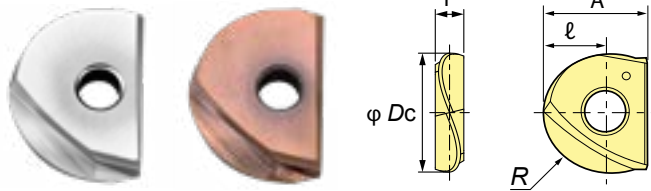
Part No.	øDc	R	Lf	øD2	M	øDb	L1	L2	C	E	Insert
ABPFNM10	10	5	26	6.5	M6	9.8	5.5	14.5	5	7	IZDFG040N-ST ZDFG06N-ST



Modular Shanks on p. 163

# IABPFN/ABPFN

## Inserts



### Inserts-Inch



Part No.	øDc	R	I	A	T	Grade		Accuracy
						ATH80D	PN15M	
IZDFG040N-ST	0.2500	0.125	0.137	0.204	2.0	•	•	F
IZDFG050N-ST	0.3125	0.156	0.172	0.274	2.4	•	•	
IZDFG060N-ST	0.3750	0.187	0.211	0.325	2.6	•	•	
IZDFG080N-ST	0.5000	0.250	0.273	0.407	3.0	•	•	
IZDFG100N-ST	0.6250	0.312	0.352	0.470	4.0	•	•	
IZDFG120N-ST	0.7500	0.375	0.434	0.572	5.0	•	•	
IZDFG160N-ST	1.0000	0.500	0.579	0.736	6.0	•	•	

### Inserts-Metric

Part No.	øDc	R	I	A	T	Grade		Accuracy
						ATH80D	PN15M	
ZDFG06N-ST	6	3.0	3.3	5.0	2.0	•	•	F
ZDFG08N-ST	8	4.0	4.4	7.0	2.4	•	•	
ZDFG10N-ST	10	5.0	5.6	8.5	2.6	•	•	
ZDFG12N-ST	12	6.0	6.6	10.0	3.0	•	•	
ZDFG16N-ST	16	8.0	9.0	12.0	4.0	•	•	
ZDFG20N-ST	20	10.0	11.5	15.0	5.0	•	•	
ZDFG25N-ST	25	12.5	14.5	18.5	6.0	•	•	

• = Stocked items in US

Material Name ISO Classification	Coating Name Coating Type	Application	Feature
<b>PN15M</b> P10	<b>PN Coating</b> PVD	General purpose for Steel (up to HRC 50) and Cast Iron	Combining of the AlCr coating layer with SI produces high hardness (3000HV) as well as good wear resistance. Good for Carbon Steel Alloy Steel and Hardened Steel.
<b>ATH80D</b> P01-M01-K01	<b>ATH Coating</b> PVD	Hardened and Pre-hardened Steel	Extraordinary performance for high-speed and high-efficiency machining in hardened steel.

Part No.	Clamp Screw		Wrench	Part No.	Clamp Screw		Wrench
		Fastening Torque (N•m)				Fastening Torque (N•m)	
IABPFN04S ○○ (W)- ○ - ○	581-140	0.5	104-T6	ABPFN06S ○○ (W)- ○ - ○	581-140	0.5	104-T6
IABPFN05S ○○ (W)- ○ - ○	581-149	0.9	104-T7	ABPFN08S ○○ (W)- ○ - ○	581-149	0.9	104-T7
IABPFN06S ○○ (W)- ○ - ○ IABPFNM06	581-150	1.1	104-T8	ABPFN10S ○○ (W)- ○ - ○ ABPFNM10	581-150	1.1	104-T8
IABPFN08S ○○ (W)- ○ - ○ IABPFNM08	581-151	2.2	104-T10	ABPFN12S ○○ (W)- ○ - ○	581-151	2.2	104-T10
IABPFN10S ○○ (W)- ○ - ○ IABPFNM10	581-152	2.9	104-T15	ABPFN16S ○○ (W)- ○ - ○	581-152	2.9	104-T15
IABPFN12S ○○ (W)- ○ - ○ IABPFNM12	581-144	4.9	105-T20	ABPFN20S ○○ (W)- ○ - ○	581-144	4.9	105-T20
IABPFN16S ○○ (W)- ○ - ○ IABPFNM16	581-146	9.8	105-T30A	ABPFNU20S18W-200-51	581-144	4.9	105-T20
				ABPFN25S ○○ (W)- ○ - ○	581-146	9.8	105-T30A

\*Wrenches, screw anti-seizure agent, and clamp screws are sold separately.



# IABPFN/ABPFN

## Cutting Conditions Inch



ø		1/4"			5/16"			3/8"			1/2"		
		Semi-finishing		Finishing	Semi-finishing		Finishing	Semi-finishing		Finishing	Semi-finishing		Finishing
		General	Hi-Speed		General	Hi-Speed		General	Hi-Speed		General	Hi-Speed	
Carbon Steel Alloy Steel (<30HRC)	N(rpm)	8030	15550	15550	6420	12440	12440	5350	9700	11710	4020	6780	9530
	Vc(sfm)	525	1017	1017	525	1017	1017	525	951	1148	525	886	1247
	Vf(in/min)	63	184	122	101	392	196	84	306	185	63	214	150
	fz(in/t)	0.004	0.006	0.004	0.008	0.016	0.008	0.008	0.016	0.008	0.008	0.016	0.008
	ap(in)	0.004	0.002	0.002	0.008	0.004	0.004	0.010	0.006	0.004	0.012	0.008	0.004
	ae(in)	0.024	0.024	0.008	0.031	0.031	0.010	0.039	0.031	0.010	0.047	0.035	0.012
Carbon Steel Alloy Steel (30-45HRC)	N(rpm)	6020	13550	13550	4820	10840	10840	4020	8030	10040	3010	5770	8280
	Vc(sfm)	394	886	886	394	886	886	394	787	984	394	755	1083
	Vf(in/min)	48	160	107	76	342	171	63	253	158	48	182	131
	fz(in/t)	0.004	0.006	0.004	0.008	0.016	0.008	0.008	0.016	0.008	0.008	0.016	0.008
	ap(in)	0.004	0.002	0.002	0.008	0.004	0.004	0.010	0.006	0.004	0.012	0.008	0.004
	ae(in)	0.024	0.024	0.008	0.031	0.031	0.010	0.039	0.031	0.010	0.047	0.035	0.012
Cast Iron FC, FCD	N(rpm)	8030	15550	15550	6420	12440	12440	5350	9700	11710	4020	6780	9530
	Vc(sfm)	525	1017	1017	525	1017	1017	525	951	1148	525	886	1247
	Vf(in/min)	63	245	122	152	588	196	126	458	277	95	320	225
	fz(in/t)	0.004	0.008	0.004	0.012	0.024	0.008	0.012	0.024	0.012	0.012	0.024	0.012
	ap(in)	0.004	0.002	0.002	0.008	0.004	0.004	0.010	0.006	0.004	0.012	0.008	0.004
	ae(in)	0.024	0.024	0.008	0.031	0.031	0.010	0.039	0.031	0.010	0.047	0.035	0.012
Hardened Steel (45-55HRC)	N(rpm)	5020	11540	11540	4020	9230	9230	3350	7030	8700	2510	5020	7280
	Vc(sfm)	328	755	755	328	755	755	328	689	853	328	656	951
	Vf(in/min)	32	91	91	32	146	146	26	111	137	20	79	115
	fz(in/t)	0.003	0.004	0.004	0.004	0.008	0.008	0.004	0.008	0.008	0.004	0.008	0.008
	ap(in)	0.004	0.002	0.002	0.008	0.004	0.004	0.010	0.006	0.004	0.012	0.008	0.004
	ae(in)	0.024	0.024	0.008	0.031	0.031	0.010	0.039	0.031	0.010	0.047	0.035	0.012
Hardened Steel (55-62HRC)	N(rpm)	4020	9030	9030	3210	7230	7230	2680	5690	6690	2010	4020	5770
	Vc(sfm)	262	591	591	262	591	591	262	558	656	262	525	755
	Vf(in/min)	26	71	71	26	114	114	21	90	106	16	63	91
	fz(in/t)	0.003	0.004	0.004	0.004	0.008	0.008	0.004	0.008	0.008	0.004	0.008	0.008
	ap(in)	0.004	0.002	0.002	0.008	0.004	0.004	0.010	0.006	0.004	0.012	0.008	0.004
	ae(in)	0.024	0.024	0.008	0.031	0.031	0.010	0.039	0.031	0.010	0.047	0.035	0.012
Maximum fz(in/t)		< 0.008			< 0.031			< 0.031			< 0.031		
Maximum ap(in)		< 0.125			< 0.156			< 0.187			< 0.25		

Overhang ratio	Vc (sfm)	Vf(in/min)
<3 Dc	100%	100%
3Dc~5Dc	70%	70%
5Dc~8Dc	60%	60%
8Dc~10Dc	50%	50%

# IABPFN/ABPFN

## Cutting Conditions Inch



ø		5/8"			3/4"			1"			
		Semi-finishing		Finishing	Semi-finishing		Finishing	Semi-finishing		Finishing	
		General	Hi-Speed		General	Hi-Speed		General	Hi-Speed		
Carbon Steel Alloy Steel (<30HRC)	N(rpm)	3210	4220	10040	2680	3520	9530	2010	2640	7900	
	Vc(sfm)	525	689	1640	525	689	1870	525	689	2067	
	Vf(in/min)	63	166	237	53	139	300	40	104	311	
	PN15M	tz(in/t)	0.010	0.020	0.012	0.010	0.020	0.016	0.010	0.020	0.020
	ATH80D	ap(in)	0.031	0.024	0.004	0.039	0.028	0.004	0.049	0.035	0.004
Carbon Steel Alloy Steel (30-45HRC)	N(rpm)	2410	3010	7630	2010	2680	7030	1510	2010	5900	
	Vc(sfm)	394	492	1247	394	525	1378	394	525	1542	
	Vf(in/min)	48	119	180	40	106	222	30	79	232	
	PN15M	tz(in/t)	0.010	0.020	0.012	0.010	0.020	0.016	0.010	0.020	0.020
	ATH80D	ap(in)	0.031	0.024	0.004	0.039	0.028	0.004	0.049	0.035	0.004
Cast Iron FC, FCD	N(rpm)	3210	4220	10040	2680	3520	9530	2010	2640	7900	
	Vc(sfm)	525	689	1640	525	689	1870	525	689	2067	
	Vf(in/min)	89	233	237	74	194	300	56	146	311	
	PN15M	tz(in/t)	0.014	0.028	0.012	0.014	0.028	0.016	0.014	0.028	0.020
	ATH80D	ap(in)	0.031	0.024	0.004	0.039	0.028	0.004	0.049	0.035	0.004
Hardened Steel (45-55HRC)	N(rpm)	2010	3010	7030	1680	2510	6690	1260	1890	5650	
	Vc(sfm)	328	492	1148	328	492	1312	328	492	1476	
	Vf(in/min)	19	57	166	16	48	211	12	36	222	
	PN15M	tz(in/t)	0.005	0.009	0.012	0.005	0.009	0.016	0.005	0.009	0.020
	ATH80D	ap(in)	0.031	0.024	0.004	0.039	0.028	0.004	0.049	0.035	0.004
Hardened Steel (55-62HRC)	N(rpm)	1610	2410	5620	1340	2010	5350	1010	1510	4520	
	Vc(sfm)	262	394	919	262	394	1050	262	394	1181	
	Vf(in/min)	15	46	133	13	38	169	10	29	178	
	PN15M	tz(in/t)	0.005	0.009	0.012	0.005	0.009	0.016	0.005	0.009	0.020
	ATH80D	ap(in)	0.031	0.024	0.004	0.039	0.028	0.004	0.049	0.035	0.004
	ae(in)	0.063	0.043	0.012	0.079	0.059	0.016	0.098	0.071	0.020	
	Maximum tz(in/t)	< 0.039			< 0.039			< 0.039			
	Maximum ap(in)	< 0.312			< 0.375			< 0.5			

Overhang ratio	Vc (sfm)	Vf(in/min)
<3 Dc	100%	100%
3Dc~5Dc	70%	70%
5Dc~8Dc	60%	60%
8Dc~10Dc	50%	50%

ø		6mm			8mm			10mm			12mm		
		Semi-finishing		Finishing	Semi-finishing		Finishing	Semi-finishing		Finishing	Semi-finishing		Finishing
		General	Hi-Speed		General	Hi-Speed		General	Hi-Speed		General	Hi-Speed	
Carbon Steel Alloy Steel (<30HRC)	N(min <sup>-1</sup> )	8,500	16,460	16,460	6,370	12,350	12,350	5,100	9,240	11,150	4,250	7,170	10,090
	Vc(m/min)	160	310	310	160	310	310	160	290	350	160	270	380
	Vf(mm/min)	1,700	4,940	3,300	2,550	9,880	4,940	2,040	7,400	4,460	1,700	5,740	4,040
	fz(mm/t)	0.1	0.15	0.1	0.2	0.4	0.2	0.2	0.4	0.2	0.2	0.4	0.2
	ap(mm)	0.1	0.05	0.05	0.2	0.1	0.1	0.25	0.15	0.1	0.3	0.2	0.1
	ae(mm)	0.6	0.6	0.2	0.8	0.8	0.25	1	0.8	0.25	1.2	0.9	0.3
Carbon Steel Alloy Steel (30-45HRC)	N(min <sup>-1</sup> )	6,370	14,340	14,340	4,780	10,750	10,750	3,830	7,650	9,560	3,190	6,110	8,760
	Vc(m/min)	120	270	270	120	270	270	120	240	300	120	230	330
	Vf(mm/min)	1,280	4,310	2,870	1,920	8,600	4,300	1,540	6,120	3,830	1,280	4,890	3,510
	fz(mm/t)	0.1	0.15	0.10	0.2	0.4	0.2	0.2	0.4	0.2	0.2	0.4	0.2
	ap(mm)	0.1	0.05	0.05	0.2	0.1	0.1	0.25	0.15	0.1	0.3	0.2	0.1
	ae(mm)	0.6	0.6	0.2	0.8	0.8	0.25	1	0.8	0.25	1.2	0.9	0.3
Cast Iron FC, FCD	N(min <sup>-1</sup> )	8,500	16,460	16,460	6,370	12,350	12,350	5,100	9,240	11,150	4,250	7,170	10,090
	Vc(m/min)	160	310	310	160	310	310	160	290	350	160	270	380
	Vf(mm/min)	1,700	6,590	3,300	3,830	14,820	4,940	3,060	11,090	6,690	2,550	8,610	6,060
	fz(mm/t)	0.1	0.2	0.1	0.3	0.6	0.2	0.3	0.60	0.3	0.3	0.60	0.30
	ap(mm)	0.1	0.05	0.05	0.2	0.1	0.1	0.25	0.15	0.1	0.3	0.2	0.1
	ae(mm)	0.6	0.6	0.2	0.8	0.8	0.25	1	0.8	0.25	1.2	0.9	0.3
Hardened Steel (45-55HRC)	N(min <sup>-1</sup> )	5,310	12,210	12,210	3,990	9,160	9,160	3,190	6,690	8,290	2,660	5,310	7,700
	Vc(m/min)	100	230	230	100	230	230	100	210	260	100	200	290
	Vf(mm/min)	850	2,450	2,450	800	3,670	3,670	640	2,680	3,320	540	2,130	3,080
	fz(mm/t)	0.08	0.10	0.10	0.1	0.2	0.2	0.1	0.2	0.2	0.1	0.2	0.2
	ap(mm)	0.1	0.05	0.05	0.2	0.1	0.1	0.25	0.15	0.1	0.3	0.2	0.1
	ae(mm)	0.6	0.6	0.2	0.8	0.8	0.25	1	0.8	0.25	1.2	0.9	0.3
Hardened Steel (55-62HRC)	N(min <sup>-1</sup> )	4,250	9,560	9,560	3,190	7,170	7,170	2,550	5,420	6,370	2,130	4,250	6,110
	Vc(m/min)	80	180	180	80	180	180	80	170	200	80	160	230
	Vf(mm/min)	680	1,920	1,920	640	2,870	2,870	510	2,170	2,550	430	1,700	2,450
	fz(mm/t)	0.08	0.10	0.10	0.1	0.20	0.20	0.10	0.20	0.20	0.10	0.20	0.20
	ap(mm)	0.1	0.05	0.05	0.2	0.1	0.1	0.25	0.15	0.1	0.3	0.2	0.1
	ae(mm)	0.6	0.6	0.2	0.8	0.8	0.25	1	0.8	0.25	1.2	0.9	0.3
Maximum fz(mm/t)		< 0.2			< 0.8			< 0.8			< 0.8		
Maximum ap(mm)		< 3.0			< 4.0			< 5.0			< 6.0		

Overhang ratio	Vc (m/min)	Vf(mm/min)
<3 Dc	100%	100%
3Dc-5Dc	70%	70%
5Dc-8Dc	60%	60%
8Dc-10Dc	50%	50%

# IABPFN/ABPFN

## Cutting Conditions Metric



ø		16mm			20mm			25mm			
		Semi-finishing		Finishing	Semi-finishing		Finishing	Semi-finishing		Finishing	
		General	Hi-Speed		General	Hi-Speed		General	Hi-Speed		
Carbon Steel Alloy Steel (<30HRC)	N(min <sup>-1</sup> )	3,190	4,180	9,960	2,550	3,350	9,080	2,040	2,680	8,030	
	Vc(m/min)	160	210	500	160	210	570	160	210	630	
	Vf(mm/min)	1,600	4,180	5,980	1,280	3,350	7,270	1,020	2,680	8,030	
	fz(mm/t)	0.25	0.5	0.3	0.25	0.5	0.4	0.25	0.5	0.5	
	PN15M	ap(mm)	0.8	0.6	0.1	1	0.7	0.1	1.25	0.9	0.1
	ATH80D	ae(mm)	1.6	1.1	0.35	2	1.5	0.4	2.5	1.8	0.5
Carbon Steel Alloy Steel (30-45HRC)	N(min <sup>-1</sup> )	2,390	2,990	7,570	1,920	2,550	6,690	1,530	2,040	5,990	
	Vc(m/min)	120	150	380	120	160	420	120	160	470	
	Vf(mm/min)	1,200	2,990	4,550	960	2,550	5,360	770	2,040	5,990	
	fz(mm/t)	0.25	0.5	0.3	0.25	0.50	0.40	0.25	0.50	0.50	
	PN15M	ap(mm)	0.8	0.6	0.1	1	0.7	0.1	1.25	0.9	0.1
	ATH80D	ae(mm)	1.6	1.1	0.3	2	1.5	0.4	2.5	1.8	0.5
Cast Iron FC, FCD	N(min <sup>-1</sup> )	3,190	4,180	9,960	2,550	3,350	9,080	2,040	2,680	8,030	
	Vc(m/min)	160	210	500	160	210	570	160	210	630	
	Vf(mm/min)	2,240	5,860	5,980	1,790	4,690	7,270	1,430	3,760	8,030	
	fz(mm/t)	0.35	0.70	0.30	0.35	0.70	0.4	0.35	0.70	0.5	
	PN15M	ap(mm)	0.8	0.6	0.1	1	0.7	0.1	1.25	0.9	0.1
	ATH80D	ae(mm)	1.6	1.1	0.3	2	1.5	0.4	2.5	1.8	0.5
Hardened Steel (45-55HRC)	N(min <sup>-1</sup> )	2,000	2,990	6,970	1,600	2,390	6,370	1,280	1,920	5,740	
	Vc(m/min)	100	150	350	100	150	400	100	150	450	
	Vf(mm/min)	480	1,440	4,190	390	1,150	5,100	310	930	5,740	
	fz(mm/t)	0.12	0.24	0.30	0.12	0.24	0.4	0.12	0.24	0.50	
	PN15M	ap(mm)	0.8	0.6	0.1	1	0.7	0.1	1.25	0.9	0.1
	ATH80D	ae(mm)	1.6	1.1	0.3	2	1.5	0.4	2.5	1.8	0.5
Hardened Steel (55-62HRC)	N(min <sup>-1</sup> )	1,600	2,390	5,580	1,280	1,920	5,100	1,020	1,530	4,590	
	Vc(m/min)	80	120	280	80	120	320	80	120	360	
	Vf(mm/min)	390	1,150	3,350	310	930	4,080	250	740	4,590	
	fz(mm/t)	0.12	0.24	0.30	0.12	0.24	0.40	0.12	0.24	0.50	
	ATH80D	ap(mm)	0.8	0.6	0.1	1	0.7	0.1	1.25	0.9	0.1
		ae(mm)	1.6	1.1	0.3	2	1.5	0.4	2.5	1.8	0.5
	Maximum fz(mm/t)	< 1.0			< 1.0			< 1.0			
	Maximum ap(mm)	< 8.0			< 10.0			< 12.5			

Overhang ratio	Vc (m/min)	Vf(mm/min)
<3 Dc	100%	100%
3Dc~5Dc	70%	70%
5Dc~8Dc	60%	60%
8Dc~10Dc	50%	50%