

# HGOB-PN

## PN Coated Ball Nose End Mills for Wide Range of Materials



### FEATURES

New PN Coating features amazing adhesion and wear resistance

Flute shape designed for excellent chip removal

Combination of coating and new geometries are ideal for stable machining, even under aggressive cutting conditions.

# HGOB-PN



## INTRODUCTION

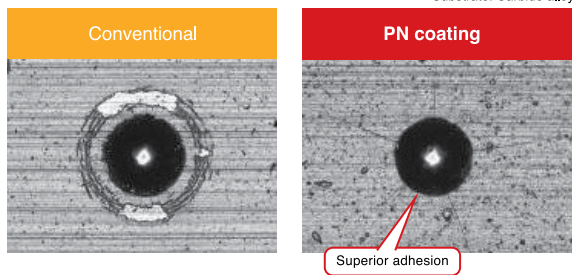
Our newly developed PN Coating enables high-efficiency machining in a wide variety of materials over a range of applications from roughing to finishing. Designed for high-performance machining in mild steels, alloy steels, pre-hardened steels, stainless steels, cast-iron and aluminum alloys, the HGOB-PN Ball Nose End Mills can easily replace multiple cutting tools in your tool cart.

## FEATURES

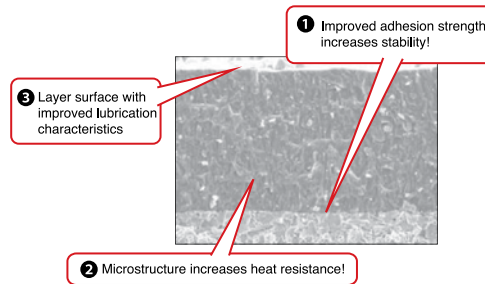
### 1. PN Coating for Maximum Efficiency and Tool Life

**PN Coating:** By optimizing the Al content, the multi-layer PN Coating exhibits both excellent heat-resistance and adhesion to the tool substrate. Combining of the AlCr coating layer with Si produces high hardness (3000HV) as well as good wear resistance. PN Coating provides extended cutting tool life in both wet and dry machining of materials including pre-hardened steel, carbon steel, alloy steel, SUS, SKD61, SKD11, and more.

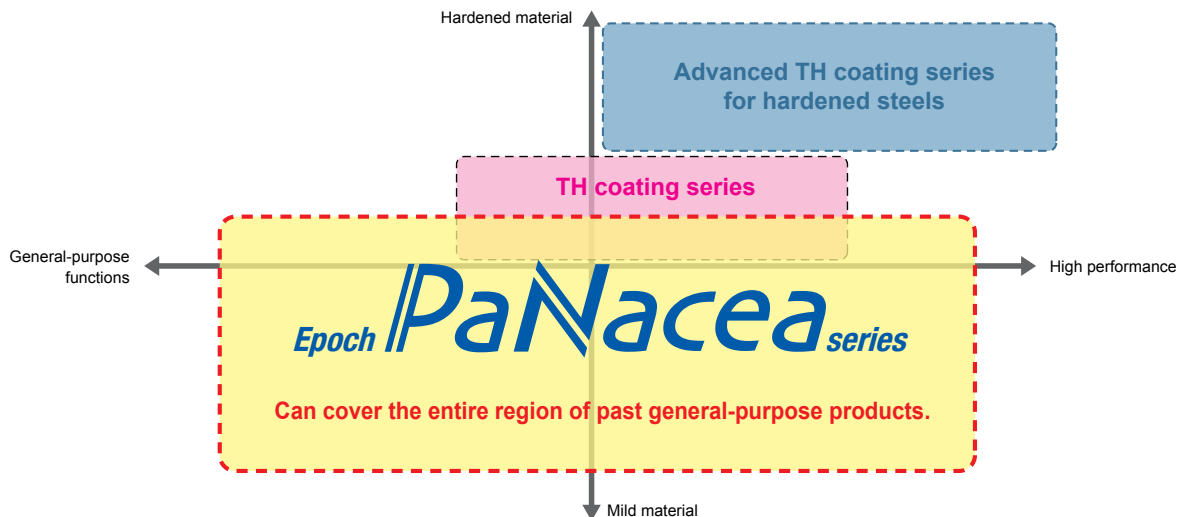
Adhesion of PN coating



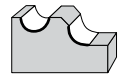
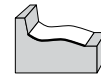
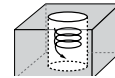
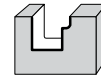
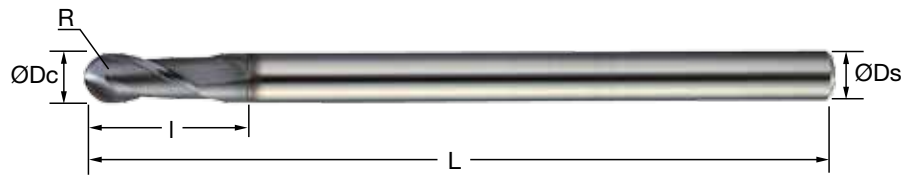
Cross-section photograph of PN coating layer structure



### 2. Cutting Area



# HGOB-PN



Helix Angle	30°	φDs	h5
R(R>8)	±0.005	R(R≤8)	±0.01

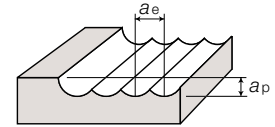
## Size (mm)

Part No.	Stock	R	D <sub>c</sub>	I	L	D <sub>s</sub>	Flutes
HGOB2003-PN	☐	0.15	0.3	0.6	50	4	2
HGOB2004-PN	☐	0.20	0.4	0.8	50	4	2
HGOB2005-PN	☐	0.25	0.5	1.0	50	4	2
HGOB2006-PN	☐	0.30	0.6	1.2	50	4	2
HGOB2008-PN	☐	0.40	0.8	1.6	50	4	2
HGOB2010-PN	●	0.50	1.0	2.5	50	4	2
HGOB2015-PN	●	0.75	1.5	4.0	50	4	2
HGOB2020-PN	●	1.00	2.0	5.0	50	6	2
HGOB2025-PN	●	1.25	2.5	7.0	50	6	2
HGOB2030-PN	●	1.50	3.0	8.0	70	6	2
HGOB2040-4-PN	●	2.00	4.0	8.0	70	4	2
HGOB2040-PN	●	2.00	4.0	8.0	70	6	2
HGOB2050-PN	●	2.50	5.0	10.0	80	6	2
HGOB2060-PN	●	3.00	6.0	12.0	90	6	2
HGOB2080-PN	●	4.00	8.0	14.0	100	8	2
HGOB2100-PN	●	5.00	10.0	18.0	100	10	2
HGOB2120-PN	●	6.00	12.0	22.0	110	12	2
HGOB2160-PN	☐	8.00	16.0	30.0	140	16	2
HGOB2200-PN	☐	10.00	20.0	38.0	160	20	2

☐ = Stocked items in Japan

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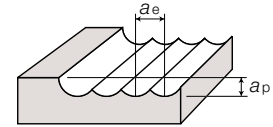
## HGOB-PN Cutting Conditions (Metric)



	R	D <sub>c</sub>	I	Copper Alloy, Aluminium Alloy				Cast Iron, Carbon Steels (150~200HB)				Stainless Steels (25~35HRC)			
				RPM	Vf (mm/ min)	a <sub>p</sub> (mm)	a <sub>e</sub> (mm)	RPM	Vf (mm/ min)	a <sub>p</sub> (mm)	a <sub>e</sub> (mm)	RPM	Vf (mm/ min)	a <sub>p</sub> (mm)	a <sub>e</sub> (mm)
Roughing	0.15	0.3	0.6	35,032	2,102	0.039	0.117	31,847	1,911	0.039	0.117	28,662	1,720	0.038	0.112
	0.20	0.4	0.8	35,032	2,102	0.052	0.156	31,847	1,911	0.052	0.156	28,662	1,720	0.050	0.150
	0.25	0.5	1.0	35,032	2,102	0.065	0.195	31,847	1,911	0.065	0.195	28,662	1,720	0.063	0.187
	0.30	0.6	1.2	29,193	2,335	0.078	0.234	26,539	2,123	0.078	0.234	23,885	1,911	0.075	0.225
	0.40	0.8	1.6	26,274	2,102	0.104	0.312	23,885	1,911	0.104	0.312	21,497	1,720	0.100	0.300
	0.50	1.0	2.5	28,025	2,803	0.130	0.390	25,478	2,548	0.130	0.390	22,930	2,293	0.125	0.375
	0.75	1.5	4.0	25,690	3,083	0.195	0.585	23,355	2,803	0.195	0.585	21,019	2,522	0.188	0.562
	1.00	2.0	5.0	24,522	3,433	0.260	0.780	22,293	3,121	0.260	0.780	20,064	2,809	0.250	0.750
	1.25	2.5	7.0	22,420	3,587	0.325	0.975	20,382	3,261	0.325	0.975	18,344	2,935	0.313	0.937
	1.50	3.0	8.0	21,019	3,783	0.390	1.170	19,108	3,439	0.390	1.170	17,197	3,096	0.375	1.125
	2.00	4.0	8.0	20,143	4,029	0.520	1.560	18,312	3,662	0.520	1.560	16,481	3,296	0.500	1.500
	2.00	4.0	8.0	20,143	4,834	0.520	1.560	18,312	4,395	0.520	1.560	16,481	3,955	0.500	1.500
	2.50	5.0	10.0	18,217	5,101	0.650	1.950	16,561	4,637	0.650	1.950	14,904	4,173	0.625	1.875
	3.00	6.0	12.0	15,764	5,045	0.780	2.340	14,331	4,586	0.780	2.340	12,898	4,127	0.750	2.250
	4.00	8.0	14.0	12,699	4,572	1.040	3.120	11,545	4,156	1.040	3.120	10,390	3,740	1.000	3.000
5.00	10.0	18.0	10,860	4,344	1.300	3.900	9,873	3,949	1.300	3.900	8,885	3,554	1.250	3.750	
6.00	12.0	22.0	9,634	4,239	1.560	4.680	8,758	3,854	1.560	4.680	7,882	3,468	1.500	4.500	
8.00	16.0	30.0	7,444	3,573	2.080	6.240	6,768	3,248	2.080	6.240	6,091	2,924	2.000	6.000	
10.00	20.0	38.0	5,955	3,097	2.600	7.800	5,414	2,815	2.600	7.800	4,873	2,534	2.500	7.500	
Finishing	0.15	0.3	0.6	44,586	1,783	0.015	0.015	37,155	3,715	0.015	0.015	33,439	3,010	0.015	0.015
	0.20	0.4	0.8	42,994	1,720	0.020	0.020	35,828	3,583	0.020	0.020	32,245	2,902	0.020	0.020
	0.25	0.5	1.0	42,038	1,682	0.025	0.025	35,032	3,503	0.025	0.025	31,529	2,838	0.025	0.025
	0.30	0.6	1.2	35,032	2,102	0.030	0.030	29,193	2,919	0.030	0.030	26,274	2,365	0.030	0.030
	0.40	0.8	1.6	31,051	1,863	0.040	0.040	25,876	2,588	0.040	0.040	23,288	2,096	0.040	0.040
	0.50	1.0	2.5	30,573	1,834	0.050	0.050	25,478	3,057	0.050	0.050	22,930	2,476	0.050	0.050
	0.75	1.5	4.0	29,299	1,758	0.075	0.075	24,416	3,418	0.075	0.075	21,975	2,769	0.075	0.075
	1.00	2.0	5.0	29,618	2,369	0.100	0.100	24,682	3,455	0.100	0.100	22,213	2,799	0.100	0.100
	1.25	2.5	7.0	28,280	2,262	0.125	0.125	23,567	3,771	0.125	0.125	21,210	3,054	0.125	0.125
	1.50	3.0	8.0	26,115	2,089	0.150	0.150	21,762	3,482	0.150	0.150	19,586	2,820	0.150	0.150
	2.00	4.0	8.0	24,363	1,949	0.200	0.200	20,303	2,842	0.200	0.200	18,272	2,302	0.200	0.200
	2.00	4.0	8.0	24,363	2,436	0.200	0.200	20,303	2,842	0.200	0.200	18,272	2,302	0.200	0.200
	2.50	5.0	10.0	22,548	2,255	0.250	0.250	18,790	3,006	0.250	0.250	16,911	2,435	0.250	0.250
	3.00	6.0	12.0	19,427	2,331	0.300	0.300	16,189	2,590	0.300	0.300	14,570	2,098	0.300	0.300
	4.00	8.0	14.0	16,003	1,920	0.400	0.400	13,336	2,400	0.400	0.400	12,002	1,944	0.400	0.400
5.00	10.0	18.0	14,713	2,060	0.500	0.500	12,261	2,207	0.500	0.500	11,035	1,788	0.500	0.500	
6.00	12.0	22.0	13,535	2,436	0.600	0.600	11,279	2,256	0.600	0.600	10,151	1,827	0.600	0.600	
8.00	16.0	30.0	10,868	2,174	0.800	0.800	9,057	2,174	0.800	0.800	8,151	1,761	0.800	0.800	
10.00	20.0	38.0	7,739	1,548	1.000	1.000	6,449	1,677	1.000	1.000	5,804	1,358	1.000	1.000	

# HGOB-PN

## HGOB-PN Cutting Conditions Metric



	R	D <sub>C</sub>	I	Alloy Steels (25~35HRC)				Pre-hardened Steels (35~45HRC)				Hardened Steels (45~52HRC)			
				RPM	Vf (mm/min)	a <sub>p</sub> (mm)	a <sub>e</sub> (mm)	RPM	Vf (mm/min)	a <sub>p</sub> (mm)	a <sub>e</sub> (mm)	RPM	Vf (mm/min)	a <sub>p</sub> (mm)	a <sub>e</sub> (mm)
Roughing	0.15	0.3	0.6	28,662	1,634	0.036	0.108	25,796	1,393	0.035	0.103	22,930	1,176	0.033	0.099
	0.20	0.4	0.8	28,662	1,634	0.048	0.144	25,796	1,393	0.046	0.138	22,930	1,176	0.044	0.132
	0.25	0.5	1.0	28,662	1,634	0.060	0.180	25,796	1,393	0.058	0.172	22,930	1,176	0.055	0.165
	0.30	0.6	1.2	23,885	1,815	0.072	0.216	21,497	1,548	0.069	0.207	19,108	1,307	0.066	0.198
	0.40	0.8	1.6	21,497	1,634	0.096	0.288	19,347	1,393	0.092	0.276	17,197	1,176	0.088	0.264
	0.50	1.0	2.5	22,930	2,178	0.120	0.360	20,637	1,857	0.115	0.345	18,344	1,568	0.110	0.330
	0.75	1.5	4.0	21,019	2,396	0.180	0.540	18,917	2,043	0.173	0.517	16,815	1,725	0.165	0.495
	1.00	2.0	5.0	20,064	2,668	0.240	0.720	18,057	2,275	0.230	0.690	16,051	1,921	0.220	0.660
	1.25	2.5	7.0	18,344	2,788	0.300	0.900	16,510	2,377	0.288	0.862	14,675	2,008	0.275	0.825
	1.50	3.0	8.0	17,197	2,941	0.360	1.080	15,478	2,507	0.345	1.035	13,758	2,117	0.330	0.990
	2.00	4.0	8.0	16,481	3,131	0.480	1.440	14,833	2,670	0.460	1.380	13,185	2,255	0.440	1.320
	2.00	4.0	8.0	16,481	3,758	0.480	1.440	14,833	3,204	0.460	1.380	13,185	2,706	0.440	1.320
	2.50	5.0	10.0	14,904	3,965	0.600	1.800	13,414	3,380	0.575	1.725	11,924	2,855	0.550	1.650
	3.00	6.0	12.0	12,898	3,921	0.720	2.160	11,608	3,343	0.690	2.070	10,318	2,823	0.660	1.980
	4.00	8.0	14.0	10,390	3,553	0.960	2.880	9,351	3,030	0.920	2.760	8,312	2,558	0.880	2.640
	5.00	10.0	18.0	8,885	3,376	1.200	3.600	7,997	2,879	1.150	3.450	7,108	2,431	1.100	3.300
6.00	12.0	22.0	7,882	3,295	1.440	4.320	7,094	2,809	1.380	4.140	6,306	2,372	1.320	3.960	
8.00	16.0	30.0	6,091	2,777	1.920	5.760	5,482	2,368	1.840	5.520	4,873	2,000	1.760	5.280	
10.00	20.0	38.0	4,873	2,407	2.400	7.200	4,385	2,052	2.300	6.900	3,898	1,733	2.200	6.600	
Finishing	0.15	0.3	0.6	33,439	3,010	0.012	0.012	30,096	2,438	0.009	0.009	26,752	1,926	0.009	0.009
	0.20	0.4	0.8	32,245	2,902	0.016	0.016	29,021	2,351	0.012	0.012	25,796	1,857	0.012	0.012
	0.25	0.5	1.0	31,529	2,838	0.020	0.020	28,376	2,298	0.015	0.015	25,223	1,816	0.015	0.015
	0.30	0.6	1.2	26,274	2,365	0.024	0.024	23,646	1,915	0.018	0.018	21,019	1,513	0.018	0.018
	0.40	0.8	1.6	23,288	2,096	0.032	0.032	20,959	1,698	0.024	0.024	18,631	1,341	0.024	0.024
	0.50	1.0	2.5	22,930	2,476	0.040	0.040	20,637	2,006	0.030	0.030	18,344	1,585	0.030	0.030
	0.75	1.5	4.0	21,975	2,769	0.060	0.060	19,777	2,243	0.045	0.045	17,580	1,772	0.045	0.045
	1.00	2.0	5.0	22,213	2,799	0.080	0.080	19,992	2,267	0.060	0.060	17,771	1,791	0.060	0.060
	1.25	2.5	7.0	21,210	3,054	0.100	0.100	19,089	2,474	0.075	0.075	16,968	1,955	0.075	0.075
	1.50	3.0	8.0	19,586	2,820	0.120	0.120	17,627	2,285	0.090	0.090	15,669	1,805	0.090	0.090
	2.00	4.0	8.0	18,272	2,302	0.160	0.160	16,445	1,865	0.120	0.120	14,618	1,473	0.120	0.120
	2.00	4.0	8.0	18,272	2,302	0.160	0.160	16,445	1,865	0.120	0.120	14,618	1,473	0.120	0.120
	2.50	5.0	10.0	16,911	2,435	0.200	0.200	15,220	1,972	0.150	0.150	13,529	1,559	0.150	0.150
	3.00	6.0	12.0	14,570	2,098	0.240	0.240	13,113	1,699	0.180	0.180	11,656	1,343	0.180	0.180
	4.00	8.0	14.0	12,002	1,944	0.320	0.320	10,802	1,575	0.240	0.240	9,602	1,244	0.240	0.240
	5.00	10.0	18.0	11,035	1,788	0.400	0.400	9,932	1,448	0.300	0.300	8,828	1,144	0.300	0.300
6.00	12.0	22.0	10,151	1,827	0.480	0.480	9,136	1,480	0.360	0.360	8,121	1,169	0.360	0.360	
8.00	16.0	30.0	8,151	1,761	0.640	0.640	7,336	1,426	0.480	0.480	6,521	1,127	0.480	0.480	
10.00	20.0	38.0	5,804	1,358	0.800	0.800	5,224	1,100	0.600	0.600	4,643	869	0.600	0.600	