

Machining Hardened Tool Steel with PCBN Cutting Tools

Tool steel is normally rough machined soft and then hardened, and PCBN is the tool material that cuts it when hardened material still has to be removed. The tables give the published conditions for cold work, hot work and high speed tool steels in both a finishing grade and a roughing grade of PCBN.

Reference only. This is a reference summary of published practice and it is not a specification of ours. The values are reproduced from the source tables, and tool material, machine rigidity, cutting fluid and workpiece condition will all move them. Final conditions are set on the job.

When hardened tool steel is machined

Finishing conditions with a low CBN grade

Material	Hardness	Speed	Feed	Depth of cut	m/min	sfm	mm/rev	in./rev	mm	in.
Cold-work tool steels	58-60 HRC	100-200	330-650	0.1	0.004	0.3	0.012			
High-speed steels	60-65 HRC	100-200	330-650	0.1	0.004	0.2	0.008			
Hot-work die steels	47-50 HRC	100-200	330-650	0.1	0.004	0.3	0.012			
Bearing steels	55-60 HRC	100-200	330-650	0.1	0.004	0.3	0.012			
Case-hardened steels	55 HRC	100-200	330-650	0.1	0.004	0.2	0.008			
Hard facing alloys	35 HRC	200-250	650-820	0.1	0.004	0.3	0.012			
Gray cast irons	200-220 HB	500-800	1650-2600	0.1	0.004	0.3	0.012			
Sintered irons	200-220 HB	300-600	980-2000	0.1	0.004	0.2	0.008			

Recommended machining conditions for initial trials with a finishing grade of PCBN cutting tool (DBC50), reproduced from Table 5 of Ultrahard Tool Materials, in ASM Handbook, Volume 16, Machining. The first three rows are the tool steels. Cutting speeds for a finishing grade are higher than for a roughing grade. The source prints 0.12 in. for the hot-work die steel depth of cut, which is a misprint of the metric value beside it.

Roughing conditions with a high CBN grade

Material	Hardness	Speed	Depth of cut	Feed	Comment			m/min	sfm	mm	in.	mm/rev	in./rev
Turning													
Ni-HARD	58 HRC	50	165	2.5	0.100	0.35	0.014					Round chamfered inserts preferable	
White or chill cast iron	55 HRC	60-100	200-330	2.0	0.080	0.4	0.016					Round chamfered inserts used	
High-speed steel	62 HRC	60-120	200-390	2.0	0.080	0.2	0.008					Interrupted cuts not possible	
Cold-work tool steel	60 HRC	80	260	2.0	0.080	0.25	0.010					...	
Nickel and chromium irons	58 HRC	55	180	2.0	0.080	0.3	0.012					...	
Gray cast iron	220 HB	600-800	2000-2620	0.1-2.0	0.004-0.080	0.1-0.4	0.004-0.016					High cutting speeds and correct workpiece microstructure essential	
Sintered iron	200 HB	300	980	0.5	0.020	0.1	0.004					...	
Cobalt-base hard facing alloys	35 HRC	200-250	650-820	1.0	0.040	0.25	0.010					Feed and speed must not be too low. Not all alloys can be machined successfully.	
Milling													
Meehanite	55 HRC	300	980	0.5	0.020	0.5	0.020					Round chamfered inserts (roughing) used	
Ni-HARD	58 HRC	200	650	1.0	0.040	0.25	0.010					Round chamfered inserts	

Material	Hardness	Speed	Depth of cut	Feed	Comment			m/min	sfm	mm	in.	mm/rev	in./rev
(roughing) used													
Cold-work tool steel	60 HRC	180	590	1.0	0.040	0.2	0.008	...					
Nickel-base hard facing alloys	35 HRC	220	720	0.5	0.020	0.3	0.012	...					

Typical machining parameters for a roughing grade of PCBN cutting tool (Amborite), reproduced from Table 6 of Ultrahard Tool Materials, in ASM Handbook, Volume 16, Machining. The milling feed column is a feed per tooth, in mm/tooth and in./tooth as printed in the source, and not a feed per revolution.

Milling hardened tool steel

Coolant

Grades and stock

Aobo Steel, tool steel supplier

Aobo Steel supplies tool steel to distributors and mold, tool and die shops, including D2, D3, DC53, A2, O1, H13, H11, H10, H21, S7, M2, M42, L6, P20 and 420 and 440C stainless. Forged or hot rolled, annealed or pre-hardened, cut to your sizes, with test certificates.
Source, ASM Handbook, Volume 16, Machining, ASM International, 1989.

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