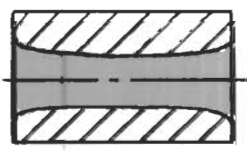
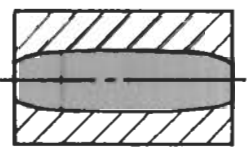
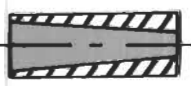


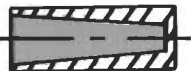


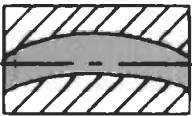


HONING GUIDE

Standard Sunnen Tooling and Procedures will satisfy all ordinary honing requirements. If problems are encountered, they can usually be solved by following the procedures suggested below. For detailed information on difficult or unusual honing problems, contact your local Sunnen Field Engineer.

Helpful Tips For Solving Bore Sizing And Finishing Problems

CONDITION TO BE CORRECTED	STEP 1	STEP 2	STEP 3	STEP 4	STEP 5
STONE NOT CUTTING STONE GLAZED* (Honing dial needle moves too slowly) Stone surface looks clean but cutting grains are dulled	Sharpen A or J stone with MAN-700 diamond dresser; use LBN-700 dressing stick on all other stones	Increase cutting pressure	Increase stroking speed	Use a softer stone (one with lower hardness number)	Increase lubricity of honing fluid. Use recommended Sunnen Honing Oil/Coolant*
STONE NOT CUTTING STONE LOADED* (Honing dial needle moves too slowly) Stone surface looks smeared and clogged with chips	Clean stone with LBN-700 dressing stick	Increase stroking speed	Use a softer stone (one with lower stone hardness number)	Use a coarser grit stone (one with lower grit number)	Increase lubricity of honing fluid. Use recommended Sunnen Honing Oil/Coolant*
SLOW STOCK REMOVAL* (Honing dial needle moves too slowly)	Increase spindle and stroke speed	Increase cutting pressure	Use a softer stone (one with lower stone hardness number)	Use a coarser grit stone (one with lower grit number)	Increase lubricity of honing fluid. Use recommended Sunnen Honing Oil/Coolant*
POOR STONE LIFE* (Honing dial needle moves too fast)	Decrease cutting pressure	Use faster spindle speed	Use harder stone (one with higher hardness number)	Use coarser grit stone (one with lower grit number)	Increase lubricity of honing fluid. Use recommended Sunnen Honing Oil/Coolant*
BELLMOUTH 	True stone and shoes with truing sleeve – if part is short or unbalanced, shorten stroke length	If Bore is LONGER than 2/3 stone length: If Bore is SHORTER than 2/3 stone length:	Shorten STONE only (or row of stones) slightly on both ends Shorten STONES AND SHOES equally to 1-1/2 times bore length	If bellmouth persists, shorten stones more but do not shorten shoes any further CAUTION: OVER-CORRECTION of bellmouth will lead to barrel condition	Use softer stone (one with lower hardness number)
BARREL 	True stone and shoes with truing sleeve	Use longer stone or shorten guide shoes on both ends CAUTION: OVER-CORRECTION of barrel condition will lead to bellmouth	Use mandrel with longer stone and shoe	Use finer grit stone (one with higher grit number)	
TAPER IN OPEN HOLE 	True stone and shoes with truing sleeve	Change stroke so tight end of the bore is stroked off the stone further	Reverse work on mandrel more often	If power stroking, make sure spindle and stroker are in alignment	

TAPER IN BLIND HOLE 	Shorten stone and shoe to about 2/3 length of bore - shorten stone more if taper persists	True stone and shoes frequently with truing sleeve – short stroke area near blind end of hole	If hole has insufficient or no relief at bottom, use hard tip stone	Provide sufficient relief at bottom of hole	Provide adequate oil flow at bottom of hole to wash chips out
OUT-OF-ROUND 	Make sure honing tool is recommended size for diameter to be honed	Thoroughly true stone and shoes to exact hole diameter	If thin-wall part, decrease cutting pressure	If stone stops cutting at decreased pressure, use stone with lower hardness number	If power stroking, make sure spindle and stroker are in alignment
WAVINESS 	Use honing tool with sufficient stone length to bridge waviness (or lands and ports in bore)				
RAINBOW 	Use L, BL, or multi-stone mandrel – stone length should be at least 1-1/2 times the length of the bore for best bow correction		Use shorter stroke length (less overstroke)	Use stone with lower hardness number to avoid part flexing	
FINISH TOO ROUGH*	Decrease cutting pressure	Use finer grit stone (one with higher grit number)	Check oil to be sure you are using Sunnen Industrial Honing Oil*	Thoroughly true shoes to exact hole diameter	For extremely fine finishes in soft or exotic materials, use bronze mandrel or bronze shoes
RANDOM SCRATCHES in bore*	Decrease cutting pressure	Use finer grit stone (one with higher grit number)	Use softer stone (one with lower hardness number)	If hard steel mandrel is being used, change to soft steel mandrel – if soft steel mandrel or shoes are being used, change to bronze mandrel or shoes	Increase lubricity of honing fluid. Use recommended Sunnen Honing Oil/Coolant*

*Many honing problems, such as poor cutting action, poor stone life, and rough finish, are caused by the wrong honing oil, insufficient honing oil, dirty honing oil, or contaminated honing oil. Use only clean, full-strength Sunnen Industrial Honing Oil. Make sure that the honing oil is neither diluted nor "cut" with other oils. Keep solvents and cleaning fluids away from hone.



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HONING STONE AND SPEED SELECTOR

Information shown is applicable to A & J (conventional) stones, which must be used with honing oil, and NM & DM stones (metal bond) which may be used with either honing oil or water based coolant. The process fluid is very important. Many honing problems, such as poor cutting action, poor stone life, and rough finish are traceable to the process fluid. In general, honing performance will be reduced when water based coolants are used.

Sunnen Stone Code

Series	Abrasive Type	Grit Size	Hardness
K8	A	5	7
↓ Series	A — Aluminum Oxide	1 - 70	1 - Soft
		2 - 80	3
		3 - 100	5
	C } — Silicon Carbide	4 - 150	7
		5 - 220	9
		6 - 280	11
	DM } — Diamond	7 - 320	13
		8 - 400	15 - Hard
		9 - 500	
	NR } — CBN/Borazon	0 - 600	
		90 - 900	
		00 - 1200	

Approximate Surface Finish in Microinches R_A/Micrometers R_A

Material	Abrasive Type	Grit Size									
		80	100	150	220	280	320	400	500	600	1200
Hard Steel	Aluminum Oxide/Silicon Carbide	25/0.65	-	20/0.50	18/0.45	12/0.30	10/0.25	5/0.12	3/0.08	1/0.03	-
	CBN/Borazon®	-	55/1.40	45/1.15	40/1.00	28/0.70	-	20/0.50	-	7/0.18	2/0.05
Soft Steel	Aluminum Oxide/Silicon Carbide	80/2.00	-	35/0.90	25/0.65	20/0.50	16/0.40	7/0.18	4/0.10	2/0.05	-
	CBN/Borazon®	-	65/1.60	-	70/1.75	-	-	25/0.65	-	16/0.40	5/0.12
Cast Iron	Silicon Carbide	100/2.50	-	30/0.75	20/0.50	12/0.30	10/0.25	6/0.15	5/0.12	3/0.08	-
	Diamond	-	-	-	80/2.00	-	-	50/1.27	-	20/0.50	12/0.30
Aluminum, Brass, Bronze	Silicon Carbide	170/4.30	-	80/2.00	55/1.40	33/0.85	27/0.70	18/0.40	12/0.30	2/0.05	-
Carbide	Diamond	-	-	30/0.75	20/0.50	-	-	7/0.18	-	3/0.08	1/0.03
Ceramic	Diamond	-	-	50/1.27	40/1.00	-	-	20/0.50	-	15/0.40	10/0.25
Glass	Diamond	-	-	95/2.40	70/1.80	-	-	30/0.75	-	15/0.40	8/0.20

Finish figures based on use of Sunnen Honing Oil. In general, use of water base coolant results in finer surface finish and reduced metal removal rates.

Borazon® is a Trademark of General Electric

RECOMMENDED STONES

DIAMETER OF BORE	HONING UNIT	FOR DE-BURRING IN ROUGH HOLES	FOR FAST STOCK REMOVAL IN DE-BURRED, BORED, REAMED OR GROUND HOLES										FOR FINE FINISHING IN PREVIOUSLY HONED HOLES				SPINDLE SPEED RPM (MAX)
			SOFT STEEL		HARDENED STEEL		SOFT BRASS	CAST IRON, BRONZE & ALUMINUM	CARBIDE & CERAMIC	GLASS	HARD STEEL, SOFT BRASS	SOFT STEEL, BRONZE, ALUMINUM, CAST IRON	CARBIDE, CERAMIC	GLASS			
			INCLUDES: CAST STEELS & STAINLESS STEELS (USE BRONZE MANDREL OR SHOES IN STAINLESS STEELS)	FOR OCCASIONAL WORK	FOR PRODUCTION RUNS	FOR OCCASIONAL WORK									FOR PRODUCTION RUNS		
1.52-2.03 (.060-.080)	D2	D6-A67	D6-A67	D6-NM69	D6-A65	D6-A63	D6-NM69	D6-J63	D6-J67	D6-DM57	D6-DM57	D6-J93	D6-J95	D6-DM07	D6-DM07	3000	
2.03-2.54 (.080-.100)		D8-A67	D8-A67	D8-NM69	D8-A65	D8-A63	D8-NM69	D8-J63	D8-J67	D8-DM57	D8-DM57	D8-J93	D8-J95	D8-DM07	D8-DM07		
2.54-3.05 (.100-.120)	K3 BL3	K3-A611 L3-A611	K3-A67 L3-A67	K3-NM69 L3-NM69	K3-A65 L3-A65	K3-A63 L3-A63	K3-NM69 L3-NM69	K3-J63 L3-J63	K3-J67 L3-J67	K3-DM57 L3-DM57	K3-DM57 L3-DM57	K3-J93 L3-J93	K3-J95 L3-J95	K3-DM07 L3-DM07	K3-DM07 L3-DM07	3000	
3.05-3.81 (.120-.150)	K4 BL4	K4-A611 L4-A611	K4-A67 L4-A67	K4-NM69 L4-NM69	K4-A65 L4-A65	K4-A63 L4-A63	K4-NM69 L4-NM69	K4-J63 L4-J63	K4-J67 L4-J67	K4-DM57 L4-DM57	K4-DM57 L4-DM57	K4-J93 L4-J93	K4-J95 L4-J95	K4-DM07 L4-DM07	K4-DM07 L4-DM07	3000	
3.81-4.70 (.150-.185)	K5 BL5	K5-A611 L5-A611	K5-A67 L5-A67	K5-NM69 L5-NM69	K5-A65 L5-A65	K5-A63 L5-A63	K5-NM69 L5-NM69	K5-J63 L5-J63	K5-J67 L5-J67	K5-DM57 L5-DM57	K5-DM57 L5-DM57	K5-J93 L5-J93	K5-J95 L5-J95	K5-DM07 L5-DM07	K5-DM07 L5-DM07	3000	
4.70-6.22 (.185-.245)	K6, JK6 L6, BL6	K6-A415 L6-A413	K6-A57 L6-A57	K6-NM69 L6-NM69	K6-A55 L6-A55	K6-A63 L6-A63	K6-NM69 L6-NM69	K6-J63 L6-J63	K6-J67 L6-J67	K6-DM57 L6-DM57	K6-DM57 L6-DM57	K6-J93 L6-J93	K6-J95 L6-J95	K6-DM07 L6-DM07	K6-DM07 L6-DM07	3000	
6.22-7.82 (.245-.308)	K8, JK8 L8, BL8 Y8	K8-A413 L8-A413 Y8-A49	K8-A57 L8-A57 Y8-A57	K8-NM55 L8-NM55 "	K8-A55 L8-A55 Y8-A55	K8-A63 L8-A63 Y8-A63	K8-NM55 L8-NM55 "	K8-J63 L8-J63 Y8-J63	K8-J67 L8-J67 Y8-J67	K8-DM55 L8-DM55 "	K8-DM55 L8-DM55 "	K8-J93 L8-J93 Y8-J93	K8-J95 L8-J95 Y8-J95	K8-DM05 L8-DM05 "	K8-DM05 L8-DM05 "	3000	
7.82-9.40 (.308-.370)	K10, JK10 L10, BL10 Y10	K10-A413 L10-A413 Y10-A49	K10-A57 L10-A57 Y10-A57	K10-NM55 L10-NM55 "	K10-A55 L10-A55 Y10-A55	K10-A63 L10-A63 Y10-A63	K10-NM55 L10-NM55 "	K10-J63 L10-J63 Y10-J63	K10-J67 L10-J67 Y10-J67	K10-DM55 L10-DM55 "	K10-DM55 L10-DM55 "	K10-J93 L10-J93 Y10-J93	K10-J95 L10-J95 Y10-J95	K10-DM05 L10-DM05 "	K10-DM05 L10-DM05 "	2000	
9.40-12.57 (.370-.495)	K12, JK12 L12, BL12 Y12	K12-A413 L12-A413 Y12-A49	K12-A57 L12-A57 Y12-A57	K12-NM55 L12-NM55 "	K12-A55 L12-A55 Y12-A55	K12-A63 L12-A63 Y12-A63	K12-NM55 L12-NM55 "	K12-J63 L12-J63 Y12-J63	K12-J67 L12-J67 Y12-J67	K12-DM55 L12-DM55 "	K12-DM55 L12-DM55 "	K12-J93 L12-J93 Y12-J93	K12-J95 L12-J95 Y12-J95	K12-DM05 L12-DM05 "	K12-DM05 L12-DM05 "	1600 to 2000	
12.57-15.72 (.495-.619)	K16, JK16 L16, BL16 Y16	K16-A413 L16-A413 Y16-A49	K16-A57 L16-A57 Y16-A57	K16-NM55 L16-NM55 "	K16-A55 L16-A55 Y16-A55	K16-A63 L16-A63 Y16-A63	K16-NM55 L16-NM55 "	K16-J63 L16-J63 Y16-J63	K16-J67 L16-J67 Y16-J67	K16-DM55 L16-DM55 "	K16-DM55 L16-DM55 "	K16-J93 L16-J93 Y16-J93	K16-J95 L16-J95 Y16-J95	K16-DM05 L16-DM05 "	K16-DM05 L16-DM05 "	1270	
15.72-18.90 (.619-.744)	K20, JK20 L20, BL20 P20 Y20	K20-A413 L20-A413 P20-A413 Y20-A411	K20-A57 L20-A57 P20-A57 Y20-A57	K20-NM55 L20-NM55 P20-NM55 "	K20-A55 L20-A55 P20-A55 Y20-A55	K20-A63 L20-A63 P20-A63 Y20-A63	K20-NM55 L20-NM55 P20-NM55 "	K20-J63 L20-J63 P20-J63 Y20-J63	K20-J67 L20-J67 P20-J67 Y20-J67	K20-DM55 L20-DM55 P20-DM55 "	K20-DM55 L20-DM55 P20-DM55 "	K20-J93 L20-J93 P20-J93 Y20-J93	K20-J95 L20-J95 P20-J95 Y20-J95	K20-DM05 L20-DM05 P20-DM05 "	K20-DM05 L20-DM05 P20-DM05 "	1000	
18.90-25.40 (.744-1.00)	AK20, JAK20 AL20, BAL20 P20 AAAY20/Y20	K20-A413 L20-A413 P20-A413 Y20-A411	K20-A57 L20-A57 P20-A57 Y20-A57	K20-NM55 L20-NM55 P20-NM55 "	K20-A55 L20-A55 P20-A55 Y20-A55	K20-A63 L20-A63 P20-A63 Y20-A63	K20-NM55 L20-NM55 P20-NM55 "	K20-J63 L20-J63 P20-J63 Y20-J63	K20-J67 L20-J67 P20-J67 Y20-J67	K20-DM55 L20-DM55 P20-DM55 "	K20-DM55 L20-DM55 P20-DM55 "	K20-J93 L20-J93 P20-J93 Y20-J93	K20-J95 L20-J95 P20-J95 Y20-J95	K20-DM05 L20-DM05 P20-DM05 "	K20-DM05 L20-DM05 P20-DM05 "	800	

25.40-26.19 (1.000-1.031)	AK20, JAK20 AL20, BAL20 P28 R28	K20-A413 L20-A413 P28-A413 R28-A413	K20-A57 L20-A57 P28-A57 R28-A57	K20-NM55 L20-NM55 P28-NM55 R28-NM55	K20-A55 L20-A55 P28-A55 R28-A55	K20-A63 L20-A63 P28-A63 R28-A63	K20-NM55 L20-NM55 P28-NM55 R28-NM55	K20-J63 L20-J63 P28-J63 R28-J63	K20-J57 L20-J57 P28-J57 R28-J57	K20-DM55 L20-DM55 P28-DM55 R28-DM55	K20-DM55 L20-DM55 P28-DM55 R28-DM55	K20-J93 L20-J93 P28-J93 R28-J93	K20-J95 L20-J95 P28-J95 R28-J95	K20-DM05 L20-DM05 P28-DM05 R28-DM05	K20-DM05 L20-DM05 P28-DM05 R28-DM05	640
26.19-31.75 (1.031-1.250)	AK20 P28 R28	K20-A413 P28-A413 R28-A413	K20-A57 P28-A57 R28-A57	K20-NM55 P28-NM55 R28-NM55	K20-A55 P28-A55 R28-A55	K20-A63 P28-A63 R28-A63	K20-NM55 P28-NM55 R28-NM55	K20-J63 P28-J63 R28-J63	K20-J57 P28-J57 R28-J57	K20-DM55 P28-DM55 R28-DM55	K20-DM55 P28-DM55 R28-DM55	K20-J93 P28-J93 R28-J93	K20-J95 P28-J95 R28-J95	K20-DM05 P28-DM05 R28-DM05	K20-DM05 P28-DM05 R28-DM05	640
31.75-92.08 (1.250-3.625)	P28 R28	P28-A413 R28-A413	P28-A57 R28-A57	P28-NM55 R28-NM55	P28-A55 R28-A55	P28-A63 R28-A63	P28-NM55 R28-NM55	P28-J63 R28-J63	P28-J57 R28-J57	P28-DM55 R28-DM55	P28-DM55 R28-DM55	P28-J93 R28-J93	P28-J95 R28-J95	P28-DM05 R28-DM05	P28-DM05 R28-DM05	640 to 200
92.08-152.40 (3.625-6.00)	P28 R28	P28-A413 R28-A413	P28-A57 R28-A57	P28-NM55 R28-NM55	P28-A55 R28-A55	P28-A63 R28-A63	P28-NM55 R28-NM55	P28-J63 R28-J63	P28-J57 R28-J57	P28-DM55 R28-DM55	P28-DM55 R28-DM55	P28-J93 R28-J93	P28-J95 R28-J95	P28-DM05 R28-DM05	P28-DM05 R28-DM05	200
25.20-34.93 (.992-1.375)	Y32	Y32-A49	Y32-A57	*	Y32-A55	Y32-A63	*	Y32-J63	Y32-J57	**	**	Y32-J93	Y32-J95	**	**	640 to 500
34.67-44.45 (1.365-1.750)	Y44	Y44-A49	Y44-A57	*	Y44-A55	Y44-A63	*	Y44-J63	Y44-J57	**	**	Y44-J93	Y44-J95	**	**	500 to 400
44.20-57.15 (1.740-2.250)	Y56	Y56-A49	Y56-A57	*	Y56-A55	Y56-A63	*	Y56-J63	Y56-J57	**	**	Y56-J93	Y56-J95	**	**	400 to 320
56.90-69.85 (2.240-2.750)	Y72	Y72-A49	Y72-A57	*	Y72-A55	Y72-A63	*	Y72-J63	Y72-J57	**	**	Y72-J93	Y72-J95	**	**	320 to 250
69.60-82.55 (2.740-3.250)	Y88	Y88-A49	Y88-A57	*	Y88-A55	Y88-A63	*	Y88-J63	Y88-J57	**	**	Y88-J93	Y88-J95	**	**	250
82.30-98.42 (3.240-3.875)	Y104	Y104-A49	Y104-A57	*	Y104-A55	Y104-A63	*	Y104-J63	Y104-J57	**	**	Y104-J93	Y104-J95	**	**	200
63.50-68.58 (2.500-2.700)	AN-600	G25-A47	G25-A45	*	G25-A45	G25-A63	*	G25-J63	G25-J45	G25-DV57	G25-DV57	G25-J85	G25-J87	G25-DV87**	G25-DV87**	250
68.58-104.14 (2.700-4.100)	AN-600	M27-A47	M27-A45	*	M27-A45	M27-A63	*	M27-J63	M27-J45	M27-DV57	M27-DV57	M27-J85	M27-J87	M27-DV87**	M27-DV87**	200
88.90-139.70 (3.500-5.500)	AN-600	N37-A47	N37-A45	*	N37-A45	N37-A63	*	N37-J63	N37-J45	N37-DV57	N37-DV57	N37-J85	N37-J87	N37-DV87**	N37-DV87**	200
63.50-83.82 (2.500-3.300)	AN-600	GY25-A47 GG25-A47	GY25-A45 GG25-A45	*	GY25-A45 GG25-A45	GY25-A63 GG25-A63	*	GY25-J45 GG25-J45	GY25-J45 GG25-J45	**	**	GY25-J85 GG25-J85	GY25-J85 GG25-J85	**	**	250
83.82-106.68 (3.300-4.200)	AN-600	MY33-A47 MM33-A47	MY33-A45 MM33-A45	*	MY33-A45 MM33-A45	MY33-A63 MM33-A63	*	MY33-J45 MM33-J45	MY33-J45 MM33-J45	**	**	MY33-J85 MM33-J85	MY33-J85 MM33-J85	**	**	200
101.60-142.24 (4.00-5.600)	AN-600	NY40-A47 NN40-A47	NY40-A45 NN40-A45	*	NY40-A45 NN40-A45	NY40-A63 NN40-A63	*	NY40-J45 NN40-J45	NY40-J45 NN40-J45	**	**	NY40-J85 NN40-J85	NY40-J85 NN40-J85	**	**	200

* CBN/Borazon® stones available on special order.

** Diamond stones available on special order.

*** In glass and some ceramic materials, 400 grit diamonds might provide better control of bore size than the 220 grit. Contact customer service for assistance.

▲ CBN/Borazon® finishing stones are available for finishing hardened or soft steel. Diamond stones are available for fine finishing aluminum and cast iron. Contact customer service for assistance.