

Ultra Micro Grain Solid Carbide End Mill

EPDRE-ATH | Recommended Cutting Conditions

 **RECOMMENDED CUTTING CONDITIONS**

1. Use a highly rigid and accurate machine as possible.
2. These conditions are for general guidance; in actual machining conditions adjust the parameters according to your actual machine and work-piece conditions.
3. If the rpm available is lower than recommended please reduce the feed rate to the same ratio.

 **EMPFOHLENE SCHNITTBEDINGUNGEN**

1. Benutzen Sie für die Bearbeitung jeweils die Maschine mit der höchsten Genauigkeit und der höchsten Stabilität.
2. Die angegebenen Schnittwerte stellen eine generelle Empfehlung dar. Die Werte sollten immer an die jeweilige Bearbeitung, deren Form und die verwendete Maschine angepasst werden.
3. Ist die Ihnen verfügbare Drehzahl niedriger als der in der Tabelle angegebene Wert, sollte der Vorschub im gleichen Verhältnis reduziert werden.

 **CONDIZIONI DI TAGLIO RACCOMANDATE**

1. Usate centri di lavoro più precisi e rigidi possibile
2. Le condizioni di taglio sono valori generali. Per ottimizzare il processo di lavoro rispettate le geometrie dello stampo e la macchina disponibile.
3. Quando i giri della macchina disponibili sono più bassi rispetto al valore espresso regolate l'avanzamento con lo stesso rapporto.

 **CONDICIONES DE CORTE RECOMENDADAS**


1. Utilizar la máquina más rígida y precisa posible.
2. Las condiciones de corte de la tabla son una orientación general. Para un trabajo específico hay que ajustar las condiciones en función de la geometría de la pieza, el resultado esperado y el tipo de máquina que vamos a utilizar.
3. Si las rpm máximas de la máquina son inferiores, hay que ajustar el avance en proporción a las mismas.


 **CONDITIONS DE COUPE RECOMMANDÉES**


1. Utiliser une machine aussi rigide et fiable que possible.
2. Ces conditions sont indicatives : en utilisation, ajuster les conditions en fonction de la machine et de la pièce usinée.
3. Si la rotation possible est inférieure à celle recommandée, ajuster l'avance dans la même proportion.


 **CONDIÇÕES DE CORTE RECOMENDADAS**


1. Use uma máquina rígida e o mais precisa possível.
2. Estas condições são para orientação geral, em condições de maquinação real ajustar os parâmetros de acordo com a sua máquina e com as condições das peças a maquinar.
3. Se o número de rotações disponível na máquina for menor do que o recomendado por favor reduza avanço na mesma proporção.


 A modification of the cutting conditions is possible at following rules: Rotation (n/r.p.m.) and feed (V_f) increasing in same ratio, but feed per tooth (f_z) should be kept.

 Die Modifizierung der Schnittwerte ist nach folgender Regel möglich: Umdrehung (n) und Vorschub (V_f) im gleichen Verhältnis steigern, jedoch den Vorschub pro Zahn (f_z) beibehalten.

 E' possibile modificare le condizioni di taglio seguendo le seguenti regole: aumentare rotazione (n/r.p.m.) ed avanzamento con la stessa proporzione mantenendo fisso l'avanzamento al dente f_z

 Modificar las condiciones de corte es posible si respetamos la siguiente regla: Las revoluciones (rpm) y el avance (V_f) se pueden incrementar o reducir en igual proporción, manteniendo el avance por diente (f_z).

 Il est possible de modifier les paramètres de coupe en suivant la règle suivante : Rotation (n/r.p.m.) et avance (V_f) augmentées du même ratio, cependant, l'avance par dent (f_z) doit être conservée à l'identique.

 A modificação das condições de corte é possível nas seguintes regras: Rotação (n/ r.p.m) e avanço (V_f) incrementar na mesma proporção, mas o avanço por dente (f_z) deve ser mantido.

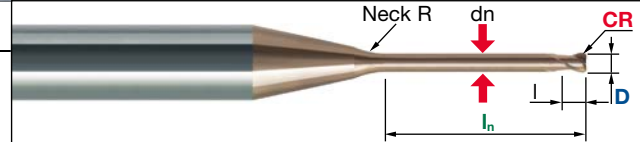
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EPDRE-ATH | High Efficiency Cutting Conditions

D	CR	Workpiece Material		I				II				III			
		I _n	Copper				Carbon Steels, Alloy Steels (180~250HB)				Tool Steels (25~35HRC)				
			a _p mm	n min ⁻¹	V _f mm/min	f _z mm/t	a _p mm	n min ⁻¹	V _f mm/min	f _z mm/t	a _p mm	n min ⁻¹	V _f mm/min	f _z mm/t	
0.2	0.5	0.5	0.024	65,000	1,430	0.011	0.020	65,000	1,430	0.011	0.018	58,500	1,287	0.011	
		1	0.017	65,000	1,430	0.011	0.014	65,000	1,430	0.011	0.013	58,500	1,287	0.011	
		1.5	0.010	65,000	1,300	0.010	0.008	61,100	1,344	0.011	0.007	55,600	1,223	0.011	
0.3	0.05	2	0.010	65,000	1,300	0.010	0.008	54,600	1,201	0.011	0.007	52,700	1,159	0.011	
		1	0.025	65,000	1,820	0.014	0.021	62,400	1,872	0.015	0.019	56,200	1,686	0.015	
		2	0.014	58,500	1,521	0.013	0.012	50,500	1,313	0.013	0.011	45,500	1,183	0.013	
0.4	0.1	3	0.010	55,600	1,334	0.012	0.008	48,000	1,152	0.012	0.007	43,200	1,037	0.012	
		1	0.030	59,900	1,917	0.016	0.025	49,800	1,594	0.016	0.023	44,900	1,437	0.016	
		2	0.019	59,900	1,797	0.015	0.016	49,800	1,494	0.015	0.014	44,900	1,347	0.015	
0.5	0.05	3	0.017	45,800	1,191	0.013	0.014	38,100	991	0.013	0.013	34,400	894	0.013	
		4	0.010	37,700	980	0.013	0.008	31,400	816	0.013	0.007	28,300	736	0.013	
		1	0.040	59,900	1,917	0.016	0.033	49,800	1,594	0.016	0.030	44,900	1,437	0.016	
0.6	0.1	2	0.034	59,900	1,797	0.015	0.028	49,800	1,494	0.015	0.025	44,900	1,347	0.015	
		3	0.019	45,800	1,191	0.013	0.016	38,100	991	0.013	0.014	34,400	894	0.013	
		4	0.012	37,700	980	0.013	0.010	31,400	816	0.013	0.009	28,300	736	0.013	
0.7	0.05	1	0.036	59,900	1,917	0.016	0.030	49,800	1,594	0.016	0.027	44,900	1,437	0.016	
		2	0.028	59,900	1,917	0.016	0.023	49,800	1,594	0.016	0.021	44,900	1,437	0.016	
		3	0.020	48,500	1,552	0.016	0.017	40,400	1,293	0.016	0.015	36,400	1,165	0.016	
0.8	0.1	4	0.020	43,100	1,379	0.016	0.017	35,900	1,149	0.016	0.015	32,300	1,034	0.016	
		5	0.013	37,700	1,206	0.016	0.011	31,400	1,005	0.016	0.010	28,300	906	0.016	
		6	0.010	33,500	1,005	0.015	0.008	28,000	840	0.015	0.007	25,200	756	0.015	
0.9	0.05	1	0.042	59,900	1,917	0.016	0.035	49,800	1,594	0.016	0.032	44,900	1,437	0.016	
		2	0.036	59,900	1,917	0.016	0.030	49,800	1,594	0.016	0.027	44,900	1,437	0.016	
		3	0.024	48,500	1,552	0.016	0.020	40,400	1,293	0.016	0.018	36,400	1,165	0.016	
0.2	0.1	4	0.024	43,100	1,379	0.016	0.020	35,900	1,149	0.016	0.018	32,300	1,034	0.016	
		5	0.016	37,700	1,206	0.016	0.013	31,400	1,005	0.016	0.012	28,300	906	0.016	
		6	0.016	33,500	1,005	0.015	0.013	28,000	840	0.015	0.012	25,200	756	0.015	
0.3	0.05	2	0.042	59,900	2,755	0.023	0.035	49,800	2,291	0.023	0.032	44,900	2,065	0.023	
		4	0.029	48,500	2,134	0.022	0.024	40,400	1,778	0.022	0.022	36,400	1,602	0.022	
		6	0.018	37,700	1,659	0.022	0.015	31,400	1,382	0.022	0.014	28,300	1,245	0.022	
0.4	0.1	8	0.016	35,900	1,580	0.022	0.013	29,900	1,316	0.022	0.012	26,900	1,184	0.022	
		10	0.011	32,100	1,284	0.020	0.009	26,700	1,068	0.020	0.008	24,100	964	0.020	
		4	0.035	48,500	2,134	0.022	0.029	40,400	1,778	0.022	0.026	36,400	1,602	0.022	
0.5	0.05	6	0.022	37,700	1,659	0.022	0.018	31,400	1,382	0.022	0.016	28,300	1,245	0.022	
		2	0.067	65,000	2,860	0.022	0.056	65,000	2,860	0.022	0.050	60,800	2,675	0.022	
		4	0.038	62,400	2,746	0.022	0.032	52,000	2,288	0.022	0.029	46,800	2,059	0.022	
0.6	0.1	6	0.023	47,700	1,908	0.020	0.019	39,800	1,592	0.020	0.017	35,800	1,432	0.020	
		8	0.018	38,200	1,452	0.019	0.015	31,800	1,208	0.019	0.014	28,600	1,087	0.019	
		10	0.016	36,300	1,307	0.018	0.014	30,200	1,087	0.018	0.012	27,200	979	0.018	
0.7	0.05	12	0.014	34,400	1,170	0.017	0.012	28,600	972	0.017	0.011	25,800	877	0.017	
		2	0.084	65,000	2,860	0.022	0.070	65,000	2,860	0.022	0.063	60,800	2,675	0.022	
		4	0.067	62,400	2,746	0.022	0.056	52,000	2,288	0.022	0.050	46,800	2,059	0.022	
0.8	0.1	6	0.038	47,700	1,908	0.020	0.032	39,800	1,592	0.020	0.029	35,800	1,432	0.020	
		8	0.022	38,200	1,452	0.019	0.018	31,800	1,208	0.019	0.016	28,600	1,087	0.019	
		10	0.020	36,300	1,307	0.018	0.017	30,200	1,087	0.018	0.015	27,200	979	0.018	
0.9	0.05	12	0.018	34,400	1,170	0.017	0.015	28,600	972	0.017	0.014	25,800	877	0.017	
		4	0.078	56,200	4,046	0.036	0.065	46,800	3,370	0.036	0.059	42,100	3,031	0.036	
		8	0.042	40,400	2,586	0.032	0.035	33,700	2,157	0.032	0.032	30,300	1,939	0.032	



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IV Tool Steels (35-45HRC)				V Hardened Steels (45-55HRC)				VI Hardened Steels (55-70HRC)				D	CR	ln
ap mm	n min ⁻¹	Vf mm/min	fz mm/t	ap mm	n min ⁻¹	Vf mm/min	fz mm/t	ap mm	n min ⁻¹	Vf mm/min	fz mm/t			
0.016	55,300	1,106	0.010	0.013	48,800	878	0.009	0.012	45,500	728	0.008	0.2	0.05	0.5
0.011	55,300	1,106	0.010	0.009	48,800	878	0.009	0.008	45,500	728	0.008			1
0.006	52,500	1,050	0.010	0.005	46,300	833	0.009	0.005	43,200	691	0.008			1.5
0.006	49,700	994	0.010	0.005	43,900	790	0.009	0.005	41,000	656	0.008	0.3	0.05	2
0.017	53,000	1,166	0.011	0.014	46,800	842	0.009	0.013	43,700	699	0.008			1
0.010	43,000	946	0.011	0.008	37,900	682	0.009	0.007	35,400	566	0.008			2
0.006	40,800	816	0.010	0.005	36,000	576	0.008	0.005	33,600	470	0.007	0.4	0.05	3
0.020	41,900	1,257	0.015	0.016	37,400	972	0.013	0.015	34,700	763	0.011			1
0.013	41,900	1,089	0.013	0.010	37,400	898	0.012	0.010	34,700	694	0.010			2
0.011	32,100	770	0.012	0.009	28,600	629	0.011	0.008	26,600	479	0.009	0.4	0.1	3
0.006	26,400	634	0.012	0.005	23,600	519	0.011	0.005	21,900	394	0.009			4
0.026	41,900	1,257	0.015	0.021	37,400	972	0.013	0.020	34,700	763	0.011			1
0.022	41,900	1,089	0.013	0.018	37,400	898	0.012	0.017	34,700	694	0.010	0.5	0.05	2
0.013	32,100	770	0.012	0.010	28,600	629	0.011	0.010	26,600	479	0.009			3
0.008	26,400	634	0.012	0.007	23,600	519	0.011	0.006	21,900	394	0.009			4
0.024	41,900	1,257	0.015	0.020	37,400	972	0.013	0.018	34,700	763	0.011	0.5	0.05	1
0.018	41,900	1,257	0.015	0.015	37,400	972	0.013	0.014	34,700	763	0.011			2
0.014	34,400	963	0.014	0.011	30,300	727	0.012	0.010	28,300	566	0.010			3
0.014	30,600	857	0.014	0.011	27,000	648	0.012	0.010	25,200	554	0.011	0.6	0.1	4
0.009	26,700	748	0.014	0.007	23,600	566	0.012	0.007	22,000	484	0.011			5
0.006	23,800	524	0.011	0.005	21,000	420	0.010	0.005	19,600	353	0.009			6
0.028	41,900	1,257	0.015	0.023	37,400	972	0.013	0.021	34,700	763	0.011	0.6	0.1	1
0.024	41,900	1,257	0.015	0.020	37,400	972	0.013	0.018	34,700	763	0.011			2
0.016	34,400	963	0.014	0.013	30,300	727	0.012	0.012	28,300	566	0.010			3
0.016	30,600	857	0.014	0.013	27,000	648	0.012	0.012	25,200	554	0.011	0.7	0.1	4
0.010	26,700	748	0.014	0.008	23,600	566	0.012	0.008	22,000	484	0.011			5
0.010	23,800	524	0.011	0.008	21,000	420	0.010	0.008	19,600	353	0.009			6
0.028	41,900	1,508	0.018	0.023	37,400	1,197	0.016	0.021	34,700	972	0.014	0.7	0.1	2
0.019	34,400	1,238	0.018	0.016	30,300	909	0.015	0.014	28,300	736	0.013			4
0.012	26,700	961	0.018	0.010	23,600	708	0.015	0.009	22,000	572	0.013			6
0.010	25,400	914	0.018	0.008	22,400	672	0.015	0.008	20,900	543	0.013	0.8	0.2	8
0.007	22,700	772	0.017	0.006	20,000	560	0.014	0.005	18,700	449	0.012			10
0.023	34,400	1,238	0.018	0.019	30,300	909	0.015	0.017	28,300	736	0.013			4
0.014	26,700	961	0.018	0.012	23,600	708	0.015	0.011	22,000	572	0.013	0.8	0.2	6
0.045	57,500	2,300	0.020	0.036	50,700	1,825	0.018	0.034	47,300	1,419	0.015			2
0.026	44,200	1,768	0.020	0.021	39,000	1,404	0.018	0.019	36,400	1,092	0.015			4
0.015	33,800	1,352	0.020	0.012	29,800	1,073	0.018	0.011	27,800	834	0.015	0.9	0.2	6
0.012	27,100	1,030	0.019	0.010	23,900	765	0.016	0.009	22,300	624	0.014			8
0.011	25,700	925	0.018	0.009	22,700	726	0.016	0.008	21,200	594	0.014			10
0.010	24,300	826	0.017	0.008	21,500	645	0.015	0.007	20,000	520	0.013	0.9	0.2	12
0.056	57,500	2,300	0.020	0.046	50,700	1,825	0.018	0.042	47,300	1,419	0.015			2
0.045	44,200	1,768	0.020	0.036	39,000	1,404	0.018	0.034	36,400	1,092	0.015			4
0.026	33,800	1,352	0.020	0.021	29,800	1,073	0.018	0.019	27,800	834	0.015	0.9	0.2	6
0.014	27,100	1,030	0.019	0.012	23,900	765	0.016	0.011	22,300	624	0.014			8
0.013	25,700	925	0.018	0.011	22,700	726	0.016	0.010	21,200	594	0.014			10
0.012	24,300	826	0.017	0.010	21,500	645	0.015	0.009	20,000	520	0.013	0.9	0.2	12
0.052	39,800	2,547	0.032	0.042	35,100	2,036	0.029	0.039	32,800	1,640	0.025			4
0.028	28,600	1,830	0.032	0.023	25,300	1,467	0.029	0.021	23,600	1,180	0.025	8		

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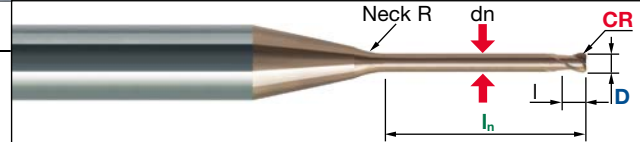
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		I _n	Copper				Carbon Steels, Alloy Steels (180~250HB)				Tool Steels (25~35HRC)				
			a _p mm	n min ⁻¹	V _f mm/min	f _z mm/t	a _p mm	n min ⁻¹	V _f mm/min	f _z mm/t	a _p mm	n min ⁻¹	V _f mm/min	f _z mm/t	
1	0.1	2	0.078	62,100	4,471	0.036	0.065	51,300	3,694	0.036	0.059	46,400	3,341	0.036	
		4	0.046	56,200	4,046	0.036	0.038	46,800	3,370	0.036	0.034	42,100	3,031	0.036	
		6	0.029	45,500	2,912	0.032	0.024	37,900	2,426	0.032	0.022	34,100	2,182	0.032	
		8	0.029	40,400	2,586	0.032	0.024	33,700	2,157	0.032	0.022	30,300	1,939	0.032	
		10	0.018	35,400	2,266	0.032	0.015	29,500	1,888	0.032	0.014	26,500	1,696	0.032	
		12	0.018	31,400	1,821	0.029	0.015	26,200	1,520	0.029	0.014	23,600	1,369	0.029	
		16	0.011	31,400	1,570	0.025	0.009	26,200	1,310	0.025	0.008	23,600	1,180	0.025	
	20	0.007	23,600	1,180	0.025	0.006	19,700	985	0.025	0.005	17,700	885	0.025		
	0.2	2	0.132	62,100	4,471	0.036	0.110	51,300	3,694	0.036	0.099	46,400	3,341	0.036	
		4	0.084	56,200	4,046	0.036	0.070	46,800	3,370	0.036	0.063	42,100	3,031	0.036	
		6	0.048	45,500	2,912	0.032	0.040	37,900	2,426	0.032	0.036	34,100	2,182	0.032	
		8	0.048	40,400	2,586	0.032	0.040	33,700	2,157	0.032	0.036	30,300	1,939	0.032	
		10	0.030	35,400	2,266	0.032	0.025	29,500	1,888	0.032	0.023	26,500	1,696	0.032	
		12	0.030	31,400	1,821	0.029	0.025	26,200	1,520	0.029	0.023	23,600	1,369	0.029	
		16	0.018	31,400	1,570	0.025	0.015	26,200	1,310	0.025	0.014	23,600	1,180	0.025	
	20	0.012	23,600	1,180	0.025	0.010	19,700	985	0.025	0.009	17,700	885	0.025		
	0.3	2	0.132	62,100	4,471	0.036	0.110	51,300	3,694	0.036	0.099	46,400	3,341	0.036	
		4	0.084	56,200	4,046	0.036	0.070	46,800	3,370	0.036	0.063	42,100	3,031	0.036	
		6	0.048	45,500	2,912	0.032	0.040	37,900	2,426	0.032	0.036	34,100	2,182	0.032	
		8	0.048	40,400	2,586	0.032	0.040	33,700	2,157	0.032	0.036	30,300	1,939	0.032	
		10	0.030	35,400	2,266	0.032	0.025	29,500	1,888	0.032	0.023	26,500	1,696	0.032	
		12	0.030	31,400	1,821	0.029	0.025	26,200	1,520	0.029	0.023	23,600	1,369	0.029	
		16	0.018	31,400	1,570	0.025	0.015	26,200	1,310	0.025	0.014	23,600	1,180	0.025	
	20	0.012	23,600	1,180	0.025	0.010	19,700	985	0.025	0.009	17,700	885	0.025		
1.25	0.2	5	0.060	51,800	3,730	0.036	0.050	41,400	2,981	0.036	0.045	38,100	2,743	0.036	
		10	0.030	35,400	2,266	0.032	0.025	33,700	2,157	0.032	0.023	26,500	1,696	0.032	
		15	0.019	31,400	1,570	0.025	0.016	26,200	1,310	0.025	0.014	23,600	1,180	0.025	
		20	0.012	23,600	1,180	0.025	0.010	19,700	985	0.025	0.009	17,700	885	0.025	
		4	0.084	43,200	3,370	0.039	0.070	36,000	2,808	0.039	0.063	32,400	2,527	0.039	
1.5	0.2	6	0.078	41,400	3,229	0.039	0.065	34,500	2,691	0.039	0.059	30,900	2,410	0.039	
		8	0.072	39,300	3,065	0.039	0.060	32,800	2,558	0.039	0.054	29,500	2,301	0.039	
		12	0.072	31,400	2,449	0.039	0.060	26,200	2,044	0.039	0.054	23,600	1,841	0.039	
		15	0.046	24,500	1,715	0.035	0.038	20,400	1,428	0.035	0.034	18,300	1,281	0.035	
	20	0.036	24,500	1,519	0.031	0.030	20,400	1,265	0.031	0.027	18,300	1,135	0.031		
	0.5	4	0.102	43,200	3,370	0.039	0.085	36,000	2,808	0.039	0.077	32,400	2,527	0.039	
		6	0.096	41,400	3,229	0.039	0.080	34,500	2,691	0.039	0.072	30,900	2,410	0.039	
8		0.084	39,300	3,065	0.039	0.070	32,800	2,558	0.039	0.063	29,500	2,301	0.039		
1.75	0.2	12	0.078	31,400	2,449	0.039	0.065	26,200	2,044	0.039	0.059	23,600	1,841	0.039	
		15	0.054	24,500	1,715	0.035	0.045	20,400	1,428	0.035	0.041	18,300	1,281	0.035	
		20	0.042	24,500	1,519	0.031	0.035	20,400	1,265	0.031	0.032	18,300	1,135	0.031	
		5	0.078	41,400	3,229	0.039	0.065	34,500	2,691	0.039	0.059	30,900	2,410	0.039	
	10	0.072	31,400	2,449	0.039	0.060	26,200	2,044	0.039	0.054	23,600	1,841	0.039		
	15	0.046	24,500	1,715	0.035	0.038	20,400	1,428	0.035	0.034	18,300	1,281	0.035		
	20	0.036	24,500	1,519	0.031	0.030	20,400	1,265	0.031	0.027	18,300	1,135	0.031		
2	0.2	4	0.120	37,300	4,998	0.067	0.100	31,500	4,221	0.067	0.090	28,400	3,806	0.067	
		6	0.096	36,000	4,824	0.067	0.080	30,000	4,020	0.067	0.072	27,000	3,618	0.067	
		8	0.084	32,800	4,395	0.067	0.070	27,300	3,658	0.067	0.063	24,600	3,296	0.067	
		12	0.048	26,500	3,233	0.061	0.040	22,100	2,696	0.061	0.036	19,900	2,428	0.061	
		16	0.048	23,600	2,879	0.061	0.040	19,700	2,403	0.061	0.036	17,700	2,159	0.061	
		20	0.042	20,600	2,513	0.061	0.035	17,200	2,098	0.061	0.032	15,500	1,891	0.061	
		25	0.030	20,600	2,513	0.061	0.025	17,200	2,098	0.061	0.023	15,500	1,891	0.061	
	30	0.020	19,600	2,391	0.061	0.017	16,300	1,989	0.061	0.015	14,700	1,793	0.061		
	0.5	4	0.240	37,300	4,998	0.067	0.200	31,500	4,221	0.067	0.180	28,400	3,806	0.067	
		6	0.204	36,000	4,824	0.067	0.170	30,000	4,020	0.067	0.153	27,000	3,618	0.067	
		8	0.168	32,800	4,395	0.067	0.140	27,300	3,658	0.067	0.126	24,600	3,296	0.067	
		12	0.096	26,500	3,233	0.061	0.080	22,100	2,696	0.061	0.072	19,900	2,428	0.061	
		16	0.096	23,600	2,879	0.061	0.080	19,700	2,403	0.061	0.072	17,700	2,159	0.061	
20		0.060	20,600	2,513	0.061	0.050	17,200	2,098	0.061	0.045	15,500	1,891	0.061		
25	0.060	20,600	2,513	0.061	0.050	17,200	2,098	0.061	0.045	15,500	1,891	0.061			
30	0.036	19,600	2,391	0.061	0.030	16,300	1,989	0.061	0.027	14,700	1,793	0.061			



Ultra Micro Grain Solid Carbide End Mill



IV Tool Steels (35-45HRC)				V Hardened Steels (45-55HRC)				VI Hardened Steels (55-70HRC)				D	CR	ln
ap mm	n min ⁻¹	Vf mm/min	fz mm/t	ap mm	n min ⁻¹	Vf mm/min	fz mm/t	ap mm	n min ⁻¹	Vf mm/min	fz mm/t			
0.052	43,500	2,784	0.032	0.042	38,500	2,233	0.029	0.039	36,000	1,800	0.025	1	0.1	2
0.030	39,800	2,547	0.032	0.025	35,100	2,036	0.029	0.023	32,800	1,640	0.025			4
0.019	32,200	2,061	0.032	0.016	28,400	1,647	0.029	0.014	26,500	1,325	0.025			6
0.019	28,600	1,830	0.032	0.016	25,300	1,467	0.029	0.014	23,600	1,180	0.025			8
0.012	25,100	1,606	0.032	0.010	22,100	1,282	0.029	0.009	20,600	1,030	0.025			10
0.012	22,300	1,115	0.025	0.010	19,700	985	0.025	0.009	18,300	805	0.022			12
0.007	22,300	1,026	0.023	0.006	19,700	867	0.022	0.005	18,300	659	0.018			16
0.005	16,700	768	0.023	0.004	14,700	647	0.022	0.004	13,800	497	0.018			20
0.088	43,500	2,784	0.032	0.072	38,500	2,233	0.029	0.066	36,000	1,800	0.025			2
0.056	39,800	2,547	0.032	0.046	35,100	2,036	0.029	0.042	32,800	1,640	0.025			4
0.032	32,200	2,061	0.032	0.026	28,400	1,647	0.029	0.024	26,500	1,325	0.025			6
0.032	28,600	1,830	0.032	0.026	25,300	1,467	0.029	0.024	23,600	1,180	0.025			8
0.020	25,100	1,606	0.032	0.016	22,100	1,282	0.029	0.015	20,600	1,030	0.025			10
0.020	22,300	1,115	0.025	0.016	19,700	985	0.025	0.015	18,300	805	0.022			12
0.012	22,300	1,026	0.023	0.010	19,700	867	0.022	0.009	18,300	659	0.018			16
0.008	16,700	768	0.023	0.007	14,700	647	0.022	0.006	13,800	497	0.018			20
0.088	43,500	2,784	0.032	0.072	38,500	2,233	0.029	0.066	36,000	1,800	0.025			2
0.056	39,800	2,547	0.032	0.046	35,100	2,036	0.029	0.042	32,800	1,640	0.025			4
0.032	32,200	2,061	0.032	0.026	28,400	1,647	0.029	0.024	26,500	1,325	0.025			6
0.032	28,600	1,830	0.032	0.026	25,300	1,467	0.029	0.024	23,600	1,180	0.025			8
0.020	25,100	1,606	0.032	0.016	22,100	1,282	0.029	0.015	20,600	1,030	0.025	10		
0.020	22,300	1,115	0.025	0.016	19,700	985	0.025	0.015	18,300	805	0.022	12		
0.012	22,300	1,026	0.023	0.010	19,700	867	0.022	0.009	18,300	659	0.018	16		
0.008	16,700	768	0.023	0.007	14,700	647	0.022	0.006	13,800	497	0.018	20		
0.040	36,000	2,304	0.032	0.033	31,900	1,850	0.029	0.030	29,800	1,490	0.025	5		
0.020	25,100	1,606	0.032	0.016	22,100	1,282	0.029	0.015	20,600	1,030	0.025	10		
0.013	22,300	1,026	0.023	0.010	19,700	867	0.022	0.010	18,300	659	0.018	15		
0.008	16,700	768	0.023	0.007	14,700	647	0.022	0.006	13,800	497	0.018	20		
0.056	30,300	2,182	0.036	0.046	27,000	1,674	0.031	0.042	25,100	1,355	0.027	4		
0.052	29,300	2,110	0.036	0.042	25,900	1,606	0.031	0.039	24,000	1,296	0.027	6		
0.048	27,800	2,002	0.036	0.039	24,600	1,525	0.031	0.036	22,900	1,237	0.027	8		
0.048	22,300	1,606	0.036	0.039	19,700	1,221	0.031	0.036	18,300	988	0.027	12		
0.030	17,300	1,038	0.030	0.025	15,300	918	0.030	0.023	14,300	744	0.026	15		
0.024	17,300	969	0.028	0.020	15,300	857	0.028	0.018	14,300	658	0.023	20		
0.068	30,300	2,182	0.036	0.055	27,000	1,674	0.031	0.051	25,100	1,355	0.027	4		
0.064	29,300	2,110	0.036	0.052	25,900	1,606	0.031	0.048	24,000	1,296	0.027	6		
0.056	27,800	2,002	0.036	0.046	24,600	1,525	0.031	0.042	22,900	1,237	0.027	8		
0.052	22,300	1,606	0.036	0.042	19,700	1,221	0.031	0.039	18,300	988	0.027	12		
0.036	17,300	1,038	0.030	0.029	15,300	918	0.030	0.027	14,300	744	0.026	15		
0.028	17,300	969	0.028	0.023	15,300	857	0.028	0.021	14,300	658	0.023	20		
0.052	29,300	2,110	0.036	0.042	25,900	1,606	0.031	0.039	24,000	1,296	0.027	5		
0.048	22,300	1,606	0.036	0.039	19,700	1,221	0.031	0.036	18,300	988	0.027	10		
0.030	17,300	1,038	0.030	0.025	15,300	918	0.030	0.023	14,300	744	0.026	15		
0.024	17,300	969	0.028	0.020	15,300	857	0.028	0.018	14,300	658	0.023	20		
0.080	26,700	3,578	0.067	0.065	23,600	2,549	0.054	0.060	22,100	2,077	0.047	4		
0.064	25,500	3,417	0.067	0.052	22,500	2,430	0.054	0.048	21,000	1,974	0.047	6		
0.056	23,200	3,109	0.067	0.046	20,500	2,214	0.054	0.042	19,100	1,795	0.047	8		
0.032	18,800	2,294	0.061	0.026	16,600	1,793	0.054	0.024	15,500	1,457	0.047	12		
0.032	16,700	2,037	0.061	0.026	14,700	1,588	0.054	0.024	13,800	1,297	0.047	16		
0.028	14,600	1,781	0.061	0.023	12,900	1,238	0.048	0.021	12,000	1,008	0.042	20		
0.020	14,600	1,781	0.061	0.016	12,900	1,238	0.048	0.015	12,000	1,008	0.042	25		
0.014	13,900	1,696	0.061	0.011	12,300	1,181	0.048	0.010	11,400	958	0.042	30		
0.160	26,700	3,578	0.067	0.130	23,600	2,549	0.054	0.120	22,100	2,077	0.047	4		
0.136	25,500	3,417	0.067	0.111	22,500	2,430	0.054	0.102	21,000	1,974	0.047	6		
0.112	23,200	3,109	0.067	0.091	20,500	2,214	0.054	0.084	19,100	1,795	0.047	8		
0.064	18,800	2,294	0.061	0.052	16,600	1,793	0.054	0.048	15,500	1,457	0.047	12		
0.064	16,700	2,037	0.061	0.052	14,700	1,588	0.054	0.048	13,800	1,297	0.047	16		
0.040	14,600	1,781	0.061	0.033	12,900	1,238	0.048	0.030	12,000	1,008	0.042	20		
0.040	14,600	1,781	0.061	0.033	12,900	1,238	0.048	0.030	12,000	1,008	0.042	25		
0.024	13,900	1,696	0.061	0.020	12,300	1,181	0.048	0.018	11,400	958	0.042	30		

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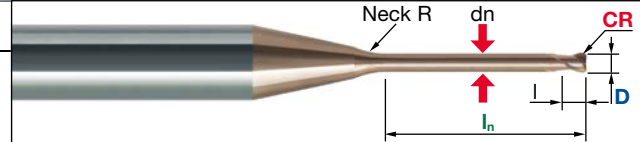
Ultra Micro Grain Solid Carbide End Mill

EPDRE-ATH | High Efficiency Cutting Conditions

D	Workpiece Material		I				II				III			
	CR	l _n	Copper				Carbon Steels, Alloy Steels (180~250HB)				Tool Steels (25~35HRC)			
			a _p mm	n min ⁻¹	V _f mm/min	f _z mm/t	a _p mm	n min ⁻¹	V _f mm/min	f _z mm/t	a _p mm	n min ⁻¹	V _f mm/min	f _z mm/t
2.5	0.2	10	0.084	26,500	3,551	0.067	0.070	22,100	2,696	0.061	0.063	19,900	2,428	0.061
		20	0.048	20,600	2,760	0.067	0.040	17,200	2,098	0.061	0.036	15,500	1,891	0.061
		30	0.030	19,600	2,391	0.061	0.025	16,300	1,989	0.061	0.023	14,700	1,793	0.061
	0.5	10	0.144	26,500	3,551	0.067	0.120	22,100	2,696	0.061	0.108	19,900	2,428	0.061
		20	0.096	20,600	2,760	0.067	0.080	17,200	2,098	0.061	0.072	15,500	1,891	0.061
		30	0.060	19,600	2,391	0.061	0.050	16,300	1,989	0.061	0.045	14,700	1,793	0.061
3	0.2	8	0.108	25,000	4,200	0.084	0.090	20,800	3,494	0.084	0.081	18,700	3,142	0.084
		12	0.084	25,000	4,200	0.084	0.070	20,800	3,494	0.084	0.063	18,700	3,142	0.084
		16	0.060	25,000	4,200	0.084	0.050	20,800	3,494	0.084	0.045	18,700	3,142	0.084
		20	0.060	20,200	3,394	0.084	0.050	16,800	2,822	0.084	0.045	15,200	2,554	0.084
		30	0.048	15,700	2,386	0.076	0.040	13,100	1,991	0.076	0.036	11,800	1,794	0.076
		35	0.042	15,700	2,386	0.076	0.035	13,100	1,991	0.076	0.032	11,800	1,794	0.076
	0.5	8	0.216	25,000	4,200	0.084	0.180	20,800	3,494	0.084	0.162	18,700	3,142	0.084
		12	0.156	25,000	4,200	0.084	0.130	20,800	3,494	0.084	0.117	18,700	3,142	0.084
		16	0.120	25,000	4,200	0.084	0.100	20,800	3,494	0.084	0.090	18,700	3,142	0.084
		20	0.120	20,200	3,394	0.084	0.100	16,800	2,822	0.084	0.090	15,200	2,554	0.084
		30	0.096	15,700	2,386	0.076	0.080	13,100	1,991	0.076	0.072	11,800	1,794	0.076
		35	0.078	15,700	2,386	0.076	0.065	13,100	1,991	0.076	0.059	11,800	1,794	0.076
		12	0.420	21,500	4,472	0.104	0.350	17,900	3,723	0.104	0.315	16,100	3,349	0.104
		16	0.300	17,900	3,723	0.104	0.250	14,900	3,099	0.104	0.225	13,100	2,725	0.104
		20	0.240	17,900	3,723	0.104	0.200	14,900	3,099	0.104	0.180	13,100	2,725	0.104
		24	0.210	17,900	3,723	0.104	0.175	14,900	3,099	0.104	0.158	13,100	2,725	0.104
		30	0.180	14,300	2,688	0.094	0.150	11,900	2,237	0.094	0.135	10,700	2,012	0.094
		36	0.120	14,300	2,688	0.094	0.100	11,900	2,237	0.094	0.090	10,700	2,012	0.094
45	0.060	11,400	1,710	0.075	0.050	9,500	1,425	0.075	0.045	8,600	1,290	0.075		
4	1	12	0.480	21,500	4,472	0.104	0.400	17,900	3,723	0.104	0.360	16,100	3,349	0.104
		16	0.348	17,900	3,723	0.104	0.290	14,900	3,099	0.104	0.261	13,100	2,725	0.104
		20	0.276	17,900	3,723	0.104	0.230	14,900	3,099	0.104	0.207	13,100	2,725	0.104
		24	0.240	17,900	3,723	0.104	0.200	14,900	3,099	0.104	0.180	13,100	2,725	0.104
		30	0.204	14,300	2,688	0.094	0.170	11,900	2,237	0.094	0.153	10,700	2,012	0.094
		36	0.144	14,300	2,688	0.094	0.120	11,900	2,237	0.094	0.108	10,700	2,012	0.094
	45	0.072	11,400	1,710	0.075	0.060	9,500	1,425	0.075	0.054	8,600	1,290	0.075	
	0.5	20	0.420	17,100	4,446	0.130	0.350	14,300	3,718	0.130	0.315	12,800	3,328	0.130
		40	0.162	15,400	3,604	0.117	0.135	12,900	3,019	0.117	0.122	11,600	2,714	0.117
		20	0.480	17,100	4,446	0.130	0.400	14,300	3,718	0.130	0.360	12,800	3,328	0.130
		40	0.180	15,400	3,604	0.117	0.150	12,900	3,019	0.117	0.135	11,600	2,714	0.117
		18	0.420	14,300	4,490	0.157	0.350	11,900	3,737	0.157	0.315	10,700	3,360	0.157
24		0.348	14,300	4,490	0.157	0.290	11,900	3,737	0.157	0.261	10,700	3,360	0.157	
6	0.5	36	0.288	12,800	3,610	0.141	0.240	10,700	3,017	0.141	0.216	9,600	2,707	0.141
		54	0.198	10,000	2,820	0.141	0.165	8,300	2,341	0.141	0.149	7,500	2,115	0.141
		18	0.480	14,300	4,490	0.157	0.400	11,900	3,737	0.157	0.360	10,700	3,360	0.157
	1	24	0.420	14,300	4,490	0.157	0.350	11,900	3,737	0.157	0.315	10,700	3,360	0.157
		36	0.336	12,800	3,610	0.141	0.280	10,700	3,017	0.141	0.252	9,600	2,707	0.141



Ultra Micro Grain Solid Carbide End Mill



IV Tool Steels (35-45HRC)				V Hardened Steels (45-55HRC)				VI Hardened Steels (55-70HRC)				D	CR	ln	
ap mm	n min ⁻¹	Vf mm/min	fz mm/t	ap mm	n min ⁻¹	Vf mm/min	fz mm/t	ap mm	n min ⁻¹	Vf mm/min	fz mm/t				
0.056	18,800	2,294	0.061	0.046	16,600	1,793	0.054	0.042	15,500	1,457	0.047	2.5	0.2	10	
0.032	14,600	1,781	0.061	0.026	12,900	1,238	0.048	0.024	12,000	1,008	0.042			20	
0.020	13,900	1,696	0.061	0.016	12,300	1,181	0.048	0.015	11,400	958	0.042			30	
0.096	18,800	2,294	0.061	0.078	16,600	1,793	0.054	0.072	15,500	1,457	0.047		10		
0.064	14,600	1,781	0.061	0.052	12,900	1,238	0.048	0.048	12,000	1,008	0.042		20		
0.040	13,900	1,696	0.061	0.033	12,300	1,181	0.048	0.030	11,400	958	0.042		30		
0.072	17,700	2,974	0.084	0.059	15,600	2,090	0.067	0.054	14,600	1,723	0.059	3	0.2	8	
0.056	17,700	2,974	0.084	0.046	15,600	2,090	0.067	0.042	14,600	1,723	0.059			12	
0.040	17,700	2,974	0.084	0.033	15,600	2,090	0.067	0.030	14,600	1,723	0.059			16	
0.040	14,300	2,402	0.084	0.033	12,600	1,688	0.067	0.030	11,800	1,392	0.059		20		
0.032	11,100	1,687	0.076	0.026	9,800	1,196	0.061	0.024	9,200	975	0.053		30		
0.028	11,100	1,687	0.076	0.023	9,800	1,196	0.061	0.021	9,200	975	0.053		35		
0.144	17,700	2,974	0.084	0.117	15,600	2,090	0.067	0.108	14,600	1,723	0.059	4	0.5	8	
0.104	17,700	2,974	0.084	0.085	15,600	2,090	0.067	0.078	14,600	1,723	0.059			12	
0.080	17,700	2,974	0.084	0.065	15,600	2,090	0.067	0.060	14,600	1,723	0.059			16	
0.080	14,300	2,402	0.084	0.065	12,600	1,688	0.067	0.060	11,800	1,392	0.059		20		
0.064	11,100	1,687	0.076	0.052	9,800	1,196	0.061	0.048	9,200	975	0.053		30		
0.052	11,100	1,687	0.076	0.042	9,800	1,196	0.061	0.039	9,200	975	0.053		35		
0.280	15,200	3,162	0.104	0.228	13,500	2,241	0.083	0.210	12,600	1,840	0.073	5	0.5	12	
0.200	12,500	2,600	0.104	0.163	10,700	1,776	0.083	0.150	10,100	1,475	0.073			16	
0.160	12,500	2,600	0.104	0.130	10,700	1,776	0.083	0.120	10,100	1,475	0.073			20	
0.140	12,500	2,600	0.104	0.114	10,700	1,776	0.083	0.105	10,100	1,475	0.073		24		
0.120	10,100	1,899	0.094	0.098	8,900	1,335	0.075	0.090	8,300	1,096	0.066		30		
0.080	10,100	1,899	0.094	0.065	8,900	1,335	0.075	0.060	8,300	1,096	0.066		36		
0.040	8,100	1,215	0.075	0.033	7,100	866	0.061	0.030	6,700	697	0.052	45			
0.320	15,200	3,162	0.104	0.260	13,500	2,241	0.083	0.240	12,600	1,840	0.073	6	1	12	
0.232	12,500	2,600	0.104	0.189	10,700	1,776	0.083	0.174	10,100	1,475	0.073			16	
0.184	12,500	2,600	0.104	0.150	10,700	1,776	0.083	0.138	10,100	1,475	0.073			20	
0.160	12,500	2,600	0.104	0.130	10,700	1,776	0.083	0.120	10,100	1,475	0.073		24		
0.136	10,100	1,899	0.094	0.111	8,900	1,335	0.075	0.102	8,300	1,096	0.066		30		
0.096	10,100	1,899	0.094	0.078	8,900	1,335	0.075	0.072	8,300	1,096	0.066		36		
0.048	8,100	1,215	0.075	0.039	7,100	866	0.061	0.036	6,700	697	0.052	45			
0.280	12,100	3,146	0.130	0.228	10,700	2,226	0.104	0.210	10,000	1,820	0.091	5	0.5	20	
0.108	10,900	2,551	0.117	0.088	9,600	1,805	0.094	0.081	9,000	1,476	0.082			40	
0.320	12,100	3,146	0.130	0.260	10,700	2,226	0.104	0.240	10,000	1,820	0.091			20	
0.120	10,900	2,551	0.117	0.098	9,600	1,805	0.094	0.090	9,000	1,476	0.082		40		
0.280	10,100	3,171	0.157	0.228	8,900	2,225	0.125	0.210	8,300	1,826	0.110		6	0.5	18
0.232	10,100	3,171	0.157	0.189	8,900	2,225	0.125	0.174	8,300	1,826	0.110				24
0.192	9,100	2,566	0.141	0.156	8,000	1,808	0.113	0.144	7,500	1,485	0.099	36			
0.132	7,100	2,002	0.141	0.107	6,200	1,401	0.113	0.099	5,800	1,148	0.099	54			
0.320	10,100	3,171	0.157	0.260	8,900	2,225	0.125	0.240	8,300	1,826	0.110	18			
0.280	10,100	3,171	0.157	0.228	8,900	2,225	0.125	0.210	8,300	1,826	0.110	24			
0.224	9,100	2,566	0.141	0.182	8,000	1,808	0.113	0.168	7,500	1,485	0.099	36			

Ultra Micro Grain Solid Carbide End Mill

EPDRE-ATH | High Precision Cutting Conditions

D	CR	I _n	I				II				III				
			Copper				Carbon Steels, Alloy Steels (180~250HB)				Tool Steels (25~35HRC)				
			a _p mm	n min ⁻¹	V _f mm/min	f _z mm/t	a _p mm	n min ⁻¹	V _f mm/min	f _z mm/t	a _p mm	n min ⁻¹	V _f mm/min	f _z mm/t	
0.2	0.05	0.5	0.022	58,500	936	0.008	0.018	58,500	936	0.008	0.016	52,650	842	0.008	
		1	0.015	58,500	936	0.008	0.013	58,500	936	0.008	0.012	52,650	842	0.008	
		1.5	0.009	58,500	819	0.007	0.007	54,990	880	0.008	0.006	50,040	801	0.008	
		2	0.009	58,500	819	0.007	0.007	49,140	786	0.008	0.006	47,430	759	0.008	
	0.3	0.05	1	0.023	58,500	1,170	0.010	0.019	56,160	1,236	0.011	0.017	50,580	1,113	0.011
			2	0.013	52,650	948	0.009	0.011	45,450	818	0.009	0.010	40,950	737	0.009
			3	0.009	50,040	801	0.008	0.007	43,200	691	0.008	0.006	38,880	622	0.008
			1	0.027	53,910	1,186	0.011	0.023	44,820	986	0.011	0.021	40,410	889	0.011
	0.4	0.05	2	0.017	53,910	1,186	0.011	0.014	44,820	986	0.011	0.013	40,410	889	0.011
			3	0.015	41,220	742	0.009	0.013	34,290	617	0.009	0.012	30,960	557	0.009
			4	0.009	33,930	611	0.009	0.007	28,260	509	0.009	0.006	25,470	458	0.009
			1	0.036	53,910	1,186	0.011	0.030	44,820	986	0.011	0.027	40,410	889	0.011
0.1		2	0.031	53,910	1,186	0.011	0.025	44,820	986	0.011	0.023	40,410	889	0.011	
		3	0.017	41,220	742	0.009	0.014	34,290	617	0.009	0.013	30,960	557	0.009	
		4	0.011	33,930	611	0.009	0.009	28,260	509	0.009	0.008	25,470	458	0.009	
		1	0.032	53,910	1,186	0.011	0.027	44,820	986	0.011	0.024	40,410	889	0.011	
0.5	0.05	2	0.025	53,910	1,186	0.011	0.021	44,820	986	0.011	0.019	40,410	889	0.011	
		3	0.018	43,650	960	0.011	0.015	36,360	800	0.011	0.014	32,760	721	0.011	
		4	0.018	38,790	853	0.011	0.015	32,310	711	0.011	0.014	29,070	640	0.011	
		5	0.012	33,930	746	0.011	0.010	28,260	622	0.011	0.009	25,470	560	0.011	
		6	0.009	30,150	663	0.011	0.007	25,200	554	0.011	0.006	22,680	499	0.011	
		1	0.038	53,910	1,186	0.011	0.032	44,820	986	0.011	0.029	40,410	889	0.011	
	0.1	2	0.032	53,910	1,186	0.011	0.027	44,820	986	0.011	0.024	40,410	889	0.011	
		3	0.022	43,650	960	0.011	0.018	36,360	800	0.011	0.016	32,760	721	0.011	
		4	0.022	38,790	853	0.011	0.018	32,310	711	0.011	0.016	29,070	640	0.011	
		5	0.014	33,930	746	0.011	0.012	28,260	622	0.011	0.011	25,470	560	0.011	
		6	0.014	30,150	663	0.011	0.012	25,200	554	0.011	0.011	22,680	499	0.011	
		2	0.038	53,910	1,725	0.016	0.032	44,820	1,434	0.016	0.029	40,410	1,293	0.016	
0.6	0.1	4	0.026	43,650	1,310	0.015	0.022	36,360	1,091	0.015	0.020	32,760	983	0.015	
		6	0.016	33,930	1,018	0.015	0.014	28,260	848	0.015	0.013	25,470	764	0.015	
		8	0.014	32,310	969	0.015	0.012	26,910	807	0.015	0.011	24,210	726	0.015	
		10	0.010	28,890	809	0.014	0.008	24,030	673	0.014	0.007	21,690	607	0.014	
		4	0.032	43,650	1,310	0.015	0.026	36,360	1,091	0.015	0.023	32,760	983	0.015	
		6	0.020	33,930	1,018	0.015	0.016	28,260	848	0.015	0.014	25,470	764	0.015	
0.7	0.05	2	0.060	58,500	1,755	0.015	0.050	58,500	1,755	0.015	0.045	54,720	1,642	0.015	
		4	0.034	56,160	1,685	0.015	0.029	46,800	1,404	0.015	0.026	42,120	1,264	0.015	
		6	0.021	42,930	1,202	0.014	0.017	35,820	1,003	0.014	0.015	32,220	902	0.014	
		8	0.016	34,380	894	0.013	0.014	28,620	744	0.013	0.013	25,740	669	0.013	
		10	0.014	32,670	849	0.013	0.013	27,180	707	0.013	0.011	24,480	636	0.013	
		12	0.013	30,960	743	0.012	0.011	25,740	618	0.012	0.010	23,220	557	0.012	
	0.1	2	0.076	58,500	1,755	0.015	0.063	58,500	1,755	0.015	0.057	54,720	1,642	0.015	
		4	0.060	56,160	1,685	0.015	0.050	46,800	1,404	0.015	0.045	42,120	1,264	0.015	
		6	0.034	42,930	1,202	0.014	0.029	35,820	1,003	0.014	0.026	32,220	902	0.014	
		8	0.020	34,380	894	0.013	0.016	28,620	744	0.013	0.014	25,740	669	0.013	
		10	0.018	32,670	849	0.013	0.015	27,180	707	0.013	0.014	24,480	636	0.013	
		12	0.016	30,960	743	0.012	0.014	25,740	618	0.012	0.013	23,220	557	0.012	
0.8	0.2	4	0.070	50,580	2,529	0.025	0.059	42,120	2,106	0.025	0.053	37,890	1,895	0.025	
		8	0.038	36,360	1,600	0.022	0.032	30,330	1,335	0.022	0.029	27,270	1,200	0.022	



Note: For finishing and precise tool definition for the CAM system please download DXF data (QuickFinder), or contact your local Hitachi Tool staff for more details.

Nota: Per lavorazioni di finitura e per una precisa e corretta definizione del profilo dell'utensile per l'utilizzo CAM si prega di richiedere file DXF tramite QuickFinder o rivolgendosi al personale Hitachi Tool.

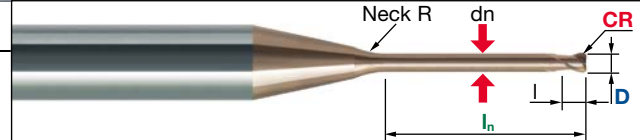
Remarque: Pour les opérations de finition et une définition précise de l'outil dans votre système FAO, demandez nous le fichier DXF des outils, téléchargez les via notre logiciel QuickFinder, ou contactez votre interlocuteur commercial pour plus de détails.

Achtung: Bitte laden Sie sich für die Schlichtbearbeitung und die präzise Definition der Werkzeuge die DXF Daten herunter (QuickFinder) oder wenden Sie sich an Ihren Hitachi Anwendungstechniker.

Nota: En procesos de acabado y para una más precisa definición de la herramienta en el sistema de CAM por favor solicite los ficheros DXF (QuickFinder), o póngase en contacto con Hitachi Tool para obtener más detalles.

Nota: Para o acabamento e precisão assim como melhor definição da ferramenta para o sistema CAM por favor solicite dados DXF (QuickFinder), ou entre em contato com sua equipe de ferramentas Hitachi local para obter mais detalhes.

Ultra Micro Grain Solid Carbide End Mill



IV Tool Steels (35-45HRC)				V Hardened Steels (45-55HRC)				VI Hardened Steels (55-70HRC)				Workpiece Material		
a_p mm	n min^{-1}	V_f mm/min	f_z mm/t	a_p mm	n min^{-1}	V_f mm/min	f_z mm/t	a_p mm	n min^{-1}	V_f mm/min	f_z mm/t	D	CR	l_n
0.014	49,770	697	0.007	0.012	43,920	527	0.006	0.011	40,950	491	0.006	0.2	0.05	0.5
0.010	49,770	697	0.007	0.008	43,920	527	0.006	0.007	40,950	491	0.006			1
0.005	47,250	662	0.007	0.005	41,670	500	0.006	0.005	38,880	467	0.006			1.5
0.005	44,730	626	0.007	0.005	39,510	474	0.006	0.005	36,900	443	0.006	0.3	0.05	2
0.015	47,700	763	0.008	0.013	42,120	505	0.006	0.012	39,330	472	0.006			1
0.009	38,700	619	0.008	0.007	34,110	409	0.006	0.006	31,860	382	0.006			2
0.005	36,720	514	0.007	0.005	32,400	389	0.006	0.005	30,240	302	0.005	0.4	0.05	3
0.018	37,710	830	0.011	0.014	33,660	606	0.009	0.014	31,230	500	0.008			1
0.012	37,710	679	0.009	0.009	33,660	539	0.008	0.009	31,230	437	0.007			2
0.010	28,890	462	0.008	0.008	25,740	412	0.008	0.007	23,940	287	0.006	0.4	0.1	3
0.005	23,760	380	0.008	0.005	21,240	340	0.008	0.005	19,710	237	0.006			4
0.023	37,710	830	0.011	0.019	33,660	606	0.009	0.018	31,230	500	0.008			1
0.020	37,710	679	0.009	0.016	33,660	539	0.008	0.015	31,230	437	0.007	0.5	0.05	2
0.012	28,890	462	0.008	0.009	25,740	412	0.008	0.009	23,940	287	0.006			3
0.007	23,760	380	0.008	0.006	21,240	340	0.008	0.005	19,710	237	0.006			4
0.022	37,710	830	0.011	0.018	33,660	606	0.009	0.016	31,230	500	0.008	0.5	0.05	1
0.016	37,710	830	0.011	0.014	33,660	606	0.009	0.013	31,230	500	0.008			2
0.013	30,960	619	0.010	0.010	27,270	436	0.008	0.009	25,470	357	0.007			3
0.013	27,540	551	0.010	0.010	24,300	389	0.008	0.009	22,680	363	0.008	0.6	0.1	4
0.008	24,030	481	0.010	0.006	21,240	340	0.008	0.006	19,800	317	0.008			5
0.005	21,420	343	0.008	0.005	18,900	265	0.007	0.005	17,640	212	0.006			6
0.025	37,710	830	0.011	0.021	33,660	606	0.009	0.019	31,230	500	0.008	0.6	0.1	1
0.022	37,710	830	0.011	0.018	33,660	606	0.009	0.016	31,230	500	0.008			2
0.014	30,960	619	0.010	0.012	27,270	436	0.008	0.011	25,470	357	0.007			3
0.014	27,540	551	0.010	0.012	24,300	389	0.008	0.011	22,680	363	0.008	0.7	0.1	4
0.009	24,030	481	0.010	0.007	21,240	340	0.008	0.007	19,800	317	0.008			5
0.009	21,420	343	0.008	0.007	18,900	265	0.007	0.007	17,640	212	0.006			6
0.025	37,710	980	0.013	0.021	33,660	741	0.011	0.019	31,230	625	0.010	0.7	0.1	2
0.017	30,960	805	0.013	0.014	27,270	600	0.011	0.013	25,470	458	0.009			4
0.011	24,030	625	0.013	0.009	21,240	467	0.011	0.008	19,800	356	0.009			6
0.009	22,860	594	0.013	0.007	20,160	444	0.011	0.007	18,810	339	0.009	0.8	0.2	8
0.006	20,430	490	0.012	0.005	18,000	360	0.010	0.005	16,830	269	0.008			10
0.021	30,960	805	0.013	0.017	27,270	600	0.011	0.015	25,470	458	0.009			4
0.013	24,030	625	0.013	0.011	21,240	467	0.011	0.010	19,800	356	0.009	0.8	0.2	6
0.041	51,750	1,449	0.014	0.032	45,630	1,186	0.013	0.031	42,570	937	0.011			2
0.023	39,780	1,114	0.014	0.019	35,100	913	0.013	0.017	32,760	721	0.011			4
0.014	30,420	852	0.014	0.011	26,820	697	0.013	0.010	25,020	550	0.011	0.9	0.2	6
0.011	24,390	634	0.013	0.009	21,510	473	0.011	0.008	20,070	401	0.010			8
0.010	23,130	601	0.013	0.008	20,430	449	0.011	0.007	19,080	382	0.010			10
0.009	21,870	525	0.012	0.007	19,350	426	0.011	0.006	18,000	324	0.009	0.9	0.2	12
0.050	51,750	1,449	0.014	0.041	45,630	1,186	0.013	0.038	42,570	937	0.011			2
0.041	39,780	1,114	0.014	0.032	35,100	913	0.013	0.031	32,760	721	0.011			4
0.023	30,420	852	0.014	0.019	26,820	697	0.013	0.017	25,020	550	0.011	0.9	0.2	6
0.013	24,390	634	0.013	0.011	21,510	473	0.011	0.010	20,070	401	0.010			8
0.012	23,130	601	0.013	0.010	20,430	449	0.011	0.009	19,080	382	0.010			10
0.011	21,870	525	0.012	0.009	19,350	426	0.011	0.008	18,000	324	0.009	0.9	0.2	12
0.047	35,820	1,576	0.022	0.038	31,590	1,264	0.020	0.035	29,520	1,063	0.018			4
0.025	25,740	1,133	0.022	0.021	22,770	911	0.020	0.019	21,240	765	0.018	8		



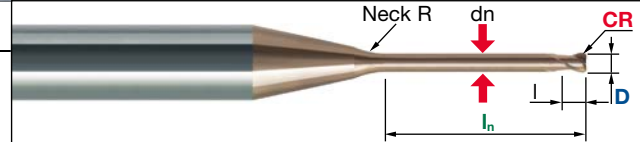
Ultra Micro Grain Solid Carbide End Mill

EPDRE-ATH | High Precision Cutting Conditions

D	CR	I _n	I				II				III			
			Copper				Carbon Steels, Alloy Steels (180~250HB)				Tool Steels (25~35HRC)			
			a _p mm	n min ⁻¹	V _f mm/min	f _z mm/t	a _p mm	n min ⁻¹	V _f mm/min	f _z mm/t	a _p mm	n min ⁻¹	V _f mm/min	f _z mm/t
1	0.1	2	0.070	55,890	2,795	0.025	0.059	46,170	2,309	0.025	0.053	41,760	2,088	0.025
		4	0.041	50,580	2,529	0.025	0.034	42,120	2,106	0.025	0.031	37,890	1,895	0.025
		6	0.026	40,950	1,802	0.022	0.022	34,110	1,501	0.022	0.020	30,690	1,350	0.022
		8	0.026	36,360	1,600	0.022	0.022	30,330	1,335	0.022	0.020	27,270	1,200	0.022
		10	0.016	31,860	1,402	0.022	0.014	26,550	1,168	0.022	0.013	23,850	1,049	0.022
		12	0.016	28,260	1,130	0.020	0.014	23,580	943	0.020	0.013	21,240	850	0.020
		16	0.010	28,260	1,017	0.018	0.008	23,580	849	0.018	0.007	21,240	765	0.018
	20	0.006	21,240	765	0.018	0.005	17,730	638	0.018	0.005	15,930	573	0.018	
	0.2	2	0.119	55,890	2,795	0.025	0.099	46,170	2,309	0.025	0.089	41,760	2,088	0.025
		4	0.076	50,580	2,529	0.025	0.063	42,120	2,106	0.025	0.057	37,890	1,895	0.025
		6	0.043	40,950	1,802	0.022	0.036	34,110	1,501	0.022	0.032	30,690	1,350	0.022
		8	0.043	36,360	1,600	0.022	0.036	30,330	1,335	0.022	0.032	27,270	1,200	0.022
		10	0.027	31,860	1,402	0.022	0.023	26,550	1,168	0.022	0.021	23,850	1,049	0.022
		12	0.027	28,260	1,130	0.020	0.023	23,580	943	0.020	0.021	21,240	850	0.020
		16	0.016	28,260	1,017	0.018	0.014	23,580	849	0.018	0.013	21,240	765	0.018
	20	0.011	21,240	765	0.018	0.009	17,730	638	0.018	0.008	15,930	573	0.018	
	0.3	2	0.119	55,890	2,795	0.025	0.099	46,170	2,309	0.025	0.089	41,760	2,088	0.025
		4	0.076	50,580	2,529	0.025	0.063	42,120	2,106	0.025	0.057	37,890	1,895	0.025
		6	0.043	40,950	1,802	0.022	0.036	34,110	1,501	0.022	0.032	30,690	1,350	0.022
		8	0.043	36,360	1,600	0.022	0.036	30,330	1,335	0.022	0.032	27,270	1,200	0.022
		10	0.027	31,860	1,402	0.022	0.023	26,550	1,168	0.022	0.021	23,850	1,049	0.022
		12	0.027	28,260	1,130	0.020	0.023	23,580	943	0.020	0.021	21,240	850	0.020
		16	0.016	28,260	1,017	0.018	0.014	23,580	849	0.018	0.013	21,240	765	0.018
	20	0.011	21,240	765	0.018	0.009	17,730	638	0.018	0.008	15,930	573	0.018	
1.25	0.2	5	0.054	46,620	2,331	0.025	0.045	37,260	1,863	0.025	0.041	34,290	1,715	0.025
		10	0.027	31,860	1,402	0.022	0.023	30,330	1,335	0.022	0.021	23,850	1,049	0.022
		15	0.017	28,260	1,017	0.018	0.014	23,580	849	0.018	0.013	21,240	765	0.018
		20	0.011	21,240	765	0.018	0.009	17,730	638	0.018	0.008	15,930	573	0.018
		4	0.076	38,880	2,100	0.027	0.063	32,400	1,750	0.027	0.057	29,160	1,575	0.027
1.5	0.2	6	0.070	37,260	2,012	0.027	0.059	31,050	1,677	0.027	0.053	27,810	1,502	0.027
		8	0.065	35,370	1,910	0.027	0.054	29,520	1,594	0.027	0.049	26,550	1,434	0.027
		12	0.065	28,260	1,526	0.027	0.054	23,580	1,273	0.027	0.049	21,240	1,147	0.027
		15	0.041	22,050	1,103	0.025	0.034	18,360	918	0.025	0.031	16,470	824	0.025
	20	0.032	22,050	970	0.022	0.027	18,360	808	0.022	0.024	16,470	725	0.022	
	0.5	4	0.092	38,880	2,100	0.027	0.077	32,400	1,750	0.027	0.069	29,160	1,575	0.027
		6	0.086	37,260	2,012	0.027	0.072	31,050	1,677	0.027	0.065	27,810	1,502	0.027
8		0.076	35,370	1,910	0.027	0.063	29,520	1,594	0.027	0.057	26,550	1,434	0.027	
1.75	0.2	12	0.070	28,260	1,526	0.027	0.059	23,580	1,273	0.027	0.053	21,240	1,147	0.027
		15	0.041	22,050	1,103	0.025	0.034	18,360	918	0.025	0.031	16,470	824	0.025
		20	0.032	22,050	970	0.022	0.027	18,360	808	0.022	0.024	16,470	725	0.022
		4	0.108	33,570	3,156	0.047	0.090	28,350	2,665	0.047	0.081	25,560	2,403	0.047
		6	0.086	32,400	3,046	0.047	0.072	27,000	2,538	0.047	0.065	24,300	2,284	0.047
2	0.2	8	0.076	29,520	2,775	0.047	0.063	24,570	2,310	0.047	0.057	22,140	2,081	0.047
		12	0.043	23,850	2,051	0.043	0.036	19,890	1,711	0.043	0.032	17,910	1,540	0.043
		16	0.043	21,240	1,827	0.043	0.036	17,730	1,525	0.043	0.032	15,930	1,370	0.043
		20	0.038	18,540	1,594	0.043	0.032	15,480	1,331	0.043	0.029	13,950	1,200	0.043
		25	0.027	18,540	1,594	0.043	0.023	15,480	1,331	0.043	0.021	13,950	1,200	0.043
		30	0.018	17,640	1,517	0.043	0.015	14,670	1,262	0.043	0.014	13,230	1,138	0.043
	0.5	4	0.216	33,570	3,156	0.047	0.180	28,350	2,665	0.047	0.162	25,560	2,403	0.047
		6	0.184	32,400	3,046	0.047	0.153	27,000	2,538	0.047	0.138	24,300	2,284	0.047
		8	0.151	29,520	2,775	0.047	0.126	24,570	2,310	0.047	0.113	22,140	2,081	0.047
		12	0.086	23,850	2,051	0.043	0.072	19,890	1,711	0.043	0.065	17,910	1,540	0.043
0.5	16	0.086	21,240	1,827	0.043	0.072	17,730	1,525	0.043	0.065	15,930	1,370	0.043	
	20	0.054	18,540	1,594	0.043	0.045	15,480	1,331	0.043	0.041	13,950	1,200	0.043	
	25	0.054	18,540	1,594	0.043	0.045	15,480	1,331	0.043	0.041	13,950	1,200	0.043	
	30	0.032	17,640	1,517	0.043	0.027	14,670	1,262	0.043	0.024	13,230	1,138	0.043	



Ultra Micro Grain Solid Carbide End Mill



IV Tool Steels (35-45HRC)				V Hardened Steels (45-55HRC)				VI Hardened Steels (55-70HRC)				Workpiece Material			
a_p mm	n min^{-1}	V_f mm/min	f_z mm/t	a_p mm	n min^{-1}	V_f mm/min	f_z mm/t	a_p mm	n min^{-1}	V_f mm/min	f_z mm/t	D	CR	l_n	
0.047	39,150	1,723	0.022	0.038	34,650	1,386	0.020	0.035	32,400	1,166	0.018	1	0.1	2	
0.027	35,820	1,576	0.022	0.023	31,590	1,264	0.020	0.021	29,520	1,063	0.018			4	
0.017	28,980	1,275	0.022	0.014	25,560	1,022	0.020	0.013	23,850	859	0.018			6	
0.017	25,740	1,133	0.022	0.014	22,770	911	0.020	0.013	21,240	765	0.018			8	
0.011	22,590	994	0.022	0.009	19,890	796	0.020	0.008	18,540	667	0.018			10	
0.011	20,070	723	0.018	0.009	17,730	638	0.018	0.008	16,470	494	0.015			12	
0.006	20,070	642	0.016	0.005	17,730	532	0.015	0.005	16,470	428	0.013			16	
0.005	15,030	481	0.016	0.004	13,230	397	0.015	0.004	12,420	323	0.013			20	
0.079	39,150	1,723	0.022	0.065	34,650	1,386	0.020	0.059	32,400	1,166	0.018			2	
0.050	35,820	1,576	0.022	0.041	31,590	1,264	0.020	0.038	29,520	1,063	0.018			4	
0.029	28,980	1,275	0.022	0.023	25,560	1,022	0.020	0.022	23,850	859	0.018		6		
0.029	25,740	1,133	0.022	0.023	22,770	911	0.020	0.022	21,240	765	0.018		8		
0.018	22,590	994	0.022	0.014	19,890	796	0.020	0.014	18,540	667	0.018		10		
0.018	20,070	723	0.018	0.014	17,730	638	0.018	0.014	16,470	494	0.015		12		
0.011	20,070	642	0.016	0.009	17,730	532	0.015	0.008	16,470	428	0.013		16		
0.007	15,030	481	0.016	0.006	13,230	397	0.015	0.005	12,420	323	0.013		20		
0.079	39,150	1,723	0.022	0.065	34,650	1,386	0.020	0.059	32,400	1,166	0.018		1.25	0.2	2
0.050	35,820	1,576	0.022	0.041	31,590	1,264	0.020	0.038	29,520	1,063	0.018				4
0.029	28,980	1,275	0.022	0.023	25,560	1,022	0.020	0.022	23,850	859	0.018				6
0.029	25,740	1,133	0.022	0.023	22,770	911	0.020	0.022	21,240	765	0.018				8
0.018	22,590	994	0.022	0.014	19,890	796	0.020	0.014	18,540	667	0.018	10			
0.018	20,070	723	0.018	0.014	17,730	638	0.018	0.014	16,470	494	0.015	12			
0.011	20,070	642	0.016	0.009	17,730	532	0.015	0.008	16,470	428	0.013	16			
0.007	15,030	481	0.016	0.006	13,230	397	0.015	0.005	12,420	323	0.013	20			
0.036	32,400	1,426	0.022	0.030	28,710	1,148	0.020	0.027	26,820	966	0.018	1.5		0.2	5
0.018	22,590	994	0.022	0.014	19,890	796	0.020	0.014	18,540	667	0.018				10
0.012	20,070	642	0.016	0.009	17,730	532	0.015	0.009	16,470	428	0.013		15		
0.007	15,030	481	0.016	0.006	13,230	397	0.015	0.005	12,420	323	0.013		20		
0.050	27,270	1,364	0.025	0.041	24,300	1,069	0.022	0.038	22,590	858	0.019		4		
0.047	26,370	1,319	0.025	0.038	23,310	1,026	0.022	0.035	21,600	821	0.019		6		
0.043	25,020	1,251	0.025	0.035	22,140	974	0.022	0.032	20,610	783	0.019		8		
0.043	20,070	1,004	0.025	0.035	17,730	780	0.022	0.032	16,470	626	0.019		12		
0.027	15,570	654	0.021	0.023	13,770	578	0.021	0.021	12,870	463	0.018		15		
0.022	15,570	623	0.020	0.018	13,770	551	0.020	0.016	12,870	412	0.016		20		
0.061	27,270	1,364	0.025	0.050	24,300	1,069	0.022	0.046	22,590	858	0.019	1.75	0.2	4	
0.058	26,370	1,319	0.025	0.047	23,310	1,026	0.022	0.043	21,600	821	0.019			6	
0.050	25,020	1,251	0.025	0.041	22,140	974	0.022	0.038	20,610	783	0.019			8	
0.047	20,070	1,004	0.025	0.038	17,730	780	0.022	0.035	16,470	626	0.019			12	
0.032	15,570	654	0.021	0.026	13,770	578	0.021	0.024	12,870	463	0.018			15	
0.025	15,570	623	0.020	0.021	13,770	551	0.020	0.019	12,870	412	0.016		20		
0.047	26,370	1,319	0.025	0.038	23,310	1,026	0.022	0.035	21,600	821	0.019		2	0.2	5
0.043	20,070	1,004	0.025	0.035	17,730	780	0.022	0.032	16,470	626	0.019				10
0.027	15,570	654	0.021	0.023	13,770	578	0.021	0.021	12,870	463	0.018				15
0.022	15,570	623	0.020	0.018	13,770	551	0.020	0.016	12,870	412	0.016				20
0.072	24,030	2,259	0.047	0.059	21,240	1,614	0.038	0.054	19,890	1,313	0.033	4			
0.058	22,950	2,157	0.047	0.047	20,250	1,539	0.038	0.043	18,900	1,247	0.033	6			
0.050	20,880	1,963	0.047	0.041	18,450	1,402	0.038	0.038	17,190	1,135	0.033	8			
0.029	16,920	1,455	0.043	0.023	14,940	1,135	0.038	0.022	13,950	921	0.033	12			
0.029	15,030	1,293	0.043	0.023	13,230	1,005	0.038	0.022	12,420	820	0.033	16			
0.025	13,140	1,130	0.043	0.021	11,610	789	0.034	0.019	10,800	626	0.029	20			
0.018	13,140	1,130	0.043	0.014	11,610	789	0.034	0.014	10,800	626	0.029	25			
0.013	12,510	1,076	0.043	0.010	11,070	753	0.034	0.009	10,260	595	0.029	30			
0.144	24,030	2,259	0.047	0.117	21,240	1,614	0.038	0.108	19,890	1,313	0.033	2	0.5	4	
0.122	22,950	2,157	0.047	0.100	20,250	1,539	0.038	0.092	18,900	1,247	0.033			6	
0.101	20,880	1,963	0.047	0.082	18,450	1,402	0.038	0.076	17,190	1,135	0.033			8	
0.058	16,920	1,455	0.043	0.047	14,940	1,135	0.038	0.043	13,950	921	0.033			12	
0.058	15,030	1,293	0.043	0.047	13,230	1,005	0.038	0.043	12,420	820	0.033		16		
0.036	13,140	1,130	0.043	0.030	11,610	789	0.034	0.027	10,800	626	0.029		20		
0.036	13,140	1,130	0.043	0.030	11,610	789	0.034	0.027	10,800	626	0.029		25		
0.022	12,510	1,076	0.043	0.018	11,070	753	0.034	0.016	10,260	595	0.029		30		



Ultra Micro Grain Solid Carbide End Mill

EPDRE-ATH | High Precision Cutting Conditions

D	Workpiece Material		I				II				III			
	CR	I _n	Copper				Carbon Steels, Alloy Steels (180~250HB)				Tool Steels (25~35HRC)			
			a _p mm	n min ⁻¹	V _f mm/min	f _z mm/t	a _p mm	n min ⁻¹	V _f mm/min	f _z mm/t	a _p mm	n min ⁻¹	V _f mm/min	f _z mm/t
2.5	0.2	10	0.076	23,850	2,242	0.047	0.063	19,890	1,711	0.043	0.057	17,910	1,540	0.043
		20	0.043	18,540	1,743	0.047	0.036	15,480	1,331	0.043	0.032	13,950	1,200	0.043
		30	0.027	17,640	1,517	0.043	0.023	14,670	1,262	0.043	0.021	13,230	1,138	0.043
	0.5	10	0.130	23,850	2,242	0.047	0.108	19,890	1,711	0.043	0.097	17,910	1,540	0.043
		20	0.086	18,540	1,743	0.047	0.072	15,480	1,331	0.043	0.065	13,950	1,200	0.043
		30	0.054	17,640	1,517	0.043	0.045	14,670	1,262	0.043	0.041	13,230	1,138	0.043
3	0.2	8	0.097	22,500	2,655	0.059	0.081	18,720	2,209	0.059	0.073	16,830	1,986	0.059
		12	0.076	22,500	2,655	0.059	0.063	18,720	2,209	0.059	0.057	16,830	1,986	0.059
		16	0.054	22,500	2,655	0.059	0.045	18,720	2,209	0.059	0.041	16,830	1,986	0.059
		20	0.054	18,180	2,145	0.059	0.045	15,120	1,784	0.059	0.041	13,680	1,614	0.059
		30	0.043	14,130	1,498	0.053	0.036	11,790	1,250	0.053	0.032	10,620	1,126	0.053
		35	0.038	14,130	1,498	0.053	0.032	11,790	1,250	0.053	0.029	10,620	1,126	0.053
	0.5	8	0.194	22,500	2,655	0.059	0.162	18,720	2,209	0.059	0.146	16,830	1,986	0.059
		12	0.140	22,500	2,655	0.059	0.117	18,720	2,209	0.059	0.105	16,830	1,986	0.059
		16	0.108	22,500	2,655	0.059	0.090	18,720	2,209	0.059	0.081	16,830	1,986	0.059
		20	0.108	18,180	2,145	0.059	0.090	15,120	1,784	0.059	0.081	13,680	1,614	0.059
		30	0.086	14,130	1,498	0.053	0.072	11,790	1,250	0.053	0.065	10,620	1,126	0.053
		35	0.070	14,130	1,498	0.053	0.059	11,790	1,250	0.053	0.053	10,620	1,126	0.053
4	0.5	12	0.378	19,350	2,825	0.073	0.315	16,110	2,352	0.073	0.284	14,490	2,116	0.073
		16	0.270	16,110	2,352	0.073	0.225	13,410	1,958	0.073	0.203	11,790	1,721	0.073
		20	0.216	16,110	2,352	0.073	0.180	13,410	1,958	0.073	0.162	11,790	1,721	0.073
		24	0.189	16,110	2,352	0.073	0.158	13,410	1,958	0.073	0.142	11,790	1,721	0.073
		30	0.162	12,870	1,699	0.066	0.135	10,710	1,414	0.066	0.122	9,630	1,271	0.066
		36	0.108	12,870	1,699	0.066	0.090	10,710	1,414	0.066	0.081	9,630	1,271	0.066
	1	45	0.054	10,260	1,088	0.053	0.045	8,550	906	0.053	0.041	7,740	820	0.053
		12	0.432	19,350	2,825	0.073	0.360	16,110	2,352	0.073	0.324	14,490	2,116	0.073
		16	0.313	16,110	2,352	0.073	0.261	13,410	1,958	0.073	0.235	11,790	1,721	0.073
		20	0.248	16,110	2,352	0.073	0.207	13,410	1,958	0.073	0.186	11,790	1,721	0.073
		24	0.216	16,110	2,352	0.073	0.180	13,410	1,958	0.073	0.162	11,790	1,721	0.073
		30	0.184	12,870	1,699	0.066	0.153	10,710	1,414	0.066	0.138	9,630	1,271	0.066
5	0.5	36	0.130	12,870	1,699	0.066	0.108	10,710	1,414	0.066	0.097	9,630	1,271	0.066
		45	0.065	10,260	1,088	0.053	0.054	8,550	906	0.053	0.049	7,740	820	0.053
		20	0.378	15,390	2,801	0.091	0.315	12,870	2,342	0.091	0.284	11,520	2,097	0.091
		40	0.146	13,860	2,273	0.082	0.122	11,610	1,904	0.082	0.110	10,440	1,712	0.082
		20	0.432	15,390	2,801	0.091	0.360	12,870	2,342	0.091	0.324	11,520	2,097	0.091
		40	0.162	13,860	2,273	0.082	0.135	11,610	1,904	0.082	0.122	10,440	1,712	0.082
	0.5	18	0.378	12,870	2,831	0.110	0.315	10,710	2,356	0.110	0.284	9,630	2,119	0.110
		24	0.313	12,870	2,831	0.110	0.261	10,710	2,356	0.110	0.235	9,630	2,119	0.110
		36	0.259	11,520	2,281	0.099	0.216	9,630	1,907	0.099	0.194	8,640	1,711	0.099
		54	0.178	9,000	1,782	0.099	0.149	7,470	1,479	0.099	0.134	6,750	1,337	0.099
		18	0.432	12,870	2,831	0.110	0.360	10,710	2,356	0.110	0.324	9,630	2,119	0.110
		24	0.378	12,870	2,831	0.110	0.315	10,710	2,356	0.110	0.284	9,630	2,119	0.110
6	1	36	0.302	11,520	2,281	0.099	0.252	9,630	1,907	0.099	0.227	8,640	1,711	0.099



UK Note: For finishing and precise tool definition for the CAM system please download DXF data (QuickFinder), or contact your local Hitachi Tool staff for more details.

IT Nota: Per lavorazioni di finitura e per una precisa e corretta definizione del profilo dell'utensile per l'utilizzo CAM si prega di richiedere file DXF tramite QuickFinder o rivolgendosi al personale Hitachi Tool.

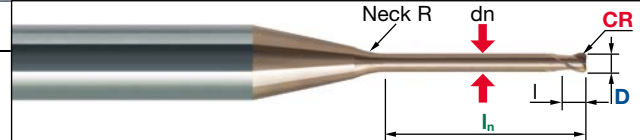
FR Remarque: Pour les opérations de finition et une définition précise de l'outil dans votre système FAO, demandez nous le fichier DXF des outils, téléchargez les via notre logiciel QuickFinder, ou contactez votre interlocuteur commercial pour plus de détails.

DE Achtung: Bitte laden Sie sich für die Schlichtbearbeitung und die präzise Definition der Werkzeuge die DXF Daten herunter (QuickFinder) oder wenden Sie sich an Ihren Hitachi Anwendungstechniker.

ES Nota: En procesos de acabado y para una más precisa definición de la herramienta en el sistema de CAM por favor solicite los ficheros DXF (QuickFinder), o póngase en contacto con Hitachi Tool para obtener más detalles.

PT Nota: Para o acabamento e precisão assim como melhor definição da ferramenta para o sistema CAM por favor solicitar dados DXF (QuickFinder), ou entre em contato com sua equipe de ferramentas Hitachi local para obter mais detalhes.

Ultra Micro Grain Solid Carbide End Mill



IV Tool Steels (35-45HRC)				V Hardened Steels (45-55HRC)				VI Hardened Steels (55-70HRC)				Workpiece Material				
a _p mm	n min ⁻¹	V _f mm/min	f _z mm/t	a _p mm	n min ⁻¹	V _f mm/min	f _z mm/t	a _p mm	n min ⁻¹	V _f mm/min	f _z mm/t	D	CR	l _n		
0.050	16,920	1,455	0.043	0.041	14,940	1,135	0.038	0.038	13,950	921	0.033	2.5	0.2	10		
0.029	13,140	1,130	0.043	0.023	11,610	789	0.034	0.022	10,800	626	0.029			20		
0.018	12,510	1,076	0.043	0.014	11,070	753	0.034	0.014	10,260	595	0.029			30		
0.086	16,920	1,455	0.043	0.070	14,940	1,135	0.038	0.065	13,950	921	0.033		0.5	10		
0.058	13,140	1,130	0.043	0.047	11,610	789	0.034	0.043	10,800	626	0.029			20		
0.036	12,510	1,076	0.043	0.030	11,070	753	0.034	0.027	10,260	595	0.029			30		
0.065	15,930	1,880	0.059	0.053	14,040	1,320	0.047	0.049	13,140	1,077	0.041	3	0.2	8		
0.050	15,930	1,880	0.059	0.041	14,040	1,320	0.047	0.038	13,140	1,077	0.041			12		
0.036	15,930	1,880	0.059	0.030	14,040	1,320	0.047	0.027	13,140	1,077	0.041			16		
0.036	12,870	1,519	0.059	0.030	11,340	1,066	0.047	0.027	10,620	871	0.041			20		
0.029	9,990	1,059	0.053	0.023	8,820	759	0.043	0.022	8,280	613	0.037			30		
0.025	9,990	1,059	0.053	0.021	8,820	759	0.043	0.019	8,280	613	0.037			35		
0.130	15,930	1,880	0.059	0.105	14,040	1,320	0.047	0.097	13,140	1,077	0.041		0.5	8		
0.094	15,930	1,880	0.059	0.077	14,040	1,320	0.047	0.070	13,140	1,077	0.041			12		
0.072	15,930	1,880	0.059	0.059	14,040	1,320	0.047	0.054	13,140	1,077	0.041			16		
0.072	12,870	1,519	0.059	0.059	11,340	1,066	0.047	0.054	10,620	871	0.041			20		
0.058	9,990	1,059	0.053	0.047	8,820	759	0.043	0.043	8,280	613	0.037			30		
0.047	9,990	1,059	0.053	0.038	8,820	759	0.043	0.035	8,280	613	0.037			35		
0.252	13,680	1,997	0.073	0.205	12,150	1,409	0.058	0.189	11,340	1,157	0.051	4	0.5	12		
0.180	11,250	1,643	0.073	0.147	9,630	1,117	0.058	0.135	9,090	927	0.051			16		
0.144	11,250	1,643	0.073	0.117	9,630	1,117	0.058	0.108	9,090	927	0.051			20		
0.126	11,250	1,643	0.073	0.103	9,630	1,117	0.058	0.095	9,090	927	0.051			24		
0.108	9,090	1,200	0.066	0.088	8,010	849	0.053	0.081	7,470	687	0.046			30		
0.072	9,090	1,200	0.066	0.059	8,010	849	0.053	0.054	7,470	687	0.046			36		
0.036	7,290	773	0.053	0.030	6,390	550	0.043	0.027	6,030	434	0.036			45		
0.288	13,680	1,997	0.073	0.234	12,150	1,409	0.058	0.216	11,340	1,157	0.051			1	12	
0.209	11,250	1,643	0.073	0.170	9,630	1,117	0.058	0.157	9,090	927	0.051				16	
0.166	11,250	1,643	0.073	0.135	9,630	1,117	0.058	0.124	9,090	927	0.051		20			
0.144	11,250	1,643	0.073	0.117	9,630	1,117	0.058	0.108	9,090	927	0.051		24			
0.122	9,090	1,200	0.066	0.100	8,010	849	0.053	0.092	7,470	687	0.046		30			
0.086	9,090	1,200	0.066	0.070	8,010	849	0.053	0.065	7,470	687	0.046		36			
0.043	7,290	773	0.053	0.035	6,390	550	0.043	0.032	6,030	434	0.036		45			
0.252	10,890	1,982	0.091	0.205	9,630	1,406	0.073	0.189	9,000	1,152	0.064		5		0.5	20
0.097	9,810	1,609	0.082	0.079	8,640	1,140	0.066	0.073	8,100	923	0.057					40
0.288	10,890	1,982	0.091	0.234	9,630	1,406	0.073	0.216	9,000	1,152	0.064			1		20
0.108	9,810	1,609	0.082	0.088	8,640	1,140	0.066	0.081	8,100	923	0.057				40	
0.252	9,090	2,000	0.110	0.205	8,010	1,410	0.088	0.189	7,470	1,150	0.077	6			0.5	18
0.209	9,090	2,000	0.110	0.170	8,010	1,410	0.088	0.157	7,470	1,150	0.077			24		
0.173	8,190	1,622	0.099	0.140	7,200	1,138	0.079	0.130	6,750	932	0.069		36			
0.119	6,390	1,265	0.099	0.096	5,580	882	0.079	0.089	5,220	720	0.069		54			
0.288	9,090	2,000	0.110	0.234	8,010	1,410	0.088	0.216	7,470	1,150	0.077		1	18		
0.252	9,090	2,000	0.110	0.205	8,010	1,410	0.088	0.189	7,470	1,150	0.077			24		
0.202	8,190	1,622	0.099	0.164	7,200	1,138	0.079	0.151	6,750	932	0.069	36				

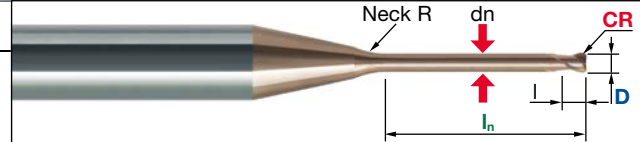
Ultra Micro Grain Solid Carbide End Mill

EPDRE-ATH | High Efficiency Cutting Conditions for Rib Application

Workpiece Material		I					II				III				
		Copper					Carbon Steels, Alloy Steels (180~250HB)				Tool Steels (25~35HRC)				
D	CR	l_n	a_p mm	n min ⁻¹	V_f mm/min	f_z mm/t	a_p mm	n min ⁻¹	V_f mm/min	f_z mm/t	a_p mm	n min ⁻¹	V_f mm/min	f_z mm/t	
0.2	0.05	0.5	0.020	58,500	1,053	0.009	0.017	58,500	1,053	0.009	0.015	52,650	948	0.009	
		1	0.014	58,500	1,053	0.009	0.012	58,500	1,053	0.009	0.011	52,650	948	0.009	
		1.5	0.009	58,500	1,053	0.009	0.007	54,990	990	0.009	0.006	50,040	901	0.009	
		2	0.009	58,500	1,053	0.009	0.007	49,140	885	0.009	0.006	47,430	854	0.009	
0.3	0.05	1	0.021	58,500	1,404	0.012	0.018	56,160	1,460	0.013	0.016	50,580	1,315	0.013	
		2	0.012	52,650	1,158	0.011	0.010	45,450	1,000	0.011	0.009	40,950	901	0.011	
		3	0.009	50,040	1,001	0.010	0.007	43,200	864	0.010	0.006	38,880	778	0.010	
0.4	0.05	1	0.026	53,910	1,509	0.014	0.021	44,820	1,255	0.014	0.020	40,410	1,131	0.014	
		2	0.016	53,910	1,402	0.013	0.014	44,820	1,165	0.013	0.012	40,410	1,051	0.013	
		3	0.014	41,220	907	0.011	0.012	34,290	754	0.011	0.011	30,960	681	0.011	
		4	0.009	33,930	746	0.011	0.007	28,260	622	0.011	0.006	25,470	560	0.011	
0.4	0.1	1	0.034	53,910	1,509	0.014	0.028	44,820	1,255	0.014	0.026	40,410	1,131	0.014	
		2	0.029	53,910	1,402	0.013	0.024	44,820	1,165	0.013	0.021	40,410	1,051	0.013	
		3	0.016	41,220	907	0.011	0.014	34,290	754	0.011	0.012	30,960	681	0.011	
		4	0.010	33,930	746	0.011	0.009	28,260	622	0.011	0.008	25,470	560	0.011	
0.5	0.05	1	0.031	53,910	1,509	0.014	0.026	44,820	1,255	0.014	0.023	40,410	1,131	0.014	
		2	0.024	53,910	1,509	0.014	0.020	44,820	1,255	0.014	0.018	40,410	1,131	0.014	
		3	0.017	43,650	1,222	0.014	0.014	36,360	1,018	0.014	0.013	32,760	917	0.014	
		4	0.017	38,790	1,086	0.014	0.014	32,310	905	0.014	0.013	29,070	814	0.014	
		5	0.011	33,930	950	0.014	0.009	28,260	791	0.014	0.009	25,470	713	0.014	
		6	0.009	30,150	784	0.013	0.007	25,200	655	0.013	0.006	22,680	590	0.013	
	0.5	0.1	1	0.036	53,910	1,509	0.014	0.030	44,820	1,255	0.014	0.027	40,410	1,131	0.014
			2	0.031	53,910	1,509	0.014	0.026	44,820	1,255	0.014	0.023	40,410	1,131	0.014
			3	0.020	43,650	1,222	0.014	0.017	36,360	1,018	0.014	0.015	32,760	917	0.014
			4	0.020	38,790	1,086	0.014	0.017	32,310	905	0.014	0.015	29,070	814	0.014
0.6	0.1	5	0.014	33,930	950	0.014	0.011	28,260	791	0.014	0.010	25,470	713	0.014	
		6	0.014	30,150	784	0.013	0.011	25,200	655	0.013	0.010	22,680	590	0.013	
		2	0.036	53,910	2,156	0.020	0.030	44,820	1,793	0.020	0.027	40,410	1,616	0.020	
		4	0.025	43,650	1,659	0.019	0.020	36,360	1,382	0.019	0.019	32,760	1,245	0.019	
0.7	0.1	6	0.015	33,930	1,289	0.019	0.013	28,260	1,074	0.019	0.012	25,470	968	0.019	
		8	0.014	32,310	1,228	0.019	0.011	26,910	1,023	0.019	0.010	24,210	920	0.019	
		10	0.009	28,890	982	0.017	0.008	24,030	817	0.017	0.007	21,690	737	0.017	
		4	0.030	43,650	1,659	0.019	0.025	36,360	1,382	0.019	0.022	32,760	1,245	0.019	
0.8	0.05	6	0.019	33,930	1,289	0.019	0.015	28,260	1,074	0.019	0.014	25,470	968	0.019	
		2	0.057	58,500	2,223	0.019	0.048	58,500	2,223	0.019	0.043	54,720	2,079	0.019	
		4	0.032	56,160	2,134	0.019	0.027	46,800	1,778	0.019	0.025	42,120	1,601	0.019	
		6	0.020	42,930	1,460	0.017	0.016	35,820	1,218	0.017	0.014	32,220	1,095	0.017	
		8	0.015	34,380	1,100	0.016	0.013	28,620	916	0.016	0.012	25,740	824	0.016	
		10	0.014	32,670	980	0.015	0.012	27,180	815	0.015	0.010	24,480	734	0.015	
	0.8	0.2	12	0.012	30,960	867	0.014	0.010	25,740	721	0.014	0.009	23,220	650	0.014
			2	0.071	58,500	2,223	0.019	0.060	58,500	2,223	0.019	0.054	54,720	2,079	0.019
			4	0.057	56,160	2,134	0.019	0.048	46,800	1,778	0.019	0.043	42,120	1,601	0.019
			6	0.032	42,930	1,460	0.017	0.027	35,820	1,218	0.017	0.025	32,220	1,095	0.017
			8	0.019	34,380	1,100	0.016	0.015	28,620	916	0.016	0.014	25,740	824	0.016
			10	0.017	32,670	980	0.015	0.014	27,180	815	0.015	0.013	24,480	734	0.015
0.9	0.2	12	0.015	30,960	867	0.014	0.013	25,740	721	0.014	0.012	23,220	650	0.014	
		4	0.066	50,580	3,136	0.031	0.055	42,120	2,611	0.031	0.050	37,890	2,349	0.031	
		8	0.036	36,360	1,963	0.027	0.030	30,330	1,638	0.027	0.027	27,270	1,473	0.027	



Ultra Micro Grain Solid Carbide End Mill



IV Tool Steels (35-45HRC)				V Hardened Steels (45-55HRC)				VI Hardened Steels (55-70HRC)				Workpiece Material		
a _p mm	n min ⁻¹	V _f mm/min	f _z mm/t	a _p mm	n min ⁻¹	V _f mm/min	f _z mm/t	a _p mm	n min ⁻¹	V _f mm/min	f _z mm/t	D	CR	l _n
0.014	49,770	896	0.009	0.011	43,920	703	0.008	0.010	40,950	573	0.007	0.2	0.05	0.5
0.009	49,770	896	0.009	0.008	43,920	703	0.008	0.007	40,950	573	0.007			1
0.005	47,250	851	0.009	0.004	41,670	667	0.008	0.004	38,880	544	0.007			1.5
0.005	44,730	805	0.009	0.004	39,510	632	0.008	0.004	36,900	517	0.007	0.3	0.05	2
0.014	47,700	859	0.009	0.012	42,120	674	0.008	0.011	39,330	551	0.007			1
0.009	38,700	697	0.009	0.007	34,110	546	0.008	0.006	31,860	446	0.007			2
0.005	36,720	661	0.009	0.004	32,400	454	0.007	0.004	30,240	363	0.006	0.4	0.05	3
0.017	37,710	980	0.013	0.014	33,660	741	0.011	0.013	31,230	562	0.009			1
0.011	37,710	830	0.011	0.009	33,660	673	0.010	0.009	31,230	562	0.009			2
0.009	28,890	578	0.010	0.008	25,740	463	0.009	0.007	23,940	383	0.008	0.5	0.05	3
0.005	23,760	475	0.010	0.004	21,240	382	0.009	0.004	19,710	315	0.008			4
0.022	37,710	980	0.013	0.018	33,660	741	0.011	0.017	31,230	562	0.009			1
0.019	37,710	830	0.011	0.015	33,660	673	0.010	0.014	31,230	562	0.009	0.6	0.05	2
0.011	28,890	578	0.010	0.009	25,740	463	0.009	0.009	23,940	383	0.008			3
0.007	23,760	475	0.010	0.006	21,240	382	0.009	0.005	19,710	315	0.008			4
0.020	37,710	980	0.013	0.017	33,660	741	0.011	0.015	31,230	562	0.009	0.7	0.05	1
0.015	37,710	980	0.013	0.013	33,660	741	0.011	0.012	31,230	562	0.009			2
0.012	30,960	743	0.012	0.009	27,270	545	0.010	0.009	25,470	458	0.009			3
0.012	27,540	661	0.012	0.009	24,300	486	0.010	0.009	22,680	408	0.009	0.8	0.05	4
0.008	24,030	577	0.012	0.006	21,240	425	0.010	0.006	19,800	356	0.009			5
0.005	21,420	386	0.009	0.004	18,900	340	0.009	0.004	17,640	282	0.008			6
0.024	37,710	980	0.013	0.020	33,660	741	0.011	0.018	31,230	562	0.009	0.9	0.05	1
0.020	37,710	980	0.013	0.017	33,660	741	0.011	0.015	31,230	562	0.009			2
0.014	30,960	743	0.012	0.011	27,270	545	0.010	0.010	25,470	458	0.009			3
0.014	27,540	661	0.012	0.011	24,300	486	0.010	0.010	22,680	408	0.009	0.9	0.05	4
0.009	24,030	577	0.012	0.007	21,240	425	0.010	0.007	19,800	356	0.009			5
0.009	21,420	386	0.009	0.007	18,900	340	0.009	0.007	17,640	282	0.008			6
0.024	37,710	1,131	0.015	0.020	33,660	942	0.014	0.018	31,230	750	0.012	0.9	0.05	2
0.016	30,960	929	0.015	0.014	27,270	709	0.013	0.012	25,470	560	0.011			4
0.010	24,030	721	0.015	0.009	21,240	552	0.013	0.008	19,800	436	0.011			6
0.009	22,860	686	0.015	0.007	20,160	524	0.013	0.007	18,810	414	0.011	0.9	0.05	8
0.006	20,430	572	0.014	0.005	18,000	432	0.012	0.004	16,830	337	0.010			10
0.020	30,960	929	0.015	0.016	27,270	709	0.013	0.014	25,470	560	0.011			4
0.012	24,030	721	0.015	0.010	21,240	552	0.013	0.009	19,800	436	0.011	0.9	0.05	6
0.038	51,750	1,760	0.017	0.031	45,630	1,369	0.015	0.029	42,570	1,107	0.013			2
0.022	39,780	1,353	0.017	0.018	35,100	1,053	0.015	0.016	32,760	852	0.013			4
0.013	30,420	1,034	0.017	0.010	26,820	805	0.015	0.009	25,020	651	0.013	0.9	0.05	6
0.010	24,390	780	0.016	0.009	21,510	602	0.014	0.008	20,070	482	0.012			8
0.009	23,130	694	0.015	0.008	20,430	572	0.014	0.007	19,080	458	0.012			10
0.009	21,870	612	0.014	0.007	19,350	503	0.013	0.006	18,000	396	0.011	0.9	0.05	12
0.048	51,750	1,760	0.017	0.039	45,630	1,369	0.015	0.036	42,570	1,107	0.013			2
0.038	39,780	1,353	0.017	0.031	35,100	1,053	0.015	0.029	32,760	852	0.013			4
0.022	30,420	1,034	0.017	0.018	26,820	805	0.015	0.016	25,020	651	0.013	0.9	0.05	6
0.012	24,390	780	0.016	0.010	21,510	602	0.014	0.009	20,070	482	0.012			8
0.011	23,130	694	0.015	0.009	20,430	572	0.014	0.009	19,080	458	0.012			10
0.010	21,870	612	0.014	0.009	19,350	503	0.013	0.008	18,000	396	0.011	0.9	0.05	12
0.044	35,820	1,934	0.027	0.036	31,590	1,580	0.025	0.033	29,520	1,240	0.021			4
0.024	25,740	1,390	0.027	0.020	22,770	1,139	0.025	0.018	21,240	892	0.021			8



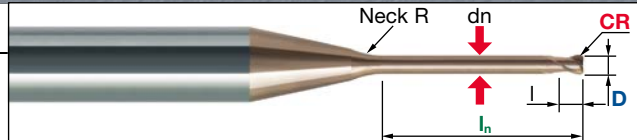
Ultra Micro Grain Solid Carbide End Mill

EPDRE-ATH | High Efficiency Cutting Conditions for Rib Application

D	CR	Workpiece Material		I				II				III			
		I _n	Copper				Carbon Steels, Alloy Steels (180~250HB)				Tool Steels (25~35HRC)				
			a _p mm	n min ⁻¹	V _f mm/min	f _z mm/t	a _p mm	n min ⁻¹	V _f mm/min	f _z mm/t	a _p mm	n min ⁻¹	V _f mm/min	f _z mm/t	
1	0.1	2	0.066	55,890	3,465	0.031	0.055	46,170	2,863	0.031	0.050	41,760	2,589	0.031	
		4	0.039	50,580	3,136	0.031	0.032	42,120	2,611	0.031	0.029	37,890	2,349	0.031	
		6	0.025	40,950	2,211	0.027	0.020	34,110	1,842	0.027	0.019	30,690	1,657	0.027	
		8	0.025	36,360	1,963	0.027	0.020	30,330	1,638	0.027	0.019	27,270	1,473	0.027	
		10	0.015	31,860	1,720	0.027	0.013	26,550	1,434	0.027	0.012	23,850	1,288	0.027	
		12	0.015	28,260	1,413	0.025	0.013	23,580	1,179	0.025	0.012	21,240	1,062	0.025	
		16	0.009	28,260	1,187	0.021	0.008	23,580	990	0.021	0.007	21,240	892	0.021	
	20	0.006	21,240	892	0.021	0.005	17,730	745	0.021	0.004	15,930	669	0.021		
	0.2	2	0.112	55,890	3,465	0.031	0.094	46,170	2,863	0.031	0.084	41,760	2,589	0.031	
		4	0.071	50,580	3,136	0.031	0.060	42,120	2,611	0.031	0.054	37,890	2,349	0.031	
		6	0.041	40,950	2,211	0.027	0.034	34,110	1,842	0.027	0.031	30,690	1,657	0.027	
		8	0.041	36,360	1,963	0.027	0.034	30,330	1,638	0.027	0.031	27,270	1,473	0.027	
		10	0.026	31,860	1,720	0.027	0.021	26,550	1,434	0.027	0.020	23,850	1,288	0.027	
		12	0.026	28,260	1,413	0.025	0.021	23,580	1,179	0.025	0.020	21,240	1,062	0.025	
		16	0.015	28,260	1,187	0.021	0.013	23,580	990	0.021	0.012	21,240	892	0.021	
	20	0.010	21,240	892	0.021	0.009	17,730	745	0.021	0.008	15,930	669	0.021		
	0.3	2	0.112	55,890	3,465	0.031	0.094	46,170	2,863	0.031	0.084	41,760	2,589	0.031	
		4	0.071	50,580	3,136	0.031	0.060	42,120	2,611	0.031	0.054	37,890	2,349	0.031	
		6	0.041	40,950	2,211	0.027	0.034	34,110	1,842	0.027	0.031	30,690	1,657	0.027	
		8	0.041	36,360	1,963	0.027	0.034	30,330	1,638	0.027	0.031	27,270	1,473	0.027	
		10	0.026	31,860	1,720	0.027	0.021	26,550	1,434	0.027	0.020	23,850	1,288	0.027	
		12	0.026	28,260	1,413	0.025	0.021	23,580	1,179	0.025	0.020	21,240	1,062	0.025	
		16	0.015	28,260	1,187	0.021	0.013	23,580	990	0.021	0.012	21,240	892	0.021	
	20	0.010	21,240	892	0.021	0.009	17,730	745	0.021	0.008	15,930	669	0.021		
1.25	0.2	5	0.051	46,620	2,890	0.031	0.043	37,260	2,310	0.031	0.038	34,290	2,126	0.031	
		10	0.026	31,860	1,720	0.027	0.021	30,330	1,638	0.027	0.020	23,850	1,288	0.027	
		15	0.016	28,260	1,187	0.021	0.014	23,580	990	0.021	0.012	21,240	892	0.021	
		20	0.010	21,240	892	0.021	0.009	17,730	745	0.021	0.008	15,930	669	0.021	
		4	0.071	38,880	2,566	0.033	0.060	32,400	2,138	0.033	0.054	29,160	1,925	0.033	
1.5	0.2	6	0.066	37,260	2,459	0.033	0.055	31,050	2,049	0.033	0.050	27,810	1,835	0.033	
		8	0.061	35,370	2,334	0.033	0.051	29,520	1,948	0.033	0.046	26,550	1,752	0.033	
		12	0.061	28,260	1,865	0.033	0.051	23,580	1,556	0.033	0.046	21,240	1,402	0.033	
		15	0.039	22,050	1,323	0.030	0.032	18,360	1,102	0.030	0.029	16,470	988	0.030	
		20	0.031	22,050	1,147	0.026	0.026	18,360	955	0.026	0.023	16,470	856	0.026	
	0.5	4	0.087	38,880	2,566	0.033	0.072	32,400	2,138	0.033	0.065	29,160	1,925	0.033	
		6	0.082	37,260	2,459	0.033	0.068	31,050	2,049	0.033	0.061	27,810	1,835	0.033	
		8	0.071	35,370	2,334	0.033	0.060	29,520	1,948	0.033	0.054	26,550	1,752	0.033	
		12	0.066	28,260	1,865	0.033	0.055	23,580	1,556	0.033	0.050	21,240	1,402	0.033	
		15	0.046	22,050	1,323	0.030	0.038	18,360	1,102	0.030	0.035	16,470	988	0.030	
20	0.036	22,050	1,147	0.026	0.030	18,360	955	0.026	0.027	16,470	856	0.026			
1.75	0.2	5	0.066	37,260	2,459	0.033	0.055	31,050	2,049	0.033	0.050	27,810	1,835	0.033	
		10	0.061	28,260	1,865	0.033	0.051	23,580	1,556	0.033	0.046	21,240	1,402	0.033	
		15	0.039	22,050	1,323	0.030	0.032	18,360	1,102	0.030	0.029	16,470	988	0.030	
		20	0.031	22,050	1,147	0.026	0.026	18,360	955	0.026	0.023	16,470	856	0.026	
		4	0.102	33,570	3,827	0.057	0.085	28,350	3,232	0.057	0.077	25,560	2,914	0.057	
2	0.2	6	0.082	32,400	3,694	0.057	0.068	27,000	3,078	0.057	0.061	24,300	2,770	0.057	
		8	0.071	29,520	3,365	0.057	0.060	24,570	2,801	0.057	0.054	22,140	2,524	0.057	
		12	0.041	23,850	2,480	0.052	0.034	19,890	2,069	0.052	0.031	17,910	1,863	0.052	
		16	0.041	21,240	2,209	0.052	0.034	17,730	1,844	0.052	0.031	15,930	1,657	0.052	
		20	0.036	18,540	1,928	0.052	0.030	15,480	1,610	0.052	0.027	13,950	1,451	0.052	
		25	0.026	18,540	1,928	0.052	0.021	15,480	1,610	0.052	0.020	13,950	1,451	0.052	
		30	0.017	17,640	1,835	0.052	0.014	14,670	1,526	0.052	0.013	13,230	1,376	0.052	
	0.5	4	0.204	33,570	3,827	0.057	0.170	28,350	3,232	0.057	0.153	25,560	2,914	0.057	
		6	0.173	32,400	3,694	0.057	0.145	27,000	3,078	0.057	0.130	24,300	2,770	0.057	
		8	0.143	29,520	3,365	0.057	0.119	24,570	2,801	0.057	0.107	22,140	2,524	0.057	
		12	0.082	23,850	2,480	0.052	0.068	19,890	2,069	0.052	0.061	17,910	1,863	0.052	
		16	0.082	21,240	2,209	0.052	0.068	17,730	1,844	0.052	0.061	15,930	1,657	0.052	
		20	0.051	18,540	1,928	0.052	0.043	15,480	1,610	0.052	0.038	13,950	1,451	0.052	
		25	0.051	18,540	1,928	0.052	0.043	15,480	1,610	0.052	0.038	13,950	1,451	0.052	
		30	0.031	17,640	1,835	0.052	0.026	14,670	1,526	0.052	0.023	13,230	1,376	0.052	



Ultra Micro Grain Solid Carbide End Mill



IV Tool Steels (35-45HRC)				V Hardened Steels (45-55HRC)				VI Hardened Steels (55-70HRC)				Workpiece Material		
a _p mm	n min ⁻¹	V _f mm/min	f _z mm/t	a _p mm	n min ⁻¹	V _f mm/min	f _z mm/t	a _p mm	n min ⁻¹	V _f mm/min	f _z mm/t	D	CR	l _n
0.044	39,150	2,114	0.027	0.036	34,650	1,733	0.025	0.033	32,400	1,361	0.021	1	0.1	2
0.026	35,820	1,934	0.027	0.021	31,590	1,580	0.025	0.020	29,520	1,240	0.021			4
0.016	28,980	1,565	0.027	0.014	25,560	1,278	0.025	0.012	23,850	1,002	0.021			6
0.016	25,740	1,390	0.027	0.014	22,770	1,139	0.025	0.012	21,240	892	0.021			8
0.010	22,590	1,220	0.027	0.009	19,890	995	0.025	0.008	18,540	779	0.021			10
0.010	20,070	843	0.021	0.009	17,730	745	0.021	0.008	16,470	626	0.019			12
0.006	20,070	803	0.020	0.005	17,730	674	0.019	0.004	16,470	494	0.015			16
0.004	15,030	601	0.020	0.003	13,230	503	0.019	0.003	12,420	373	0.015			20
0.075	39,150	2,114	0.027	0.061	34,650	1,733	0.025	0.056	32,400	1,361	0.021			2
0.048	35,820	1,934	0.027	0.039	31,590	1,580	0.025	0.036	29,520	1,240	0.021			4
0.027	28,980	1,565	0.027	0.022	25,560	1,278	0.025	0.020	23,850	1,002	0.021		6	
0.027	25,740	1,390	0.027	0.022	22,770	1,139	0.025	0.020	21,240	892	0.021		8	
0.017	22,590	1,220	0.027	0.014	19,890	995	0.025	0.013	18,540	779	0.021		10	
0.017	20,070	843	0.021	0.014	17,730	745	0.021	0.013	16,470	626	0.019		12	
0.010	20,070	803	0.020	0.009	17,730	674	0.019	0.008	16,470	494	0.015		16	
0.007	15,030	601	0.020	0.006	13,230	503	0.019	0.005	12,420	373	0.015		20	
0.075	39,150	2,114	0.027	0.061	34,650	1,733	0.025	0.056	32,400	1,361	0.021		2	
0.048	35,820	1,934	0.027	0.039	31,590	1,580	0.025	0.036	29,520	1,240	0.021		4	
0.027	28,980	1,565	0.027	0.022	25,560	1,278	0.025	0.020	23,850	1,002	0.021		6	
0.027	25,740	1,390	0.027	0.022	22,770	1,139	0.025	0.020	21,240	892	0.021		8	
0.017	22,590	1,220	0.027	0.014	19,890	995	0.025	0.013	18,540	779	0.021	10		
0.017	20,070	843	0.021	0.014	17,730	745	0.021	0.013	16,470	626	0.019	12		
0.010	20,070	803	0.020	0.009	17,730	674	0.019	0.008	16,470	494	0.015	16		
0.007	15,030	601	0.020	0.006	13,230	503	0.019	0.005	12,420	373	0.015	20		
0.034	32,400	1,750	0.027	0.028	28,710	1,436	0.025	0.026	26,820	1,126	0.021	5		
0.017	22,590	1,220	0.027	0.014	19,890	995	0.025	0.013	18,540	779	0.021	10		
0.011	20,070	803	0.020	0.009	17,730	674	0.019	0.009	16,470	494	0.015	15		
0.007	15,030	601	0.020	0.006	13,230	503	0.019	0.005	12,420	373	0.015	20		
0.048	27,270	1,691	0.031	0.039	24,300	1,264	0.026	0.036	22,590	1,039	0.023	4		
0.044	26,370	1,635	0.031	0.036	23,310	1,212	0.026	0.033	21,600	994	0.023	6		
0.041	25,020	1,551	0.031	0.033	22,140	1,151	0.026	0.031	20,610	948	0.023	8		
0.041	20,070	1,244	0.031	0.033	17,730	922	0.026	0.031	16,470	758	0.023	12		
0.026	15,570	810	0.026	0.021	13,770	716	0.026	0.020	12,870	566	0.022	15		
0.020	15,570	747	0.024	0.017	13,770	661	0.024	0.015	12,870	515	0.020	20		
0.058	27,270	1,691	0.031	0.047	24,300	1,264	0.026	0.043	22,590	1,039	0.023	4		
0.054	26,370	1,635	0.031	0.044	23,310	1,212	0.026	0.041	21,600	994	0.023	6		
0.048	25,020	1,551	0.031	0.039	22,140	1,151	0.026	0.036	20,610	948	0.023	8		
0.044	20,070	1,244	0.031	0.036	17,730	922	0.026	0.033	16,470	758	0.023	12		
0.031	15,570	810	0.026	0.025	13,770	716	0.026	0.023	12,870	566	0.022	15		
0.024	15,570	747	0.024	0.020	13,770	661	0.024	0.018	12,870	515	0.020	20		
0.044	26,370	1,635	0.031	0.036	23,310	1,212	0.026	0.033	21,600	994	0.023	5		
0.041	20,070	1,244	0.031	0.033	17,730	922	0.026	0.031	16,470	758	0.023	10		
0.026	15,570	810	0.026	0.021	13,770	716	0.026	0.020	12,870	566	0.022	15		
0.020	15,570	747	0.024	0.017	13,770	661	0.024	0.015	12,870	515	0.020	20		
0.068	24,030	2,739	0.057	0.055	21,240	1,954	0.046	0.051	19,890	1,591	0.040	4		
0.054	22,950	2,616	0.057	0.044	20,250	1,863	0.046	0.041	18,900	1,512	0.040	6		
0.048	20,880	2,380	0.057	0.039	18,450	1,697	0.046	0.036	17,190	1,375	0.040	8		
0.027	16,920	1,760	0.052	0.022	14,940	1,374	0.046	0.020	13,950	1,116	0.040	12		
0.027	15,030	1,563	0.052	0.022	13,230	1,217	0.046	0.020	12,420	994	0.040	16		
0.024	13,140	1,367	0.052	0.020	11,610	952	0.041	0.018	10,800	778	0.036	20		
0.017	13,140	1,367	0.052	0.014	11,610	952	0.041	0.013	10,800	778	0.036	25		
0.012	12,510	1,301	0.052	0.009	11,070	908	0.041	0.009	10,260	739	0.036	30		
0.136	24,030	2,739	0.057	0.111	21,240	1,954	0.046	0.102	19,890	1,591	0.040	4		
0.116	22,950	2,616	0.057	0.094	20,250	1,863	0.046	0.087	18,900	1,512	0.040	6		
0.095	20,880	2,380	0.057	0.077	18,450	1,697	0.046	0.071	17,190	1,375	0.040	8		
0.054	16,920	1,760	0.052	0.044	14,940	1,374	0.046	0.041	13,950	1,116	0.040	12		
0.054	15,030	1,563	0.052	0.044	13,230	1,217	0.046	0.041	12,420	994	0.040	16		
0.034	13,140	1,367	0.052	0.028	11,610	952	0.041	0.026	10,800	778	0.036	20		
0.034	13,140	1,367	0.052	0.028	11,610	952	0.041	0.026	10,800	778	0.036	25		
0.020	12,510	1,301	0.052	0.017	11,070	908	0.041	0.015	10,260	739	0.036	30		

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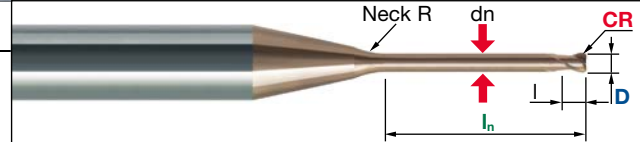
Ultra Micro Grain Solid Carbide End Mill

EPDRE-ATH | High Efficiency Cutting Conditions for Rib Application

D	Workpiece Material		I				II				III				
	CR	I _n	Copper				Carbon Steels, Alloy Steels (180~250HB)				Tool Steels (25~35HRC)				
			a _p mm	n min ⁻¹	V _f mm/min	f _z mm/t	a _p mm	n min ⁻¹	V _f mm/min	f _z mm/t	a _p mm	n min ⁻¹	V _f mm/min	f _z mm/t	
2.5	0.2	10	0.071	23,850	2,719	0.057	0.060	19,890	2,069	0.052	0.054	17,910	1,863	0.052	
		20	0.041	18,540	2,114	0.057	0.034	15,480	1,610	0.052	0.031	13,950	1,451	0.052	
		30	0.026	17,640	1,835	0.052	0.021	14,670	1,526	0.052	0.020	13,230	1,376	0.052	
	0.5	10	0.122	23,850	2,719	0.057	0.102	19,890	2,069	0.052	0.092	17,910	1,863	0.052	
		20	0.082	18,540	2,114	0.057	0.068	15,480	1,610	0.052	0.061	13,950	1,451	0.052	
		30	0.051	17,640	1,835	0.052	0.043	14,670	1,526	0.052	0.038	13,230	1,376	0.052	
3	0.2	8	0.092	22,500	3,195	0.071	0.077	18,720	2,658	0.071	0.069	16,830	2,390	0.071	
		12	0.071	22,500	3,195	0.071	0.060	18,720	2,658	0.071	0.054	16,830	2,390	0.071	
		16	0.051	22,500	3,195	0.071	0.043	18,720	2,658	0.071	0.038	16,830	2,390	0.071	
		20	0.051	18,180	2,582	0.071	0.043	15,120	2,147	0.071	0.038	13,680	1,943	0.071	
		30	0.041	14,130	1,837	0.065	0.034	11,790	1,533	0.065	0.031	10,620	1,381	0.065	
		35	0.036	14,130	1,837	0.065	0.030	11,790	1,533	0.065	0.027	10,620	1,381	0.065	
	0.5	8	0.184	22,500	3,195	0.071	0.153	18,720	2,658	0.071	0.138	16,830	2,390	0.071	
		12	0.133	22,500	3,195	0.071	0.111	18,720	2,658	0.071	0.099	16,830	2,390	0.071	
		16	0.102	22,500	3,195	0.071	0.085	18,720	2,658	0.071	0.077	16,830	2,390	0.071	
		20	0.102	18,180	2,582	0.071	0.085	15,120	2,147	0.071	0.077	13,680	1,943	0.071	
		30	0.082	14,130	1,837	0.065	0.068	11,790	1,533	0.065	0.061	10,620	1,381	0.065	
		35	0.066	14,130	1,837	0.065	0.055	11,790	1,533	0.065	0.050	10,620	1,381	0.065	
		12	0.357	19,350	3,406	0.088	0.298	16,110	2,835	0.088	0.268	14,490	2,550	0.088	
		16	0.255	16,110	2,835	0.088	0.213	13,410	2,360	0.088	0.191	11,790	2,075	0.088	
		20	0.204	16,110	2,835	0.088	0.170	13,410	2,360	0.088	0.153	11,790	2,075	0.088	
		24	0.179	16,110	2,835	0.088	0.149	13,410	2,360	0.088	0.134	11,790	2,075	0.088	
		30	0.153	12,870	2,059	0.080	0.128	10,710	1,714	0.080	0.115	9,630	1,541	0.080	
		36	0.102	12,870	2,059	0.080	0.085	10,710	1,714	0.080	0.077	9,630	1,541	0.080	
4	1	12	0.408	19,350	3,406	0.088	0.340	16,110	2,835	0.088	0.306	14,490	2,550	0.088	
		16	0.296	16,110	2,835	0.088	0.247	13,410	2,360	0.088	0.222	11,790	2,075	0.088	
		20	0.235	16,110	2,835	0.088	0.196	13,410	2,360	0.088	0.176	11,790	2,075	0.088	
		24	0.204	16,110	2,835	0.088	0.170	13,410	2,360	0.088	0.153	11,790	2,075	0.088	
		30	0.173	12,870	2,059	0.080	0.145	10,710	1,714	0.080	0.130	9,630	1,541	0.080	
		36	0.122	12,870	2,059	0.080	0.102	10,710	1,714	0.080	0.092	9,630	1,541	0.080	
	45	0.061	10,260	1,313	0.064	0.051	8,550	1,094	0.064	0.046	7,740	991	0.064		
	0.5	20	0.357	15,390	3,417	0.111	0.298	12,870	2,857	0.111	0.268	11,520	2,557	0.111	
		40	0.138	13,860	2,744	0.099	0.115	11,610	2,299	0.099	0.104	10,440	2,067	0.099	
		20	0.408	15,390	3,417	0.111	0.340	12,870	2,857	0.111	0.306	11,520	2,557	0.111	
		40	0.153	13,860	2,744	0.099	0.128	11,610	2,299	0.099	0.115	10,440	2,067	0.099	
		5	0.5	18	0.357	12,870	3,423	0.133	0.298	10,710	2,849	0.133	0.268	9,630	2,562
24				0.296	12,870	3,423	0.133	0.247	10,710	2,849	0.133	0.222	9,630	2,562	0.133
36	0.245			11,520	2,765	0.120	0.204	9,630	2,311	0.120	0.184	8,640	2,074	0.120	
1	54		0.168	9,000	2,160	0.120	0.140	7,470	1,793	0.120	0.127	6,750	1,620	0.120	
	18		0.408	12,870	3,423	0.133	0.340	10,710	2,849	0.133	0.306	9,630	2,562	0.133	
	24		0.357	12,870	3,423	0.133	0.298	10,710	2,849	0.133	0.268	9,630	2,562	0.133	
6	0.5	36	0.286	11,520	2,765	0.120	0.238	9,630	2,311	0.120	0.214	8,640	2,074	0.120	



Ultra Micro Grain Solid Carbide End Mill



IV Tool Steels (35-45HRC)				V Hardened Steels (45-55HRC)				VI Hardened Steels (55-70HRC)				Workpiece Material		
a _p mm	n min ⁻¹	V _f mm/min	f _z mm/t	a _p mm	n min ⁻¹	V _f mm/min	f _z mm/t	a _p mm	n min ⁻¹	V _f mm/min	f _z mm/t	D	CR	l _n
0.048	16,920	1,760	0.052	0.039	14,940	1,374	0.046	0.036	13,950	1,116	0.040	2.5	0.2	10
0.027	13,140	1,367	0.052	0.022	11,610	952	0.041	0.020	10,800	778	0.036			20
0.017	12,510	1,301	0.052	0.014	11,070	908	0.041	0.013	10,260	739	0.036			30
0.082	16,920	1,760	0.052	0.066	14,940	1,374	0.046	0.061	13,950	1,116	0.040		10	
0.054	13,140	1,367	0.052	0.044	11,610	952	0.041	0.041	10,800	778	0.036		20	
0.034	12,510	1,301	0.052	0.028	11,070	908	0.041	0.026	10,260	739	0.036		30	
0.061	15,930	2,262	0.071	0.050	14,040	1,601	0.057	0.046	13,140	1,314	0.050	3	0.2	8
0.048	15,930	2,262	0.071	0.039	14,040	1,601	0.057	0.036	13,140	1,314	0.050			12
0.034	15,930	2,262	0.071	0.028	14,040	1,601	0.057	0.026	13,140	1,314	0.050			16
0.034	12,870	1,828	0.071	0.028	11,340	1,293	0.057	0.026	10,620	1,062	0.050		20	
0.027	9,990	1,299	0.065	0.022	8,820	917	0.052	0.020	8,280	745	0.045		30	
0.024	9,990	1,299	0.065	0.020	8,820	917	0.052	0.018	8,280	745	0.045		35	
0.122	15,930	2,262	0.071	0.099	14,040	1,601	0.057	0.092	13,140	1,314	0.050	4	0.5	8
0.088	15,930	2,262	0.071	0.072	14,040	1,601	0.057	0.066	13,140	1,314	0.050			12
0.068	15,930	2,262	0.071	0.055	14,040	1,601	0.057	0.051	13,140	1,314	0.050			16
0.068	12,870	1,828	0.071	0.055	11,340	1,293	0.057	0.051	10,620	1,062	0.050		20	
0.054	9,990	1,299	0.065	0.044	8,820	917	0.052	0.041	8,280	745	0.045		30	
0.044	9,990	1,299	0.065	0.036	8,820	917	0.052	0.033	8,280	745	0.045		35	
0.238	13,680	2,408	0.088	0.194	12,150	1,725	0.071	0.179	11,340	1,406	0.062	5	0.5	12
0.170	11,250	1,980	0.088	0.139	9,630	1,367	0.071	0.128	9,090	1,127	0.062			16
0.136	11,250	1,980	0.088	0.111	9,630	1,367	0.071	0.102	9,090	1,127	0.062			20
0.119	11,250	1,980	0.088	0.097	9,630	1,367	0.071	0.089	9,090	1,127	0.062		24	
0.102	9,090	1,454	0.080	0.083	8,010	1,025	0.064	0.077	7,470	837	0.056		30	
0.068	9,090	1,454	0.080	0.055	8,010	1,025	0.064	0.051	7,470	837	0.056		36	
0.034	7,290	933	0.064	0.028	6,390	665	0.052	0.026	6,030	531	0.044	6	1	45
0.272	13,680	2,408	0.088	0.221	12,150	1,725	0.071	0.204	11,340	1,406	0.062			12
0.197	11,250	1,980	0.088	0.161	9,630	1,367	0.071	0.148	9,090	1,127	0.062			16
0.156	11,250	1,980	0.088	0.128	9,630	1,367	0.071	0.117	9,090	1,127	0.062		20	
0.136	11,250	1,980	0.088	0.111	9,630	1,367	0.071	0.102	9,090	1,127	0.062		24	
0.116	9,090	1,454	0.080	0.094	8,010	1,025	0.064	0.087	7,470	837	0.056		30	
0.082	9,090	1,454	0.080	0.066	8,010	1,025	0.064	0.061	7,470	837	0.056	7	0.5	36
0.041	7,290	933	0.064	0.033	6,390	665	0.052	0.031	6,030	531	0.044			45
0.238	10,890	2,418	0.111	0.194	9,630	1,695	0.088	0.179	9,000	1,386	0.077			20
0.092	9,810	1,942	0.099	0.075	8,640	1,382	0.080	0.069	8,100	1,134	0.070		40	
0.272	10,890	2,418	0.111	0.221	9,630	1,695	0.088	0.204	9,000	1,386	0.077		20	
0.102	9,810	1,942	0.099	0.083	8,640	1,382	0.080	0.077	8,100	1,134	0.070		40	
0.238	9,090	2,418	0.133	0.194	8,010	1,698	0.106	0.179	7,470	1,404	0.094	8	0.5	18
0.197	9,090	2,418	0.133	0.161	8,010	1,698	0.106	0.148	7,470	1,404	0.094			24
0.163	8,190	1,966	0.120	0.133	7,200	1,382	0.096	0.122	6,750	1,134	0.084			36
0.112	6,390	1,534	0.120	0.091	5,580	1,071	0.096	0.084	5,220	877	0.084		54	
0.272	9,090	2,418	0.133	0.221	8,010	1,698	0.106	0.204	7,470	1,404	0.094		18	
0.238	9,090	2,418	0.133	0.194	8,010	1,698	0.106	0.179	7,470	1,404	0.094		24	
0.190	8,190	1,966	0.120	0.155	7,200	1,382	0.096	0.143	6,750	1,134	0.084	36		