

# Combined Drill & Countersink

Series 301 Fractional	Hardness	Vc (sfm)	DC • in						
			1/32	5/64	1/8	3/16	7/32		
<b>CARBON STEELS</b> 1018, 1040, 1080, 1090, 10L50, 1140, 1212, 12L15, 1525, 1536	≤ 175 Bhn or ≤ 7 HRc	265	RPM	8098	5399	3239	2314	2025	
		(212-318)	Fr	0.00068	0.0010	0.0017	0.0024	0.0027	
			Feed (ipm)	5.5	5.5	5.5	5.5	5.5	
	≤ 300 Bhn or ≤ 32 HRc	125	RPM	3820	2547	1528	1091	955	
		(100-150)	Fr	0.00065	0.0010	0.0016	0.0023	0.0026	
			Feed (ipm)	2.5	2.5	2.5	2.5	2.5	
	≤ 425 Bhn or ≤ 45 HRc	85	RPM	2598	1732	1039	742	649	
		(68-102)	Fr	0.00038	0.0006	0.0010	0.0013	0.0015	
			Feed (ipm)	1.0	1.0	1.0	1.0	1.0	
	<b>ALLOY STEELS</b> 4140, 4150, 4320, 5120, 5150, 8630, 86L20, 50100	≤ 275 Bhn or ≤ 28 HRc	230	RPM	7029	4686	2812	2008	1757
			(184-276)	Fr	0.00064	0.0010	0.0016	0.0022	0.0026
				Feed (ipm)	4.5	4.5	4.5	4.5	4.5
≤ 375 Bhn or ≤ 40 HRc		145	RPM	4431	2954	1772	1266	1108	
		(116-174)	Fr	0.00059	0.0009	0.0015	0.0021	0.0023	
			Feed (ipm)	2.6	2.6	2.6	2.6	2.6	
≤ 425 Bhn or ≤ 45 HRc		60	RPM	1834	1222	733	524	458	
		(48-72)	Fr	0.00027	0.0004	0.0007	0.0010	0.0011	
			Feed (ipm)	0.5	0.5	0.5	0.5	0.5	
<b>TOOL STEELS</b> A2, D2, H13, L2, M2, P20, S7, T15, W2		≤ 250 Bhn or ≤ 24 HRc	85	RPM	2598	1732	1039	742	649
			(68-102)	Fr	0.00035	0.0005	0.0009	0.0012	0.0014
				Feed (ipm)	0.9	0.9	0.9	0.9	0.9
	≤ 375 Bhn or ≤ 40 HRc	55	RPM	1681	1121	672	480	420	
		(44-66)	Fr	0.00016	0.0002	0.0004	0.0006	0.0006	
			Feed (ipm)	0.3	0.3	0.3	0.3	0.3	
<b>STAINLESS STEELS</b> (FREE MACHINING) 303, 416, 420F, 430F 440F	≤ 250 Bhn or ≤ 24 HRc	210	RPM	6418	4278	2567	1834	1604	
		(168-252)	Fr	0.00048	0.0007	0.0012	0.0017	0.0019	
			Feed (ipm)	3.1	3.1	3.1	3.1	3.1	
	≤ 330 Bhn or ≤ 36 HRc	110	RPM	3362	2241	1345	960	840	
		(88-132)	Fr	0.00028	0.0004	0.0007	0.0010	0.0011	
			Feed (ipm)	0.9	0.9	0.9	0.9	0.9	
	<b>STAINLESS STEELS</b> (DIFFICULT) 304, 316, 321, 13-8 PH, 15-5PH, 17-4 PH, Custom 450	≤ 275 Bhn or ≤ 28 HRc	65	RPM	1986	1324	795	568	497
			(52-78)	Fr	0.00036	0.0005	0.0009	0.0013	0.0014
				Feed (ipm)	0.7	0.7	0.7	0.7	0.7
		≤ 375 Bhn or ≤ 40 HRc	55	RPM	1681	1121	672	480	420
			(44-66)	Fr	0.00032	0.0005	0.0008	0.0011	0.0013
				Feed (ipm)	0.5	0.5	0.5	0.5	0.5
<b>CAST IRONS</b> Gray, Malleable, Ductile	≤ 220 Bhn or ≤ 19 HRc	280	RPM	8557	5705	3423	2445	2139	
		(224-336)	Fr	0.00084	0.0013	0.0021	0.0029	0.0034	
			Feed (ipm)	7.2	7.2	7.2	7.2	7.2	
	≤ 330 Bhn or ≤ 36 HRc	250	RPM	7640	5093	3056	2183	1910	
		(200-300)	Fr	0.00084	0.0013	0.0021	0.0029	0.0034	
			Feed (ipm)	6.4	6.4	6.4	6.4	6.4	

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Series 301 Fractional	Hardness	Vc (sfm)		DC • in					
				1/32	5/64	1/8	3/16	7/32	
N	ALUMINUM ALLOYS 2017, 2024, 356, 6061, 7075	≤ 80 Bhn or ≤ 47 HRb	540	RPM	16502	11002	6601	4715	4126
			(432-648)	Fr	0.00100	0.0015	0.0025	0.0035	0.0040
				Feed (ipm)	16.5	16.5	16.5	16.5	16.5
		≤ 150 Bhn or ≤ 88 HRb	455	RPM	13905	9270	5562	3973	3476
			(364-546)	Fr	0.00100	0.0015	0.0025	0.0035	0.0040
				Feed (ipm)	13.9	13.9	13.9	13.9	13.9
	COPPER ALLOYS Alum Bronze, C110, Muntz Brass	≤ 140 Bhn or ≤ 3 HRc	190	RPM	5806	3871	2323	1659	1452
			(152-228)	Fr	0.00048	0.0007	0.0012	0.0017	0.0019
				Feed (ipm)	2.8	2.8	2.8	2.8	2.8
		≤ 200 Bhn or ≤ 23 HRc	175	RPM	5348	3565	2139	1528	1337
			(140-210)	Fr	0.00048	0.0007	0.0012	0.0017	0.0019
				Feed (ipm)	2.6	2.6	2.6	2.6	2.6
PLASTICS Polycarbonate, PVC	500	RPM	15280	10187	6112	4366	3820		
		Fr	0.00100	0.0015	0.0025	0.0035	0.0040		
		Feed (ipm)	15.3	15.3	15.3	15.3	15.3		
S	HIGH TEMP ALLOYS (NICKEL, COBALT, IRON BASE) Inconel 601, 617, 625, Incoloy 800, Monel 400, Rene, Waspaloy	≤ 220 Bhn or ≤ 19 HRc	40	RPM	1222	815	489	349	306
			(32-48)	Fr	0.00036	0.0005	0.0009	0.0013	0.0014
				Feed (ipm)	0.4	0.4	0.4	0.4	0.4
		≤ 320 Bhn or ≤ 34 HRc	25	RPM	764	509	306	218	191
			(20-30)	Fr	0.00033	0.0005	0.0008	0.0011	0.0013
				Feed (ipm)	0.3	0.3	0.3	0.3	0.3
	≤ 425 Bhn or ≤ 45 HRc	20	RPM	611	407	244	175	153	
		(16-24)	Fr	0.00016	0.0002	0.0004	0.0006	0.0007	
			Feed (ipm)	0.1	0.1	0.1	0.1	0.1	
	TITANIUM ALLOYS Pure Titanium, Ti6Al4V, Ti6Al2Sn4Zr2Mo, Ti4Al4Mo2Sn0.5Si, Ti-6Al4V	≤ 275 Bhn or ≤ 28 HRc	85	RPM	2598	1732	1039	742	649
			(68-102)	Fr	0.00064	0.0010	0.0016	0.0022	0.0026
				Feed (ipm)	1.7	1.7	1.7	1.7	1.7
≤ 350 Bhn or ≤ 38 HRc		65	RPM	1986	1324	795	568	497	
		(52-78)	Fr	0.00036	0.0005	0.0009	0.0013	0.0014	
			Feed (ipm)	0.7	0.7	0.7	0.7	0.7	
≤ 440 Bhn or ≤ 47 HRc	55	RPM	1681	1121	672	480	420		
	(44-66)	Fr	0.00032	0.0005	0.0008	0.0011	0.0013		
		Feed (ipm)	0.5	0.5	0.5	0.5	0.5		
H	TOOL STEELS A2, D2, H13, L2, M2, P20, S7, T15, W2	≤ 475 Bhn or ≤ 50 HRc	40	RPM	1222	815	489	349	306
			(32-48)	Fr	0.00016	0.0002	0.0004	0.0006	0.0007
				Feed (ipm)	0.2	0.2	0.2	0.2	0.2

Bhn (Brinell) HRc (Rockwell C) HRb (Rockwell B)  
 rpm = Vc x 3.82 / DCON  
 ipm = Fr x rpm  
 reduce speed and feed 30 percent when using uncoated drills  
 reduce speed and feed for materials harder than listed  
 refer to the SGS Tool Wizard® for complete technical information (www.kyocera-sgstool.com)

# Combined Drill & Countersink

Series 301M Metric	Hardness	Vc (m/min)	DC • mm						
			1	1.6	2.5	4	5		
<b>CARBON STEELS</b> 1018, 1040, 1080, 1090, 10L50, 1140, 1212, 12L15, 1525, 1536	≤ 175 Bhn or ≤ 7 HRc	81	RPM	8155	6422	4078	2569	2055	
		(65-97)	Fr	0.017	0.022	0.034	0.054	0.068	
			Feed (mm/min)	139	139	139	139	139	
	≤ 300 Bhn or ≤ 32 HRc	38	RPM	3847	3029	1923	1212	969	
		(30-46)	Fr	0.016	0.020	0.032	0.051	0.064	
			Feed (mm/min)	62	62	62	62	62	
	≤ 425 Bhn or ≤ 45 HRc	26	RPM	2616	2060	1308	824	659	
		(21-31)	Fr	0.010	0.013	0.020	0.032	0.039	
			Feed (mm/min)	26	26	26	26	26	
	<b>ALLOY STEELS</b> 4140, 4150, 4320, 5120, 5150, 8630, 86L20, 50100	≤ 275 Bhn or ≤ 28 HRc	70	RPM	7078	5574	3539	2230	1784
			(56-84)	Fr	0.016	0.020	0.032	0.051	0.063
				Feed (mm/min)	113	113	113	113	113
≤ 375 Bhn or ≤ 40 HRc		44	RPM	4462	3514	2231	1406	1125	
		(35-53)	Fr	0.015	0.019	0.030	0.048	0.060	
			Feed (mm/min)	67	67	67	67	67	
≤ 425 Bhn or ≤ 45 HRc		18	RPM	1847	1454	923	582	465	
		(15-22)	Fr	0.007	0.009	0.014	0.022	0.028	
			Feed (mm/min)	13	13	13	13	13	
<b>TOOL STEELS</b> A2, D2, H13, L2, M2, P20, S7, T15, W2		≤ 250 Bhn or ≤ 24 HRc	26	RPM	2616	2060	1308	824	659
			(21-31)	Fr	0.009	0.012	0.018	0.029	0.036
				Feed (mm/min)	24	24	24	24	24
	≤ 375 Bhn or ≤ 40 HRc	17	RPM	1693	1333	846	533	427	
		(13-20)	Fr	0.004	0.005	0.008	0.013	0.016	
			Feed (mm/min)	7	7	7	7	7	
<b>STAINLESS STEELS (FREE MACHINING)</b> 303, 416, 420F, 430F 440F	≤ 250 Bhn or ≤ 24 HRc	64	RPM	6463	5089	3231	2036	1629	
		(51-77)	Fr	0.012	0.015	0.024	0.038	0.048	
			Feed (mm/min)	78	78	78	78	78	
	≤ 330 Bhn or ≤ 36 HRc	34	RPM	3385	2666	1693	1066	853	
		(27-40)	Fr	0.007	0.009	0.014	0.023	0.028	
			Feed (mm/min)	24	24	24	24	24	
	<b>STAINLESS STEELS (DIFFICULT)</b> 304, 316, 321, 13-8 PH, 15-5PH, 17-4 PH, Custom 450	≤ 275 Bhn or ≤ 28 HRc	20	RPM	2000	1575	1000	630	504
			(16-24)	Fr	0.009	0.011	0.018	0.029	0.036
				Feed (mm/min)	18	18	18	18	18
		≤ 375 Bhn or ≤ 40 HRc	17	RPM	1693	1333	846	533	427
			(13-20)	Fr	0.008	0.011	0.017	0.026	0.033
				Feed (mm/min)	14	14	14	14	14
<b>CAST IRONS</b> Gray, Malleable, Ductile	≤ 220 Bhn or ≤ 19 HRc	85	RPM	8617	6786	4309	2714	2171	
		(68-102)	Fr	0.021	0.027	0.042	0.067	0.083	
			Feed (mm/min)	181	181	181	181	181	
	≤ 330 Bhn or ≤ 36 HRc	76	RPM	7694	6059	3847	2424	1939	
		(61-91)	Fr	0.021	0.027	0.042	0.067	0.084	
			Feed (mm/min)	162	162	162	162	162	

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# Combined Drill & Countersink

Series 301M Metric	Hardness	Vc (m/min)	DC•mm						
			1	1.6	2.5	4	5		
N <b>ALUMINUM ALLOYS</b> 2017, 2024, 356, 6061, 7075	≤ 80 Bhn or ≤ 47 HRb	165	RPM	16619	13087	8309	5235	4188	
		(132-198)	Fr	0.025	0.032	0.050	0.079	0.099	
			Feed (mm/min)	415	415	415	415	415	
	≤ 150 Bhn or ≤ 88 HRc	139	RPM	14003	11027	7001	4411	3529	
		(111-166)	Fr	0.025	0.032	0.050	0.079	0.099	
			Feed (mm/min)	350	350	350	350	350	
	COPPER ALLOYS Alum Bronze, C110, Muntz Brass	≤ 140 Bhn or ≤ 3 HRc	58	RPM	5847	4605	2924	1842	1474
			(46-69)	Fr	0.012	0.015	0.024	0.038	0.048
				Feed (mm/min)	70	70	70	70	70
		≤ 200 Bhn or ≤ 23 HRc	53	RPM	5386	4241	2693	1696	1357
			(43-64)	Fr	0.012	0.015	0.024	0.038	0.048
				Feed (mm/min)	65	65	65	65	65
PLASTICS Polycarbonate, PVC		152	RPM	15388	12118	7694	4847	3878	
		(122-183)	Fr	0.025	0.032	0.050	0.079	0.099	
			Feed (mm/min)	385	385	385	385	385	
S <b>HIGH TEMP ALLOYS</b> (NICKEL, COBALT, IRON BASE) Inconel 601, 617, 625, Incoloy 800, Monel 400, Rene, Waspaloy	≤ 220 Bhn or ≤ 19 HRc	12	RPM	1231	969	616	388	310	
		(10-15)	Fr	0.009	0.011	0.018	0.028	0.035	
			Feed (mm/min)	11	11	11	11	11	
	≤ 320 Bhn or ≤ 34 HRc	8	RPM	769	606	385	242	194	
		(6-9)	Fr	0.008	0.010	0.016	0.025	0.031	
			Feed (mm/min)	6	6	6	6	6	
	≤ 425 Bhn or ≤ 45 HRc	6	RPM	616	485	308	194	155	
		(5-7)	Fr	0.003	0.004	0.006	0.010	0.013	
			Feed (mm/min)	2	2	2	2	2	
	TITANIUM ALLOYS Pure Titanium, Ti6Al4V, Ti6Al2Sn4Zr2Mo, Ti4Al4Mo2Sn0.5Si, Ti-6Al4V	≤ 275 Bhn or ≤ 28 HRc	26	RPM	2616	2060	1308	824	659
			(21-31)	Fr	0.016	0.020	0.032	0.051	0.064
				Feed (mm/min)	42	42	42	42	42
≤ 350 Bhn or ≤ 38 HRc		20	RPM	2000	1575	1000	630	504	
		(16-24)	Fr	0.009	0.011	0.018	0.029	0.036	
			Feed (mm/min)	18	18	18	18	18	
≤ 440 Bhn or ≤ 47 HRc	17	RPM	1693	1333	846	533	427		
	(13-20)	Fr	0.008	0.011	0.017	0.026	0.033		
		Feed (mm/min)	14	14	14	14	14		
H <b>TOOL STEELS</b> A2, D2, H13, L2, M2, P20, S7, T15, W2	≤ 475 Bhn or ≤ 50 HRc	12	RPM	1231	969	616	388	310	
		(10-15)	Fr	0.004	0.005	0.008	0.013	0.016	
			Feed (mm/min)	5	5	5	5	5	

Bhn (Brinell) HRc (Rockwell C) HRb (Rockwell B)  
 $rpm = (Vc \times 1000) / (DCON \times 3.14)$   
 $mm/min = Fr \times rpm$   
 reduce speed and feed 30 percent when using uncoated drills  
 reduce speed and feed for materials harder than listed  
 refer to the SGS Tool Wizard® for complete technical information ([www.kyocera-sgstool.com](http://www.kyocera-sgstool.com))