HARVEY TOOL

Speeds & Feeds

Product Table: Dovetail Cutters - Parker Hannifin O-Ring Dovetail Cutters
Series: 238xx, 239xx, 563xx

MATERIAL	SFM	Hardness: ≤ 28 Rc (≤ 271 HBn) Chip Load by Neck Diameter (IPT) 0.015	0.031	0.047	0.062	0.078	0.093	0.125	0.187	0.250	0.312	0.375	0.500	0.625	0.750
ALUMINUM ALLOYS															
Casting (2xx, 5xx, 7xx, 8xx)	750	.00017	.00034	.00052	.00068	.00086	.00102	.00138	.00206	.00275	.00343	.00413	.00550	.00688	.00825
Wrought (1xxx, 2xxx, 3xxx, 5xxx, 6xxx, 7xxx, 8xxx)	1000														
Casting - 3%-5% Si (3xx, A3xx, C3xx, 4xx, A4xx, B4xx)	750	.00015	.00031	.00047	.00061	.00077	.00092	.00124	.00185	.00248	.00309	.00371	.00495	.00619	.00743
Casting - 5%-8% Si (3xx, A3xx, C3xx, 4xx, A4xx, B4xx)	700														
Casting - 8%-12% Si (3xx, A3xx, C3xx, 4xx, A4xx, B4xx)	650														
Casting - 12%-16% Si (3xx, A3xx, C3xx, 4xx, A4xx, B4xx)	475														
Wrought - 5%-8% Si (4xxx)	1000														
Wrought - 8%-12% Si (4xxx)	800														
MAGNESIUM ALLOYS	1500	.00017	.00034	.00052	.00068	.00086	.00102	.00138	.00206	.00275	.00343	.00413	.00550	.00688	.00825
ZINC ALLOYS	800														
COPPER ALLOYS															
High Coppers - 90%+ (C1xxxx)	225	.00013	.00027	.00041	.00055	.00069	.00082	.00110	.00165	.00220	.00275	.00330	.00440	.00550	.00660
Brass (Copper Zinc alloys, C2xxxx, C3xxxx, C4xxxx, C66400-C69800)	500														
Phosphor Bronzes (Copper Tin alloys, C5xxxx)	225														
Aluminum Bronzes (Copper Aluminum alloys, C60600-C64200)	500														
Silicon Bronzes (Copper Silicon alloys, C64700-C66100)	500														
Copper Nickels, Nickel Silvers (Copper Nickel alloys, C7xxxx)	225														
Cast Copper Alloys (C83300-C86200, C86400-C87900, C9200-C95800, C97300-C97800, C99400-C99700)	550														

Product Notes:

Posted Radial Passes reflect machining on one side of groove at full axial depth
If machining on both sides of part, reduce Chip Loads (IPT) by 40%

O-Ring grooves require machining with circular interpolation. The Linear Feed must be reduced to account for angular velocity (see example).

General Notes:

All posted speed and feed parameters are suggested starting values that may be increased given optimal setup conditions. Chip loads reflect uncoated cutters and may be increased 5%-10% if coated. For ferrous materials with hardness ≤ 28 Rc, chip loads can be increased 5%-10%.

If you require additional information, Harvey Tool has a team of technical experts available to assist you through even the most challenging applications. Please contact us at **800-645-5609** or **Harveytech@harveyperformance.com.**

WARNING: Cutting tools may shatter under improper use. Government regulations require use of safety glasses and other appropriate safety equipment in the vicinity of use.

MATERIAL	SFM	Hardness: 29-37 Rc (279-344 HBn) Chip Load by Neck Diameter (IPT) 0.015	0.031	0.047	0.062	0.078	0.093	0.125	0.187	0.250	0.312	0.375	0.500	0.625	0.750
CARBON STEELS															
Free-Machining/Low Carbon steels, 10xx - 1029 & all 10Lxx, 11xx - 1139 & all 11Lxx, 12xx - 1215 & all 12Lxx	600	.00006	.00012	.00018	.00023	.00029	.00035	.00047	.00071	.00095	.00118	.00142	.00189	.00236	.00284
1030 - 1095, 1140 - 1151, 13xx, 15xx, 2xxx, 3xxx, 4xxx & 4xLxx, 5xxx & 5xLxx, 51xxx & 50Lxxx, 51xxx & 51Lxxx, 52xxx & 52Lxxx, 6xxx, 8xxx, 9xxx	200	.00005	.00011	.00016	.00021	.00027	.00032	.00043	.00065	.00086	.00108	.00130	.00173	.00216	.00259
STAINLESS STEELS															
203 EZ, 303 (all types), 416, 416Se, 416 Plus X, 420F, 420FSe, 430F, 430FSe, 440F, 440FSe	450	.00006	.00012	.00018	.00023	.00029	.00035	.00047	.00071	.00095	.00118	.00142	.00189	.00236	.00284
201, 202, 203, 205, 301, 302, 304, 304L, 308, 309, 310, 314, 316, 316L, 317, 321, 329, 330, 347, 348, 385, 403, 405, 409, 410, 413, 420, 429, 430, 434, 436, 442, 446, 501, 502	200	.00005	.00011	.00016	.00021	.00027	.00032	.00043	.00065	.00086	.00108	.00130	.00173	.00216	.00259
414, 431, 440A, 440B, 440C, 13-8, 15-5, 15-7, 17-4, 17-7	150	.00003	.00007	.00010	.00013	.00017	.00020	.00027	.00040	.00054	.00067	.00081	.00108	.00135	.00162
TOOL STEELS															
A, L, O, P, W series	200	.00005	.00011	.00016	.00021	.00027	.00032	.00043	.00065	.00086	.00108	.00130	.00173	.00216	.00259
D, H, M, T, S series	150	.00003	.00007	.00010	.00013	.00017	.00020	.00027	.00040	.00054	.00067	.00081	.00108	.00135	.00162
TITANIUM ALLOYS	150	.00003	.00007	.00010	.00013	.00017	.00020	.00027	.00040	.00054	.00067	.00081	.00108	.00135	.00162
HIGH TEMP ALLOYS															
Inconel, Hastelloy, Waspalloy, Monel, Nimonic, Haynes, Discoloy, Incoloy	70	.00003	.00007	.00010	.00013	.00017	.00020	.00027	.00040	.00054	.00067	.00081	.00108	.00135	.00162

MATERIAL	SFM	Hardness: 38-45 Rc (353-421 HBn) Chip Load by Neck Diameter (IPT) 0.015	0.031	0.047	0.062	0.078	0.093	0.125	0.187	0.250	0.312	0.375	0.500	0.625	0.750
CARBON STEELS															
Free-Machining/Low Carbon steels, 10xx - 1029 & all 10Lxx, 11xx - 1139 & all 11Lxx, 12xx - 1215 & all 12Lxx	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1030 - 1095, 1140 - 1151, 13xx, 15xx, 2xxx, 3xxx, 4xxx & 4xLxx, 5xxx & 5xLxx, 51xxx & 50Lxxx, 51xxx & 51Lxxx, 52xxx & 52Lxxx, 6xxx, 8xxx, 9xxx	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
STAINLESS STEELS															
203 EZ, 303 (all types), 416, 416Se, 416 Plus X, 420F, 420FSe, 430F, 430FSe, 440F, 440FSe	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
201, 202, 203, 205, 301, 302, 304, 304L, 308, 309, 310, 314, 316, 316L, 317, 321, 329, 330, 347, 348, 385, 403, 405, 409, 410, 413, 420, 429, 430, 434, 436, 442, 446, 501, 502	100	.00003	.00005	.00008	.00011	.00013	.00016	.00022	.00032	.00043	.00054	.00065	.00086	.00108	.00130
414, 431, 440A, 440B, 440C, 13-8, 15-5, 15-7, 17-4, 17-7	90	.00002	.00003	.00005	.00007	.00008	.00010	.00014	.00020	.00027	.00034	.00041	.00054	.00068	.00081
TOOL STEELS															
A, L, O, P, W series	100	.00003	.00005	.00008	.00011	.00013	.00016	.00022	.00032	.00043	.00054	.00065	.00086	.00108	.00130
D, H, M, T, S series	90	.00002	.00003	.00005	.00007	.00008	.00010	.00014	.00020	.00027	.00034	.00041	.00054	.00068	.00081
TITANIUM ALLOYS	75	.00002	.00003	.00005	.00007	.00008	.00010	.00014	.00020	.00027	.00034	.00041	.00054	.00068	.00081
HIGH TEMP ALLOYS															
Inconel, Hastelloy, Waspalloy, Monel, Nimonic, Haynes, Discoloy, Incoloy	50	.00002	.00003	.00005	.00007	.00008	.00010	.00014	.00020	.00027	.00034	.00041	.00054	.00068	.00081

O-Ring Cutter Guide

Dovetail and O-ring style cutters have a variety of applications ranging from customized grooves to tricky seals. Unfortunately, they are very fragile due to their trapezoidal profile of a large Cutter Diameter with a smaller Neck Diameter. This combination of features demands specific machining parameters to avoid breakage.

Speeds & Feeds calculations:
1. Determine the correct SFM and Chip Load (IPT) for the cutter and material
2. Calculate the Speed (RPM) and Linear Feed (IPM)
3. Adjust Linear Feed to account for Angular Velocity due to Circular Interpolation
4. Determine Radial Passes at full axial depth
5. Conclusion
6. Additional Tips

Example: Tool #23921 machining a o-ring groove (without drop hole provision) to fit a AS568-204 seal in 4140 steel at 32 Rc

1. The Cutter Diameter is .113" and is used to find SFM and calculate Speed (RPM).
   The Neck Diameter is .044" and is used to find Chip Load (IPT) and calculate Linear Feed (IPM).
   Using the Speeds & Feeds chart (next page), SFM is 200 and the Chip Load (IPT) is .00016.

2. Calculate Speed (RPM) and Linear Feed (IPM)

   RPM = (SFM x 3.82) / Cutter Diameter
   = (200 x 3.82) / .113
   = 6761

   Linear Feed (IPM) = RPM x IPT x Number of Flutes
   = 6761 x .00016 x 2
   = 2.16

3. Adjust Linear Feed rate (see O-Ring Feed Rate Adjustment chart)

   Adjusted Feed = [(Groove Major Dia - Cutter Dia) / Groove Major Dia] x Linear Feed
   = [(.519 - .113) / .519] x 2.16
   = 1.69

4. Using Table 1, locate the Item # and determine the Max Radial DOC and the Number of Radial Passes needed at full Axial depth. Then using Table 2, determine the actual descending radial stepover for each pass:

   12 Radial Passes at 23%, 17%, 13%, 11%, 8%, 7%, 6%, 5%, 4%, 3%, 2% and 1% of .0335 Max Radial Depth of Cut.

5. Conclusion

   In this example, the tool would run at 6761 RPM, 1.69 IPM and make 12 radial passes of .0077, .0057, .0044, .0039, .0027, .0023, .0020, .0017, .0013, .0010, .0007, .0003 on each side of the groove at full axial depth.

6. Additional Tips

   Please note that tools are very fragile (some more than others) due to reduced neck design and flute runout through neck. Given that torque is generated on the larger head diameter and is multiplied as it is transferred to neck of tool, care must be taken when using these tools. Each successive stepover will increase tool engagement, requiring a descending radial stepover to avoid

Setup and Application (Series 238xx for use with Drop Hole)
- Mill slot with appropriate O-Ring Slotting End Mill (see series 565xx) or with other comprable end mill (Fig.1).
- Plunge off-center drop hole (Fig. 2).
- Insert O-Ring Cutter through drop hole at full axial depth and mill single pass down center of groove (Fig.3). Please note that cutter is contacting both sides of part and it may be necessary to reduce the feed rate (up to 40%).
- Mill multiple passes with descending radial stepover as calculated using Tables 1 & 2 on one side of part (Fig. 4).
- Mill multiple passes with descending radial stepover as calculated using Tables 1 & 2 on other side of part (Fig. 5).

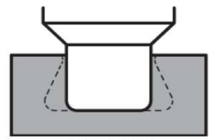
Fig.1: Mill Slot

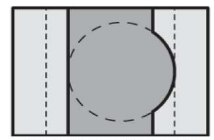
Fig.2: Plunge Off-Center Drop Hole

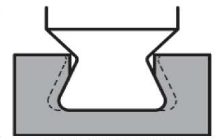
Fig.3: Mill on Center

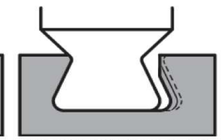
Fig.4: Multiple Descending Radial Passes

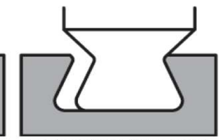
Fig.5: Multiple Descending Radial Passes

Setup and Application (Series 239xx for use without Drop Hole)
- Mill slot with appropriate O-Ring Slotting End Mill (see series 565xx) or with other comprable end mill (Fig. 1).
- Insert O-Ring Cutter into slot at full axial depth (Fig. 2).
- Mill multiple passes with descending radial stepover as calculated using Tables 1 & 2 on one side of part (Fig. 3).
- Mill multiple passes with descending radial stepover as calculated using Tables 1 & 2 on other side of part (Fig. 4).
- These tools are able to mill both Full and Half O-Ring grooves. As such, a corner radius at the top of the part (Fig. 5) must be machined for final groove form (see series 170xx).

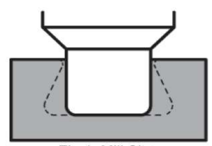
Fig.1: Mill Slot

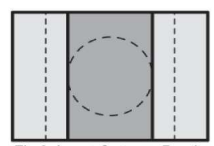
Fig.2: Insert Cutter to Depth

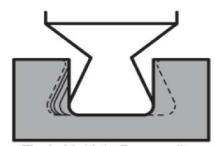
Fig.3: Multiple Descending Radial Passes

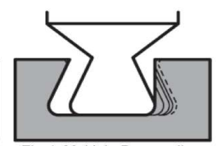
Fig.4: Multiple Descending Radial Passes

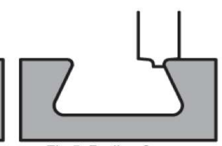
Fig.5: Radius Corner

TABLE 1

Item ID	Max Radial DOC	Radial Passes per Side		
		≤ 28 Rc	29 - 37 Rc	38 - 45 Rc
23807	0.0159	2	3	4
56307	0.0159	2	3	4
23814	0.0287	2	3	4
23821	0.0335	2	3	4
23828	0.0591	2	3	4
23835	0.0700	2	3	4
23842	0.0896	2	3	4
23907	0.0159	8	12	16
23914	0.0287	12	16	20
23921	0.0335	8	12	16
23928	0.0591	12	16	20
23935	0.0700	8	12	16
23942	0.0896	8	12	16

TABLE 2

Radial Passes	Percentage of CUTTER'S Maximum Radial Depth of Cut																			
2	70%	30%																		
3	50%	30%	20%																	
4	46%	25%	18%	11%																
5	46%	25%	16%	8%	5%															
6	43%	22%	16%	10%	6%	3.0%														
8	32%	21%	16%	12%	9%	6.0%	3.0%	1.0%												
10	27%	19%	15%	12%	9%	7.0%	5.0%	3.0%	2.0%	1.0%										
12	23%	17%	13%	11%	8%	7.0%	6.0%	5.0%	4.0%	3.0%	2.0%	1.0%								
14	19%	15%	13%	11%	9%	7.5%	6.5%	5.5%	4.5%	3.5%	2.5%	1.5%	1.0%	0.5%						
16	13%	11%	10%	10%	9%	9.0%	8.0%	7.0%	6.0%	5.0%	4.0%	3.0%	2.0%	1.5%	1.0%	0.5%				
18	12%	10%	9%	9%	8%	8.0%	7.0%	7.0%	6.0%	6.0%	5.0%	4.0%	3.0%	2.0%	2.0%	1.0%	0.5%	0.5%		
20	11%	10%	9%	8%	8%	7.0%	7.0%	6.0%	6.0%	5.0%	5.0%	4.0%	4.0%	3.0%	2.0%	2.0%	1.0%	1.0%	0.5%	0.5%