HARVEY TOOL

Dovetail 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. Determine Radial Passes at full axial depth
4. Conclusion

Example: Tool # 16412 machining 4140 steel at 32 Rc

1. The Cutter Diameter is .187" and is used to find SFM and calculate Speed (RPM).
   The Neck Diameter is .125" and is used to find Chip Load (IPT) and calculate Feed (IPM).
   Using the Speeds & Feeds chart (next page), SFM is 200 and the Chip Load (IPT) is .00043.

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

   RPM = (SFM x 3.82) / Cutter Diameter
   = (200 x 3.82) / .187
   = 4086

   Linear Feed (IPM) = RPM x IPT x Number of Flutes
   = 4086 x .00043 x 2
   = 3.51

3. Calculate the Max Radial:

   Max Radial DOC = (Cutter Diameter- Neck Diameter)/2
   = (.187 - .125)/2
   = .031

4. Use Table 1 to find the Number of Radial Passes needed at full axial depth.

   Tool # 16412 falls in "All Others" in Table 1 & has 3 radial passes at 32 Rc

   Then using Table 2, determine the actual descending Radial Stepover for each pass:

   3 Radial Passes at 50%, 30% and 20% of .031 Max Radial Depth of Cut yields radial stepovers of .0155, .0093 and .0062 respectively.

5. Conclusion

   In this example, the tool would run at 4086 RPM, 3.51 IPM and make 3 radial passes of .0155, .0093 and .0062 on each side of the groove at full axial depth.

Setup and Application

1. Rough out slot with appropriate O-Ring Slotting End Mill (see series 565xx) or with other comprable end mill
2. Insert O-Ring Cutter into slot at full axial depth and mill multiple passes with descending radial stepover as calculated using Tables 1 & 2 on one side of part
3. Mill multiple passes with descending radial stepover as calculated using Tables 1 & 2 on other side of part
4. Finished part

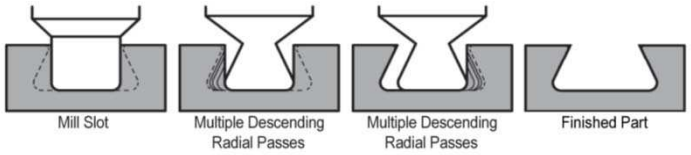

TABLE 1

Item ID	Radial Passes per Side			Item ID	Radial Passes per Side		
	≤ 28 Rc	29-37 Rc	38-45 Rc		≤ 28 Rc	29-37 Rc	38-45 Rc
16506	3	4	5	926212	3	4	5
16608	5	6	8	926216	3	4	5
16612	3	4	5	926224	3	4	5
16616	3	4	5	926232	3	4	5
16620	3	4	5	928408	3	4	5
16624	3	4	5	928412	3	4	5
16632	3	4	5	928416	3	4	5
16716	3	4	5	928424	3	4	5
16720	3	4	5	928432	3	4	5
16724	3	4	5	930004	3	4	5
16728	3	4	5	932304	3	4	5
16732	3	4	5	959908	3	4	5
16740	3	4	5	959916	3	4	5
16748	3	4	5	959924	5	6	8
16764	3	4	5	959932	3	4	5
16824	3	4	5	973112	3	4	5
27008	3	4	5	973116	3	4	5
28508	3	4	5	973124	3	4	5
28548	3	4	5	973132	3	4	5
61504	3	4	5	979406	3	4	5
65116	3	4	5	979408	3	4	5
66332	3	4	5	979412	3	4	5
827916	3	4	5	979416	3	4	5
827932	3	4	5	979424	3	4	5
832316	3	4	5	979432	3	4	5
832332	3	4	5	984808	3	4	5
873404	3	4	5	989206	3	4	5
874516	3	4	5	989208	3	4	5
874524	3	4	5	989212	3	4	5
874532	3	4	5	989216	3	4	5
883608	3	4	5	989224	3	4	5
883612	3	4	5	989232	3	4	5
883616	3	4	5	990108	3	4	5
883624	3	4	5	991406	3	4	5
891208	3	4	5	991408	3	4	5
891212	3	4	5	991412	3	4	5
891216	3	4	5	991416	3	4	5
891224	3	4	5	991424	3	4	5
900102	3	4	5	991432	3	4	5
900104	3	4	5	995216	3	4	5
990108	3	4	5	All Others	2	3	4
926208	5	6	8				

Note: If the Item ID is not listed, please refer to "All Others" at the bottom of the table.

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%

HARVEY TOOL

Speeds & Feeds

Product Table: Dovetail Cutters
Series: 164xx, 165xx, 166xx, 167xx 168xx, 270xx, 285xx, 615xx, 623xx, 634xx, 646xx, 651xx, 663xx, 8067xx, 8068xx, 8114xx, 8279xx, 8323xx, 8339xx, 8451xx, 8734xx, 8745xx, 8836xx, 8912xx, 8965xx, 9262xx, 9284xx, 9300xx, 9323xx, 9599xx, 9644xx, 9731xx, 9778xx, 9794xx, 9833xx, 9848xx, 9860xx, 9892xx, 9901xx, 9914xx, 9920xx, 9952xx

Product Notes:

True dovetail grooves (with trapezoidal shape) must be roughed out with end mill prior to using dovetail cutter

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%

When machining grooves with circular interpolation, reduce the Linear Feed (IPM) using the following formula:

Adj Feed = [(Major Groove Dia - Cutter Dia) / Major Groove Dia] x Linear Feed

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@harveyperformancecom**.

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: ≤ 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														

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

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
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
100	.00003	.00005	.00008	.00011	.00013	.00016	.00022	.00032	.00043	.00054	.00065	.00086	.00108	.00130
90	.00002	.00003	.00005	.00007	.00008	.00010	.00014	.00020	.00027	.00034	.00041	.00054	.00068	.00081
100	.00003	.00005	.00008	.00011	.00013	.00016	.00022	.00032	.00043	.00054	.00065	.00086	.00108	.00130
90	.00002	.00003	.00005	.00007	.00008	.00010	.00014	.00020	.00027	.00034	.00041	.00054	.00068	.00081
75	.00002	.00003	.00005	.00007	.00008	.00010	.00014	.00020	.00027	.00034	.00041	.00054	.00068	.00081
50	.00002	.00003	.00005	.00007	.00008	.00010	.00014	.00020	.00027	.00034	.00041	.00054	.00068	.00081