




## List HP441

### Side Milling (Fractional)

Hardness	–		<20 HRC		<30 HRC		30-38 HRC		38-45 HRC		45-55 HRC		55-60 HRC										
Work Material	Cast Iron		Mild Steels Carbon Steels		Alloy Steels Tool Steels Ti Alloys (Annealed)		Hardened Steels Pre-hardened Steels Ti Alloys (Solution Treated and Aged)		Hardened Steels Pre-hardened Steels Stainless Steels Inconel Ni Based Alloys		Hardened Steels		Hardened Steels										
Cutting Speed	390 SFM		330 SFM		270 SFM		220 SFM		190 SFM		120 SFM		80 SFM										
Depth of Cut	<table border="1"> <thead> <tr> <th>Dia</th> <th>aa</th> <th>ar</th> </tr> </thead> <tbody> <tr> <td>D≤1/8</td> <td>1.5D</td> <td>0.05D</td> </tr> <tr> <td>1/8&lt;D</td> <td>1.5D</td> <td>0.10D</td> </tr> </tbody> </table> 										Dia	aa	ar	D≤1/8	1.5D	0.05D	1/8<D	1.5D	0.10D	$aa=1D$ $ar=0.02D$			
Dia	aa	ar																					
D≤1/8	1.5D	0.05D																					
1/8<D	1.5D	0.10D																					
Mill Dia.	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min									
1/16	23,820	17.6	20,155	13.9	15,670	11.2	13,435	5.8	11,605	4.9	7,330	2.8	5,400	1.6									
3/32	16,305	21.5	13,720	18.1	11,550	14.5	13,435	9.0	13,435	9.6	4,885	3.4	3,260	2.2									
1/8	12,060	28.4	10,205	24.0	8,245	16.0	10,075	8.3	10,075	9.6	3,665	3.3	2,445	2.3									
5/32	9,630	29.9	8,060	25.0	8,060	17.9	5,170	6.3	4,475	5.3	2,930	3.6	1,955	2.4									
3/16	8,075	33.7	6,740	28.3	6,720	22.0	4,455	6.5	3,935	5.7	2,360	3.5	1,565	2.0									
1/4	5,955	29.0	5,090	28.9	4,235	20.0	3,375	6.9	3,030	6.1	1,775	3.3	1,205	1.9									
5/16	4,820	33.6	4,000	27.8	3,330	19.8	2,660	6.9	2,360	6.1	1,390	3.2	960	1.7									
3/8	4,005	33.6	3,360	27.8	2,795	19.8	2,225	6.9	1,970	6.1	1,200	3.8	800	1.7									
7/16	3,440	33.6	2,870	27.8	2,405	19.8	1,895	6.9	1,690	6.1	1,035	3.4	690	1.5									
1/2	3,010	32.7	2,510	27.5	2,090	19.7	1,655	6.9	1,475	6.0	900	2.7	600	1.3									
5/8	2,355	31.4	1,995	26.1	1,630	19.6	1,325	6.1	1,200	5.4	720	2.3	470	0.9									
3/4	1,920	29.7	1,605	24.9	1,350	15.7	1,095	5.0	975	4.5	580	1.7	405	1.0									
1	1,485	23.3	1,240	19.5	1,050	14.0	840	3.9	750	3.5	440	1.4	300	0.7									

For High Speed see milling parameters, pg 1396-1397.

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## List HP441 (Continued)

### Side Milling (Metric)

Hardness	–	<20 HRC	20-30 HRC	30-38 HRC	38-45 HRC	45-55 HRC	55-60 HRC												
Work Material	Cast Iron	Mild Steels Carbon Steels	Alloy Steels Tool Steels Ti Alloys (Annealed)	Hardened Steels Pre-hardened Steels Ti Alloys (Solution Treated and Aged)	Hardened Steels Pre-hardened Steels Stainless Steels Inconel Ni Based Alloys	Hardened Steels	Hardened Steels												
Cutting Speed	390 SFM	330 SFM	270 SFM	220 SFM	190 SFM	120 SFM	80 SFM												
Depth of Cut	<table border="1"> <thead> <tr> <th>Dia</th> <th>a<sub>a</sub></th> <th>a<sub>r</sub></th> </tr> </thead> <tbody> <tr> <td>D≤3</td> <td>1.5D</td> <td>0.05D</td> </tr> <tr> <td>3&lt;D</td> <td>1.5D</td> <td>0.10D</td> </tr> </tbody> </table>						Dia	a <sub>a</sub>	a <sub>r</sub>	D≤3	1.5D	0.05D	3<D	1.5D	0.10D			$a_a=1D$ $a_r=0.02D$	
	Dia	a <sub>a</sub>	a <sub>r</sub>																
D≤3	1.5D	0.05D																	
3<D	1.5D	0.10D																	
Mill Dia.	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min					
1	25,000	13.6	25,000	13.7	25,000	14.4	21,330	7.6	18,420	6.6	11,635	3.9	7,755	2.4					
2	18,905	17.6	15,995	14.9	13,090	12.8	10,188	6.1	9,240	5.6	5,772	3.4	4,050	2.3					
3	12,605	29.7	10,665	25.1	8,725	17.0	7,110	5.9	6,140	5.8	3,816	3.5	2,585	2.4					
4	9,450	29.4	8,000	24.8	6,545	14.5	5,330	6.5	4,605	5.5	2,910	3.6	1,940	2.3					
5	7,560	34.7	6,400	30.2	5,235	20.2	4,265	6.8	3,685	5.9	2,325	3.7	1,550	2.1					
6	6,300	30.8	5,330	30.2	4,365	20.6	3,555	7.2	3,070	6.2	1,940	3.6	1,295	2.0					
8	4,725	32.9	4,000	27.8	3,270	19.4	2,665	6.9	2,300	6.0	1,455	3.4	970	1.7					
10	3,780	34.5	3,200	28.8	2,620	20.2	2,135	7.2	1,840	6.2	1,165	4.1	775	1.7					
12	3,150	34.3	2,665	29.3	2,180	20.5	1,775	7.4	1,535	6.2	970	2.9	645	1.4					
14	2,700	31.2	2,285	27.2	1,870	19.7	1,525	7.0	1,315	5.9	830	2.4	555	1.2					
16	2,365	31.5	2,000	26.1	1,635	19.6	1,335	6.2	1,150	5.2	725	2.3	485	1.0					
18	2,100	31.0	1,775	26.1	1,455	19.3	1,185	5.4	1,025	4.8	645	2.0	430	1.0					
20	1,890	29.3	1,600	24.8	1,310	15.3	1,065	4.9	920	4.3	580	1.7	390	0.9					
22	1,720	27.1	1,455	23.0	1,190	16.0	970	4.4	835	3.9	530	1.5	355	0.8					
25	1,510	23.7	1,280	20.2	1,045	13.9	855	3.9	735	3.4	465	1.5	310	0.7					

For High Speed see milling parameters, pg 1396-1397.

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
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## List HP421, HP441 (Continued)

### High Speed Light Milling (Fractional)

Hardness	<20 HRC		20-30 HRC		30-38 HRC		38-45 HRC		45-55 HRC																					
Work Material	Mild Steels Carbon Steels		Alloy Steels Tool Steels Ti Alloys (Annealed)		Hardened Steels Pre-hardened Steels Ti Alloys (Solution Treated and Aged)		Hardened Steels Pre-hardened Steels Stainless Steels Inconel Ni Based Alloys		Hardened Steels																					
Cutting Speed	1,310 SFM		1,150 SFM		820 SFM		490 SFM		260 SFM																					
Depth of Cut	<table border="1"> <thead> <tr><th>Dia</th><th>aa</th><th>ar</th></tr> </thead> <tbody> <tr><td>D&lt;5/16</td><td>1.5D</td><td>0.01D</td></tr> <tr><td>5/16≤D&lt;5/8</td><td>1.5D</td><td>0.02D</td></tr> <tr><td>5/8≤D</td><td>1.5D</td><td>0.05D</td></tr> </tbody> </table>			Dia	aa	ar	D<5/16	1.5D	0.01D	5/16≤D<5/8	1.5D	0.02D	5/8≤D	1.5D	0.05D				<table border="1"> <thead> <tr><th>Dia</th><th>aa</th><th>ar</th></tr> </thead> <tbody> <tr><td>D≤5/16</td><td>1D</td><td>0.01D</td></tr> <tr><td>5/16&lt;D</td><td>1D</td><td>0.02D</td></tr> </tbody> </table>			Dia	aa	ar	D≤5/16	1D	0.01D	5/16<D	1D	0.02D
	Dia	aa	ar																											
D<5/16	1.5D	0.01D																												
5/16≤D<5/8	1.5D	0.02D																												
5/8≤D	1.5D	0.05D																												
Dia	aa	ar																												
D≤5/16	1D	0.01D																												
5/16<D	1D	0.02D																												
Mill Dia.	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min																				
1/16	25,000	14.7	25,000	18.8	25,000	18.4	25,000	16.6	15,900	11.9																				
3/32	25,000	27.1	25,000	31.2	25,000	32.6	20,800	24.4	11,050	14.2																				
1/8	25,000	49.3	25,000	49.6	25,000	49	15,200	26	8,050	14.6																				
5/32	25,000	64.7	25,000	64.4	20,100	52.8	12,000	26.8	6,400	16.1																				
3/16	25,000	104.5	23,550	81.1	16,850	54.3	10,100	28.7	5,350	17.3																				
1/4	20,000	96.5	17,600	84.3	12,450	58.7	7,600	31.1	4,000	16.5																				
5/16	15,650	96.5	13,650	82.7	9,950	57.1	6,000	31.1	3,150	16.5																				
3/8	13,200	97.6	11,550	82.7	8,400	57.1	5,000	31.1	2,650	16.5																				
7/16	11,350	97.2	10,000	82.7	7,150	57.1	4,300	31.1	2,250	16.1																				
1/2	9,950	94.9	8,750	81.1	6,250	55.5	3,750	30.3	1,950	15.7																				
5/8	8,000	88.6	7,000	76.8	4,950	53.1	2,950	28	1,550	14.6																				
3/4	6,650	85.4	5,800	73.6	4,150	51.2	2,450	26.8	1,300	14.2																				
1	4,950	65.7	4,400	58.3	3,100	40.6	1,850	21.7	950	10.6																				

Reduce feeds 50% for Series HP421 High Speed Light Milling.

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## List HP421, HP441 (Continued)

### High Speed Light Milling (Metric)

Hardness	<20 HRC		20-30 HRC		30-38 HRC		38-45 HRC		45-55 HRC																								
Work Material	Mild Steels Carbon Steels		Alloy Steels Tool Steels Ti Alloys (Annealed)		Hardened Steels Pre-hardened Steels Ti Alloys (Solution Treated and Aged)		Hardened Steels Pre-hardened Steels Stainless Steels Inconel Ni Based Alloys		Hardened Steels																								
Cutting Speed	1,310 SFM		1,150 SFM		820 SFM		490 SFM		260 SFM																								
Depth of Cut	<table border="1"> <thead> <tr> <th>Dia</th> <th>aa</th> <th>ar</th> </tr> </thead> <tbody> <tr> <td>D&lt;8</td> <td>1.5D</td> <td>0.01D</td> </tr> <tr> <td>8≤D&lt;16</td> <td>1.5D</td> <td>0.02D</td> </tr> <tr> <td>16≤D</td> <td>1.5D</td> <td>0.05D</td> </tr> </tbody> </table>					Dia	aa	ar	D<8	1.5D	0.01D	8≤D<16	1.5D	0.02D	16≤D	1.5D	0.05D			<table border="1"> <thead> <tr> <th>Dia</th> <th>aa</th> <th>ar</th> </tr> </thead> <tbody> <tr> <td>D≤8</td> <td>1D</td> <td>0.01D</td> </tr> <tr> <td>8&lt;D</td> <td>1D</td> <td>0.02D</td> </tr> </tbody> </table>					Dia	aa	ar	D≤8	1D	0.01D	8<D	1D	0.02D
	Dia	aa	ar																														
D<8	1.5D	0.01D																															
8≤D<16	1.5D	0.02D																															
16≤D	1.5D	0.05D																															
Dia	aa	ar																															
D≤8	1D	0.01D																															
8<D	1D	0.02D																															
Mill Dia.	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min																							
1	25,000	10.9	25,000	12.4	25,000	12.4	25,000	11.2	25,000	12.8																							
2	25,000	19.2	25,000	24.7	25,000	27.2	23,850	23.6	12,700	14.2																							
3	25,000	46.8	25,000	47.2	25,000	46.4	15,900	26.0	8,450	14.2																							
4	25,000	65.6	25,000	65.4	19,900	53.1	11,900	27.2	6,350	16.5																							
5	25,000	119.8	22,250	83.9	15,900	55.1	9,550	29.5	5,050	17.7																							
6	21,000	96.5	18,500	84.6	13,000	59.1	7,950	31.3	4,200	16.5																							
8	15,500	96.5	13,500	82.7	9,900	57.1	5,950	31.3	3,150	16.7																							
10	12,500	98.4	11,000	82.7	7,950	57.1	4,750	31.5	2,500	16.5																							
12	10,500	96.5	9,250	82.7	6,600	57.1	3,950	31.1	2,100	16.1																							
14	9,050	92.5	7,950	78.7	5,650	53.1	3,400	29.1	1,800	15.4																							
16	7,950	88.6	6,950	76.8	4,950	53.1	2,950	28.1	1,550	14.8																							
18	7,050	88.6	6,150	74.8	4,400	51.2	2,650	27.8	1,400	14.8																							
20	6,350	82.7	5,550	72.8	3,950	51.2	2,350	26.2	1,250	14.0																							
22	5,750	76.8	5,050	66.9	3,600	47.2	2,150	25.0	1,150	12.8																							
24	5,300	70.9	4,600	61.0	3,300	43.3	1,950	22.6	1,050	11.6																							
25	5,050	66.9	4,450	59.1	3,150	41.3	1,900	22.0	1,000	11.0																							

Reduce feeds 50% for Series HP421 High Speed Light Milling.

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