

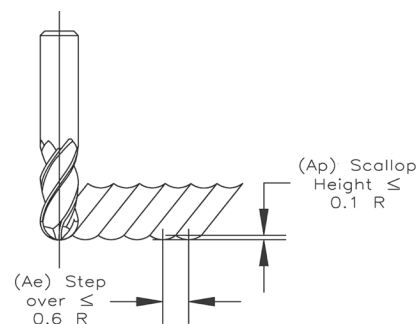
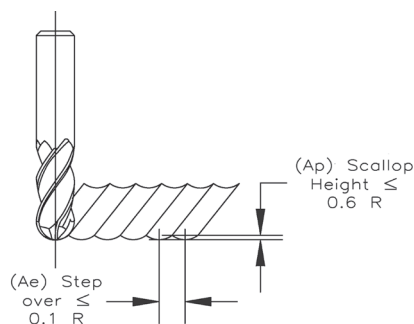
# TuffCut® XT

## 279 Series Recommended Cutting Data - Contouring - Inch

See pages 142-145 for profile milling and slotting data.

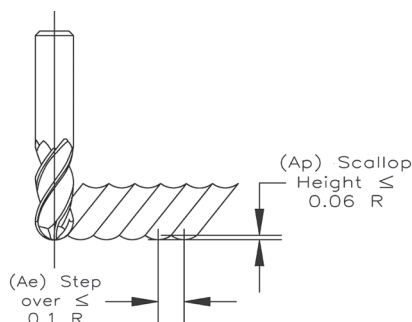
| Semi Roughing / Roughing (25 - 48 Rc) |         |        |      |                |       |       |
|---------------------------------------|---------|--------|------|----------------|-------|-------|
|                                       |         |        |      |                | Max   | Max   |
| Diameter                              | Decimal | Radius | SFM  | in/tooth Range | Ae    | Ap    |
| 1/8                                   | 0.1250  | 0.063  | 820  | .0008 - .0012  | 0.006 | 0.035 |
| 3/16                                  | 0.1875  | 0.094  | 1020 | .0010 - .0017  | 0.009 | 0.053 |
| 1/4                                   | 0.2500  | 0.125  | 1235 | .0010 - .0027  | 0.012 | 0.071 |
| 5/16                                  | 0.3125  | 0.156  | 1235 | .0014 - .0032  | 0.016 | 0.094 |
| 3/8                                   | 0.3750  | 0.188  | 1235 | .0018 - .0037  | 0.020 | 0.118 |
| 1/2                                   | 0.5000  | 0.250  | 1235 | .0018 - .0040  | 0.024 | 0.142 |
| 5/8                                   | 0.6250  | 0.313  | 1235 | .0020 - .0041  | 0.032 | 0.189 |
| 3/4                                   | 0.7500  | 0.375  | 1235 | .0025 - .0045  | 0.038 | 0.225 |

| Semi Finishing / Finishing (25 - 48 Rc) |         |        |      |                |       |       |
|-----------------------------------------|---------|--------|------|----------------|-------|-------|
|                                         |         |        |      |                | Max   | Max   |
| Diameter                                | Decimal | Radius | SFM  | in/tooth Range | Ae    | Ap    |
| 1/8                                     | 0.1250  | 0.063  | 820  | .0008 - .0012  | 0.035 | 0.006 |
| 3/16                                    | 0.1875  | 0.094  | 1020 | .0010 - .0017  | 0.053 | 0.009 |
| 1/4                                     | 0.2500  | 0.125  | 1235 | .0010 - .0027  | 0.070 | 0.012 |
| 5/16                                    | 0.3125  | 0.156  | 1235 | .0014 - .0032  | 0.094 | 0.016 |
| 3/8                                     | 0.3750  | 0.188  | 1235 | .0018 - .0037  | 0.118 | 0.020 |
| 1/2                                     | 0.5000  | 0.250  | 1235 | .0018 - .0040  | 0.141 | 0.024 |
| 5/8                                     | 0.6250  | 0.313  | 1235 | .0020 - .0041  | 0.188 | 0.031 |
| 3/4                                     | 0.7500  | 0.375  | 1235 | .0025 - .0045  | 0.225 | 0.038 |



| Titanium |         |        |     |          |
|----------|---------|--------|-----|----------|
| Diameter | Decimal | Radius | SFM | In/tooth |
| 1/8      | 0.1250  | 0.063  | 500 | 0.0011   |
| 3/16     | 0.1875  | 0.094  | 500 | 0.0015   |
| 1/4      | 0.2500  | 0.125  | 500 | 0.0018   |
| 5/16     | 0.3125  | 0.156  | 500 | 0.0026   |
| 3/8      | 0.3750  | 0.188  | 500 | 0.0031   |
| 1/2      | 0.5000  | 0.250  | 500 | 0.0036   |
| 5/8      | 0.6250  | 0.313  | 500 | 0.0039   |
| 3/4      | 0.7500  | 0.375  | 500 | 0.0041   |

| High Temp Alloys |         |        |     |          |
|------------------|---------|--------|-----|----------|
| Diameter         | Decimal | Radius | SFM | In/tooth |
| 1/8              | 0.1250  | 0.063  | 150 | 0.0011   |
| 3/16             | 0.1875  | 0.094  | 150 | 0.0015   |
| 1/4              | 0.2500  | 0.125  | 150 | 0.0018   |
| 5/16             | 0.3125  | 0.156  | 150 | 0.0026   |
| 3/8              | 0.3750  | 0.188  | 150 | 0.0031   |
| 1/2              | 0.5000  | 0.250  | 150 | 0.0036   |
| 5/8              | 0.6250  | 0.313  | 150 | 0.0039   |
| 3/4              | 0.7500  | 0.375  | 150 | 0.0041   |



Technical data provided should be considered advisory only as variations may be necessary depending on the particular application.

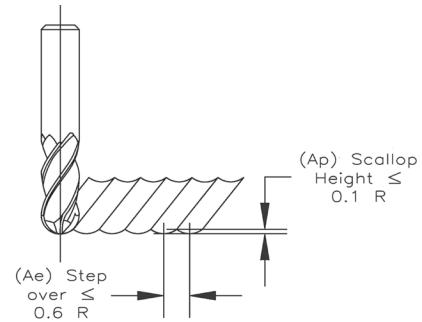
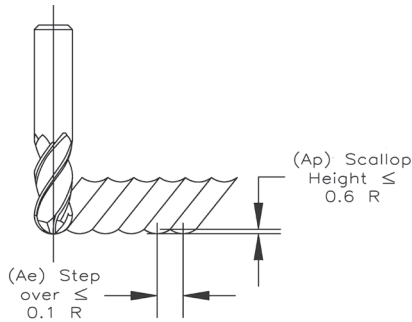
# TuffCut® XT

## 279 Series Recommended Cutting Data - Contouring - Metric

See pages 142-145 for profile milling and slotting data.

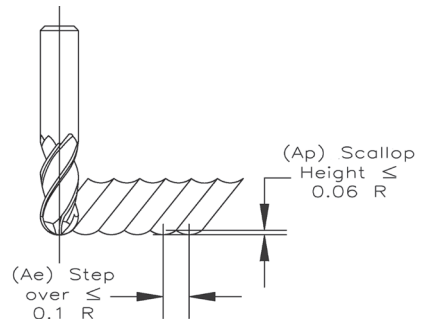
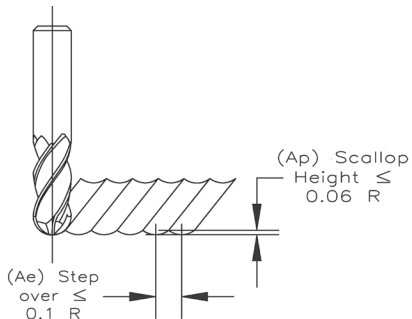
| Semi Roughing / Roughing (25 - 48 Rc) |        |            |                |      |     |
|---------------------------------------|--------|------------|----------------|------|-----|
|                                       |        |            |                | Max  | Max |
| Diameter                              | Radius | meters/min | mm/tooth Range | Ae   | Ap  |
| 3                                     | 1.5    | 250        | .020 - .030    | 0.15 | 0.9 |
| 4                                     | 2      | 290        | .025 - .040    | 0.2  | 1.2 |
| 5                                     | 2.5    | 315        | .025 - .045    | 0.25 | 1.5 |
| 6                                     | 3      | 375        | .025 - .065    | 0.3  | 1.8 |
| 8                                     | 4      | 375        | .035 - .080    | 0.4  | 2.4 |
| 10                                    | 5      | 375        | .045 - .090    | 0.5  | 3   |
| 12                                    | 6      | 375        | .045 - .100    | 0.6  | 3.6 |
| 16                                    | 8      | 375        | .050 - .105    | 0.8  | 4.8 |

| Semi Finishing / Finishing (25 - 48 Rc) |        |            |                |     |      |
|-----------------------------------------|--------|------------|----------------|-----|------|
|                                         |        |            |                | Max | Max  |
| Diameter                                | Radius | meters/min | mm/tooth Range | Ae  | Ap   |
| 3                                       | 1.5    | 250        | .020 - .030    | 0.9 | 0.15 |
| 4                                       | 2      | 290        | .025 - .040    | 1.2 | 0.2  |
| 5                                       | 2.5    | 315        | .025 - .045    | 1.5 | 0.25 |
| 6                                       | 3      | 375        | .025 - .065    | 1.8 | 0.3  |
| 8                                       | 4      | 375        | .035 - .080    | 2.4 | 0.4  |
| 10                                      | 5      | 375        | .045 - .090    | 3   | 0.5  |
| 12                                      | 6      | 375        | .045 - .100    | 3.6 | 0.6  |
| 16                                      | 8      | 375        | .050 - .105    | 4.8 | 0.8  |



| Titanium |        |            |          |      |      |
|----------|--------|------------|----------|------|------|
|          |        |            |          | Max  | Max  |
| Diameter | Radius | meters/min | mm/tooth | Ae   | Ap   |
| 3        | 1.5    | 150        | 0.030    | 0.15 | 0.09 |
| 4        | 2      | 150        | 0.035    | 0.2  | 0.12 |
| 5        | 2.5    | 150        | 0.040    | 0.25 | 0.15 |
| 6        | 3      | 150        | 0.045    | 0.3  | 0.18 |
| 8        | 4      | 150        | 0.065    | 0.4  | 0.24 |
| 10       | 5      | 150        | 0.080    | 0.5  | 0.3  |
| 12       | 6      | 150        | 0.090    | 0.6  | 0.36 |
| 16       | 8      | 150        | 0.100    | 0.8  | 0.48 |

| High Temp Alloys |        |            |          |      |      |
|------------------|--------|------------|----------|------|------|
|                  |        |            |          | Max  | Max  |
| Diameter         | Radius | meters/min | mm/tooth | Ae   | Ap   |
| 3                | 1.5    | 45         | 0.030    | 0.15 | 0.09 |
| 4                | 2      | 45         | 0.035    | 0.2  | 0.12 |
| 5                | 2.5    | 45         | 0.040    | 0.25 | 0.15 |
| 6                | 3      | 45         | 0.045    | 0.3  | 0.18 |
| 8                | 4      | 45         | 0.065    | 0.4  | 0.24 |
| 10               | 5      | 45         | 0.080    | 0.5  | 0.3  |
| 12               | 6      | 45         | 0.090    | 0.6  | 0.36 |
| 16               | 8      | 45         | 0.100    | 0.8  | 0.48 |



Technical data provided should be considered advisory only as variations may be necessary depending on the particular application.

## TuffCut® XR

### 279 / 177 / 177L / 177S / 179 / 179L Series Recommended Cutting Data - Profile Milling - Inch

279 / 179 / 179L series - If axial depth (ap) is less than the ball diameter, the speed is figured using the effective cutting diameter. See pages 134-135 for 279 Series contouring data.

| Workpiece Material Group                                                                                                                | I<br>S<br>O | Hardness     | Coolant<br>● Preferred<br>○ Possible<br>x Not Possible |                |     | Profiling (ae)*                                                                   |                                                                                   |                                                                                   |                                                                                   | End Mill Diameter (inch)                                                                                                                                                                                                               |       |       |       |       |       |       |       |       |
|-----------------------------------------------------------------------------------------------------------------------------------------|-------------|--------------|--------------------------------------------------------|----------------|-----|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|
|                                                                                                                                         |             |              |                                                        |                |     |  |  |  |  | 1/8*                                                                                                                                                                                                                                   | 3/16* | 1/4*  | 5/16  | 3/8   | 1/2   | 5/8   | 3/4   | 1     |
|                                                                                                                                         |             |              |                                                        |                |     | 5%                                                                                | 10%                                                                               | 25%                                                                               | 50%                                                                               | *Profile Milling at ≥ 50% ap is not recommended for diameters 1/4" and below.                                                                                                                                                          |       |       |       |       |       |       |       |       |
|                                                                                                                                         |             |              | Emulsion                                               | Compressed Air | MQL | 2.3                                                                               | 1.8                                                                               | 1.2                                                                               | 1.0                                                                               |  Multiply fz by this Factor based on ae. When finishing, use the standard fz per chart below. Only add chip thinning when roughing or semi-finishing. |       |       |       |       |       |       |       |       |
|                                                                                                                                         |             |              |                                                        |                |     | vc - SFM                                                                          |                                                                                   |                                                                                   |                                                                                   |                                                                                                                                                                                                                                        |       |       |       |       |       |       |       |       |
|                                                                                                                                         |             |              |                                                        |                |     |                                                                                   |                                                                                   |                                                                                   |                                                                                   | fz - in/tooth                                                                                                                                                                                                                          |       |       |       |       |       |       |       |       |
| Low Carbon Steels<br>1018, 1020                                                                                                         | P           | up to 28 Rc  | ●                                                      | ●              | ●   | 1475                                                                              | 1150                                                                              | 980                                                                               | 500                                                                               | .0012                                                                                                                                                                                                                                  | .0020 | .0024 | .0031 | .0039 | .0047 | .0060 | .0078 | .0100 |
| Medium Carbon Steels<br>1140, 1145                                                                                                      | P           | 28 to 38 Rc  | ●                                                      | ●              | ●   | 1130                                                                              | 900                                                                               | 840                                                                               | 250                                                                               | .0012                                                                                                                                                                                                                                  | .0020 | .0024 | .0031 | .0039 | .0047 | .0060 | .0078 | .0100 |
| Alloy Steels<br>4140, 4145                                                                                                              | P           | 28 to 44 Rc  | ●                                                      | ●              | ●   | 1035                                                                              | 840                                                                               | 755                                                                               | 250                                                                               | .0012                                                                                                                                                                                                                                  | .0020 | .0024 | .0031 | .0039 | .0047 | .0060 | .0078 | .0100 |
| Die / Tool Steels<br>A2, D2, H13, P20                                                                                                   | P           | 28 to 44 Rc  | ●                                                      | ●              | ●   | 900                                                                               | 725                                                                               | 615                                                                               | 200                                                                               | .0012                                                                                                                                                                                                                                  | .0020 | .0024 | .0031 | .0039 | .0047 | .0060 | .0078 | .0100 |
| Hardened Steels<br>A2, D2                                                                                                               | H           | 45 to 50 Rc  | ●                                                      | ○              | ○   | 610                                                                               | 495                                                                               | 325                                                                               | 250                                                                               | .0006                                                                                                                                                                                                                                  | .0010 | .0012 | .0016 | .0020 | .0024 | .0030 | .0040 | .0050 |
| Hardened Steels<br>A2, D2                                                                                                               | H           | 50 to 55 Rc  | ●                                                      | ○              | ○   | 510                                                                               | 410                                                                               | 280                                                                               | 200                                                                               | .0003                                                                                                                                                                                                                                  | .0005 | .0006 | .0008 | .0010 | .0012 | .0016 | .0020 | .0024 |
| Stainless Steel - Easy to Machine<br>430F, 301, 303, 410, 416 Annealed, 420F, 430                                                       | M           | up to 28 Rc  | ●                                                      | x              | ○   | 675                                                                               | 545                                                                               | 425                                                                               | 360                                                                               | .0012                                                                                                                                                                                                                                  | .0020 | .0024 | .0031 | .0039 | .0047 | .0060 | .0078 | .0100 |
| Stainless Steel - Austenitic<br>301, 302, 303 High Tensile, 304, 304L, 305, 420, 15-5PH, 17-4PH, 17-7PH                                 | M           | up to 28 Rc  | ●                                                      | x              | ○   | 525                                                                               | 430                                                                               | 400                                                                               | 210                                                                               | .0012                                                                                                                                                                                                                                  | .0020 | .0024 | .0031 | .0039 | .0047 | .0060 | .0078 | .0100 |
| Stainless Steel - Difficult to Machine<br>302B, 304B, 309, 310, 316, 316B, 316L, 316Ti, 317, 317L, 321                                  | M           | up to 28 Rc  | ●                                                      | x              | ○   | 410                                                                               | 330                                                                               | 295                                                                               | 210                                                                               | .0012                                                                                                                                                                                                                                  | .0020 | .0024 | .0031 | .0039 | .0047 | .0060 | .0078 | .0100 |
| Stainless Steel - Difficult to Machine<br>17-4 PH, PH13-8Mo, Nitronics                                                                  | M           | over 28 Rc   | ●                                                      | x              | ○   | 525                                                                               | 430                                                                               | 395                                                                               | 110                                                                               | .0006                                                                                                                                                                                                                                  | .0010 | .0012 | .0016 | .0020 | .0024 | .0030 | .0040 | .0050 |
| Cobalt Chrome Alloys                                                                                                                    | M           |              | ●                                                      | x              | ○   | 410                                                                               | 325                                                                               | 295                                                                               | 130                                                                               | .0006                                                                                                                                                                                                                                  | .0010 | .0012 | .0016 | .0020 | .0024 | .0030 | .0040 | .0050 |
| Duplex (22%)                                                                                                                            | M           |              | ●                                                      | x              | ○   | 245                                                                               | 195                                                                               | 180                                                                               | 130                                                                               | .0006                                                                                                                                                                                                                                  | .0010 | .0012 | .0016 | .0020 | .0024 | .0030 | .0040 | .0050 |
| Super Duplex (25%)                                                                                                                      | M           |              | ●                                                      | x              | ○   | 245                                                                               | 195                                                                               | 180                                                                               | 110                                                                               | .0006                                                                                                                                                                                                                                  | .0010 | .0012 | .0016 | .0020 | .0024 | .0030 | .0040 | .0050 |
| High Temp Alloys                                                                                                                        | S           | up to 42 Rc  | ●                                                      | x              | x   | 180                                                                               | 150                                                                               | 130                                                                               | 85                                                                                | .0003                                                                                                                                                                                                                                  | .0005 | .0006 | .0008 | .0010 | .0012 | .0016 | .0020 | .0024 |
| Inconel                                                                                                                                 | S           |              | ●                                                      | x              | x   | 180                                                                               | 150                                                                               | 130                                                                               | 85                                                                                | .0003                                                                                                                                                                                                                                  | .0005 | .0006 | .0008 | .0010 | .0012 | .0016 | .0020 | .0024 |
| Titanium Alloys<br>6Al-4V, 5Al-2.5 Sn, 6Al-2 Sn-4Zr-6Mo, 3Al-8V-6Cr-4Mo-4Zr, 10V-2Fe-3Al, 13V-11Cr-3Al                                  | S           | up to 42 Rc  | ●                                                      | x              | x   | 375                                                                               | 350                                                                               | 330                                                                               | 175                                                                               | .0003                                                                                                                                                                                                                                  | .0005 | .0006 | .0008 | .0010 | .0012 | .0016 | .0020 | .0024 |
| Cast-Iron - Gray CG, ASTM A48, CLASS 20, 25, 30, 35, SAE J431C, GRADES G1800, G3000, G3500, GG 10, 15, 20, 25, 30, 35, 40               | K           | up to 240 HB | ●                                                      | ○              | ○   | 1625                                                                              | 1295                                                                              | 870                                                                               | 350                                                                               | .0012                                                                                                                                                                                                                                  | .0020 | .0024 | .0031 | .0039 | .0047 | .0060 | .0078 | .0100 |
| Cast Iron - Ductile & Malleable CGI 60-40-18, 65-45-12, D4018, D4512, D5506, 32510, 35108, M3210, M4504, M5503, 250, 300, 350, 400, 450 | K           | over 240 HB  | ●                                                      | ○              | ○   | 675                                                                               | 540                                                                               | 510                                                                               | 260                                                                               | .0012                                                                                                                                                                                                                                  | .0020 | .0024 | .0031 | .0039 | .0047 | .0060 | .0078 | .0100 |

Spindle Maximum - Should the calculated spindle speed be more than your actual spindle maximum, use this formula:  
 (Calculated Feed x Spindle Maximum)/Calculated Speed.

Technical data provided should be considered advisory only as variations may be necessary depending on the particular application.

# TuffCut® XR

## 279 / 177 / 177L / 177S / 179 / 179L Series Recommended Cutting Data - Profile Milling - Metric

279 / 179 / 179L series - If axial depth (ap) is less than the ball diameter, the speed is figured using the effective cutting diameter. See pages 134-135 for 279 Series contouring data.

| Workpiece Material Group                                                                                                                | ISO | Hardness     | Coolant<br>● Preferred<br>○ Possible<br>x Not Possible |                |     | Profiling (ae)* |     |     |     | End Mill Diameter (mm) |       |       |       |       |       |       |       |
|-----------------------------------------------------------------------------------------------------------------------------------------|-----|--------------|--------------------------------------------------------|----------------|-----|-----------------|-----|-----|-----|------------------------|-------|-------|-------|-------|-------|-------|-------|
|                                                                                                                                         |     |              |                                                        |                |     |                 |     |     |     |                        |       |       |       |       |       |       |       |
|                                                                                                                                         |     |              | Emulsion                                               | Compressed Air | MQL | 5%              | 10% | 25% | 50% |                        |       |       |       |       |       |       |       |
|                                                                                                                                         |     |              |                                                        |                |     | 2.3             | 1.8 | 1.2 | 1.0 |                        |       |       |       |       |       |       |       |
|                                                                                                                                         |     |              |                                                        |                |     | vc - m/min      |     |     |     | fz - mm/tooth          |       |       |       |       |       |       |       |
| Low Carbon Steels<br>1018, 1020                                                                                                         | P   | up to 28 Rc  | ●                                                      | ●              | ●   | 450             | 350 | 300 | 150 | .0300                  | .0500 | .0600 | .0800 | .1000 | .1200 | .1600 | .2000 |
| Medium Carbon Steels<br>1140, 1145                                                                                                      | P   | 28 to 38 Rc  | ●                                                      | ●              | ●   | 345             | 275 | 255 | 75  | .0300                  | .0500 | .0600 | .0800 | .1000 | .1200 | .1600 | .2000 |
| Alloy Steels<br>4140, 4145                                                                                                              | P   | 28 to 44 Rc  | ●                                                      | ●              | ●   | 315             | 255 | 230 | 75  | .0300                  | .0500 | .0600 | .0800 | .1000 | .1200 | .1600 | .2000 |
| Die / Tool Steels<br>A2, D2, H13, P20                                                                                                   | P   | 28 to 44 Rc  | ●                                                      | ●              | ●   | 275             | 220 | 185 | 60  | .0300                  | .0500 | .0600 | .0800 | .1000 | .1200 | .1600 | .2000 |
| Hardened Steels<br>A2, D2                                                                                                               | H   | 45 to 50 Rc  | ●                                                      | ○              | ○   | 185             | 150 | 100 | 75  | .0150                  | .0250 | .0300 | .0400 | .0500 | .0600 | .0800 | .1000 |
| Hardened Steels<br>A2, D2                                                                                                               | H   | 50 to 55 Rc  | ●                                                      | ○              | ○   | 155             | 125 | 85  | 60  | .0070                  | .0120 | .0150 | .0200 | .0250 | .0300 | .0400 | .0500 |
| Stainless Steel - Easy to Machine<br>430F, 301, 303, 410, 416 Annealed, 420F, 430                                                       | M   | up to 28 Rc  | ●                                                      | x              | ○   | 205             | 165 | 130 | 110 | .0300                  | .0500 | .0600 | .0800 | .1000 | .1200 | .1600 | .2000 |
| Stainless Steel - Austenitic 301, 302, 303 High Tensile, 304, 304L, 305, 420, 15-5PH, 17-4PH, 17-7PH                                    | M   | up to 28 Rc  | ●                                                      | x              | ○   | 160             | 130 | 120 | 65  | .0300                  | .0500 | .0600 | .0800 | .1000 | .1200 | .1600 | .2000 |
| Stainless Steel - Difficult to Machine<br>302B, 304B, 309, 310, 316, 316B, 316L, 316Ti, 317, 317L, 321                                  | M   | up to 28 Rc  | ●                                                      | x              | ○   | 125             | 100 | 90  | 65  | .0300                  | .0500 | .0600 | .0800 | .1000 | .1200 | .1600 | .2000 |
| Stainless Steel - Difficult to Machine<br>17-4 PH, PH13-8Mo, Nitronics                                                                  | M   |              | ●                                                      | x              | ○   | 160             | 130 | 120 | 35  | .0150                  | .0250 | .0300 | .0400 | .0500 | .0600 | .0800 | .1000 |
| Cobalt Chrome Alloys                                                                                                                    | M   | over 28 Rc   | ●                                                      | x              | ○   | 125             | 100 | 90  | 40  | .0150                  | .0250 | .0300 | .0400 | .0500 | .0600 | .0800 | .1000 |
| Duplex (22%)                                                                                                                            | M   |              | ●                                                      | x              | ○   | 75              | 60  | 55  | 40  | .0150                  | .0250 | .0300 | .0400 | .0500 | .0600 | .0800 | .1000 |
| Super Duplex (25%)                                                                                                                      | M   |              | ●                                                      | x              | ○   | 75              | 60  | 55  | 35  | .0150                  | .0250 | .0300 | .0400 | .0500 | .0600 | .0800 | .1000 |
| High Temp Alloys                                                                                                                        | S   | up to 42 Rc  | ●                                                      | x              | x   | 55              | 45  | 40  | 25  | .0070                  | .0120 | .0150 | .0200 | .0250 | .0300 | .0400 | .0500 |
| Inconel                                                                                                                                 | S   |              | ●                                                      | x              | x   | 55              | 45  | 40  | 25  | .0070                  | .0120 | .0150 | .0200 | .0250 | .0300 | .0400 | .0500 |
| Titanium Alloys<br>6Al-4V, 5Al-2.5 Sn, 6Al-2 Sn-4Zr-6Mo, 3Al-8V-6Cr-4Mo-4Zr, 10V-2Fe-3Al, 13V-11Cr-3Al                                  | S   | up to 42 Rc  | ●                                                      | x              | x   | 115             | 105 | 100 | 55  | .0070                  | .0120 | .0150 | .0200 | .0250 | .0300 | .0400 | .0500 |
| Cast-Iron - Gray CG, ASTM A48, CLASS 20, 25, 30, 35, SAE J431C, GRADES G1800, G3000, G3500, GG 10, 15, 20, 25, 30, 35, 40               | K   | up to 240 HB | ●                                                      | ○              | ○   | 495             | 395 | 265 | 110 | .0300                  | .0500 | .0600 | .0800 | .1000 | .1200 | .1600 | .2000 |
| Cast Iron - Ductile & Malleable CGI 60-40-18, 65-45-12, D4018, D4512, D5506, 32510, 35108, M3210, M4504, M5503, 250, 300, 350, 400, 450 | K   | over 240 HB  | ●                                                      | ○              | ○   | 205             | 165 | 155 | 80  | .0300                  | .0500 | .0600 | .0800 | .1000 | .1200 | .1600 | .2000 |

Spindle Maximum - Should the calculated spindle speed be more than your actual spindle maximum, use this formula:  
(Calculated Feed x Spindle Maximum)/Calculated Speed.

Technical data provided should be considered advisory only as variations may be necessary depending on the particular application.

## TuffCut® XR

### 279 / 177 / 177L / 177S / 179 / 179L Series Recommended Cutting Data - Slotting - Inch

279 / 179 / 179L series - If axial depth (ap) is less than the ball diameter, the speed is figured using the effective cutting diameter. See pages 134-135 for 279 Series contouring data.

| Workpiece Material Group                                                                                                                | ISO | Hardness     | Coolant<br>● Preferred<br>○ Possible<br>x Not Possible |                |     | Slotting*                                                                         |                                                                                   |                                                                                   | End Mill Diameter (inch)                                               |       |       |       |       |       |       |       |       |
|-----------------------------------------------------------------------------------------------------------------------------------------|-----|--------------|--------------------------------------------------------|----------------|-----|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|
|                                                                                                                                         |     |              |                                                        |                |     |  |  |  | 1/8*                                                                   | 3/16* | 1/4*  | 5/16  | 3/8   | 1/2   | 5/8   | 3/4   | 1     |
|                                                                                                                                         |     |              | Emulsion                                               | Compressed Air | MQL | 25%                                                                               | 50%                                                                               | 100%                                                                              | *Slotting at > 25% ap is not recommended for diameters 1/4" and below. |       |       |       |       |       |       |       |       |
|                                                                                                                                         |     |              |                                                        |                |     | vc - SFM                                                                          |                                                                                   |                                                                                   | fz - in/tooth                                                          |       |       |       |       |       |       |       |       |
| Low Carbon Steels<br>1018, 1020                                                                                                         | P   | up to 28 Rc  | ●                                                      | ●              | ●   | 550                                                                               | 500                                                                               | 475                                                                               | .0004                                                                  | .0010 | .0012 | .0016 | .0020 | .0025 | .0031 | .0040 | .0050 |
| Medium Carbon Steels<br>1140, 1145                                                                                                      | P   | 28 to 38 Rc  | ●                                                      | ●              | ●   | 275                                                                               | 250                                                                               | 225                                                                               | .0004                                                                  | .0010 | .0012 | .0016 | .0020 | .0025 | .0031 | .0040 | .0050 |
| Alloy Steels<br>4140, 4145                                                                                                              | P   | 28 to 44 Rc  | ●                                                      | ●              | ●   | 275                                                                               | 250                                                                               | 225                                                                               | .0004                                                                  | .0010 | .0012 | .0016 | .0020 | .0025 | .0031 | .0040 | .0050 |
| Die / Tool Steels<br>A2, D2, H13, P20                                                                                                   | P   | 28 to 44 Rc  | ●                                                      | ●              | ●   | 225                                                                               | 200                                                                               | 175                                                                               | .0004                                                                  | .0010 | .0012 | .0016 | .0020 | .0025 | .0031 | .0040 | .0050 |
| Hardened Steels<br>A2, D2                                                                                                               | H   | 45 to 50 Rc  | ●                                                      | ○              | ○   | 275                                                                               | 250                                                                               | 225                                                                               | .0003                                                                  | .0005 | .0006 | .0008 | .0010 | .0012 | .0016 | .0020 | .0024 |
| Hardened Steels<br>A2, D2                                                                                                               | H   | 50 to 55 Rc  | ●                                                      | ○              | ○   | 225                                                                               | 200                                                                               | 175                                                                               | .0001                                                                  | .0002 | .0003 | .0004 | .0005 | .0006 | .0008 | .0010 | .0015 |
| Stainless Steel - Easy to Machine<br>430F, 301, 303, 410, 416 Annealed, 420F, 430                                                       | M   | up to 28 Rc  | ●                                                      | x              | ○   | 385                                                                               | 360                                                                               | 350                                                                               | .0004                                                                  | .0010 | .0012 | .0016 | .0020 | .0024 | .0031 | .0040 | .0050 |
| Stainless Steel - Austenitic<br>301, 302, 303 High Tensile, 304, 304L, 305, 420, 15-5PH, 17-4PH, 17-7PH                                 | M   | up to 28 Rc  | ●                                                      | x              | ○   | 225                                                                               | 210                                                                               | 200                                                                               | .0004                                                                  | .0010 | .0012 | .0016 | .0020 | .0024 | .0031 | .0040 | .0050 |
| Stainless Steel - Difficult to Machine<br>302B, 304B, 309, 310, 316, 316B, 316L, 316Ti, 317, 317L, 321                                  | M   | up to 28 Rc  | ●                                                      | x              | ○   | 225                                                                               | 210                                                                               | 200                                                                               | .0004                                                                  | .0010 | .0012 | .0016 | .0020 | .0024 | .0031 | .0040 | .0050 |
| Stainless Steel - Difficult to Machine<br>17-4 PH, PH13-8Mo, Nitronics                                                                  | M   |              | ●                                                      | x              | ○   | 125                                                                               | 110                                                                               | 100                                                                               | .0003                                                                  | .0005 | .0006 | .0008 | .0010 | .0012 | .0016 | .0020 | .0024 |
| Cobalt Chrome Alloys                                                                                                                    | M   | over 28 Rc   | ●                                                      | x              | ○   | 150                                                                               | 130                                                                               | 120                                                                               | .0003                                                                  | .0005 | .0006 | .0008 | .0010 | .0012 | .0016 | .0020 | .0024 |
| Duplex (22%)                                                                                                                            | M   |              | ●                                                      | x              | ○   | 150                                                                               | 130                                                                               | 120                                                                               | .0003                                                                  | .0005 | .0006 | .0008 | .0010 | .0012 | .0016 | .0020 | .0024 |
| Super Duplex (25%)                                                                                                                      | M   |              | ●                                                      | x              | ○   | 120                                                                               | 110                                                                               | 100                                                                               | .0003                                                                  | .0005 | .0006 | .0008 | .0010 | .0012 | .0016 | .0020 | .0024 |
| High Temp Alloys                                                                                                                        | S   | up to 42 Rc  | ●                                                      | x              | x   | 100                                                                               | 85                                                                                | 75                                                                                | .0003                                                                  | .0005 | .0006 | .0008 | .0010 | .0012 | .0016 | .0020 | .0024 |
| Inconel                                                                                                                                 | S   |              | ●                                                      | x              | x   | 95                                                                                | 85                                                                                | 75                                                                                | .0003                                                                  | .0005 | .0006 | .0008 | .0010 | .0012 | .0016 | .0020 | .0024 |
| Titanium Alloys<br>6Al-4V, 5Al-2.5 Sn, 6Al-2 Sn-4Zr-6Mo, 3Al-8V-6Cr-4Mo-4Zr, 10V-2Fe-3Al, 13V-11Cr-3Al                                  | S   | up to 42 Rc  | ●                                                      | x              | x   | 180                                                                               | 175                                                                               | 160                                                                               | .0003                                                                  | .0005 | .0006 | .0008 | .0010 | .0012 | .0016 | .0020 | .0024 |
| Cast-Iron - Gray CG, ASTM A48, CLASS 20, 25, 30, 35, SAE J431C, GRADES G1800, G3000, G3500, GG 10, 15, 20, 25, 30, 35, 40               | K   | up to 240 HB | ●                                                      | ○              | ○   | 375                                                                               | 350                                                                               | 325                                                                               | .0004                                                                  | .0010 | .0012 | .0016 | .0020 | .0024 | .0031 | .0040 | .0050 |
| Cast Iron - Ductile & Malleable CGI 60-40-18, 65-45-12, D4018, D4512, D5506, 32510, 35108, M3210, M4504, M5503, 250, 300, 350, 400, 450 | K   | over 240 HB  | ●                                                      | ○              | ○   | 275                                                                               | 260                                                                               | 250                                                                               | .0004                                                                  | .0010 | .0012 | .0016 | .0020 | .0024 | .0031 | .0040 | .0050 |

Spindle Maximum - Should the calculated spindle speed be more than your actual spindle maximum, use this formula:  
(Calculated Feed x Spindle Maximum)/Calculated Speed.

Technical data provided should be considered advisory only as variations may be necessary depending on the particular application.

# TuffCut® XR

## 279 / 177 / 177L / 177S / 179 / 179L Series Recommended Cutting Data - Slotting - Metric

279 / 179 / 179L series - If axial depth (ap) is less than the ball diameter, the speed is figured using the effective cutting diameter. See pages 134-135 for 279 Series contouring data.

| Workpiece<br>Material<br>Group                                                                                                          | I<br>S<br>O | Hardness     | Coolant<br>● Preferred<br>○ Possible<br>x Not Possible |                   |     | Slotting*                                                                         |                                                                                   |                                                                                   | End Mill Diameter (mm) |       |       |       |       |       |               |       |       |  |  |  |  |  |  |
|-----------------------------------------------------------------------------------------------------------------------------------------|-------------|--------------|--------------------------------------------------------|-------------------|-----|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------------|-------|-------|-------|-------|-------|---------------|-------|-------|--|--|--|--|--|--|
|                                                                                                                                         |             |              | Emulsion                                               | Compressed<br>Air | MQL |  |  |  | 3*                     | 5*    | 6*    | 8     | 10    | 12    | 16            | 20    | 25    |  |  |  |  |  |  |
|                                                                                                                                         |             |              |                                                        |                   |     | *Slotting at > 25% ap is not recommended for diameters 6mm and below.             |                                                                                   |                                                                                   |                        |       |       |       |       |       |               |       |       |  |  |  |  |  |  |
|                                                                                                                                         |             |              |                                                        |                   |     | vc - m/min                                                                        |                                                                                   |                                                                                   |                        |       |       |       |       |       | fz - mm/tooth |       |       |  |  |  |  |  |  |
|                                                                                                                                         |             |              |                                                        |                   |     |                                                                                   |                                                                                   |                                                                                   |                        |       |       |       |       |       |               |       |       |  |  |  |  |  |  |
| Low Carbon Steels<br>1018, 1020                                                                                                         | P           | up to 28 Rc  | ●                                                      | ●                 | ●   | 170                                                                               | 150                                                                               | 145                                                                               | .0100                  | .0250 | .0300 | .0400 | .0500 | .0600 | .0800         | .1000 | .1250 |  |  |  |  |  |  |
| Medium Carbon Steels<br>1140, 1145                                                                                                      | P           | 28 to 38 Rc  | ●                                                      | ●                 | ●   | 85                                                                                | 75                                                                                | 70                                                                                | .0100                  | .0250 | .0300 | .0400 | .0500 | .0600 | .0800         | .1000 | .1250 |  |  |  |  |  |  |
| Alloy Steels<br>4140, 4145                                                                                                              | P           | 28 to 44 Rc  | ●                                                      | ●                 | ●   | 85                                                                                | 75                                                                                | 70                                                                                | .0100                  | .0250 | .0300 | .0400 | .0500 | .0600 | .0800         | .1000 | .1250 |  |  |  |  |  |  |
| Die / Tool Steels<br>A2, D2, H13, P20                                                                                                   | P           | 28 to 44 Rc  | ●                                                      | ●                 | ●   | 70                                                                                | 60                                                                                | 55                                                                                | .0100                  | .0250 | .0300 | .0400 | .0500 | .0600 | .0800         | .1000 | .1250 |  |  |  |  |  |  |
| Hardened Steels<br>A2, D2                                                                                                               | H           | 45 to 50 Rc  | ●                                                      | ○                 | ○   | 85                                                                                | 75                                                                                | 70                                                                                | .0070                  | .0120 | .0150 | .0200 | .0250 | .0300 | .0400         | .0500 | .0620 |  |  |  |  |  |  |
| Hardened Steels<br>A2, D2                                                                                                               | H           | 50 to 55 Rc  | ●                                                      | ○                 | ○   | 70                                                                                | 60                                                                                | 55                                                                                | .0030                  | .0060 | .0070 | .0100 | .0120 | .0150 | .0200         | .0250 | .0370 |  |  |  |  |  |  |
| Stainless Steel - Easy to Machine<br>430F, 301, 303, 410, 416 Annealed, 420F, 430                                                       | M           | up to 28 Rc  | ●                                                      | x                 | ○   | 120                                                                               | 110                                                                               | 110                                                                               | .0100                  | .0250 | .0300 | .0400 | .0500 | .0600 | .0800         | .1000 | .1250 |  |  |  |  |  |  |
| Stainless Steel - Austenitic<br>301, 302, 303 High Tensile, 304, 304L, 305, 420, 15-5PH, 17-4PH, 17-7PH                                 | M           | up to 28 Rc  | ●                                                      | x                 | ○   | 70                                                                                | 65                                                                                | 60                                                                                | .0100                  | .0250 | .0300 | .0400 | .0500 | .0600 | .0800         | .1000 | .1250 |  |  |  |  |  |  |
| Stainless Steel - Difficult to Machine<br>302B, 304B, 309, 310, 316, 316B, 316L, 316Ti, 317, 317L, 321                                  | M           | up to 28 Rc  | ●                                                      | x                 | ○   | 70                                                                                | 65                                                                                | 60                                                                                | .0100                  | .0250 | .0300 | .0400 | .0500 | .0600 | .0800         | .1000 | .1250 |  |  |  |  |  |  |
| Stainless Steel - Difficult to Machine<br>17-4 PH, PH13-8Mo, Nitronics                                                                  | M           | over 28 Rc   | ●                                                      | x                 | ○   | 40                                                                                | 35                                                                                | 30                                                                                | .0070                  | .0120 | .0150 | .0200 | .0250 | .0300 | .0400         | .0500 | .0620 |  |  |  |  |  |  |
| Cobalt Chrome Alloys                                                                                                                    | M           |              | ●                                                      | x                 | ○   | 45                                                                                | 40                                                                                | 40                                                                                | .0070                  | .0120 | .0150 | .0200 | .0250 | .0300 | .0400         | .0500 | .0620 |  |  |  |  |  |  |
| Duplex (22%)                                                                                                                            | M           |              | ●                                                      | x                 | ○   | 45                                                                                | 40                                                                                | 40                                                                                | .0070                  | .0120 | .0150 | .0200 | .0250 | .0300 | .0400         | .0500 | .0620 |  |  |  |  |  |  |
| Super Duplex (25%)                                                                                                                      | M           |              | ●                                                      | x                 | ○   | 40                                                                                | 35                                                                                | 30                                                                                | .0070                  | .0120 | .0150 | .0200 | .0250 | .0300 | .0400         | .0500 | .0620 |  |  |  |  |  |  |
| High Temp Alloys                                                                                                                        | S           | up to 42 Rc  | ●                                                      | x                 | x   | 30                                                                                | 25                                                                                | 25                                                                                | .0070                  | .0120 | .0150 | .0200 | .0250 | .0300 | .0400         | .0500 | .0620 |  |  |  |  |  |  |
| Inconel                                                                                                                                 | S           |              | ●                                                      | x                 | x   | 30                                                                                | 25                                                                                | 25                                                                                | .0070                  | .0120 | .0150 | .0200 | .0250 | .0300 | .0400         | .0500 | .0620 |  |  |  |  |  |  |
| Titanium Alloys<br>6Al-4V, 5Al-2.5 Sn, 6Al-2 Sn-4Zr-6Mo, 3Al-8V-6Cr4Mo-4Zr, 10V-2Fe-3Al, 13V-11Cr-3Al                                   | S           | up to 42 Rc  | ●                                                      | x                 | x   | 55                                                                                | 55                                                                                | 50                                                                                | .0070                  | .0120 | .0150 | .0200 | .0250 | .0300 | .0400         | .0500 | .0620 |  |  |  |  |  |  |
| Cast-Iron - Gray CG, ASTM A48, CLASS 20, 25, 30, 35, SAE J431C, GRADES G1800, G3000, G3500, GG 10, 15, 20, 25, 30, 35, 40               | K           | up to 240 HB | ●                                                      | ○                 | ○   | 115                                                                               | 105                                                                               | 100                                                                               | .0100                  | .0250 | .0300 | .0400 | .0500 | .0600 | .0800         | .1000 | .1250 |  |  |  |  |  |  |
| Cast Iron - Ductile & Malleable CGI 60-40-18, 65-45-12, D4018, D4512, D5506, 32510, 35108, M3210, M4504, M5503, 250, 300, 350, 400, 450 | K           | over 240 HB  | ●                                                      | ○                 | ○   | 85                                                                                | 80                                                                                | 75                                                                                | .0100                  | .0250 | .0300 | .0400 | .0500 | .0600 | .0800         | .1000 | .1250 |  |  |  |  |  |  |

Spindle Maximum - Should the calculated spindle speed be more than your actual spindle maximum, use this formula:  
(Calculated Feed x Spindle Maximum)/Calculated Speed.

Technical data provided should be considered advisory only as variations may be necessary depending on the particular application.