

High Performance Tools
Metric Catalogue

TuffCut[®] X-AL

TuffCut[®] DM

TuffCut[®] XR-XT

Twister Drills



Innovation for Today's Industries

 **M.A.FORD**
High Performance Cutting Tools

ISO 9001:2008 Certified



At M.A.Ford®, we pride ourselves on being one of the world's premier manufacturers of high performance cutting tools. That's as true today as it was back in 1919 when Matthew A. Ford produced the first hand cut HSS rotary files made in America.

Whether it's engineering the exacting tolerances of the first circuit board drills, or developing the intricate geometries for application specific high performance cutting tools, such as Aero engine casings in Inconel 718, or Aluminium wing spars at 40 M/Min feed, our commitment to innovation, quality and professional service put us a cut above.

M.A.Ford has two modern solid carbide and HSS cutting tool manufacturing facilities located in Davenport, Iowa and Vero Beach, Florida, USA. Both plants employ a team concept that strives for improved response times, the highest quality tools, innovative ideas and cost reduction & control.

European markets are covered from our stock and distribution headquarters located in Derby, England, supported by factory trained technical field sales personnel.

M.A.Ford strives to keep ahead of market requirements for unique tooling technology and speciality coatings, by creating partnerships and joint ventures with worldwide market leaders.

M.A.Fords' ALtima® coating is produced by Miracle Tools America, an M.A.Ford subsidiary established with Mitsubishi Carbide and MMC Kobelco Tool. MMC Kobelco Tool licences the PVD technology to Miracle Tools America.

Nous sommes fiers chez M.A.Ford® d'être parmi les meilleurs fabricants d'outils coupants à haute performance sur le plan mondial. Ceci est aussi vrai aujourd'hui que ce l'était en 1919 quand Matthew A. Ford a fabriqué les premières limes rotatives en HSS taillées à la main en Amérique.

Que ce soit les tolérances exigeantes dans l'ingénierie de forets pour les premiers circuits imprimés, ou le développement de géométries très élaborées pour des outils coupants à haute performance dans des applications particulières telles que carters de réacteurs dans de l'Inconel, ou des envergures d'aile en Aluminium avec des avances de 40M/Min, notre engagement en matière d'innovation, de qualité et d'un service professionnel nous place dans une catégorie supérieure.

M.A.Ford possède deux installations modernes de fabrication d'outils de coupe en carbure et en HSS situées à Davenport, Iowa et Vero Beach, Floride, aux E-U. Les deux usines sont encadrés dans un concept d'équipe s'efforçant d'améliorer continuellement les temps de réponses, la meilleure qualité possible, des idées innovatrices, ainsi que la diminution et la maîtrise des coûts.

Les marchés européens, pour le stock et la distribution, sont gérés à partir de notre quartier général situé à Derby en Angleterre, avec l'appui d'un personnel technico-commercial formé en usine et sur le terrain.

M.A.Fords' efforce de rester à l'avant-garde des exigences du marché en matière de technologie d'outillage unique et de revêtements spécialisés en créant des partenariats et des contreprises avec des leaders du marché mondial.

Le revêtement ALtima® de M.A.Ford est fabriqué par Miracle Tools America, une succursale d' M.A.Ford établie conjointement avec Mitsubishi Carbide et MMC Kobelco Tool. La technologie PVD de Miracle Tools America provient sous licence de MMC Kobelco Tool.

Tool application guide

High Performance milling tools

| Series | Page | No. of Flutes | Square End | Ball Nose | Corner Radius | Neck Relief | Rough / Finish | HSC | Available Coating | Steel (up to 35 Rc) | Steel (36-50Rc) | Hardened Materials | Austenitic Stainless 48HRC+ | Precipitation Hardened Stainless | High Temp Alloys | Titanium | Gray Cast Iron | Ductile Cast Iron | Aluminium-Non-Ferrous | Kevlar-Composites-Plastics | Glass/Ceramic |
|---------|------|---------------|------------|-----------|---------------|-------------|----------------|-----|-------------------|---------------------|-----------------|--------------------|-----------------------------|----------------------------------|------------------|----------|----------------|-------------------|-----------------------|----------------------------|---------------|
| 113A | 13 | 6 | X | | | | F | X | Altima® | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| 177 | 4 | 4 | X | | | | R/F | X | Altima® | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| 177LR | 7 | 4 | | | X | X | R/F | X | Altima® | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| 177R | 5 | 4 | | | X | | R/F | X | Altima® | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| 177S | 6 | 4 | X | | X | X | R/F | X | Altima® | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| 178 | 9 | 5 | X | | | | R/F | X | Altima® | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| 178R | 10 | 5 | | | X | | R/F | X | Altima® | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| 178-1 | 10 | 5 | X | | | | R/F | X | Altima® | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| 179 | 11 | 4 | | X | | | R/F | | Altima® | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| 179L | 11 | 4 | | X | | X | R/F | | Altima® | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| 180NR | 12 | 7 | | | X | X | R/F | X | Altima® Blaze | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| 180R | 12 | 7 | | | X | | R/F | X | Altima® Blaze | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| 192 | 13 | Multi | X | | | | R | | Altima® | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| 277 | 8 | 4 | X | | | | R/F | X | Altima® Blaze | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| 277R | 8 | 4 | | | X | | R/F | X | Altima® Blaze | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| 134 | 16 | 3 | X | | | | R | | FordLube* | | | | | | | | | | | | |
| 135 | 17 | 2 | | | X | | R | | FordLube* | | | | | | | | | | | | |
| 135B-N3 | 23 | 2 | | X | | X | R | | FordLube* | | | | | | | | | | | | |
| 135B-N5 | 23 | 2 | | X | | X | R | | FordLube* | | | | | | | | | | | | |
| 135N | 18 | 2 | | | X | X | R | | FordLube* | | | | | | | | | | | | |
| 135N3 | 19 | 2 | X | | X | X | R | | FordLube* | | | | | | | | | | | | |
| 135N5 | 21 | 2 | X | | X | X | R | | FordLube* | | | | | | | | | | | | |
| 136 | 24 | 2 | X | | | | F | | FordLube* | | | | | | | | | | | | |
| 138 | 25 | 3 | X | | | | R/F | X | FordLube* | | | | | | | | | | | | |
| 138B | 27 | 3 | | X | | | R/F | | FordLube* | | | | | | | | | | | | |
| 138B-N5 | 27 | 3 | | X | | X | R/F | | FordLube* | | | | | | | | | | | | |
| 138R | 26 | 3 | | | X | | R/F | X | FordLube* | | | | | | | | | | | | |
| 156 | 30 | 2 | | X | | X | F | | Altima® 52 | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| 157 | 33 | Multi | X | | X | | F | | Altima® 52 | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| 158 | 34 | 4 | | | X | X | R/F | X | Altima® 52 | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |

FordLube* Available to order - delivery 3-4 weeks

High performance drilling tools

| Series | Page | Drill Length | Coolant Fed | Diameter range-mm | Available Coating | Steel (up to 35 Rc) | Steel (36-50Rc) | Hardened Materials | Austenitic Stainless 48HRC+ | Precipitation Hardened Stainless | High Temp Alloys | Titanium | Gray Cast Iron | Ductile Cast Iron | Aluminium-Non-Ferrous | Kevlar-Composites-Plastics | Glass/Ceramic |
|-------------------------------|------|--------------|-------------|-------------------|-------------------|---------------------|-----------------|--------------------|-----------------------------|----------------------------------|------------------|----------|----------------|-------------------|-----------------------|----------------------------|---------------|
| 2MDCLM | 38 | 10X Micro | Y | 2.0 - 2.95 | Altima® | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| 2XDCEM | 54 | 12X-25X | Y | 3.0 - 12.7 | Altima® | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| 2XDCLM | 51 | 7-8X | Y | 3.0 - 12 | Altima® | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| 2XDCRM | 48 | 5X | Y | 3.0 - 20 | Altima® | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| 2XDSCM | 42 | 3X | Y | 3.0 - 16 | Altima® | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| 2XDSRM | 45 | 5X | N | 0.5 - 16 | Altima® | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| 2XDSSM | 39 | 3X | N | 2.5 - 20 | Altima® | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| 200A | 57 | 3X | N | 3.0 - 20 | Altima® | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| 200S | 56 | Spot Drill | N | 3.0 - 16 | Altima® | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| 205B | 60 | 5X | N | 0.3 - 20 | Altima® Blaze | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| 207 | 64 | 3X | N | 2.4 - 16 | None | | | | | | | | | | | | |
| 229 | 66 | 5X-3 Flute | N | 2.0 - 16 | None | | | | | | | | | | | | |
| Technical Information section | 69 | | | | | | | | | | | | | | | | |

■ 1st Choice
 ■ 2nd Choice
 ■ For chip removal in deep slotting

TuffCut® XR-XT

Series 113A ,177, 178, 179, 180 & 277

XTREME ROUGHING End Mills

Ebauche Xtrême Fraises pour Ebauche

Features

- Unique M.A. Ford® Heli-Pitch Geometry.
- Proprietary Carbide Substrate.
- Eccentric Primary Relief Angle.
- ALtima® Coating.

Caractéristique

- Géométrie Héll Décalée de M.A. Ford®.
- Substrat Carbure sous licence.
- Angle de dépouille primaire excentrique.
- Revêtement ALtima®

Benefits

- Higher Feeds and Speeds for Increased Productivity. Reduced Vibration Harmonics
- Maintains Cutting Edge Strength & Sharpness for Improved Tool Life.
- Strong Cutting Edges Allowing for Increased Depths of Cut at Elevated Cutting Data.
- State-of-the-Art ALtima® (AlTiN) PVD Coating for Superior Tool Life in Virtually All Materials.

Avantage

- Avances et Vitesses supérieures pour un Meilleur Rendement. Diminution des Vibrations.
- Maintient la Résistance et l'Acuité de l'arête de coupe pour une meilleure Durée de Vie.
- Fortes Arêtes permettant des Profondeurs de Coupe Accrues avec des paramètres de coupe élevés.
- Revêtement PVD de pointe ALtima® (AlTiN) pour Une Durée de vie supérieure pour presque toutes matières.

**Use Roughing Speeds
and
Achieve Your
Finishing Needs!**

**Utilisez des Vitesses
pour l'Ebauche
Et
Obtenez vos Besoins
en Finition !**




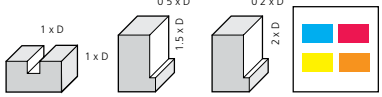



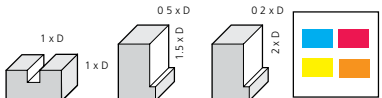



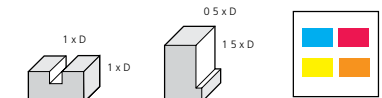



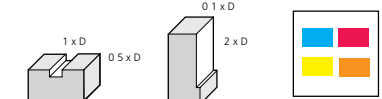



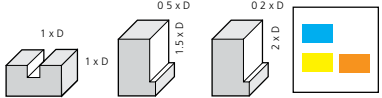



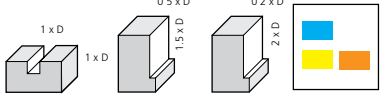



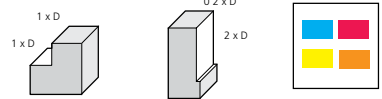



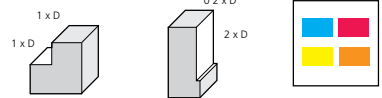



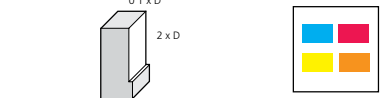



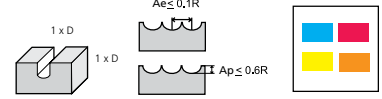



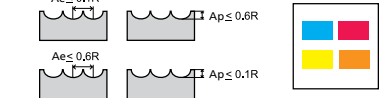



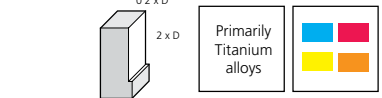



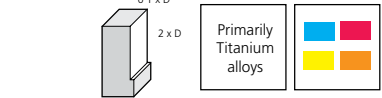



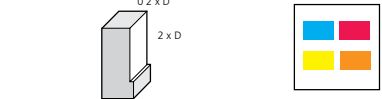



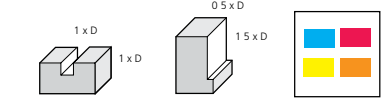


Celebrating

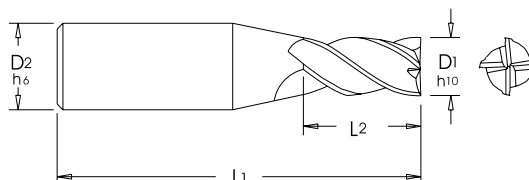
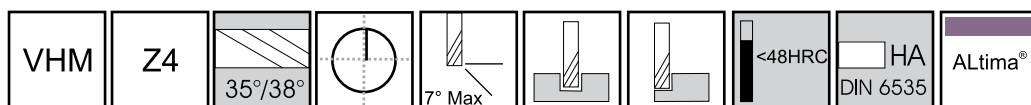
90 Years
1919 - 2009

M.A. Ford®

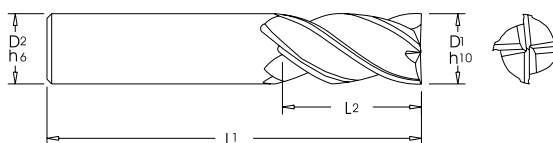
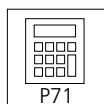
Contents Vue d'Ensemble

| | Series Séries | Form Forme | No. of Teeth Nbre.Dents | Lengths Longueurs | Corner Prep Prép.Bec | Application Area Secteur d'Application | Page |
|---|------------------|---|----------------------------|---|-------------------------|--|------|
|  | 177 |  | Z=4 |  | Sharp corner |  | 4 |
|  | 177R |  | Z=4 |  | 0.25 - 6.0mm radius |  | 5 |
|  | 177S |  | Z=4 |  | 0.2 - 1.0mm radius |  | 6 |
|  | 177LR |  | Z=4 |  | 0.3 - 3.0mm radius |  | 7 |
|  | 277 |  | Z=4 |  | Sharp corner |  | 8 |
|  | 277R |  | Z=4 |  | 0.25 - 0.8mm radius |  | 8 |
|  | 178 |  | Z=5 |  | Sharp corner |  | 9 |
|  | 178R |  | Z=5 |  | 0.5 - 1.0mm radius |  | 10 |
|  | 178-1 |  | Z=5 |  | Sharp corner |  | 10 |
|  | 179 |  | Z=4 |  | N/A |  | 11 |
|  | 179L |  | Z=4 |  | N/A |  | 11 |
|  | 180R |  | Z=7 |  | 0.5 - 4.0mm radius |  | 12 |
|  | 180NR |  | Z=7 |  | 1.0 - 4.0mm radius |  | 12 |
|  | 113A |  | Z=6 |  | Sharp corner |  | 13 |
|  | 192 |  | Z=4 |  | Sharp corner |  | 13 |
| Technical Section | | | | | | | 69 |

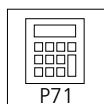
TuffCut® XR Series 177



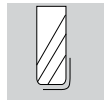
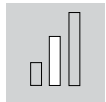
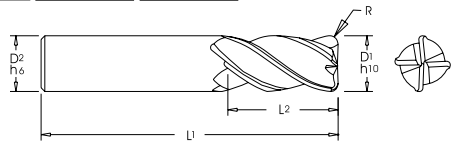
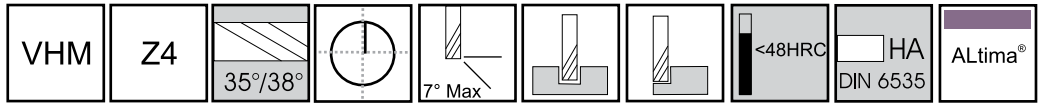
| Tool No. | EDP | D1 (Tol h10) | D2 (h6) | L1 | L2 |
|-----------|-------|--------------|---------|----|----|
| 177 0150A | 17680 | 1.5 | 3 | 38 | 3 |
| 177 0200A | 17682 | 2 | 3 | 38 | 4 |
| 177 0250A | 17684 | 2.5 | 3 | 38 | 5 |
| 177 0303A | 17686 | 3 | 3 | 38 | 6 |



| Tool No. | EDP | D1 (Tol h10) | D2 (h6) | L1 | L2 |
|-----------|-------|--------------|---------|-----|----|
| 177 0300A | 17928 | 3 | 6 | 57 | 8 |
| 177 0350A | 17688 | 3.5 | 6 | 63 | 7 |
| 177 0400A | 17930 | 4 | 6 | 57 | 11 |
| 177 0450A | 17690 | 4.5 | 6 | 63 | 9 |
| 177 0500A | 17932 | 5 | 6 | 57 | 13 |
| 177 0600A | 17934 | 6 | 6 | 57 | 13 |
| 177 0800A | 17937 | 8 | 8 | 63 | 19 |
| 177 1000A | 17940 | 10 | 10 | 72 | 22 |
| 177 1200A | 17943 | 12 | 12 | 83 | 26 |
| 177 1400A | 17946 | 14 | 14 | 83 | 26 |
| 177 1600A | 17950 | 16 | 16 | 92 | 32 |
| 177 1800A | 17952 | 18 | 18 | 92 | 32 |
| 177 2000A | 17955 | 20 | 20 | 104 | 38 |
| 177 2500A | 17957 | 25 | 25 | 104 | 38 |

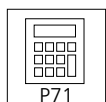


TuffCut[®] XR Series 177R

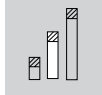
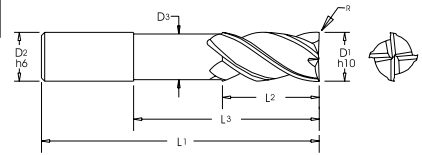
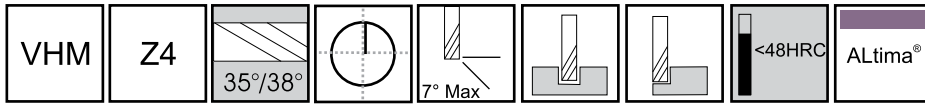


Corner Radius
Eckenradius
Rayon

| Tool No. | EDP | D1 (Tol h10) | D2 (h6) | L1 | L2 | R |
|-----------------|-------|--------------|---------|-----|----|------|
| 177 0300-0.25RA | 17929 | 3 | 6 | 57 | 8 | 0.25 |
| 177 0300-0.50RA | 17783 | 3 | 6 | 57 | 8 | 0.50 |
| 177 0400-0.25RA | 17931 | 4 | 6 | 57 | 11 | 0.25 |
| 177 0400-0.50RA | 17784 | 4 | 6 | 57 | 11 | 0.50 |
| 177 0500-0.25RA | 17933 | 5 | 6 | 57 | 13 | 0.25 |
| 177 0500-0.50RA | 17785 | 5 | 6 | 57 | 13 | 0.50 |
| 177 0600-0.25RA | 17786 | 6 | 6 | 57 | 13 | 0.25 |
| 177 0600-0.50RA | 17935 | 6 | 6 | 57 | 13 | 0.50 |
| 177 0600-1.0RA | 17787 | 6 | 6 | 57 | 13 | 1.00 |
| 177 0600-1.5RA | 17788 | 6 | 6 | 57 | 13 | 1.50 |
| 177 0600-2.0RA | 18070 | 6 | 6 | 57 | 13 | 2.00 |
| 177 0800-0.50RA | 17938 | 8 | 8 | 63 | 19 | 0.50 |
| 177 0800-1.0RA | 17789 | 8 | 8 | 63 | 19 | 1.00 |
| 177 0800-1.5RA | 17790 | 8 | 8 | 63 | 19 | 1.50 |
| 177 0800-2.0RA | 17791 | 8 | 8 | 63 | 19 | 2.00 |
| 177 0800-3.0RA | 18072 | 8 | 8 | 63 | 19 | 3.00 |
| 177 1000-0.50RA | 17941 | 10 | 10 | 72 | 22 | 0.50 |
| 177 1000-1.0RA | 17792 | 10 | 10 | 72 | 22 | 1.00 |
| 177 1000-1.5RA | 17793 | 10 | 10 | 72 | 22 | 1.50 |
| 177 1000-2.0RA | 17794 | 10 | 10 | 72 | 22 | 2.00 |
| 177 1000-3.0RA | 96603 | 10 | 10 | 72 | 22 | 3.00 |
| 177 1200-0.50RA | 17795 | 12 | 12 | 83 | 26 | 0.50 |
| 177 1200-0.75RA | 17944 | 12 | 12 | 83 | 26 | 0.75 |
| 177 1200-1.0RA | 17796 | 12 | 12 | 83 | 26 | 1.00 |
| 177 1200-1.5RA | 17797 | 12 | 12 | 83 | 26 | 1.50 |
| 177 1200-2.0RA | 17798 | 12 | 12 | 83 | 26 | 2.00 |
| 177 1200-2.5RA | 18074 | 12 | 12 | 83 | 26 | 2.50 |
| 177 1200-3.0RA | 96506 | 12 | 12 | 83 | 26 | 3.00 |
| 177 1200-4.0RA | 18076 | 12 | 12 | 83 | 26 | 4.00 |
| 177 1400-0.75RA | 17947 | 14 | 14 | 83 | 26 | 0.75 |
| 177 1600-0.50RA | 18078 | 16 | 16 | 92 | 32 | 0.50 |
| 177 1600-1.0RA | 17951 | 16 | 16 | 92 | 32 | 1.00 |
| 177 1600-1.5RA | 17799 | 16 | 16 | 92 | 32 | 1.50 |
| 177 1600-2.0RA | 17673 | 16 | 16 | 92 | 32 | 2.00 |
| 177 1600-2.5RA | 18080 | 16 | 16 | 92 | 32 | 2.50 |
| 177 1600-3.0RA | 17674 | 16 | 16 | 92 | 32 | 3.00 |
| 177 1600-4.0RA | 18082 | 16 | 16 | 92 | 32 | 4.00 |
| 177 1800-1.0RA | 17953 | 18 | 18 | 92 | 32 | 1.00 |
| 177 2000-1.0RA | 17956 | 20 | 20 | 104 | 38 | 1.00 |
| 177 2000-1.5RA | 18091 | 20 | 20 | 104 | 38 | 1.50 |
| 177 2000-2.0RA | 18084 | 20 | 20 | 104 | 38 | 2.00 |
| 177 2000-3.0RA | 18086 | 20 | 20 | 104 | 38 | 3.00 |
| 177 2000-4.0RA | 18088 | 20 | 20 | 104 | 38 | 4.00 |
| 177 2000-5.0RA | 18090 | 20 | 20 | 104 | 38 | 5.00 |
| 177 2000-6.0RA | 18092 | 20 | 20 | 104 | 38 | 6.00 |
| 177 2500-1.0RA | 17958 | 25 | 25 | 104 | 38 | 1.00 |

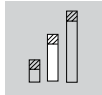


TuffCut® XR Series 177S



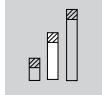
HA
DIN 6535

| Tool No. | EDP | D1 (Tol h10) | D2 (h6) | D3 | L1 | L2 | L3 | Shank |
|------------|-------|--------------|---------|------|-----|----|----|-------------|
| 177S 0300A | 18218 | 3 | 6 | 2.9 | 50 | 5 | 11 | DIN 6535 HA |
| 177S 0400A | 18220 | 4 | 6 | 3.9 | 50 | 6 | 14 | DIN 6535 HA |
| 177S 0500A | 18222 | 5 | 6 | 4.9 | 57 | 8 | 17 | DIN 6535 HA |
| 177S 0600A | 18224 | 6 | 6 | 5.8 | 57 | 9 | 20 | DIN 6535 HA |
| 177S 0800A | 18226 | 8 | 8 | 7.6 | 63 | 12 | 26 | DIN 6535 HA |
| 177S 1000A | 18228 | 10 | 10 | 9.6 | 72 | 15 | 32 | DIN 6535 HA |
| 177S 1200A | 18230 | 12 | 12 | 11.4 | 83 | 18 | 38 | DIN 6535 HA |
| 177S 1600A | 18232 | 16 | 16 | 15.2 | 98 | 24 | 50 | DIN 6535 HA |
| 177S 2000A | 18234 | 20 | 20 | 19.2 | 112 | 30 | 62 | DIN 6535 HA |

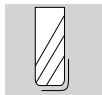


HB
DIN 6535

| Tool No. | EDP | D1 (Tol h10) | D2 (h6) | D3 | L1 | L2 | L3 | Shank |
|-------------|-------|--------------|---------|------|-----|----|----|-------------|
| 177S 0300AW | 18254 | 3 | 6 | 2.9 | 50 | 5 | 11 | DIN 6535 HB |
| 177S 0400AW | 18256 | 4 | 6 | 3.9 | 50 | 6 | 14 | DIN 6535 HB |
| 177S 0500AW | 18258 | 5 | 6 | 4.9 | 57 | 8 | 17 | DIN 6535 HB |
| 177S 0600AW | 18260 | 6 | 6 | 5.8 | 57 | 9 | 20 | DIN 6535 HB |
| 177S 0800AW | 18262 | 8 | 8 | 7.6 | 63 | 12 | 26 | DIN 6535 HB |
| 177S 1000AW | 18264 | 10 | 10 | 9.6 | 72 | 15 | 32 | DIN 6535 HB |
| 177S 1200AW | 18266 | 12 | 12 | 11.4 | 83 | 18 | 38 | DIN 6535 HB |
| 177S 1600AW | 18268 | 16 | 16 | 15.2 | 98 | 24 | 50 | DIN 6535 HB |
| 177S 2000AW | 18270 | 20 | 20 | 19.2 | 112 | 30 | 62 | DIN 6535 HB |

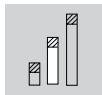


HA
DIN 6535

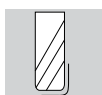


Corner Radius
Eckenradius
Rayon

| Tool No. | EDP | D1 (Tol h10) | D2 (h6) | D3 | L1 | L2 | L3 | R | Shank |
|---------------|-------|--------------|---------|------|-----|----|----|-----|-------------|
| 177S 03-0.2RA | 18200 | 3 | 6 | 2.9 | 50 | 5 | 11 | 0.2 | DIN 6535 HA |
| 177S 04-0.2RA | 18202 | 4 | 6 | 3.9 | 50 | 6 | 14 | 0.2 | DIN 6535 HA |
| 177S 05-0.2RA | 18204 | 5 | 6 | 4.9 | 57 | 8 | 17 | 0.2 | DIN 6535 HA |
| 177S 06-0.3RA | 18206 | 6 | 6 | 5.8 | 57 | 9 | 20 | 0.3 | DIN 6535 HA |
| 177S 08-0.5RA | 18208 | 8 | 8 | 7.6 | 63 | 12 | 26 | 0.5 | DIN 6535 HA |
| 177S 10-0.5RA | 18210 | 10 | 10 | 9.6 | 72 | 15 | 32 | 0.5 | DIN 6535 HA |
| 177S 12-0.5RA | 18212 | 12 | 12 | 11.4 | 83 | 18 | 38 | 0.5 | DIN 6535 HA |
| 177S 16-1.0RA | 18214 | 16 | 16 | 15.2 | 98 | 24 | 50 | 1.0 | DIN 6535 HA |
| 177S 20-1.0RA | 18216 | 20 | 20 | 19.2 | 112 | 30 | 62 | 1.0 | DIN 6535 HA |



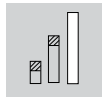
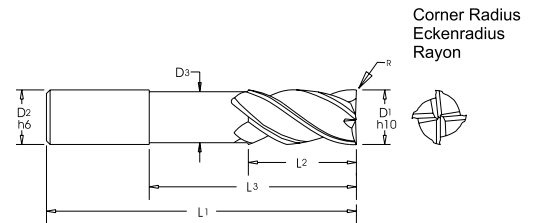
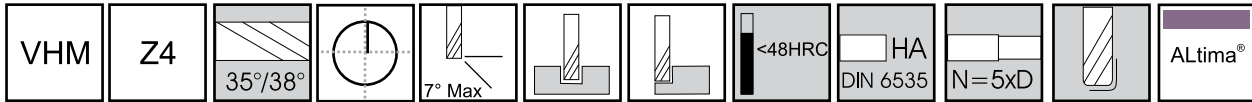
HB
DIN 6535



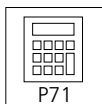
Corner Radius
Eckenradius
Rayon

| Tool No. | EDP | D1 (Tol h10) | D2 (h6) | D3 | L1 | L2 | L3 | R | Shank |
|----------------|-------|--------------|---------|------|-----|----|----|-----|-------------|
| 177S 03-0.2RAW | 18236 | 3 | 6 | 2.9 | 50 | 5 | 11 | 0.2 | DIN 6535 HB |
| 177S 04-0.2RAW | 18238 | 4 | 6 | 3.9 | 50 | 6 | 14 | 0.2 | DIN 6535 HB |
| 177S 05-0.2RAW | 18240 | 5 | 6 | 4.9 | 57 | 8 | 17 | 0.2 | DIN 6535 HB |
| 177S 06-0.3RAW | 18242 | 6 | 6 | 5.8 | 57 | 9 | 20 | 0.3 | DIN 6535 HB |
| 177S 08-0.5RAW | 18244 | 8 | 8 | 7.6 | 63 | 12 | 26 | 0.5 | DIN 6535 HB |
| 177S 10-0.5RAW | 18246 | 10 | 10 | 9.6 | 72 | 15 | 32 | 0.5 | DIN 6535 HB |
| 177S 12-0.5RAW | 18248 | 12 | 12 | 11.4 | 83 | 18 | 38 | 0.5 | DIN 6535 HB |
| 177S 16-1.0RAW | 18250 | 16 | 16 | 15.2 | 98 | 24 | 50 | 1.0 | DIN 6535 HB |
| 177S 20-1.0RAW | 18252 | 20 | 20 | 19.2 | 112 | 30 | 62 | 1.0 | DIN 6535 HB |

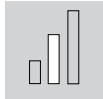
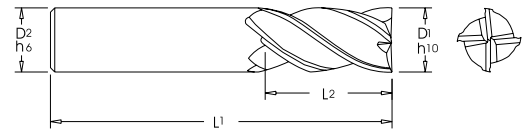
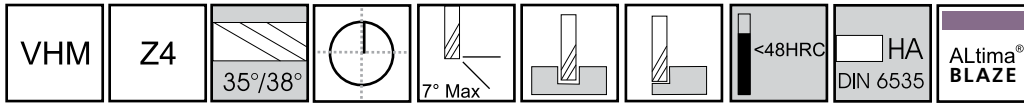
TuffCut® XR Series 177LR



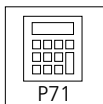
| Tool No. | EDP | D1 (Tol h10) | D2 (h6) | D3 | L1 | L2 | L3 | R |
|------------------|-------|--------------|---------|------|-----|----|-----|------|
| 177L 06N5-0.25RA | 18186 | 6 | 6 | 5.8 | 101 | 12 | 30 | 0.25 |
| 177L 06N5-0.5RA | 18183 | 6 | 6 | 5.8 | 101 | 12 | 30 | 0.50 |
| 177L 06N5-1.0RA | 18184 | 6 | 6 | 5.8 | 101 | 12 | 30 | 1.00 |
| 177L 08N5-0.5RA | 18187 | 8 | 8 | 7.6 | 101 | 16 | 40 | 0.50 |
| 177L 08N5-1.0RA | 18194 | 8 | 8 | 7.6 | 101 | 16 | 40 | 1.00 |
| 177L 08N5-2.0RA | 18195 | 8 | 8 | 7.6 | 101 | 16 | 40 | 2.00 |
| 177L 08N5-3.0RA | 18196 | 8 | 8 | 7.6 | 101 | 16 | 40 | 3.00 |
| 177L 10N5-0.5RA | 18188 | 10 | 10 | 9.6 | 127 | 20 | 50 | 0.50 |
| 177L 10N5-1.0RA | 18197 | 10 | 10 | 9.6 | 127 | 20 | 50 | 1.00 |
| 177L 10N5-2.0RA | 18198 | 10 | 10 | 9.6 | 127 | 20 | 50 | 2.00 |
| 177L 10N5-3.0RA | 18199 | 10 | 10 | 9.6 | 127 | 20 | 50 | 3.00 |
| 177L 12N5-0.5RA | 18189 | 12 | 12 | 11.4 | 152 | 24 | 60 | 0.50 |
| 177L 12N5-1.0RA | 18176 | 12 | 12 | 11.4 | 152 | 24 | 60 | 1.00 |
| 177L 12N5-2.0RA | 18177 | 12 | 12 | 11.4 | 152 | 24 | 60 | 2.00 |
| 177L 12N5-3.0RA | 18190 | 12 | 12 | 11.4 | 152 | 24 | 60 | 3.00 |
| 177L 12N5-4.0RA | 18178 | 12 | 12 | 11.4 | 152 | 24 | 60 | 4.00 |
| 177L 16N5-0.5RA | 18181 | 16 | 16 | 15.2 | 152 | 32 | 80 | 0.50 |
| 177L 16N5-1.0RA | 18191 | 16 | 16 | 15.2 | 152 | 32 | 80 | 1.00 |
| 177L 16N5-2.0RA | 18179 | 16 | 16 | 15.2 | 152 | 32 | 80 | 2.00 |
| 177L 16N5-3.0RA | 18180 | 16 | 16 | 15.2 | 152 | 32 | 80 | 3.00 |
| 177L 20N5-0.5RA | 18182 | 20 | 20 | 19.2 | 152 | 40 | 100 | 0.50 |
| 177L 20N5-1.0RA | 18192 | 20 | 20 | 19.2 | 152 | 40 | 100 | 1.00 |
| 177L 20N5-3.0RA | 18193 | 20 | 20 | 19.2 | 152 | 40 | 100 | 3.00 |



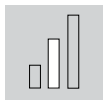
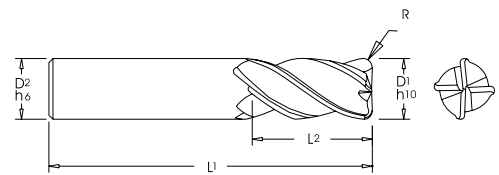
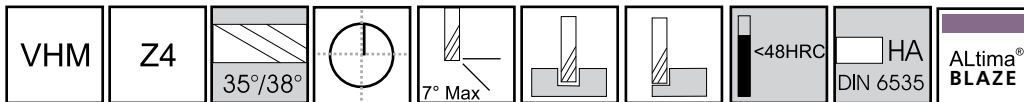
TuffCut® XT Series 277



| Tool No. | D1 (Tol h10) | D2 (h6) | L1 | L2 |
|-----------|--------------|---------|-----|----|
| 277 0300B | 3 | 6 | 57 | 8 |
| 277 0400B | 4 | 6 | 57 | 11 |
| 277 0500B | 5 | 6 | 57 | 13 |
| 277 0600B | 6 | 6 | 57 | 13 |
| 277 0800B | 8 | 8 | 63 | 19 |
| 277 1000B | 10 | 10 | 72 | 22 |
| 277 1200B | 12 | 12 | 83 | 26 |
| 277 1600B | 16 | 16 | 92 | 32 |
| 277 2000B | 20 | 20 | 104 | 38 |



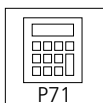
Series 277R



| Tool No. | D1 (Tol h10) | D2 (h6) | L1 | L2 | R |
|-----------------|--------------|---------|-----|----|------|
| 277 0300-0.25RB | 3 | 6 | 57 | 8 | 0.25 |
| 277 0400-0.25RB | 4 | 6 | 57 | 11 | 0.25 |
| 277 0500-0.25RB | 5 | 6 | 57 | 13 | 0.25 |
| 277 0600-0.25RB | 6 | 6 | 57 | 13 | 0.25 |
| 277 0800-0.8RB | 8 | 8 | 63 | 19 | 0.80 |
| 277 1000-0.8RB | 10 | 10 | 72 | 22 | 0.80 |
| 277 1200-0.8RB | 12 | 12 | 83 | 26 | 0.80 |
| 277 1200-3.0RB | 12 | 12 | 83 | 26 | 3.00 |
| 277 1600-0.8RB | 16 | 16 | 92 | 32 | 0.80 |
| 277 2000-0.8RB | 20 | 20 | 104 | 38 | 0.80 |

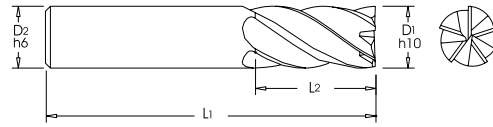
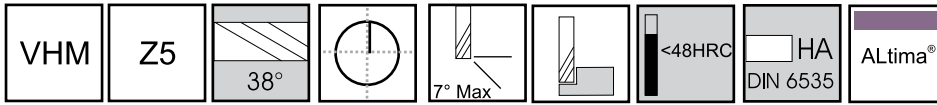


Corner Radius
Eckenradius
Rayon

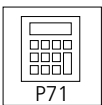


TuffCut XT - For enhanced performance in stainless steel type materials

TuffCut® XR Series 178

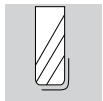
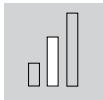
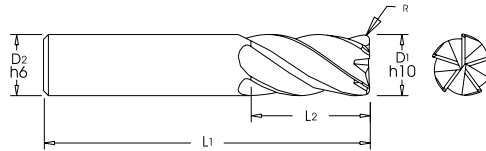
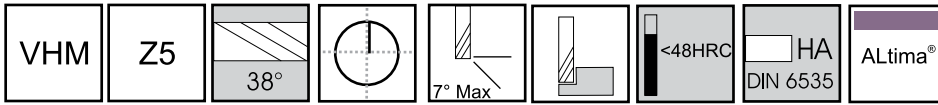


| Tool No. | EDP | D1 (Tol h10) | D2 (h6) | L1 | L2 |
|-----------|-------|--------------|---------|-----|----|
| 178 0300A | 17959 | 3 | 6 | 57 | 8 |
| 178 0400A | 17961 | 4 | 6 | 57 | 11 |
| 178 0500A | 17963 | 5 | 6 | 57 | 13 |
| 178 0600A | 17965 | 6 | 6 | 57 | 13 |
| 178 0800A | 17968 | 8 | 8 | 63 | 19 |
| 178 1000A | 17971 | 10 | 10 | 72 | 22 |
| 178 1200A | 17974 | 12 | 12 | 83 | 26 |
| 178 1400A | 17977 | 14 | 14 | 83 | 26 |
| 178 1600A | 17981 | 16 | 16 | 92 | 32 |
| 178 1800A | 17983 | 18 | 18 | 92 | 32 |
| 178 2000A | 17986 | 20 | 20 | 104 | 38 |
| 178 2500A | 17988 | 25 | 25 | 104 | 38 |

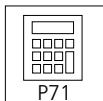


P71

TuffCut® XR Series 178R

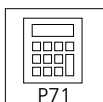
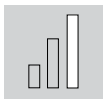
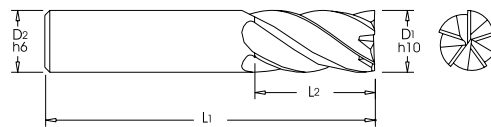
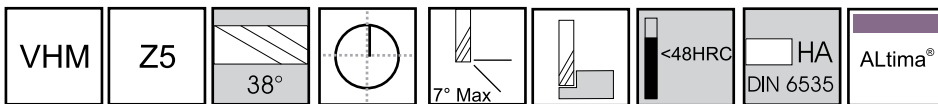


Corner Radius
Eckenradius
Rayon



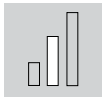
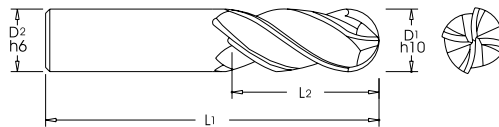
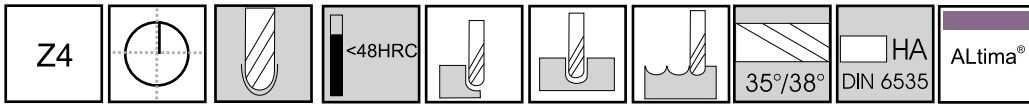
| Tool No. | EDP | D1 (Tol h10) | D2 (h6) | L1 | L2 | R |
|-----------------|-------|--------------|---------|-----|----|------|
| 178 0600-0.50RA | 17966 | 6 | 6 | 57 | 13 | 0.50 |
| 178 0800-0.50RA | 17969 | 8 | 8 | 63 | 19 | 0.50 |
| 178 1000-0.50RA | 17972 | 10 | 10 | 72 | 22 | 0.50 |
| 178 1200-0.75RA | 17975 | 12 | 12 | 83 | 26 | 0.75 |
| 178 1400-0.75RA | 17978 | 14 | 14 | 83 | 26 | 0.75 |
| 178 1600-1.0RA | 17982 | 16 | 16 | 92 | 32 | 1.00 |
| 178 1800-1.0RA | 17984 | 18 | 18 | 92 | 32 | 1.00 |
| 178 2000-1.0RA | 17987 | 20 | 20 | 104 | 38 | 1.00 |
| 178 2500-1.0RA | 17989 | 25 | 25 | 104 | 38 | 1.00 |

Series 178-1

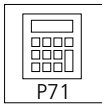


| Tool No. | EDP | D1 (Tol h10) | D2 (h6) | L1 | L2 |
|-------------|-------|--------------|---------|-----|----|
| 178 0300-1A | 17998 | 3 | 3 | 75 | 25 |
| 178 0400-1A | 17999 | 4 | 4 | 75 | 25 |
| 178 0500-1A | 18026 | 5 | 5 | 75 | 25 |
| 178 0600-1A | 18027 | 6 | 6 | 75 | 25 |
| 178 0800-1A | 18028 | 8 | 8 | 75 | 30 |
| 178 1000-1A | 18029 | 10 | 10 | 100 | 45 |
| 178 1200-1A | 18030 | 12 | 12 | 150 | 75 |
| 178 1600-1A | 18031 | 16 | 16 | 150 | 75 |
| 178 2000-1A | 18032 | 20 | 20 | 150 | 75 |

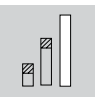
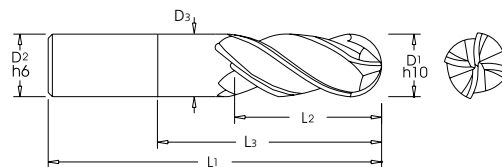
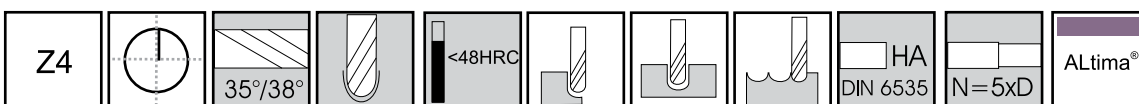
TuffCut® XR Series 179



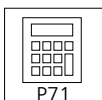
| Tool No. | EDP | D1 (Tol h10) | D2 (h6) | L1 | L2 |
|-----------|-------|--------------|---------|----|----|
| 179 0150A | 18272 | 1.5 | 3 | 38 | 3 |
| 179 0200A | 18274 | 2 | 3 | 38 | 4 |
| 179 0250A | 18276 | 2.5 | 3 | 38 | 5 |
| 179 0300A | 18018 | 3 | 6 | 57 | 8 |
| 179 0303A | 18278 | 3 | 3 | 38 | 6 |
| 179 0350A | 18280 | 3.5 | 6 | 63 | 7 |
| 179 0400A | 18019 | 4 | 6 | 57 | 11 |
| 179 0450A | 18282 | 4.5 | 6 | 63 | 9 |
| 179 0500A | 18020 | 5 | 6 | 57 | 13 |
| 179 0600A | 18021 | 6 | 6 | 57 | 13 |
| 179 0800A | 18022 | 8 | 8 | 63 | 19 |
| 179 1000A | 18023 | 10 | 10 | 72 | 22 |
| 179 1200A | 18024 | 12 | 12 | 83 | 26 |
| 179 1600A | 18059 | 16 | 16 | 92 | 32 |



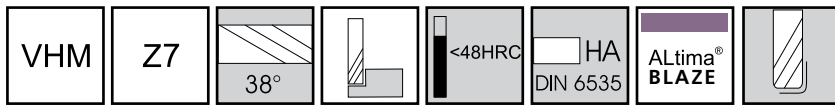
Series 179L



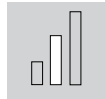
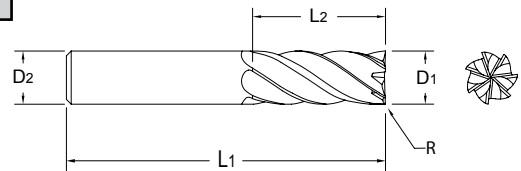
| Tool No. | EDP | D1 (Tol h10) | D2 (h6) | D3 | L1 | L2 | L3 |
|------------|-------|--------------|---------|------|-----|------|----|
| 179L 03N5A | 18290 | 3 | 6 | 2.9 | 75 | 4.5 | 17 |
| 179L 04N5A | 18292 | 4 | 6 | 3.9 | 75 | 6.0 | 22 |
| 179L 05N5A | 18294 | 5 | 6 | 4.9 | 75 | 7.5 | 27 |
| 179L 06N5A | 19296 | 6 | 6 | 5.8 | 101 | 9.0 | 32 |
| 179L 08N5A | 19298 | 8 | 8 | 7.6 | 101 | 12.0 | 42 |
| 179L 10N5A | 18302 | 10 | 10 | 9.6 | 127 | 15.0 | 52 |
| 179L 12N5A | 18304 | 12 | 12 | 11.4 | 152 | 18.0 | 62 |
| 179L 16N5A | 18306 | 16 | 16 | 15.2 | 152 | 24.0 | 82 |



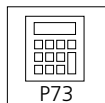
TuffCut® XR Series 180R



Corner Radius
Eckenradius
Rayon



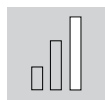
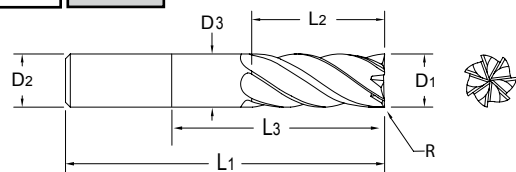
| Tool No. | EDP | D1 (Tol h10) | D2 (h6) | L1 | L2 | R |
|----------------|-------|--------------|---------|-----|----|-----|
| 180 1200-0.5RB | 18501 | 12 | 12 | 84 | 32 | 0.5 |
| 180 1200-1.0RB | 18503 | 12 | 12 | 84 | 32 | 1.0 |
| 180 1200-2.0RB | 18505 | 12 | 12 | 84 | 32 | 2.0 |
| 180 1200-3.0RB | 18507 | 12 | 12 | 84 | 32 | 3.0 |
| 180 1200-4.0RB | 18508 | 12 | 12 | 84 | 32 | 4.0 |
| 180 1600-0.5RB | 18509 | 16 | 16 | 92 | 42 | 0.5 |
| 180 1600-1.0RB | 18510 | 16 | 16 | 92 | 42 | 1.0 |
| 180 1600-2.0RB | 18511 | 16 | 16 | 92 | 42 | 2.0 |
| 180 1600-3.0RB | 18513 | 16 | 16 | 92 | 42 | 3.0 |
| 180 1600-4.0RB | 18527 | 16 | 16 | 92 | 42 | 4.0 |
| 180 2000-0.5RB | 18528 | 20 | 20 | 102 | 52 | 0.5 |
| 180 2000-1.0RB | 18529 | 20 | 20 | 102 | 52 | 1.0 |
| 180 2000-2.0RB | 18530 | 20 | 20 | 102 | 52 | 2.0 |
| 180 2000-3.0RB | 18531 | 20 | 20 | 102 | 52 | 3.0 |
| 180 2000-4.0RB | 18533 | 20 | 20 | 102 | 52 | 4.0 |



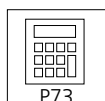
TuffCut® XR Series 180NR



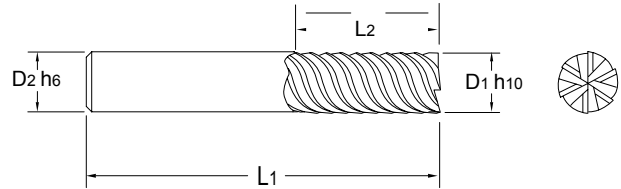
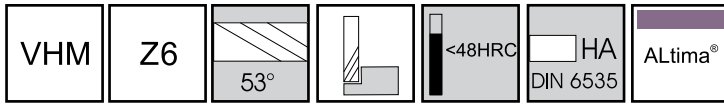
Corner Radius
Eckenradius
Rayon



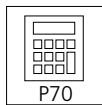
| Tool No. | EDP | D1 (Tol h10) | D2 (h6) | D3 | L1 | L2 | L3 | R |
|------------------|-------|--------------|---------|------|-----|----|-----|---|
| 180 1200N5-1.0RB | 18500 | 12 | 12 | 11.4 | 120 | 30 | 60 | 1 |
| 180 1200N5-2.0RB | 18502 | 12 | 12 | 11.4 | 120 | 30 | 60 | 2 |
| 180 1200N5-3.0RB | 18504 | 12 | 12 | 11.4 | 120 | 30 | 60 | 3 |
| 180 1200N5-4.0RB | 18506 | 12 | 12 | 11.4 | 120 | 30 | 60 | 4 |
| 180 1600N5-1.0RB | 18548 | 16 | 16 | 15.2 | 150 | 40 | 80 | 1 |
| 180 1600N5-2.0RB | 18550 | 16 | 16 | 15.2 | 150 | 40 | 80 | 2 |
| 180 1600N5-3.0RB | 18552 | 16 | 16 | 15.2 | 150 | 40 | 80 | 3 |
| 180 1600N5-4.0RB | 18554 | 16 | 16 | 15.2 | 150 | 40 | 80 | 4 |
| 180 2000N5-1.0RB | 18590 | 20 | 20 | 19.2 | 150 | 50 | 100 | 1 |
| 180 2000N5-2.0RB | 18592 | 20 | 20 | 19.2 | 150 | 50 | 100 | 2 |
| 180 2000N5-3.0RB | 18594 | 20 | 20 | 19.2 | 150 | 50 | 100 | 3 |
| 180 2000N5-4.0RB | 18596 | 20 | 20 | 19.2 | 150 | 50 | 100 | 4 |



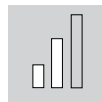
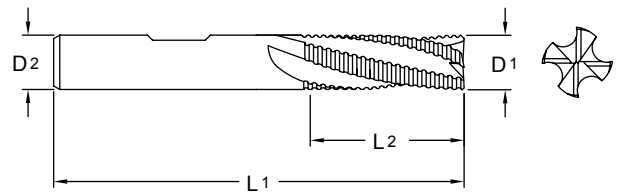
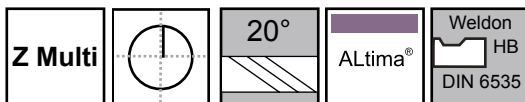
TuffCut® XR Series 113A



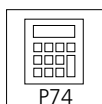
| Tool No. | EDP | D1 (Tol h10) | D2 (h6) | L1 | L2 |
|-----------|-------|--------------|---------|-----|----|
| 113 0300A | 11384 | 3 | 3 | 38 | 12 |
| 113 0400A | 11385 | 4 | 4 | 51 | 14 |
| 113 0500A | 11386 | 5 | 5 | 51 | 20 |
| 113 0600A | 11387 | 6 | 6 | 64 | 20 |
| 113 0800A | 11388 | 8 | 8 | 64 | 20 |
| 113 1000A | 11389 | 10 | 10 | 70 | 25 |
| 113 1200A | 11390 | 12 | 12 | 76 | 25 |
| 113 1600A | 11391 | 16 | 16 | 89 | 30 |
| 113 2000A | 11392 | 20 | 20 | 102 | 38 |



TuffCut® XR Series 192



| Tool No. | EDP | D1 Tol h10 | D2 | L1 | L2 | Z |
|-----------|-------|------------|----|-----|----|---|
| 192 0800A | 95744 | 8 | 8 | 51 | 8 | 3 |
| 192 0801A | 95749 | 8 | 8 | 64 | 16 | 3 |
| 192 1000A | 95745 | 10 | 10 | 51 | 10 | 4 |
| 192 1001A | 95750 | 10 | 10 | 70 | 20 | 4 |
| 192 1200A | 95746 | 12 | 12 | 64 | 12 | 4 |
| 192 1201A | 95751 | 12 | 12 | 76 | 25 | 4 |
| 192 1600A | 95747 | 16 | 16 | 76 | 16 | 4 |
| 192 1601A | 95752 | 16 | 16 | 89 | 32 | 4 |
| 192 2000A | 95748 | 20 | 20 | 76 | 20 | 4 |
| 192 2001A | 95753 | 20 | 20 | 102 | 38 | 4 |



TuffCut® X-AL

Designed for Extreme Productivity

Features / Caractéristique

Benefit / Avantage

134 Series / Série 134

- Chipbreaker design
- Sinusoidal Flute Form
- Conception brise-copeaux
- Goujure à forme sinusoidale

Reduced power consumption on low power/torque machines
Produces small manageable chips for ease of evacuation.
Chips not thrown clear on unguarded machines.

Diminution de la puissance absorbée sur les machines à faible puissance/couple.
Produit des petits copeaux facilitant leur évacuation
Les copeaux ne sont pas rejetés de machines non protégées.

135 series / Série 135

- Unique double grind geometry
- Variety of lengths from stock with neck relief as standard.
- Industry standard radii from stock.
- Géométrie unique à double rectification.
- Choix de longueurs en stock avec fraises détalonnées en standard.
- Rayons industriels stockés en standard

Controlled chip form for easy evacuation.
Highest tooth loading capability (1 mm/tooth/rev during 1 x D slotting)
Enabling the use of best practice tool length.
3 x D and 5 x D neck relieved shanks available.
Tool availability reduces forward planning required for short lead time components.
Forme du copeau maîtrisée pour en faciliter l'évacuation
Capacité de charge à la dent la plus élevée (1 mm/dent/tour lors de rainurage 1 x D).
Permettant l'utilisation d'une longueur d'outil optimale.
3 x D et 5 x D disponibles avec queues détalonnée.
Moins de planification nécessaire, diminuant le délai d'approvisionnement.

138 series / Série 138

- 3 Flute geometry
- Circular land
- Wiper flats
- Géométrie à 3 Dents
- Face de dépouille circulaire
- Arêtes de Raclage



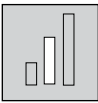


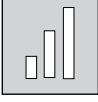


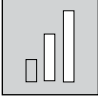

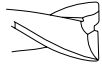
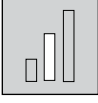


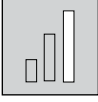


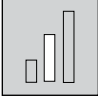


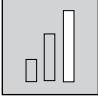


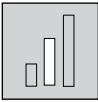





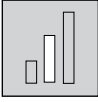


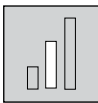


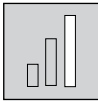
HS finishing endmill for smoother cutting and higher feed rates.
Improved surface finishes and reduced chatter on walls/ribs.
Best possible web/rib surface finishes.
Fraise finition HV pour coupes plus douces et avances plus élevées.
Etats de surface améliorées et broutage diminué sur les parois.
Meilleures états de surface possibles pour les parois/fonds.

General Features / Caractéristiques Générales

- Unique carbide substrates
- Fordlube coating
- Substrats en carbure exceptionnels
- Revêtement Fordlube

Application specific grades for optimum tool performance.
To prevent chip adhesion and extend tool life during Ultra high speed machining or applications involving the use of minimal coolant.
Nuances pour applications particulières afin d'assurer une performance optimale.
Pour éviter l'adhérence de copeaux et prolonger la durée de vie lors d'usinages à très hautes vitesses ou pour des applications utilisant un minimum d'arrosage.

Contents Vue d'Ensemble

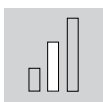
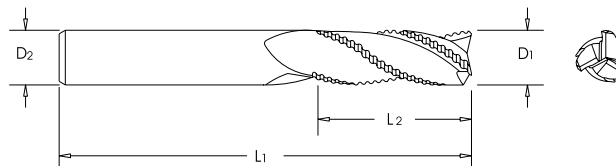
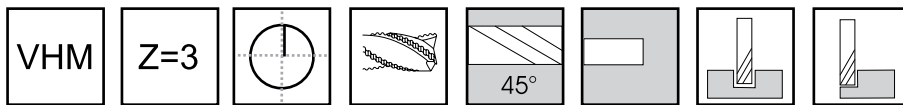
| | Series Séries | Form Forme | No. of Teeth Nbre.Dents | Lengths Longueurs | Corner Prep Prép.Bec | Application Area Secteur d'Application | Page |
|---|------------------|---|----------------------------|---|--|---|------|
|  | 134 |  | Z=3 |  | Chamfer 45 deg Chanfrein 45° | Older-Lower KW machine, long DOC (Ae) M/c anciennes, < KW, long DOC (Ae) | 16 |
|  | 135 |  | Z=2 |  | 0.2 - 0.75mm Radius Rayon | High feed machine -1> mm tooth loading possible Fortes avances -1> mm à la dent | 17 |
|  | 135N |  | Z=2 |  | 0.2 - 0.75mm Radius Rayon | High feed machine -1> mm tooth loading possible Fortes avances -1> mm à la dent | 18 |
|  | 135N3 |  | Z=2 |  | 0 - 5.0mm Radius Rayon | High feed machine -1> mm tooth loading possible Fortes avances -1> mm à la dent | 19 |
|  | 135N5 |  | Z=2 |  | 0 - 5.0mm Radius Rayon | Rough & finish profile milling Ebauche & Fraisage finition profil | 21 |
|  | 135B-N3 |  | Z=2 |  | N/A | Rough & finish profile milling Ebauche & Fraisage finition profil | 23 |
|  | 135B-N5 |  | Z=2 |  | N/A | Rough & finish profile milling Ebauche & Fraisage finition profil | 23 |
|  | 136 |  | Z=2 |  | Sharp corner radius to order Coin carré Rayon à la cde. | Finishing Al alloys Wiper flats for surface finish Finition Aciers Alliés Al Arêtes de raclage | 24 |
|  | 138 |  | Z=3 |  | Sharp corner Coin carré | High performance finish machining. Wiper flats for surface finish Finition HP Arêtes de raclage | 25 |
|  | 138R |  | Z=3 |  | 0.5 - 5.0mm Radius Rayon | High performance finish machining. Wiper flats for surface finish Finition HP Arêtes de raclage | 26 |
|  | 138B |  | Z=3 |  | N/A | Finish profile milling Finition profil | 27 |
|  | 138B-N5 |  | Z=3 |  | N/A | Finish profile milling Finition profil | 27 |

Technical Section

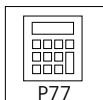
69

| Available Coatings - Delivery 3 - 4 weeks | | | Revêtements Disponibles - Livraison 3 - 4 semaines | | |
|---|---------------------|------------------------|--|-------------------|--|
| | Micro Hardness (HV) | Max Work Temp. °C | Colour | Coef. of Friction | Application Area |
| | Dureté Micro (HV) | Max. Fonctionnement °C | Couleur | Coef. friction | |
| F - Fordlube | 4000 | 850 | Light Grey Gris clair | <0.45 | Al-Si Alloys / Ti Alloys / Mg Alloys / Copper Alloys Alliages Al-Si/Alliages Ti / Alliages Mg/Alliages Cuivre |

TuffCut® X-AL Series 134

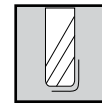
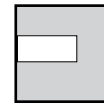
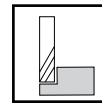
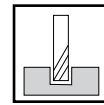
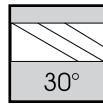
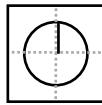
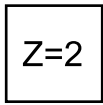


| Tool No. | EDP | D1 | D2 | L1 | L2 |
|----------|-------|----|----|-----|----|
| 134 0600 | 13409 | 6 | 6 | 64 | 20 |
| 134 0800 | 13414 | 8 | 8 | 64 | 20 |
| 134 1000 | 13419 | 10 | 10 | 70 | 25 |
| 134 1200 | 13423 | 12 | 12 | 76 | 25 |
| 134 1400 | 95321 | 14 | 14 | 89 | 30 |
| 134 1600 | 13429 | 16 | 16 | 89 | 30 |
| 134 1800 | 13430 | 18 | 18 | 102 | 35 |
| 134 2000 | 13433 | 20 | 20 | 102 | 38 |
| 134 2500 | 13435 | 25 | 25 | 102 | 50 |

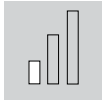
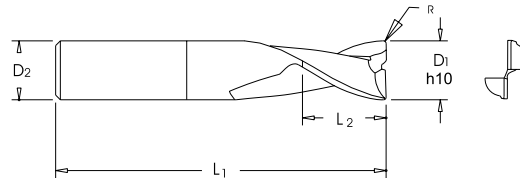


Available with Fordlube upon request.

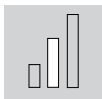
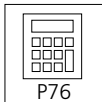
TuffCut® X-AL Series 135



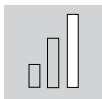
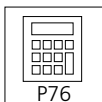
Corner Radius
Eckenradius
Avec Rayons



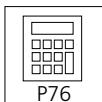
| Tool No. | EDP | D1 Tol h10 | D2 | L1 | L2 | R |
|----------|-------|------------|----|-----|------|------|
| 135 0300 | 13523 | 3 | 3 | 38 | 3.5 | 0.20 |
| 135 0400 | 13533 | 4 | 4 | 51 | 4.8 | 0.20 |
| 135 0500 | 13502 | 5 | 5 | 51 | 6.0 | 0.25 |
| 135 0600 | 13504 | 6 | 6 | 64 | 7.0 | 0.30 |
| 135 0800 | 13508 | 8 | 8 | 64 | 9.5 | 0.35 |
| 135 1000 | 13515 | 10 | 10 | 70 | 12.0 | 0.50 |
| 135 1200 | 13525 | 12 | 12 | 76 | 14.0 | 0.50 |
| 135 1400 | 13552 | 14 | 14 | 89 | 16.0 | 0.50 |
| 135 1600 | 13535 | 16 | 16 | 89 | 18.0 | 0.75 |
| 135 1800 | 13563 | 18 | 18 | 102 | 20.0 | 0.75 |
| 135 2000 | 13545 | 20 | 20 | 102 | 22.0 | 0.75 |
| 135 2500 | 13555 | 25 | 25 | 102 | 25.0 | 0.75 |



| Tool No. | EDP | D1 Tol h10 | D2 | L1 | L2 | R |
|----------|-------|------------|----|-----|----|------|
| 135 1001 | 13516 | 10 | 10 | 76 | 12 | 0.50 |
| 135 1201 | 13526 | 12 | 12 | 102 | 14 | 0.50 |
| 135 1401 | 13554 | 14 | 14 | 102 | 16 | 0.50 |
| 135 1601 | 13536 | 16 | 16 | 117 | 18 | 0.75 |
| 135 1801 | 13568 | 18 | 18 | 127 | 20 | 0.75 |
| 135 2001 | 13546 | 20 | 20 | 127 | 22 | 0.75 |
| 135 2501 | 13556 | 25 | 25 | 127 | 25 | 0.75 |

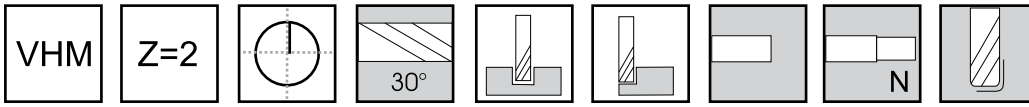


| Tool No. | EDP | D1 Tol h10 | D2 | L1 | L2 | R |
|----------|-------|------------|----|-----|----|------|
| 135 1002 | 13517 | 10 | 10 | 89 | 12 | 0.50 |
| 135 1202 | 13527 | 12 | 12 | 127 | 14 | 0.50 |
| 135 1402 | 13573 | 14 | 14 | 127 | 16 | 0.50 |
| 135 1602 | 13537 | 16 | 16 | 133 | 18 | 0.75 |
| 135 1802 | 13574 | 18 | 18 | 152 | 20 | 0.75 |
| 135 2002 | 13547 | 20 | 20 | 152 | 22 | 0.75 |
| 135 2502 | 13557 | 25 | 25 | 152 | 25 | 0.75 |

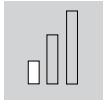
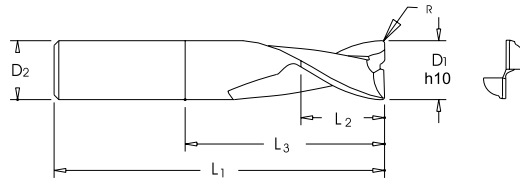


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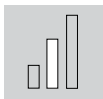
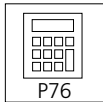
TuffCut® X-AL Series 135N



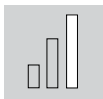
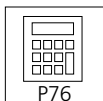
Corner Radius
Eckenradius
Avec Rayons



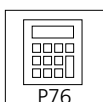
| Tool No. | EDP | D1 Tol h10 | D2 | L1 | L2 | L3 | R |
|-----------|-------|------------|----|-----|------|----|------|
| 135 0300N | 13524 | 3 | 3 | 38 | 3.5 | 11 | 0.20 |
| 135 0400N | 13534 | 4 | 4 | 51 | 4.8 | 22 | 0.20 |
| 135 0500N | 13503 | 5 | 5 | 51 | 6.0 | 22 | 0.25 |
| 135 0600N | 13505 | 6 | 6 | 64 | 7.0 | 26 | 0.30 |
| 135 0800N | 13509 | 8 | 8 | 64 | 9.5 | 26 | 0.35 |
| 135 1000N | 13565 | 10 | 10 | 70 | 12.0 | 28 | 0.50 |
| 135 1200N | 13575 | 12 | 12 | 76 | 14.0 | 28 | 0.50 |
| 135 1400N | 13553 | 14 | 14 | 89 | 16.0 | 42 | 0.50 |
| 135 1600N | 13585 | 16 | 16 | 89 | 18.0 | 39 | 0.75 |
| 135 1800N | 13564 | 18 | 18 | 102 | 20.0 | 52 | 0.75 |
| 135 2000N | 13594 | 20 | 20 | 102 | 22.0 | 50 | 0.75 |
| 135 2500N | 13597 | 25 | 25 | 102 | 25.0 | 36 | 0.75 |



| Tool No. | EDP | D1 Tol h10 | D2 | L1 | L2 | L3 | R |
|-----------|-------|------------|----|-----|----|----|------|
| 135 1001N | 13566 | 10 | 10 | 76 | 12 | 34 | 0.50 |
| 135 1201N | 13576 | 12 | 12 | 102 | 14 | 54 | 0.50 |
| 135 1401N | 13558 | 14 | 14 | 102 | 16 | 55 | 0.50 |
| 135 1601N | 13586 | 16 | 16 | 117 | 18 | 83 | 0.75 |
| 135 1801N | 13569 | 18 | 18 | 127 | 20 | 77 | 0.75 |
| 135 2001N | 13595 | 20 | 20 | 127 | 22 | 75 | 0.75 |
| 135 2501N | 13598 | 25 | 25 | 127 | 25 | 61 | 0.75 |

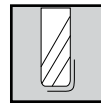
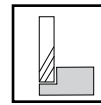
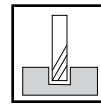
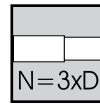
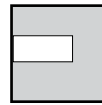
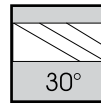
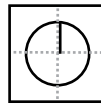
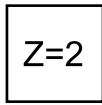


| Tool No. | EDP | D1 Tol h10 | D2 | L1 | L2 | L3 | R |
|-----------|-------|------------|----|-----|----|-----|------|
| 135 1002N | 13567 | 10 | 10 | 89 | 12 | 47 | 0.50 |
| 135 1202N | 13577 | 12 | 12 | 127 | 14 | 79 | 0.50 |
| 135 1402N | 13559 | 14 | 14 | 127 | 16 | 80 | 0.50 |
| 135 1602N | 13587 | 16 | 16 | 133 | 18 | 99 | 0.75 |
| 135 1802N | 13578 | 18 | 18 | 152 | 20 | 102 | 0.75 |
| 135 2002N | 13596 | 20 | 20 | 152 | 22 | 100 | 0.75 |
| 135 2502N | 13599 | 25 | 25 | 152 | 25 | 86 | 0.75 |

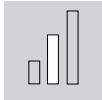
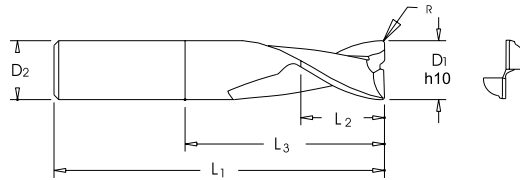


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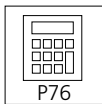
TuffCut® X-AL Series 135N3



Corner Radius
Eckenradius
Avec Rayons

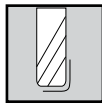
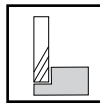
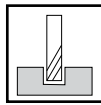
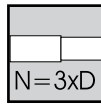
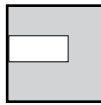
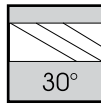
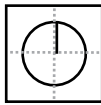
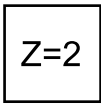


| Tool No. | EDP | D1 Tol h10 | D2 | L1 | L2 | L3 | R |
|---------------|-------|------------|----|----|------|----|-----|
| 135 03N3 | 96620 | 3 | 3 | 38 | 3.5 | 11 | - |
| 135 03N3-0.5R | 96621 | 3 | 3 | 38 | 3.5 | 11 | 0.5 |
| 135 03N3-1.0R | 96622 | 3 | 3 | 38 | 3.5 | 11 | 1.0 |
| 135 04N3 | 96626 | 4 | 4 | 51 | 4.8 | 14 | - |
| 135 04N3-0.5R | 96627 | 4 | 4 | 51 | 4.8 | 14 | 0.5 |
| 135 04N3-1.0R | 96628 | 4 | 4 | 51 | 4.8 | 14 | 1.0 |
| 135 05N3 | 96632 | 5 | 6 | 64 | 6.0 | 17 | - |
| 135 05N3-0.5R | 96633 | 5 | 6 | 64 | 6.0 | 17 | 0.5 |
| 135 05N3-1.0R | 96634 | 5 | 6 | 64 | 6.0 | 17 | 1.0 |
| 135 06N3 | 96638 | 6 | 6 | 64 | 7.0 | 20 | - |
| 135 06N3-0.5R | 96639 | 6 | 6 | 64 | 7.0 | 20 | 0.5 |
| 135 06N3-1.0R | 96640 | 6 | 6 | 64 | 7.0 | 20 | 1.0 |
| 135 06N3-1.5R | 96641 | 6 | 6 | 64 | 7.0 | 20 | 1.5 |
| 135 06N3-2.0R | 96642 | 6 | 6 | 64 | 7.0 | 20 | 2.0 |
| 135 08N3 | 96648 | 8 | 8 | 64 | 9.5 | 26 | - |
| 135 08N3-0.5R | 96649 | 8 | 8 | 64 | 9.5 | 26 | 0.5 |
| 135 08N3-1.0R | 96650 | 8 | 8 | 64 | 9.5 | 26 | 1.0 |
| 135 08N3-1.5R | 96651 | 8 | 8 | 64 | 9.5 | 26 | 1.5 |
| 135 08N3-2.0R | 96652 | 8 | 8 | 64 | 9.5 | 26 | 2.0 |
| 135 08N3-3.0R | 96653 | 8 | 8 | 64 | 9.5 | 26 | 3.0 |
| 135 10N3 | 96660 | 10 | 10 | 76 | 12.0 | 34 | - |
| 135 10N3-1.0R | 96662 | 10 | 10 | 76 | 12.0 | 34 | 1.0 |
| 135 10N3-1.5R | 96663 | 10 | 10 | 76 | 12.0 | 34 | 1.5 |
| 135 10N3-2.0R | 96664 | 10 | 10 | 76 | 12.0 | 34 | 2.0 |
| 135 10N3-3.0R | 96665 | 10 | 10 | 76 | 12.0 | 34 | 3.0 |
| 135 12N3 | 96671 | 12 | 12 | 76 | 14.0 | 38 | - |

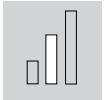
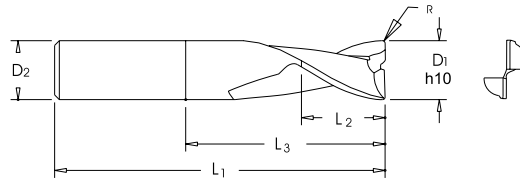


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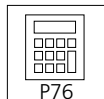
TuffCut® X-AL Series 135N3



Corner Radius
Eckenradius
Avec Rayons

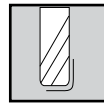
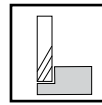
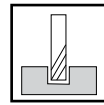
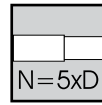
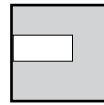
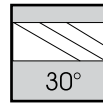
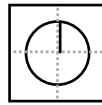
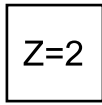


| Tool No. | EDP | D1 Tol h10 | D2 | L1 | L2 | L3 | R |
|---------------|-------|------------|----|-----|----|----|-----|
| 135 12N3-0.5R | 96672 | 12 | 12 | 76 | 14 | 38 | 0.5 |
| 135 12N3-1.0R | 96673 | 12 | 12 | 76 | 14 | 38 | 1.0 |
| 135 12N3-1.5R | 96674 | 12 | 12 | 76 | 14 | 38 | 1.5 |
| 135 12N3-2.0R | 96675 | 12 | 12 | 76 | 14 | 38 | 2.0 |
| 135 12N3-3.0R | 96676 | 12 | 12 | 76 | 14 | 38 | 3.0 |
| 135 12N3-4.0R | 96677 | 12 | 12 | 76 | 14 | 38 | 4.0 |
| 135 16N3 | 96684 | 16 | 16 | 117 | 18 | 53 | - |
| 135 16N3-0.5R | 96685 | 16 | 16 | 117 | 18 | 53 | 0.5 |
| 135 16N3-1.0R | 96686 | 16 | 16 | 117 | 18 | 53 | 1.0 |
| 135 16N3-1.5R | 96687 | 16 | 16 | 117 | 18 | 53 | 1.5 |
| 135 16N3-2.0R | 96688 | 16 | 16 | 117 | 18 | 53 | 2.0 |
| 135 16N3-3.0R | 96689 | 16 | 16 | 117 | 18 | 53 | 3.0 |
| 135 16N3-4.0R | 96690 | 16 | 16 | 117 | 18 | 53 | 4.0 |
| 135 20N3-0.5R | 96697 | 20 | 20 | 127 | 22 | 65 | 0.5 |
| 135 20N3-1.0R | 96698 | 20 | 20 | 127 | 22 | 65 | 1.0 |
| 135 20N3-1.5R | 96699 | 20 | 20 | 127 | 22 | 65 | 1.5 |
| 135 20N3-2.0R | 96700 | 20 | 20 | 127 | 22 | 65 | 2.0 |
| 135 20N3-3.0R | 96701 | 20 | 20 | 127 | 22 | 65 | 3.0 |
| 135 20N3-4.0R | 96702 | 20 | 20 | 127 | 22 | 65 | 4.0 |
| 135 25N3-0.5R | 96709 | 25 | 25 | 127 | 25 | 80 | 0.5 |
| 135 25N3-1.0R | 96710 | 25 | 25 | 127 | 25 | 80 | 1.0 |
| 135 25N3-1.5R | 96711 | 25 | 25 | 127 | 25 | 80 | 1.5 |
| 135 25N3-2.0R | 96712 | 25 | 25 | 127 | 25 | 80 | 2.0 |
| 135 25N3-3.0R | 96713 | 25 | 25 | 127 | 25 | 80 | 3.0 |
| 135 25N3-4.0R | 96714 | 25 | 25 | 127 | 25 | 80 | 4.0 |

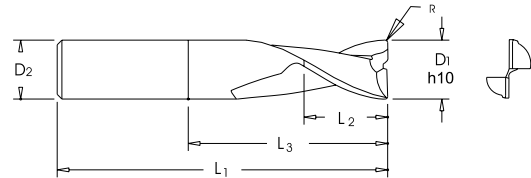


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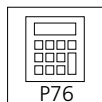
TuffCut® X-AL Series 135N5



Corner Radius
Eckenradius
Avec Rayons

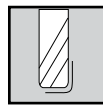
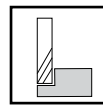
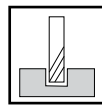
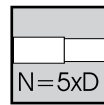
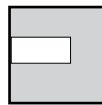
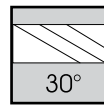
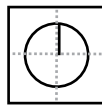
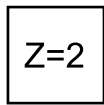


| Tool No. | EDP | D1 Tol h10 | D2 | L1 | L2 | L3 | R |
|---------------|-------|------------|----|-----|------|----|-----|
| 135 03N5 | 96623 | 3 | 3 | 38 | 3.5 | 16 | - |
| 135 03N5-0.5R | 96624 | 3 | 3 | 38 | 3.5 | 16 | 0.5 |
| 135 03N5-1.0R | 96625 | 3 | 3 | 38 | 3.5 | 16 | 1.0 |
| 135 04N5 | 96629 | 4 | 4 | 51 | 4.8 | 22 | - |
| 135 04N5-0.5R | 96630 | 4 | 4 | 51 | 4.8 | 22 | 0.5 |
| 135 04N5-1.0R | 96631 | 4 | 4 | 51 | 4.8 | 22 | 1.0 |
| 135 05N5 | 96635 | 5 | 6 | 64 | 6.0 | 27 | - |
| 135 05N5-0.5R | 96636 | 5 | 6 | 64 | 6.0 | 27 | 0.5 |
| 135 05N5-1.0R | 96637 | 5 | 6 | 64 | 6.0 | 27 | 1.0 |
| 135 06N5 | 96643 | 6 | 6 | 64 | 7.0 | 32 | - |
| 135 06N5-0.5R | 96644 | 6 | 6 | 64 | 7.0 | 32 | 0.5 |
| 135 06N5-1.0R | 96645 | 6 | 6 | 64 | 7.0 | 32 | 1.0 |
| 135 06N5-1.5R | 96646 | 6 | 6 | 64 | 7.0 | 32 | 1.5 |
| 135 06N5-2.0R | 96647 | 6 | 6 | 64 | 7.0 | 32 | 2.0 |
| 135 08N5 | 96654 | 8 | 8 | 75 | 9.5 | 42 | - |
| 135 08N5-0.5R | 96655 | 8 | 8 | 75 | 9.5 | 42 | 0.5 |
| 135 08N5-1.0R | 96656 | 8 | 8 | 75 | 9.5 | 42 | 1.0 |
| 135 08N5-1.5R | 96657 | 8 | 8 | 75 | 9.5 | 42 | 1.5 |
| 135 08N5-2.0R | 96658 | 8 | 8 | 75 | 9.5 | 42 | 2.0 |
| 135 08N5-3.0R | 96659 | 8 | 8 | 75 | 9.5 | 42 | 3.0 |
| 135 10N5-0.5R | 96666 | 10 | 10 | 89 | 12.0 | 52 | 0.5 |
| 135 10N5-1.0R | 96667 | 10 | 10 | 89 | 12.0 | 52 | 1.0 |
| 135 10N5-1.5R | 96668 | 10 | 10 | 89 | 12.0 | 52 | 1.5 |
| 135 10N5-2.0R | 96669 | 10 | 10 | 89 | 12.0 | 52 | 2.0 |
| 135 10N5-3.0R | 96670 | 10 | 10 | 89 | 12.0 | 52 | 3.0 |
| 135 12N5-0.5R | 96678 | 12 | 12 | 110 | 14.0 | 62 | 0.5 |

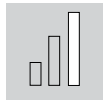
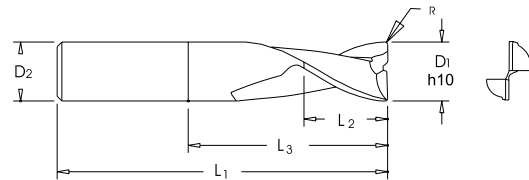


Available with Fordlube upon request.

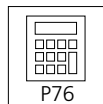
TuffCut® X-AL Series 135N5



Corner Radius
Eckenradius
Avec Rayons

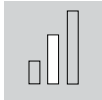
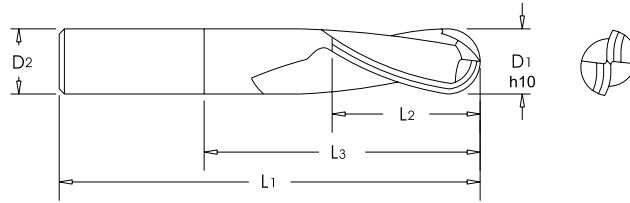
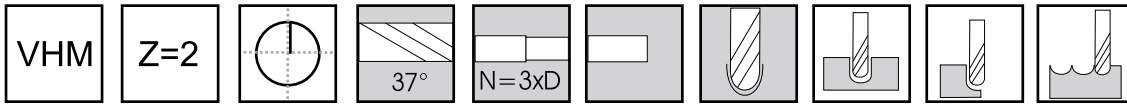


| Tool No. | EDP | D1 Tol h10 | D2 | L1 | L2 | L3 | R |
|---------------|-------|------------|----|-----|----|-----|-----|
| 135 12N5-1.0R | 96679 | 12 | 12 | 110 | 14 | 62 | 1.0 |
| 135 12N5-1.5R | 96680 | 12 | 12 | 110 | 14 | 62 | 1.5 |
| 135 12N5-2.0R | 96681 | 12 | 12 | 110 | 14 | 62 | 2.0 |
| 135 12N5-3.0R | 96682 | 12 | 12 | 110 | 14 | 62 | 3.0 |
| 135 12N5-4.0R | 96683 | 12 | 12 | 110 | 14 | 62 | 4.0 |
| 135 12N5-5.0R | 96723 | 12 | 12 | 110 | 14 | 62 | 5.0 |
| 135 16N5-0.5R | 96691 | 16 | 16 | 127 | 18 | 85 | 0.5 |
| 135 16N5-1.0R | 96692 | 16 | 16 | 127 | 18 | 85 | 1.0 |
| 135 16N5-1.5R | 96693 | 16 | 16 | 127 | 18 | 85 | 1.5 |
| 135 16N5-2.0R | 96694 | 16 | 16 | 127 | 18 | 85 | 2.0 |
| 135 16N5-3.0R | 96695 | 16 | 16 | 127 | 18 | 85 | 3.0 |
| 135 16N5-4.0R | 96696 | 16 | 16 | 127 | 18 | 85 | 4.0 |
| 135 20N5-0.5R | 96703 | 20 | 20 | 152 | 22 | 105 | 0.5 |
| 135 20N5-1.0R | 96704 | 20 | 20 | 152 | 22 | 105 | 1.0 |
| 135 20N5-1.5R | 96705 | 20 | 20 | 152 | 22 | 105 | 1.5 |
| 135 20N5-2.0R | 96706 | 20 | 20 | 152 | 22 | 105 | 2.0 |
| 135 20N5-3.0R | 96707 | 20 | 20 | 152 | 22 | 105 | 3.0 |
| 135 20N5-4.0R | 96708 | 20 | 20 | 152 | 22 | 105 | 4.0 |
| 135 20N5-5.0R | 96724 | 20 | 20 | 152 | 22 | 105 | 5.0 |
| 135 25N5-0.5R | 96715 | 25 | 25 | 180 | 25 | 130 | 0.5 |
| 135 25N5-1.0R | 96716 | 25 | 25 | 180 | 25 | 130 | 1.0 |
| 135 25N5-1.5R | 96717 | 25 | 25 | 180 | 25 | 130 | 1.5 |
| 135 25N5-2.0R | 96718 | 25 | 25 | 180 | 25 | 130 | 2.0 |
| 135 25N5-3.0R | 96719 | 25 | 25 | 180 | 25 | 130 | 3.0 |
| 135 25N5-4.0R | 96720 | 25 | 25 | 180 | 25 | 130 | 4.0 |

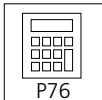


Available with Fordlube upon request.

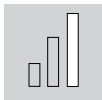
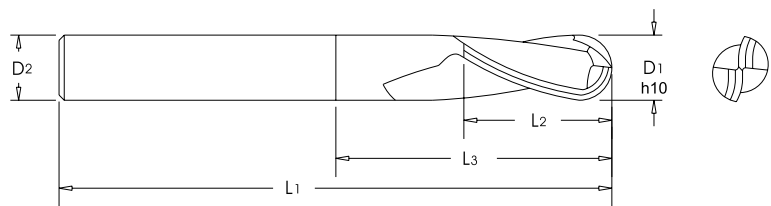
TuffCut® X-AL Series 135B-N3



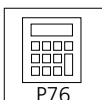
| Tool No. | EDP | D1 Tol h10 | D2 | L1 | L2 | L3 |
|-------------|-------|------------|----|----|----|----|
| 135B 0300N3 | 13236 | 3 | 3 | 38 | 5 | 11 |
| 135B 0400N3 | 13238 | 4 | 4 | 51 | 6 | 14 |
| 135B 0500N3 | 13240 | 5 | 5 | 64 | 7 | 17 |
| 135B 0600N3 | 13242 | 6 | 6 | 64 | 8 | 20 |
| 135B 0800N3 | 13244 | 8 | 8 | 64 | 10 | 26 |
| 135B 1000N3 | 13246 | 10 | 10 | 70 | 12 | 32 |
| 135B 1200N3 | 13248 | 12 | 12 | 76 | 16 | 38 |
| 135B 1600N3 | 13250 | 16 | 16 | 89 | 20 | 50 |



TuffCut® X-AL Series 135B-N5

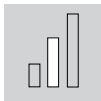
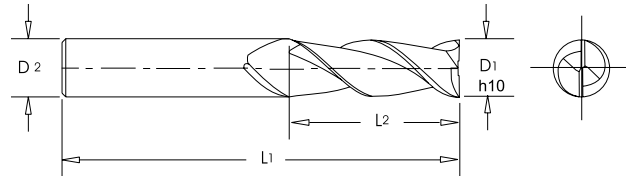
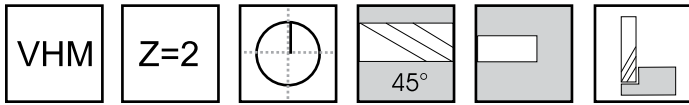


| Tool No. | EDP | D1 Tol h10 | D2 | L1 | L2 | L3 |
|-------------|-------|------------|------|-------|------|------|
| 135B 0200N5 | 13252 | 2.0 | 6.0 | 75.0 | 4.0 | 12.0 |
| 135B 0300N5 | 13254 | 3.0 | 6.0 | 75.0 | 5.0 | 17.0 |
| 135B 0400N5 | 13256 | 4.0 | 6.0 | 75.0 | 6.0 | 22.0 |
| 135B 0500N5 | 13258 | 5.0 | 6.0 | 75.0 | 7.0 | 27.0 |
| 135B 0600N5 | 13260 | 6.0 | 6.0 | 110.0 | 8.0 | 32.0 |
| 135B 0800N5 | 13262 | 8.0 | 8.0 | 110.0 | 10.0 | 42.0 |
| 135B 1000N5 | 13264 | 10.0 | 10.0 | 110.0 | 12.0 | 52.0 |
| 135B 1200N5 | 13266 | 12.0 | 12.0 | 120.0 | 16.0 | 62.0 |
| 135B 1600N5 | 13268 | 16.0 | 16.0 | 130.0 | 20.0 | 82.0 |

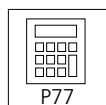


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TuffCut® X-AL Series 136

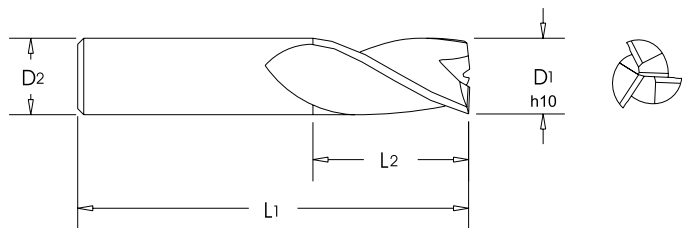
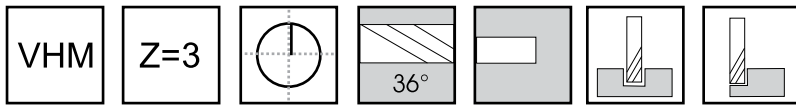


| Tool No. | EDP | D1 Tol h10 | D2 | L1 | L2 |
|----------|-------|------------|----|-----|------|
| 136 0300 | 13600 | 3 | 6 | 52 | 8.0 |
| 136 0400 | 13602 | 4 | 6 | 55 | 11.0 |
| 136 0500 | 13605 | 5 | 6 | 58 | 13.0 |
| 136 0600 | 13610 | 6 | 6 | 58 | 13.0 |
| 136 0800 | 13615 | 8 | 8 | 64 | 19.0 |
| 136 1000 | 13620 | 10 | 10 | 70 | 22.0 |
| 136 1200 | 13625 | 12 | 12 | 84 | 26.0 |
| 136 1400 | 13626 | 14 | 14 | 83 | 26.0 |
| 136 1600 | 13630 | 16 | 16 | 89 | 32.0 |
| 136 1800 | 13631 | 18 | 18 | 92 | 32.0 |
| 136 2000 | 13635 | 20 | 20 | 102 | 38.0 |

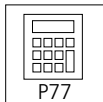


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TuffCut® X-AL Series 138

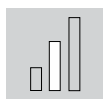
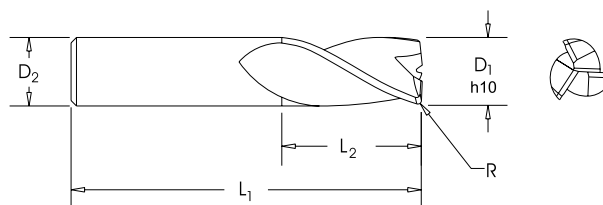
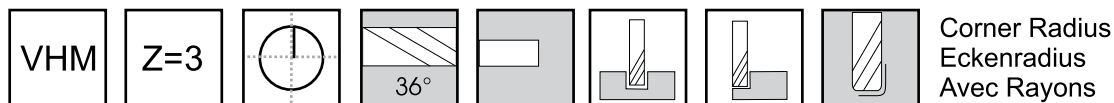


| Uncoated | | Fordlube | | D1 Tol. h10 | D2 | L1 | L2 |
|----------|-------|-----------|-------|----------------|----|-----|----|
| Tool No. | EDP | Tool No. | EDP | | | | |
| 138 0300 | 13892 | 138 0300F | 14295 | 3 | 6 | 52 | 8 |
| 138 0400 | 13893 | 138 0400F | 14296 | 4 | 6 | 55 | 11 |
| 138 0500 | 13894 | 138 0500F | 14297 | 5 | 6 | 58 | 13 |
| 138 0600 | 13895 | 138 0600F | 14298 | 6 | 6 | 58 | 13 |
| 138 0800 | 13896 | 138 0800F | 14299 | 8 | 8 | 64 | 19 |
| 138 1000 | 13897 | 138 1000F | 14300 | 10 | 10 | 70 | 22 |
| 138 1200 | 13898 | 138 1200F | 14301 | 12 | 12 | 84 | 26 |
| 138 1400 | 13899 | 138 1400F | 14302 | 14 | 14 | 84 | 26 |
| 138 1600 | 13900 | 138 1600F | 14303 | 16 | 16 | 89 | 32 |
| 138 1800 | 13901 | 138 1800F | 14304 | 18 | 18 | 92 | 32 |
| 138 2000 | 13902 | 138 2000F | 14305 | 20 | 20 | 102 | 38 |

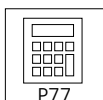


Available with Fordlube upon request.

TuffCut® X-AL Series 138R

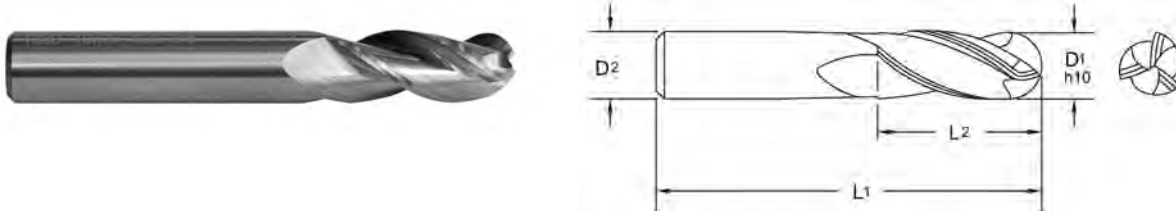
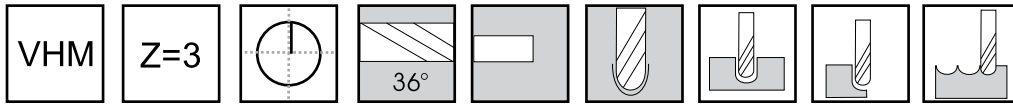


| Tool No. | EDP | D1 Tol h10 | D2 | L1 | L2 | R |
|---------------|-------|------------|----|-----|----|------|
| 138 0300-0.5R | 13100 | 3 | 6 | 52 | 8 | 0.50 |
| 138 0300-1.0R | 13101 | 3 | 6 | 52 | 8 | 1.00 |
| 138 0400-0.5R | 13102 | 4 | 6 | 55 | 11 | 0.50 |
| 138 0400-1.0R | 13103 | 4 | 6 | 55 | 11 | 1.00 |
| 138 0500-0.5R | 13104 | 5 | 6 | 58 | 13 | 0.50 |
| 138 0500-1.0R | 13105 | 5 | 6 | 58 | 13 | 1.00 |
| 138 0600-0.5R | 13106 | 6 | 6 | 58 | 13 | 0.50 |
| 138 0600-1.0R | 13107 | 6 | 6 | 58 | 13 | 1.00 |
| 138 0600-1.5R | 13108 | 6 | 6 | 58 | 13 | 1.50 |
| 138 0600-2.0R | 13109 | 6 | 6 | 58 | 13 | 2.00 |
| 138 0800-0.5R | 13110 | 8 | 8 | 64 | 19 | 0.50 |
| 138 0800-1.0R | 13111 | 8 | 8 | 64 | 19 | 1.00 |
| 138 0800-1.5R | 13112 | 8 | 8 | 64 | 19 | 1.50 |
| 138 0800-2.0R | 13113 | 8 | 8 | 64 | 19 | 2.00 |
| 138 0800-3.0R | 13114 | 8 | 8 | 64 | 19 | 3.00 |
| 138 1000-0.5R | 13115 | 10 | 10 | 70 | 22 | 0.50 |
| 138 1000-1.0R | 13116 | 10 | 10 | 70 | 22 | 1.00 |
| 138 1000-1.5R | 13117 | 10 | 10 | 70 | 22 | 1.50 |
| 138 1000-2.0R | 13118 | 10 | 10 | 70 | 22 | 2.00 |
| 138 1000-3.0R | 13119 | 10 | 10 | 70 | 22 | 3.00 |
| 138 1200-0.5R | 13120 | 12 | 12 | 84 | 26 | 0.50 |
| 138 1200-1.0R | 13121 | 12 | 12 | 84 | 26 | 1.00 |
| 138 1200-1.5R | 13122 | 12 | 12 | 84 | 26 | 1.50 |
| 138 1200-2.0R | 13123 | 12 | 12 | 84 | 26 | 2.00 |
| 138 1200-3.0R | 13124 | 12 | 12 | 84 | 26 | 3.00 |
| 138 1200-4.0R | 13125 | 12 | 12 | 84 | 26 | 4.00 |
| 138 1200-5.0R | 13126 | 12 | 12 | 84 | 26 | 5.00 |
| 138 1600-0.5R | 13127 | 16 | 16 | 89 | 32 | 0.50 |
| 138 1600-1.0R | 13128 | 16 | 16 | 89 | 32 | 1.00 |
| 138 1600-1.5R | 13129 | 16 | 16 | 89 | 32 | 1.50 |
| 138 1600-2.0R | 13130 | 16 | 16 | 89 | 32 | 2.00 |
| 138 1600-3.0R | 13131 | 16 | 16 | 89 | 32 | 3.00 |
| 138 1600-4.0R | 13132 | 16 | 16 | 89 | 32 | 4.00 |
| 138 1600-5.0R | 13133 | 16 | 16 | 89 | 32 | 5.00 |
| 138 2000-0.5R | 13134 | 20 | 20 | 102 | 38 | 0.50 |
| 138 2000-1.0R | 13135 | 20 | 20 | 102 | 38 | 1.00 |
| 138 2000-1.5R | 13136 | 20 | 20 | 102 | 38 | 1.50 |
| 138 2000-2.0R | 13137 | 20 | 20 | 102 | 38 | 2.00 |
| 138 2000-3.0R | 13138 | 20 | 20 | 102 | 38 | 3.00 |
| 138 2000-4.0R | 13139 | 20 | 20 | 102 | 38 | 4.00 |
| 138 2000-5.0R | 13140 | 20 | 20 | 102 | 38 | 5.00 |

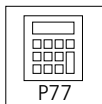


Available with Fordlube upon request.

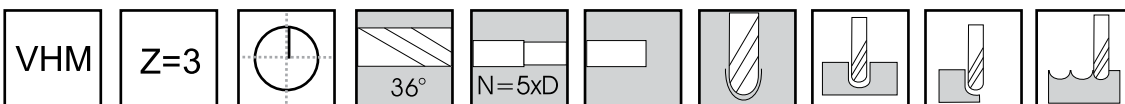
TuffCut® X-AL Series 138B



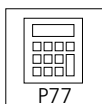
| Tool No. | EDP | D1 Tol h10 | D2 | L1 | L2 |
|-----------|-------|------------|----|----|----|
| 138B 0300 | 13356 | 3 | 3 | 38 | 12 |
| 138B 0400 | 13358 | 4 | 4 | 51 | 15 |
| 138B 0500 | 13360 | 5 | 5 | 64 | 20 |
| 138B 0600 | 13362 | 6 | 6 | 64 | 20 |
| 138B 0800 | 13364 | 8 | 8 | 64 | 20 |
| 138B 1000 | 13366 | 10 | 10 | 70 | 25 |
| 138B 1200 | 13368 | 12 | 12 | 76 | 25 |
| 138B 1600 | 13370 | 16 | 16 | 89 | 35 |



TuffCut® X-AL Series 138B-N5



| Tool No. | EDP | D1 Tol h10 | D2 | L1 | L2 | L3 |
|-------------|-------|------------|----|-----|----|----|
| 138B 0200N5 | 13372 | 2 | 6 | 75 | 4 | 12 |
| 138B 0300N5 | 13374 | 3 | 6 | 75 | 5 | 17 |
| 138B 0400N5 | 13376 | 4 | 6 | 75 | 6 | 22 |
| 138B 0500N5 | 13378 | 5 | 6 | 75 | 7 | 27 |
| 138B 0600N5 | 13380 | 6 | 6 | 110 | 8 | 32 |
| 138B 0800N5 | 13382 | 8 | 8 | 110 | 10 | 42 |
| 138B 1000N5 | 13384 | 10 | 10 | 110 | 12 | 52 |
| 138B 1200N5 | 13386 | 12 | 12 | 120 | 16 | 62 |
| 138B 1600N5 | 13388 | 16 | 16 | 130 | 20 | 82 |



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TuffCut[®] DM

Features & Benefits










Features

- Series 156 - New additions to our ballnose endmill range.
- Improved ballnose radius tolerance (± 0.005)
- New & Improved Series 157 Multi Flute Endmills
- Series 158 - Brand new range of four flute necked endmill with corner radius.
- New coating technology with ALtima[®] 52

Benefits

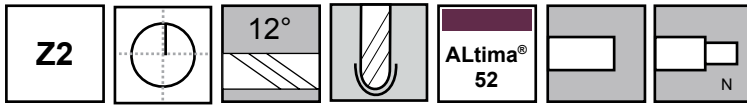
- Offering greater application solutions for the Die/Mould industry.
- For precision finishing applications.
- Allows for high feed machining of hardened steels.
- Extended range offering for high feed milling of pre-hardened and hardened tool steels.
- Allows for machining pre-hardened and hardened steels up to 65HRc

Contents Vue d'Ensemble

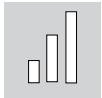
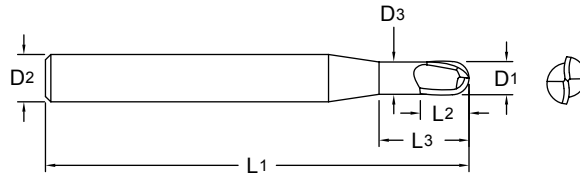
| | Series | Lengths | Diameter Range | Application Area | Page |
|--|--------|--|----------------|--|------|
|  | 156 |  | 0.5 - 12mm |  | 30 |
|  | 157 |  | 3.0 - 16mm |  | 33 |
|  | 158 |  | 3.0 - 20mm |  | 34 |
| Technical Information | | | | | 69 |



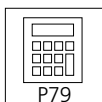
TuffCut® DM Series 156



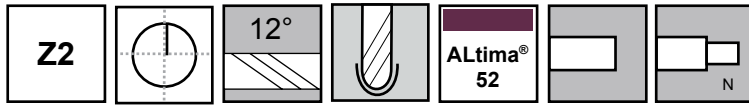
Available
March
2011



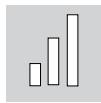
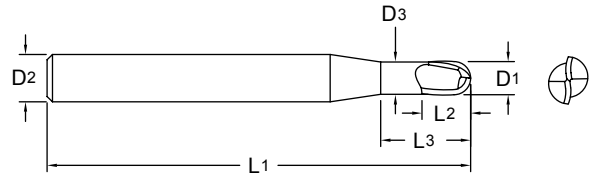
| Tool No. | EDP | D1 +0.0/-0.015 | R +0.005/ -0.005 | D2 (h5) | D3 | L1 | L2 | L3 |
|--------------|-------|-------------------|---------------------|---------|------|----|------|----|
| 156 0050N1A | 15400 | 0.5 | 0.25 | 4 | 0.47 | 50 | 0.35 | 1 |
| 156 0050N2A | 15401 | 0.5 | 0.25 | 4 | 0.47 | 50 | 0.35 | 2 |
| 156 0050N3A | 15402 | 0.5 | 0.25 | 4 | 0.47 | 50 | 0.35 | 3 |
| 156 0050N4A | 15403 | 0.5 | 0.25 | 4 | 0.47 | 50 | 0.35 | 4 |
| 156 0050N5A | 15404 | 0.5 | 0.25 | 4 | 0.47 | 50 | 0.35 | 5 |
| 156 0050N6A | 15406 | 0.5 | 0.25 | 4 | 0.47 | 50 | 0.35 | 6 |
| 156 0060N2A | 15409 | 0.6 | 0.3 | 4 | 0.57 | 50 | 0.4 | 2 |
| 156 0060N4A | 15411 | 0.6 | 0.3 | 4 | 0.57 | 50 | 0.4 | 4 |
| 156 0060N6A | 15413 | 0.6 | 0.3 | 4 | 0.57 | 50 | 0.4 | 6 |
| 156 0060N8A | 15415 | 0.6 | 0.3 | 4 | 0.57 | 50 | 0.4 | 8 |
| 156 0060N10A | 15417 | 0.6 | 0.3 | 4 | 0.57 | 50 | 0.4 | 10 |
| 156 0080N2A | 15419 | 0.8 | 0.4 | 4 | 0.77 | 50 | 0.5 | 2 |
| 156 0080N4A | 15420 | 0.8 | 0.4 | 4 | 0.77 | 50 | 0.5 | 4 |
| 156 0080N6A | 15422 | 0.8 | 0.4 | 4 | 0.77 | 50 | 0.5 | 6 |
| 156 0080N8A | 15423 | 0.8 | 0.4 | 4 | 0.77 | 50 | 0.5 | 8 |
| 156 0080N10A | 15424 | 0.8 | 0.4 | 4 | 0.77 | 50 | 0.5 | 10 |
| 156 0100N2A | 15425 | 1.0 | 0.5 | 4 | 0.96 | 50 | 0.8 | 2 |
| 156 0100N3A | 15426 | 1.0 | 0.5 | 4 | 0.96 | 50 | 0.8 | 3 |
| 156 0100N4A | 15427 | 1.0 | 0.5 | 4 | 0.96 | 50 | 0.8 | 4 |
| 156 0100N6A | 15429 | 1.0 | 0.5 | 4 | 0.96 | 50 | 0.8 | 6 |
| 156 0100N10A | 15431 | 1.0 | 0.5 | 4 | 0.96 | 50 | 0.8 | 10 |
| 156 0100N12A | 15432 | 1.0 | 0.5 | 4 | 0.96 | 63 | 0.8 | 12 |
| 156 0100N14A | 15433 | 1.0 | 0.5 | 4 | 0.96 | 63 | 0.8 | 14 |
| 156 0100N16A | 15434 | 1.0 | 0.5 | 4 | 0.96 | 63 | 0.8 | 16 |
| 156 0100N18A | 15435 | 1.0 | 0.5 | 4 | 0.96 | 63 | 0.8 | 18 |
| 156 0100N20A | 15436 | 1.0 | 0.5 | 4 | 0.96 | 63 | 0.8 | 20 |
| 156 0120N8A | 15437 | 1.2 | 0.6 | 4 | 1.15 | 50 | 1.1 | 8 |
| 156 0120N12A | 15438 | 1.2 | 0.6 | 4 | 1.15 | 63 | 1.1 | 12 |
| 156 0140N8A | 15439 | 1.4 | 0.7 | 4 | 1.34 | 50 | 1.3 | 8 |
| 156 0140N12A | 15440 | 1.4 | 0.7 | 4 | 1.34 | 63 | 1.3 | 12 |
| 156 0140N16A | 15441 | 1.4 | 0.7 | 4 | 1.34 | 63 | 1.3 | 16 |
| 156 0150N4A | 15442 | 1.5 | 0.75 | 4 | 1.44 | 50 | 1.35 | 4 |
| 156 0150N8A | 15444 | 1.5 | 0.75 | 4 | 1.44 | 50 | 1.35 | 8 |
| 156 0150N16A | 15446 | 1.5 | 0.75 | 4 | 1.44 | 63 | 1.35 | 16 |



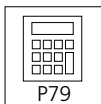
TuffCut[®] DM Series 156



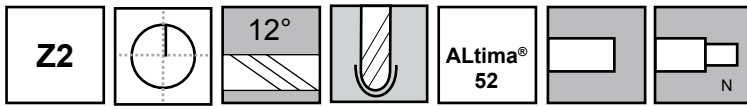
March 2011



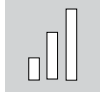
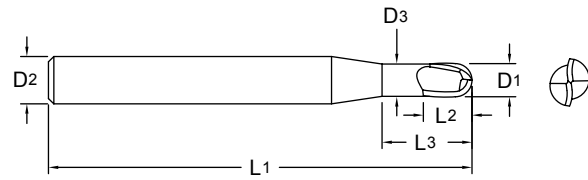
| Tool No. | EDP | D1 +0.0/-0.015 | R +0.005/- .005 | D2 (h5) | D3 | L1 | L2 | L3 |
|--------------|-------|-------------------|--------------------|---------|------|-----|------|----|
| 156 0150N20A | 15447 | 1.5 | 0.75 | 4 | 1.44 | 63 | 1.35 | 20 |
| 156 0160N8A | 15448 | 1.6 | 0.8 | 4 | 1.54 | 50 | 1.4 | 8 |
| 156 0160N12A | 15449 | 1.6 | 0.8 | 4 | 1.54 | 63 | 1.4 | 12 |
| 156 0160N16A | 15450 | 1.6 | 0.8 | 4 | 1.54 | 63 | 1.4 | 16 |
| 156 0160N20A | 15451 | 1.6 | 0.8 | 4 | 1.54 | 63 | 1.4 | 20 |
| 156 0180N8A | 15452 | 1.8 | 0.9 | 4 | 1.73 | 50 | 1.6 | 8 |
| 156 0180N12A | 15453 | 1.8 | 0.9 | 4 | 1.73 | 63 | 1.6 | 12 |
| 156 0180N16A | 15454 | 1.8 | 0.9 | 4 | 1.73 | 63 | 1.6 | 16 |
| 156 0180N20A | 15455 | 1.8 | 0.9 | 4 | 1.73 | 63 | 1.6 | 20 |
| 156 0200N3A | 15456 | 2.0 | 1.0 | 4 | 1.92 | 50 | 1.7 | 3 |
| 156 0200N4A | 15457 | 2.0 | 1.0 | 4 | 1.92 | 50 | 1.7 | 4 |
| 156 0200N6A | 15458 | 2.0 | 1.0 | 4 | 1.92 | 50 | 1.7 | 6 |
| 156 0200N8A | 15459 | 2.0 | 1.0 | 4 | 1.92 | 50 | 1.7 | 8 |
| 156 0200N10A | 15460 | 2.0 | 1.0 | 4 | 1.92 | 50 | 1.7 | 10 |
| 156 0200N12A | 15461 | 2.0 | 1.0 | 4 | 1.92 | 63 | 1.7 | 12 |
| 156 0200N16A | 15463 | 2.0 | 1.0 | 4 | 1.92 | 63 | 1.7 | 16 |
| 156 0200N20A | 15465 | 2.0 | 1.0 | 4 | 1.92 | 63 | 1.7 | 20 |
| 156 0200N25A | 15467 | 2.0 | 1.0 | 4 | 1.92 | 80 | 1.7 | 25 |
| 156 0200N30A | 15468 | 2.0 | 1.0 | 4 | 1.92 | 80 | 1.7 | 30 |
| 156 0200N35A | 15469 | 2.0 | 1.0 | 4 | 1.92 | 80 | 1.7 | 35 |
| 156 0200N40A | 15470 | 2.0 | 1.0 | 4 | 1.92 | 80 | 1.7 | 40 |
| 156 0300N8A | 15471 | 3.0 | 1.5 | 6 | 2.88 | 75 | 2.5 | 8 |
| 156 0300N10A | 15472 | 3.0 | 1.5 | 6 | 2.88 | 75 | 2.5 | 10 |
| 156 0300N16A | 15474 | 3.0 | 1.5 | 6 | 2.88 | 75 | 2.5 | 16 |
| 156 0300N25A | 15476 | 3.0 | 1.5 | 6 | 2.88 | 75 | 2.5 | 25 |
| 156 0300N30A | 15477 | 3.0 | 1.5 | 6 | 2.88 | 75 | 2.5 | 30 |
| 156 0300N35A | 15478 | 3.0 | 1.5 | 6 | 2.88 | 75 | 2.5 | 35 |
| 156 0400N10A | 15480 | 4.0 | 2.0 | 6 | 3.9 | 75 | 3 | 10 |
| 156 0400N16A | 15482 | 4.0 | 2.0 | 6 | 3.9 | 75 | 3 | 16 |
| 156 0400N25A | 15484 | 4.0 | 2.0 | 6 | 3.9 | 75 | 3 | 25 |
| 156 0400N35A | 15486 | 4.0 | 2.0 | 6 | 3.9 | 75 | 3 | 35 |
| 156 0400N40A | 15487 | 4.0 | 2.0 | 6 | 3.9 | 75 | 3 | 40 |
| 156 0400N50A | 15489 | 4.0 | 2.0 | 6 | 3.9 | 100 | 3 | 50 |
| 156 0500N25A | 15490 | 5.0 | 2.5 | 6 | 4.9 | 75 | 3.5 | 25 |



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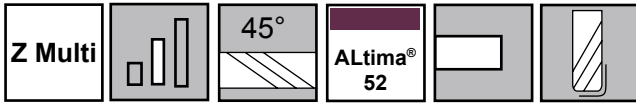
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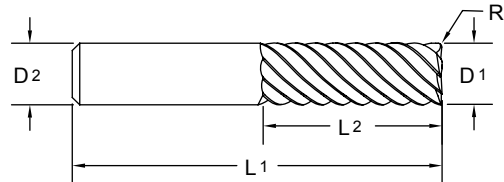
| Tool No. | EDP | D1 +0.0/-0.015 | R +0.005/- .005 | D2 (h5) | D3 | L1 | L2 | L3 |
|--------------|-------|-------------------|--------------------|---------|------|-----|-----|----|
| 156 0500N40A | 15493 | 5.0 | 2.5 | 6 | 4.9 | 75 | 3.5 | 40 |
| 156 0600N30A | 15494 | 6.0 | 3.0 | 6 | 5.9 | 75 | 4.5 | 30 |
| 156 0600N50A | 15495 | 6.0 | 3.0 | 6 | 5.9 | 100 | 4.5 | 50 |
| 156 0800N30A | 15666 | 8.0 | 4.0 | 8 | 7.9 | 102 | 5.5 | 30 |
| 156 0800N50A | 15667 | 8.0 | 4.0 | 8 | 7.9 | 102 | 5.5 | 50 |
| 156 0100N30A | 15670 | 10.0 | 5.0 | 10 | 9.9 | 102 | 6.5 | 30 |
| 156 0100N50A | 15671 | 10.0 | 5.0 | 10 | 9.9 | 102 | 6.5 | 50 |
| 156 0120N30A | 15672 | 12.0 | 6.0 | 12 | 11.9 | 102 | 7.5 | 30 |
| 156 0120N50A | 15673 | 12.0 | 6.0 | 12 | 11.9 | 102 | 7.5 | 50 |



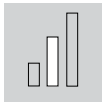
TuffCut® DM Series 157



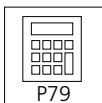
Available
March
2011



Non-Center
Cutting



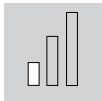
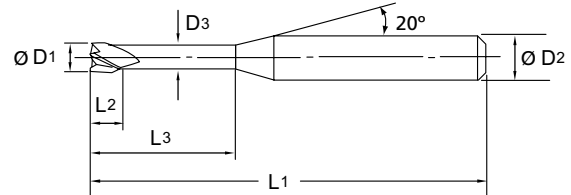
| Tool No. | EDP | D1 | D2 | L1 | L2 | Z | R |
|-----------------|-------|----|----|-----|----|---|------|
| 157 0300A | 15700 | 3 | 6 | 76 | 9 | 4 | - |
| 157 0300-0.50RA | 15701 | 3 | 6 | 76 | 9 | 4 | 0.50 |
| 157 0400A | 15708 | 4 | 6 | 76 | 12 | 4 | - |
| 157 0400-0.50RA | 15709 | 4 | 6 | 76 | 12 | 4 | 0.50 |
| 157 0500A | 15715 | 5 | 6 | 90 | 15 | 4 | - |
| 157 0500-0.50RA | 15716 | 5 | 6 | 90 | 15 | 4 | 0.50 |
| 157 0600A | 15719 | 6 | 6 | 90 | 15 | 6 | - |
| 157 0600-0.50RA | 15720 | 6 | 6 | 90 | 15 | 6 | 0.50 |
| 157 0600-1.00RA | 15722 | 6 | 6 | 90 | 15 | 6 | 1.00 |
| 157 0800A | 15733 | 8 | 8 | 100 | 20 | 6 | - |
| 157 0800-0.50RA | 15734 | 8 | 8 | 100 | 20 | 6 | 0.50 |
| 157 0800-1.00RA | 15736 | 8 | 8 | 100 | 20 | 6 | 1.00 |
| 157 0800-2.00RA | - | 8 | 8 | 100 | 20 | 6 | 2.00 |
| 157 1000A | 15743 | 10 | 10 | 100 | 25 | 6 | - |
| 157 1000-0.50RA | 15744 | 10 | 10 | 100 | 25 | 6 | 0.50 |
| 157 1000-1.00RA | 15746 | 10 | 10 | 100 | 25 | 6 | 1.00 |
| 157 1000-1.50RA | 15747 | 10 | 10 | 100 | 25 | 6 | 1.50 |
| 157 1000-2.00RA | - | 10 | 10 | 100 | 25 | 6 | 2.00 |
| 157 1200A | 15748 | 12 | 12 | 100 | 30 | 6 | - |
| 157 1200-0.50RA | 15749 | 12 | 12 | 100 | 30 | 6 | 0.50 |
| 157 1200-1.00RA | 15751 | 12 | 12 | 100 | 30 | 6 | 1.00 |
| 157 1200-1.50RA | 15752 | 12 | 12 | 100 | 30 | 6 | 1.50 |
| 157 1200-2.00RA | 15753 | 12 | 12 | 100 | 30 | 6 | 2.00 |
| 157 1200-3.00RA | - | 12 | 12 | 100 | 30 | 6 | 3.00 |
| 157 1600A | 15767 | 16 | 16 | 150 | 40 | 6 | - |
| 157 1600-0.50RA | 15768 | 16 | 16 | 150 | 40 | 6 | 0.50 |
| 157 1600-1.00RA | 15770 | 16 | 16 | 150 | 40 | 6 | 1.00 |
| 157 1600-1.50RA | 15771 | 16 | 16 | 150 | 40 | 6 | 1.50 |
| 157 1600-2.00RA | 15772 | 16 | 16 | 150 | 40 | 6 | 2.00 |
| 157 1600-3.00RA | 15774 | 16 | 16 | 150 | 40 | 6 | 3.00 |



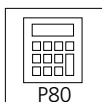
TuffCut® DM Series 158









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2011



| Metric No. | EDP | D1 (+0/-0.02) | D2 (h6) | D3 | L1 | L2 | L3 | L3/D1 | R (+0.02/-0.02) |
|----------------|-------|------------------|------------|------|-----|----|-----|-------|--------------------|
| 158 03N3-0.3RB | 15526 | 3 | 6 | 2.9 | 50 | 5 | 9 | 3 x D | 0.3 |
| 158 03N4-0.3RB | - | 3 | 6 | 2.9 | 50 | 5 | 12 | 4 x D | 0.3 |
| 158 03N5-0.3RB | 15528 | 3 | 6 | 2.9 | 50 | 5 | 15 | 5 x D | 0.3 |
| 158 03N4-0.8RB | - | 3 | 6 | 2.9 | 50 | 5 | 12 | 4 x D | 0.8 |
| 158 03N5-0.8RB | 15530 | 3 | 6 | 2.9 | 50 | 5 | 15 | 5 x D | 0.8 |
| 158 06N3-0.3RB | 15536 | 6 | 6 | 5.8 | 100 | 9 | 18 | 3 x D | 0.3 |
| 158 06N4-0.3RB | - | 6 | 6 | 5.8 | 100 | 9 | 24 | 4 x D | 0.3 |
| 158 06N5-0.3RB | 15538 | 6 | 6 | 5.8 | 100 | 9 | 30 | 5 x D | 0.3 |
| 158 06N4-1.5RB | - | 6 | 6 | 5.8 | 100 | 9 | 24 | 4 x D | 1.5 |
| 158 06N5-1.5RB | 15540 | 6 | 6 | 5.8 | 100 | 9 | 30 | 5 x D | 1.5 |
| 158 08N3-0.3RB | 15546 | 8 | 8 | 7.6 | 100 | 12 | 24 | 3 x D | 0.3 |
| 158 08N4-0.3RB | - | 8 | 8 | 7.6 | 100 | 12 | 32 | 4 x D | 0.3 |
| 158 08N5-0.3RB | 15548 | 8 | 8 | 7.6 | 100 | 12 | 40 | 5 x D | 0.3 |
| 158 08N4-2.0RB | - | 8 | 8 | 7.6 | 100 | 12 | 32 | 4 x D | 2.0 |
| 158 08N5-2.0RB | 15550 | 8 | 38 | 7.6 | 100 | 12 | 40 | 5 x D | 2.0 |
| 158 10N3-0.3RB | 15556 | 10 | 10 | 9.6 | 100 | 15 | 30 | 3 x D | 0.3 |
| 158 10N4-0.3RB | - | 10 | 10 | 9.6 | 100 | 15 | 40 | 4 x D | 0.3 |
| 158 10N5-0.3RB | 15558 | 10 | 10 | 9.6 | 100 | 15 | 50 | 5 x D | 0.3 |
| 158 10N4-2.0RB | - | 10 | 10 | 9.6 | 100 | 15 | 40 | 4 x D | 2.0 |
| 158 10N5-2.0RB | 15560 | 10 | 10 | 9.6 | 100 | 15 | 50 | 5 x D | 2.0 |
| 158 12N3-0.3RB | 15566 | 12 | 12 | 11.4 | 100 | 18 | 36 | 3 x D | 0.3 |
| 158 12N4-0.3RB | - | 12 | 12 | 11.4 | 100 | 18 | 48 | 4 x D | 0.3 |
| 158 12N5-0.3RB | 15568 | 12 | 12 | 11.4 | 130 | 18 | 60 | 5 x D | 0.3 |
| 158 12N4-2.0RB | - | 12 | 12 | 11.4 | 100 | 18 | 48 | 4 x D | 2.0 |
| 158 12N5-2.0RB | 15570 | 12 | 12 | 11.4 | 130 | 18 | 60 | 5 x D | 2.0 |
| 158 16N3-0.3RB | 15576 | 16 | 16 | 15.2 | 130 | 24 | 48 | 3 x D | 0.3 |
| 158 16N4-0.3RB | - | 16 | 16 | 15.2 | 130 | 24 | 64 | 4 x D | 0.3 |
| 158 16N5-0.3RB | 15578 | 16 | 16 | 15.2 | 150 | 24 | 80 | 5 x D | 0.3 |
| 158 16N4-3.0RB | - | 16 | 16 | 15.2 | 130 | 24 | 64 | 4 x D | 3.0 |
| 158 16N5-3.0RB | 15580 | 16 | 16 | 15.2 | 150 | 24 | 80 | 5 x D | 3.0 |
| 158 20N4-0.3RB | - | 20 | 20 | 19.2 | 150 | 30 | 80 | 4 x D | 0.3 |
| 158 20N5-0.3RB | 15584 | 20 | 20 | 19.2 | 150 | 30 | 100 | 5 x D | 0.3 |
| 158 20N4-3.0RB | - | 20 | 20 | 19.2 | 150 | 30 | 80 | 4 x D | 3.0 |
| 158 20N5-3.0RB | 15586 | 20 | 20 | 19.2 | 150 | 30 | 100 | 5 x D | 3.0 |



Material cross reference chart

| |  |  |  |  |  |  | |
|-------------|---|---|---|--|---|---|-------------------|
| | UK | German DIN | French | Swedish | Spanish | USA | |
| TOOL STEELS | | 1.1525 | C80W1 | Y190;Y180 | | | W108 |
| | | 1.1545 | C105W1 | Y1105 | 1880 | | W110 |
| | BW1B | 1.1625 | C80W2 | | | F.1507 C80 | W1 |
| | | 1.1663 | C125W | Y2120 | | F.5123 C120 | W112 |
| | BW1A | 1.175 | C75W | | | | W1 |
| | BL3 | 1.2067 | 100Cr6 | Y100C6 | | F.5230 100 Cr6 | L3 |
| | | 1.221 | 115CrV3 | | | | L2 |
| | BO1 | 1.251 | 100MnCrW4 | | 2140 | F.5220 95 MnCrW5 | O1 |
| | BS1 | 1.2542 | 45WCrV7 | | 2710 | F.5241 45 WCrSi 8 | S1 |
| | BW2 | 1.2833 | 100V1 | Y1105V | | | W210 |
| | BO2 | 1.2842 | 90MnCrV8 | 90MV8 | | | 2 |
| | 534A99 | 1.3505 | 100Cr6 | 100C6 | 2258 | F.1310 - 100 Cr 6 | S2100 |
| | | 1.2713 | 55NiCrMoV6 | 55NCDV7 | | F.528 | L6 |
| | Grade2A | 0.962 | G-X260NiCr42 | | | | A532IBNiCr-LC |
| | Grade2B | 0.9625 | G-X330NiCr42 | | | | A532IANiCr-HC |
| | Grade2C;D;E | 0.963 | G-X300CrNiSi952 | | | | A532IDNi-HiCr |
| | Grade3A;B | 0.964 | G-X300CrMoNi1521 | | | | |
| | Grade3C | 0.9645 | G-X260CrMoNi2021 | | | | A532IID20%CrMo-LC |
| | Grade3D | 0.965 | G-X260Cr27 | | | | A532IIIA25%Cr |
| | Grade3E | 0.9655 | G-X300CrMo271 | | | | A532IIIA25%Cr |
| | BD3 | 1.208 | X210Cr12 | Z200C12 | | F.5212 X210 Cr12 | D3 |
| | BH11 | 1.2343 | X38CrMoV51 | Z38CDV5 | | F.5317 X37 CrMoV5 | H11 |
| | BH13 | 1.2344 | X40CrMoV51 | Z40CDV5 | 2242 | F.5318 X40 CrMoV5 | H13 |
| | BA2 | 1.2363 | X100CrMoV51 | Z100CDV5 | 2260 | F.5227 X100 CrMoV5 | A2 |
| | BH10 | 1.2365 | X32CrMoV33 | 32DCV28 | | F.5313 CrMoV 12 | H10 |
| | BD2 | 1.2379 | X155CrVMo121 | Z160CDV12 | | | D2 |
| | | 1.2436 | X210CrW12 | | 2312 | F.5213 X210 CrW12 | |
| | | 1.2567 | X30WCrV53 | Z32WCV5 | | | |
| | BH21 | 1.2581 | X30WCrV93 | Z30WCV9 | | F.5323 X30 WCrV9 | H21 |
| | | 1.2601 | X165CrMoV12 | | 2310 | F.5211 X160 CrMoV12 | |
| | BH12 | 1.2606 | X37CrMoV51 | Z35CWDV5 | | | H12 |
| | BT15 | 1.3202 | S12-1-4-5 | | | F.5563 12-1-5-5 | T15 |
| | | 1.3207 | S10-4-3-10 | Z130WKCDV10-10-04-03 | | F.553 10-4-3-10 | |
| | | 1.3243 | S6-5-2-5 | Z85WDCV06-05-05-04-02 | 2723 | F.5613 6-5-2-5 | |
| | | 1.3246 | S7-4-2-5 | Z110WKCDV07-05-04-04-02 | | F.5613 6-5-2-5 | M41 |
| | BT42 | 1.3247 | S2-10-1-8 | Z110DKCWW09-08-04-02-01 | | F.5615 7-4-2-5 | M42 |
| | BM34 | 1.3249 | S2-9-2-8 | | | F.5611 2-9-2-8 | M33/M34 |
| | BT4 | 1.3255 | S18-1-2-5 | Z80WKCV18-05-04-01 | | F.5530 18-1-1-5 | T4 |
| | BT5 | 1.3265 | S18-1-2-10 | | | F.5540 18-0-2-10 | T5 |
| | | 1.3342 | SC6-5-2 | Z90WDCV06-05-04-03 | | | M3 |
| | BM2 | 1.3343 | S6-5-2 | Z85WDCV06-05-04-02 | 2722 | F.5603 6-5-2 | M2 |
| | | 1.3344 | S6-5-3 | Z130WDCV06-05-04-04 | | F.5605 6-5-3 | M3Class2 |
| | BM1 | 1.3346 | S2-9-1 | Z85DCVW08-04-02-01 | | | H41/M1 |
| | | 1.3348 | S2-9-2 | Z100DCVW09-04-02-02 | 2782 | F.5607 2-9-2 | M7 |
| | BT1 | 1.3355 | S18-0-1 | Z80WCV18-04-01 | | F.5520 18-0-1 | T1 |
| | | 1.3401 | X120Mn12 | Z120M12 / Z120Mn12 | | F.82551-AM-X 120 Mn 12 | A128(A) |

TuffCut XR - XT

TuffCut X-AL

TuffCut Die & Mold

Twister Drills

Technical Section

Twister Drills



*Xtreme High Performance Drilling
with
Xtended tool life in a broad range of materials*

Features

- Advanced "Active Cut" Geometric Design
- Refined Critical Cut Zone Characteristics
- High-Efficiency Flute Profile
- "State-of-the-Art" Proprietary Coating
- Stable Low-Thrust Point Form
- Coolant-Fed or Solid
- Diameter Range - .5mm to 20.0mm
- Stub (3x), Regular (5x), Long Flute Lengths (7x+) (12x-25x) and Micro (10x)
- Engineered & Produced in the USA

Benefits

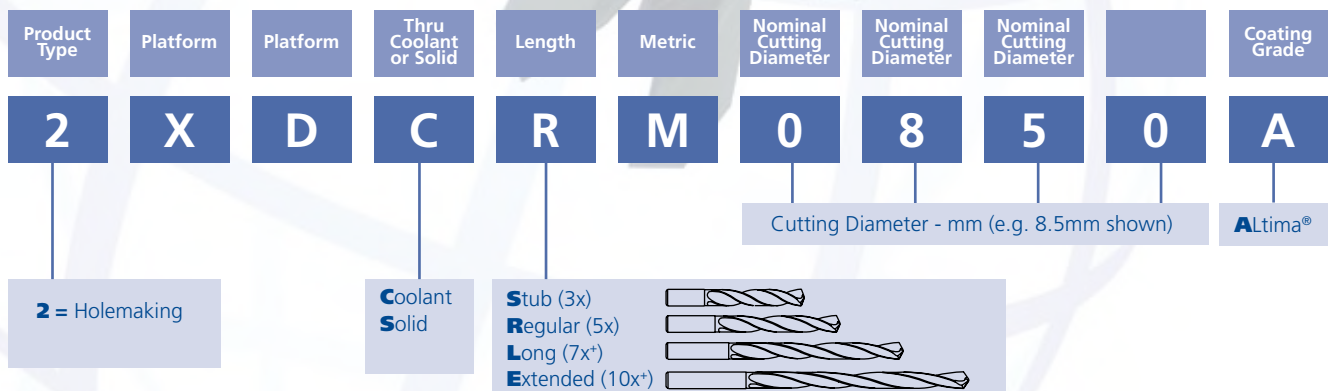
- Extended Tool Life
- Elevated Metal Removal Rates (MRR)
- Lower Cost Per Hole
- Improved Hole/Part Quality
- Increased Tool Reliability
- Factory Trained Network of Application & Technical Specialists
- Factory Reconditioning Service
- Ideal Platform for Modification or an Engineered "Special" Tool
- Compatibility to a Wide Range of Standard Toolholder Systems

Tolerances

| Drill Dia. (h7) | Tolerance |
|-----------------|-----------|
| 0 - 3.0 | +0/-.010 |
| 3.01 - 6.0 | +0/-.012 |
| 6.01 - 10.0 | +0/-.015 |
| 10.01 - 18.0 | +0/-.018 |
| 18.01 - 30.0 | +0/-.021 |

| Shank Dia. (h6) | Tolerance |
|-----------------|-----------|
| 0 - 3.0 | +0/-.006 |
| 3.01 - 6.0 | +0/-.008 |
| 6.01 - 10.0 | +0/-.009 |
| 10.01 - 18.0 | +0/-.011 |
| 18.01 - 30.0 | +0/-.013 |

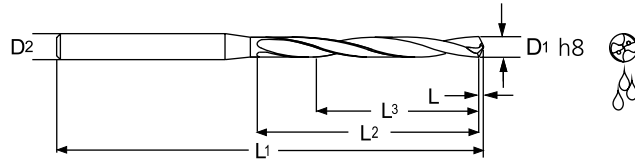
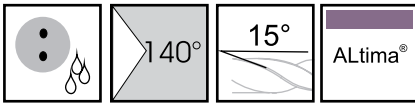
New easy read numbering system



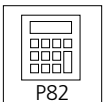
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|   | 2MDCSM | 3X  | 3.0 - 16.0 |  | 42 |
|   | 2XD SRM | 5X  | 0.5 - 16.0 |  | 45 |
|   | 2XD CRM | 5X  | 3.0 - 20.0 |  | 48 |
|   | 2XDCLM | 7X+  | 3.0 - 12.0 |  | 51 |
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|   | 200A | 3X  | 3.0 - 20.0 |  | 57 |
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Twister® MD 2MDCLM



| Metric No. | EDP | D1 (Tol h8) | D2 | L1 | L2 | L3 | L4 |
|-------------|-------|-------------|----|----|----|------|------|
| 2MDCLM0200A | 04198 | 2.00 | 3 | 68 | 24 | 18 | 0.31 |
| 2MDCLM0205A | 04200 | 2.05 | 3 | 74 | 28 | 21 | 0.32 |
| 2MDCLM0210A | 04202 | 2.10 | 3 | 74 | 28 | 21 | 0.33 |
| 2MDCLM0215A | 04204 | 2.15 | 3 | 74 | 28 | 21 | 0.33 |
| 2MDCLM0220A | 04206 | 2.20 | 3 | 74 | 28 | 21 | 0.34 |
| 2MDCLM0225A | 04208 | 2.25 | 3 | 74 | 28 | 21 | 0.35 |
| 2MDCLM0230A | 04210 | 2.30 | 3 | 74 | 28 | 21 | 0.36 |
| 2MDCLM0235A | 04212 | 2.35 | 3 | 74 | 28 | 21 | 0.36 |
| 2MDCLM0240A | 04214 | 2.40 | 3 | 74 | 28 | 21 | 0.37 |
| 2MDCLM0245A | 04216 | 2.45 | 3 | 74 | 28 | 21 | 0.38 |
| 2MDCLM0250A | 04218 | 2.50 | 3 | 74 | 28 | 21 | 0.39 |
| 2MDCLM0255A | 04220 | 2.55 | 3 | 81 | 34 | 25.5 | 0.4 |
| 2MDCLM0260A | 04222 | 2.60 | 3 | 81 | 34 | 25.5 | 0.4 |
| 2MDCLM0265A | 04224 | 2.65 | 3 | 81 | 34 | 25.5 | 0.41 |
| 2MDCLM0270A | 04226 | 2.70 | 3 | 81 | 34 | 25.5 | 0.42 |
| 2MDCLM0275A | 04228 | 2.75 | 3 | 81 | 34 | 25.5 | 0.43 |
| 2MDCLM0280A | 04230 | 2.80 | 3 | 81 | 34 | 25.5 | 0.43 |
| 2MDCLM0285A | 04232 | 2.85 | 3 | 81 | 34 | 25.5 | 0.44 |
| 2MDCLM0290A | 04234 | 2.90 | 3 | 81 | 34 | 25.5 | 0.45 |
| 2MDCLM0295A | 04236 | 2.95 | 3 | 81 | 34 | 25.5 | 0.46 |



Tolerances

| Drill Dia. (h8) | Tolerance |
|-----------------|-----------|
| 2.0 - 2.95 | +0/-0.014 |

| Shank Dia. (h6) | Tolerance |
|-----------------|-----------|
| 3.0 | +0/-0.006 |

Machine Requirements

High Pressure Pump System (1000 psi)
Coolant filtration of 10 microns or better
Machine runout of .0004" (.01mm) Max.

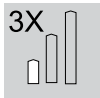
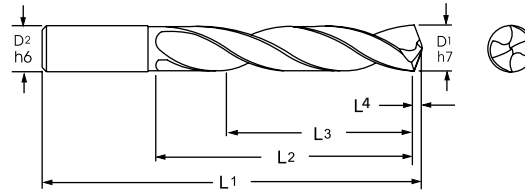
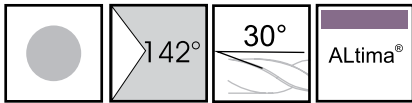
Estimated Peck Depths

For hole depths up to 6x diameter No pecks
For hole depths up to 10x diameter 0-2 pecks
For hole depths up to 15x diameter 2-4 pecks

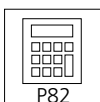
M.A. Ford® recommends full retraction of the body of the drill from the hole during the peck cycle. It is recommended to leave the drill point within the hole.

For hole depths deeper than 4x the diameter, M.A. Ford® recommends using a "soft start" program that drills to .5x diameter deep at 2/3 of the speed and feed.

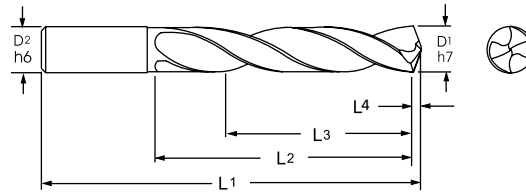
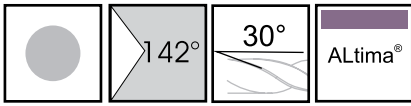
Twister Xtreme Drilling® 2XDSSM



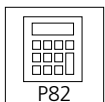
| Metric No. | EDP | D1 (Tol h7) | D2 (h6) | L1 | L2 | L3 | L4 |
|-------------|-------|-------------|---------|----|----|----|------|
| 2XDSSM0250A | 22601 | 2.5 | 2.5 | 43 | 14 | 11 | 0.39 |
| 2XDSSM0290A | 22602 | 2.9 | 2.9 | 46 | 16 | 12 | 0.45 |
| 2XDSSM0300A | 02100 | 3.0 | 3.0 | 57 | 16 | 13 | 0.46 |
| 2XDSSM0310A | 02103 | 3.1 | 4.0 | 63 | 22 | 18 | 0.48 |
| 2XDSSM0320A | 02106 | 3.2 | 4.0 | 63 | 22 | 18 | 0.50 |
| 2XDSSM0330A | 02110 | 3.3 | 4.0 | 63 | 22 | 18 | 0.51 |
| 2XDSSM0340A | 02112 | 3.4 | 4.0 | 63 | 22 | 18 | 0.53 |
| 2XDSSM0350A | 02116 | 3.5 | 4.0 | 63 | 22 | 18 | 0.54 |
| 2XDSSM0360A | 02119 | 3.6 | 4.0 | 63 | 22 | 18 | 0.56 |
| 2XDSSM0370A | 02120 | 3.7 | 4.0 | 63 | 22 | 18 | 0.57 |
| 2XDSSM0380A | 02122 | 3.8 | 4.0 | 63 | 22 | 18 | 0.59 |
| 2XDSSM0390A | 02123 | 3.9 | 4.0 | 63 | 22 | 18 | 0.60 |
| 2XDSSM0400A | 02126 | 4.0 | 4.0 | 63 | 22 | 18 | 0.62 |
| 2XDSSM0410A | 04000 | 4.1 | 5.0 | 63 | 26 | 21 | 0.64 |
| 2XDSSM0420A | 02128 | 4.2 | 5.0 | 63 | 26 | 21 | 0.65 |
| 2XDSSM0430A | 02129 | 4.3 | 5.0 | 63 | 26 | 21 | 0.67 |
| 2XDSSM0440A | 02131 | 4.4 | 5.0 | 63 | 26 | 21 | 0.68 |
| 2XDSSM0450A | 02132 | 4.5 | 5.0 | 63 | 26 | 21 | 0.70 |
| 2XDSSM0460A | 02134 | 4.6 | 5.0 | 63 | 26 | 21 | 0.71 |
| 2XDSSM0470A | 02135 | 4.7 | 5.0 | 63 | 26 | 21 | 0.73 |
| 2XDSSM0480A | 02138 | 4.8 | 5.0 | 63 | 26 | 21 | 0.74 |
| 2XDSSM0490A | 02140 | 4.9 | 5.0 | 63 | 26 | 21 | 0.76 |
| 2XDSSM0500A | 02142 | 5.0 | 5.0 | 63 | 26 | 21 | 0.77 |
| 2XDSSM0510A | 02144 | 5.1 | 6.0 | 76 | 30 | 24 | 0.79 |
| 2XDSSM0520A | 02148 | 5.2 | 6.0 | 76 | 30 | 24 | 0.81 |
| 2XDSSM0530A | 02150 | 5.3 | 6.0 | 76 | 30 | 24 | 0.82 |
| 2XDSSM0540A | 02152 | 5.4 | 6.0 | 76 | 30 | 24 | 0.84 |
| 2XDSSM0550A | 02154 | 5.5 | 6.0 | 76 | 30 | 24 | 0.85 |
| 2XDSSM0570A | 02160 | 5.7 | 6.0 | 76 | 30 | 24 | 0.88 |
| 2XDSSM0580A | 02162 | 5.8 | 6.0 | 76 | 30 | 24 | 0.90 |
| 2XDSSM0590A | 02164 | 5.9 | 6.0 | 76 | 30 | 24 | 0.91 |
| 2XDSSM0600A | 02168 | 6.0 | 6.0 | 76 | 30 | 24 | 0.93 |
| 2XDSSM0610A | 02170 | 6.1 | 8.0 | 82 | 35 | 28 | 0.95 |
| 2XDSSM0620A | 02174 | 6.2 | 8.0 | 82 | 35 | 28 | 0.96 |
| 2XDSSM0630A | 02178 | 6.3 | 8.0 | 82 | 35 | 28 | 0.98 |
| 2XDSSM0640A | 02182 | 6.4 | 8.0 | 82 | 35 | 28 | 0.99 |
| 2XDSSM0650A | 02184 | 6.5 | 8.0 | 82 | 35 | 28 | 1.01 |
| 2XDSSM0660A | 02185 | 6.6 | 8.0 | 82 | 35 | 28 | 1.03 |
| 2XDSSM0670A | 02189 | 6.7 | 8.0 | 82 | 35 | 28 | 1.04 |
| 2XDSSM0680A | 02192 | 6.8 | 8.0 | 82 | 35 | 28 | 1.05 |
| 2XDSSM0690A | 02194 | 6.9 | 8.0 | 82 | 35 | 28 | 1.07 |



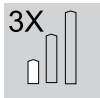
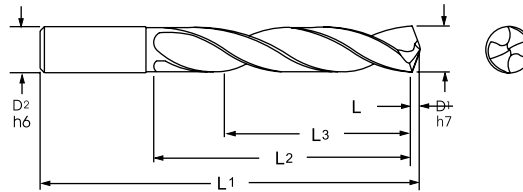
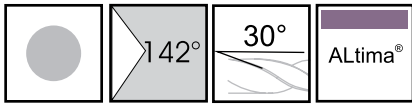
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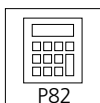
| Metric No. | EDP | D1 (Tol h7) | D2 (h6) | L1 | L2 | L3 | L4 |
|-------------|-------|-------------|---------|-----|----|----|------|
| 2XDSSM0700A | 02196 | 7.0 | 8 | 82 | 35 | 28 | 1.08 |
| 2XDSSM0710A | 02197 | 7.1 | 8 | 82 | 38 | 31 | 1.10 |
| 2XDSSM0720A | 02200 | 7.2 | 8 | 82 | 38 | 31 | 1.12 |
| 2XDSSM0730A | 02201 | 7.3 | 8 | 82 | 38 | 31 | 1.13 |
| 2XDSSM0740A | 02202 | 7.4 | 8 | 82 | 38 | 31 | 1.15 |
| 2XDSSM0750A | 02204 | 7.5 | 8 | 82 | 38 | 31 | 1.16 |
| 2XDSSM0760A | 02208 | 7.6 | 8 | 82 | 38 | 31 | 1.18 |
| 2XDSSM0770A | 02210 | 7.7 | 8 | 82 | 38 | 31 | 1.19 |
| 2XDSSM0780A | 02212 | 7.8 | 8 | 82 | 38 | 31 | 1.21 |
| 2XDSSM0790A | 02213 | 7.9 | 8 | 82 | 38 | 31 | 1.22 |
| 2XDSSM0800A | 02216 | 8.0 | 8 | 82 | 38 | 31 | 1.24 |
| 2XDSSM0810A | 02218 | 8.1 | 10 | 89 | 43 | 35 | 1.26 |
| 2XDSSM0820A | 02220 | 8.2 | 10 | 89 | 43 | 35 | 1.27 |
| 2XDSSM0830A | 02222 | 8.3 | 10 | 89 | 43 | 35 | 1.29 |
| 2XDSSM0840A | 02223 | 8.4 | 10 | 89 | 43 | 35 | 1.31 |
| 2XDSSM0850A | 02226 | 8.5 | 10 | 89 | 43 | 35 | 1.32 |
| 2XDSSM0860A | 02227 | 8.6 | 10 | 89 | 43 | 35 | 1.33 |
| 2XDSSM0870A | 04001 | 8.7 | 10 | 89 | 43 | 35 | 1.35 |
| 2XDSSM0880A | 02230 | 8.8 | 10 | 89 | 43 | 35 | 1.36 |
| 2XDSSM0890A | 02232 | 8.9 | 10 | 89 | 43 | 35 | 1.38 |
| 2XDSSM0900A | 02234 | 9.0 | 10 | 89 | 43 | 35 | 1.39 |
| 2XDSSM0910A | 02235 | 9.1 | 10 | 89 | 43 | 35 | 1.41 |
| 2XDSSM0920A | 02238 | 9.2 | 10 | 89 | 43 | 35 | 1.43 |
| 2XDSSM0925A | 02240 | 9.25 | 10 | 89 | 43 | 35 | 1.43 |
| 2XDSSM0930A | 02242 | 9.3 | 10 | 89 | 43 | 35 | 1.44 |
| 2XDSSM0940A | 02243 | 9.4 | 10 | 89 | 43 | 35 | 1.46 |
| 2XDSSM0950A | 02244 | 9.5 | 10 | 89 | 43 | 35 | 1.47 |
| 2XDSSM0960A | 02247 | 9.6 | 10 | 89 | 43 | 35 | 1.49 |
| 2XDSSM0970A | 02248 | 9.7 | 10 | 89 | 43 | 35 | 1.50 |
| 2XDSSM0980A | 02250 | 9.8 | 10 | 89 | 43 | 35 | 1.52 |
| 2XDSSM0990A | 02251 | 9.9 | 10 | 89 | 43 | 35 | 1.53 |
| 2XDSSM1000A | 02254 | 10.0 | 10 | 89 | 43 | 35 | 1.55 |
| 2XDSSM1010A | 02255 | 10.1 | 10 | 101 | 51 | 41 | 1.56 |
| 2XDSSM1020A | 02256 | 10.2 | 10 | 101 | 51 | 41 | 1.58 |
| 2XDSSM1030A | 02257 | 10.3 | 10 | 101 | 51 | 41 | 1.60 |
| 2XDSSM1040A | 02259 | 10.4 | 10 | 101 | 51 | 41 | 1.61 |
| 2XDSSM1050A | 02260 | 10.5 | 10 | 101 | 51 | 41 | 1.63 |
| 2XDSSM1060A | 02261 | 10.6 | 10 | 101 | 51 | 41 | 1.64 |
| 2XDSSM1070A | 04002 | 10.7 | 10 | 101 | 51 | 41 | 1.66 |
| 2XDSSM1080A | 02263 | 10.8 | 10 | 101 | 51 | 41 | 1.67 |
| 2XDSSM1090A | 04003 | 10.9 | 10 | 101 | 51 | 41 | 1.69 |



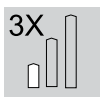
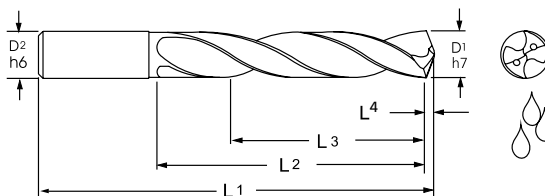
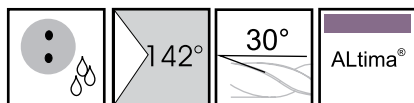
Twister Xtreme Drilling® 2XDSSM



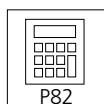
| Metric No. | EDP | D1 (Tol h7) | D2 (h6) | L1 | L2 | L3 | L4 |
|-------------|-------|-------------|---------|-----|----|----|------|
| 2XDSSM1100A | 02264 | 11.0 | 12 | 101 | 51 | 41 | 1.70 |
| 2XDSSM1110A | 02265 | 11.1 | 12 | 101 | 51 | 41 | 1.72 |
| 2XDSSM1120A | 02268 | 11.2 | 12 | 101 | 51 | 41 | 1.74 |
| 2XDSSM1130A | 02269 | 11.3 | 12 | 101 | 51 | 41 | 1.75 |
| 2XDSSM1140A | 04004 | 11.4 | 12 | 101 | 51 | 41 | 1.77 |
| 2XDSSM1150A | 02270 | 11.5 | 12 | 101 | 51 | 41 | 1.78 |
| 2XDSSM1160A | 02271 | 11.6 | 12 | 101 | 51 | 41 | 1.80 |
| 2XDSSM1170A | 02272 | 11.7 | 12 | 101 | 51 | 41 | 1.81 |
| 2XDSSM1180A | 02273 | 11.8 | 12 | 101 | 51 | 41 | 1.83 |
| 2XDSSM1190A | 04005 | 11.9 | 12 | 101 | 51 | 41 | 1.84 |
| 2XDSSM1200A | 02276 | 12.0 | 12 | 101 | 51 | 41 | 1.86 |
| 2XDSSM1210A | 02278 | 12.1 | 14 | 107 | 54 | 43 | 1.87 |
| 2XDSSM1250A | 02282 | 12.5 | 14 | 107 | 54 | 43 | 1.94 |
| 2XDSSM1280A | 02286 | 12.8 | 14 | 107 | 54 | 43 | 1.98 |
| 2XDSSM1290A | 02287 | 12.9 | 14 | 107 | 54 | 43 | 2.00 |
| 2XDSSM1300A | 02288 | 13.0 | 14 | 107 | 54 | 43 | 2.01 |
| 2XDSSM1350A | 02292 | 13.5 | 14 | 107 | 54 | 43 | 2.09 |
| 2XDSSM1370A | 02294 | 13.7 | 14 | 107 | 54 | 43 | 2.12 |
| 2XDSSM1400A | 02298 | 14.0 | 14 | 107 | 54 | 43 | 2.17 |
| 2XDSSM1450A | 02302 | 14.5 | 16 | 117 | 60 | 48 | 2.25 |
| 2XDSSM1470A | 02304 | 14.7 | 16 | 117 | 60 | 48 | 2.28 |
| 2XDSSM1500A | 02306 | 15.0 | 16 | 117 | 60 | 48 | 2.32 |
| 2XDSSM1530A | 02309 | 15.3 | 16 | 117 | 60 | 48 | 2.37 |
| 2XDSSM1550A | 02310 | 15.5 | 16 | 117 | 60 | 48 | 2.40 |
| 2XDSSM1570A | 02312 | 15.7 | 16 | 117 | 60 | 48 | 2.43 |
| 2XDSSM1600A | 02316 | 16.0 | 16 | 117 | 60 | 48 | 2.48 |
| 2XDSSM1608A | 02318 | 16.08 | 18 | 122 | 63 | 51 | 2.49 |
| 2XDSSM1630A | 02319 | 16.3 | 18 | 122 | 63 | 51 | 2.53 |
| 2XDSSM1650A | 02320 | 16.5 | 18 | 122 | 63 | 51 | 2.56 |
| 2XDSSM1700A | 02324 | 17.0 | 18 | 122 | 63 | 51 | 2.63 |
| 2XDSSM1750A | 02328 | 17.5 | 18 | 122 | 63 | 51 | 2.71 |
| 2XDSSM1800A | 02330 | 18.0 | 18 | 122 | 63 | 51 | 2.79 |
| 2XDSSM1850A | 02332 | 18.5 | 20 | 133 | 70 | 56 | 2.87 |
| 2XDSSM1916A | 02336 | 19.16 | 20 | 133 | 70 | 56 | 2.97 |
| 2XDSSM1925A | 02338 | 19.25 | 20 | 133 | 70 | 56 | 2.98 |
| 2XDSSM1930A | 02340 | 19.3 | 20 | 133 | 70 | 56 | 2.99 |
| 2XDSSM1950A | 02342 | 19.5 | 20 | 133 | 70 | 56 | 3.02 |
| 2XDSSM2000A | 02344 | 20.0 | 20 | 133 | 70 | 56 | 3.10 |



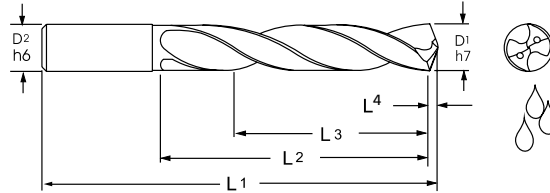
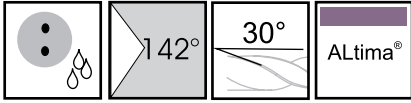
Twister X^D Xtreme Drilling® 2XDSCSM



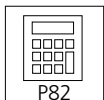
| Metric No. | EDP | D1 (Tol h7) | D2 (h6) | L1 | L2 | L3 | L4 |
|--------------|-------|-------------|---------|----|----|----|------|
| 2XDSCSM0300A | 04400 | 3.0 | 3 | 57 | 16 | 13 | 0.46 |
| 2XDSCSM0310A | 04404 | 3.1 | 4 | 63 | 22 | 18 | 0.48 |
| 2XDSCSM0320A | 04408 | 3.2 | 4 | 63 | 22 | 18 | 0.50 |
| 2XDSCSM0330A | 04412 | 3.3 | 4 | 63 | 22 | 18 | 0.51 |
| 2XDSCSM0340A | 04414 | 3.4 | 4 | 63 | 22 | 18 | 0.53 |
| 2XDSCSM0350A | 04418 | 3.5 | 4 | 63 | 22 | 18 | 0.54 |
| 2XDSCSM0360A | 04422 | 3.6 | 4 | 63 | 22 | 18 | 0.56 |
| 2XDSCSM0370A | 04424 | 3.7 | 4 | 63 | 22 | 18 | 0.57 |
| 2XDSCSM0380A | 04426 | 3.8 | 4 | 63 | 22 | 18 | 0.59 |
| 2XDSCSM0390A | 04430 | 3.9 | 4 | 63 | 22 | 18 | 0.60 |
| 2XDSCSM0400A | 04434 | 4.0 | 4 | 63 | 22 | 18 | 0.62 |
| 2XDSCSM0410A | 04438 | 4.1 | 5 | 63 | 26 | 21 | 0.64 |
| 2XDSCSM0420A | 04440 | 4.2 | 5 | 63 | 26 | 21 | 0.65 |
| 2XDSCSM0430A | 04442 | 4.3 | 5 | 63 | 26 | 21 | 0.67 |
| 2XDSCSM0440A | 04446 | 4.4 | 5 | 63 | 26 | 21 | 0.68 |
| 2XDSCSM0450A | 04448 | 4.5 | 5 | 63 | 26 | 21 | 0.70 |
| 2XDSCSM0460A | 04450 | 4.6 | 5 | 63 | 26 | 21 | 0.71 |
| 2XDSCSM0470A | 04452 | 4.7 | 5 | 63 | 26 | 21 | 0.73 |
| 2XDSCSM0480A | 04456 | 4.8 | 5 | 63 | 26 | 21 | 0.74 |
| 2XDSCSM0490A | 04458 | 4.9 | 5 | 63 | 26 | 21 | 0.76 |
| 2XDSCSM0500A | 04460 | 5.0 | 5 | 63 | 26 | 21 | 0.77 |
| 2XDSCSM0510A | 04462 | 5.1 | 6 | 66 | 28 | 20 | 0.79 |
| 2XDSCSM0520A | 04466 | 5.2 | 6 | 66 | 28 | 20 | 0.81 |
| 2XDSCSM0530A | 04468 | 5.3 | 6 | 66 | 28 | 20 | 0.82 |
| 2XDSCSM0540A | 04470 | 5.4 | 6 | 66 | 28 | 20 | 0.84 |
| 2XDSCSM0550A | 04472 | 5.5 | 6 | 66 | 28 | 20 | 0.85 |
| 2XDSCSM0570A | 04478 | 5.7 | 6 | 66 | 28 | 20 | 0.88 |
| 2XDSCSM0580A | 04480 | 5.8 | 6 | 66 | 28 | 20 | 0.90 |
| 2XDSCSM0590A | 04482 | 5.9 | 6 | 66 | 28 | 20 | 0.91 |
| 2XDSCSM0600A | 04486 | 6.0 | 6 | 66 | 28 | 20 | 0.93 |
| 2XDSCSM0610A | 04488 | 6.1 | 8 | 79 | 34 | 24 | 0.95 |
| 2XDSCSM0620A | 04492 | 6.2 | 8 | 79 | 34 | 24 | 0.96 |
| 2XDSCSM0630A | 04496 | 6.3 | 8 | 79 | 34 | 24 | 0.98 |
| 2XDSCSM0640A | 04500 | 6.4 | 8 | 79 | 34 | 24 | 0.99 |
| 2XDSCSM0650A | 04502 | 6.5 | 8 | 79 | 34 | 24 | 1.01 |
| 2XDSCSM0660A | 04506 | 6.6 | 8 | 79 | 34 | 24 | 1.03 |
| 2XDSCSM0670A | 04510 | 6.7 | 8 | 79 | 34 | 24 | 1.04 |
| 2XDSCSM0680A | 04514 | 6.8 | 8 | 79 | 34 | 24 | 1.05 |
| 2XDSCSM0690A | 04516 | 6.9 | 8 | 79 | 34 | 24 | 1.07 |
| 2XDSCSM0700A | 04518 | 7.0 | 8 | 79 | 34 | 24 | 1.08 |
| 2XDSCSM0710A | 04520 | 7.1 | 8 | 79 | 41 | 29 | 1.10 |



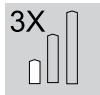
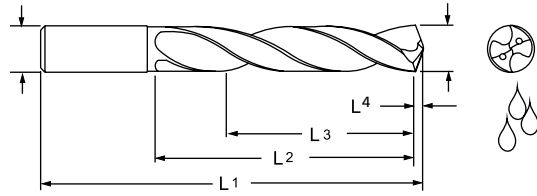
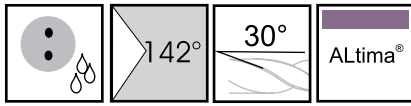
Twister ^{XTreme Drilling} 2XDCSM



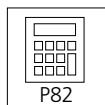
| Metric No. | EDP | D1 (Tol h7) | D2 (h6) | L1 | L2 | L3 | L4 |
|-------------|-------|-------------|---------|-----|----|----|------|
| 2XDCSM0720A | 04524 | 7.2 | 8 | 79 | 41 | 29 | 1.12 |
| 2XDCSM0730A | 04526 | 7.3 | 8 | 79 | 41 | 29 | 1.13 |
| 2XDCSM0740A | 04528 | 7.4 | 8 | 79 | 41 | 29 | 1.15 |
| 2XDCSM0750A | 04530 | 7.5 | 8 | 79 | 41 | 29 | 1.16 |
| 2XDCSM0760A | 04534 | 7.6 | 8 | 79 | 41 | 29 | 1.18 |
| 2XDCSM0770A | 04536 | 7.7 | 8 | 79 | 41 | 29 | 1.19 |
| 2XDCSM0780A | 04538 | 7.8 | 8 | 79 | 41 | 29 | 1.21 |
| 2XDCSM0790A | 04540 | 7.9 | 8 | 79 | 41 | 29 | 1.22 |
| 2XDCSM0800A | 04544 | 8.0 | 8 | 79 | 41 | 29 | 1.24 |
| 2XDCSM0810A | 04546 | 8.1 | 10 | 89 | 47 | 35 | 1.26 |
| 2XDCSM0820A | 04548 | 8.2 | 10 | 89 | 47 | 35 | 1.27 |
| 2XDCSM0830A | 04550 | 8.3 | 10 | 89 | 47 | 35 | 1.29 |
| 2XDCSM0840A | 04554 | 8.4 | 10 | 89 | 47 | 35 | 1.31 |
| 2XDCSM0850A | 04558 | 8.5 | 10 | 89 | 47 | 35 | 1.32 |
| 2XDCSM0860A | 04560 | 8.6 | 10 | 89 | 47 | 35 | 1.33 |
| 2XDCSM0870A | 04562 | 8.7 | 10 | 89 | 47 | 35 | 1.35 |
| 2XDCSM0880A | 04566 | 8.8 | 10 | 89 | 47 | 35 | 1.36 |
| 2XDCSM0890A | 04568 | 8.9 | 10 | 89 | 47 | 35 | 1.38 |
| 2XDCSM0900A | 04570 | 9.0 | 10 | 89 | 47 | 35 | 1.39 |
| 2XDCSM0910A | 04572 | 9.1 | 10 | 89 | 47 | 35 | 1.41 |
| 2XDCSM0920A | 04576 | 9.2 | 10 | 89 | 47 | 35 | 1.43 |
| 2XDCSM0925A | 04578 | 9.25 | 10 | 89 | 47 | 35 | 1.43 |
| 2XDCSM0930A | 04580 | 9.3 | 10 | 89 | 47 | 35 | 1.44 |
| 2XDCSM0940A | 04582 | 9.4 | 10 | 89 | 47 | 35 | 1.46 |
| 2XDCSM0950A | 04584 | 9.5 | 10 | 89 | 47 | 35 | 1.47 |
| 2XDCSM0960A | 04588 | 9.6 | 10 | 89 | 47 | 35 | 1.49 |
| 2XDCSM0970A | 04590 | 9.7 | 10 | 89 | 47 | 35 | 1.50 |
| 2XDCSM0980A | 04592 | 9.8 | 10 | 89 | 47 | 35 | 1.52 |
| 2XDCSM0990A | 04594 | 9.9 | 10 | 89 | 47 | 35 | 1.53 |
| 2XDCSM1000A | 04598 | 10.0 | 10 | 89 | 47 | 35 | 1.55 |
| 2XDCSM1010A | 04600 | 10.1 | 12 | 102 | 55 | 40 | 1.56 |
| 2XDCSM1020A | 04602 | 10.2 | 12 | 102 | 55 | 40 | 1.58 |
| 2XDCSM1030A | 04604 | 10.3 | 12 | 102 | 55 | 40 | 1.60 |
| 2XDCSM1040A | 04608 | 10.4 | 12 | 102 | 55 | 40 | 1.61 |
| 2XDCSM1050A | 04610 | 10.5 | 12 | 102 | 55 | 40 | 1.63 |
| 2XDCSM1060A | 04612 | 10.6 | 12 | 102 | 55 | 40 | 1.64 |
| 2XDCSM1070A | 04614 | 10.7 | 12 | 102 | 55 | 40 | 1.66 |
| 2XDCSM1080A | 04618 | 10.8 | 12 | 102 | 55 | 40 | 1.67 |
| 2XDCSM1090A | 04620 | 10.9 | 12 | 102 | 55 | 40 | 1.69 |
| 2XDCSM1100A | 04622 | 11.0 | 12 | 102 | 55 | 40 | 1.70 |
| 2XDCSM1110A | 04624 | 11.1 | 12 | 102 | 55 | 40 | 1.72 |



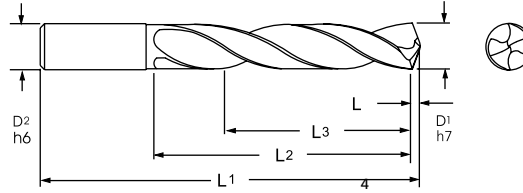
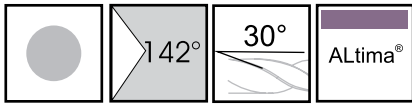
Twister [®] Xtreme Drilling 2XDCSM



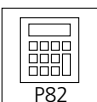
| Metric No. | EDP | D1 (Tol h7) | D2 (h6) | L1 | L2 | L3 | L4 |
|-------------|-------|-------------|---------|-----|----|----|------|
| 2XDCSM1120A | 04628 | 11.2 | 12 | 102 | 55 | 40 | 1.74 |
| 2XDCSM1130A | 04630 | 11.3 | 12 | 102 | 55 | 40 | 1.75 |
| 2XDCSM1140A | 04632 | 11.4 | 12 | 102 | 55 | 40 | 1.77 |
| 2XDCSM1150A | 04634 | 11.5 | 12 | 102 | 55 | 40 | 1.78 |
| 2XDCSM1160A | 04636 | 11.6 | 12 | 102 | 55 | 40 | 1.80 |
| 2XDCSM1170A | 04638 | 11.7 | 12 | 102 | 55 | 40 | 1.81 |
| 2XDCSM1180A | 04640 | 11.8 | 12 | 102 | 55 | 40 | 1.83 |
| 2XDCSM1190A | 04642 | 11.9 | 12 | 102 | 55 | 40 | 1.84 |
| 2XDCSM1200A | 04646 | 12.0 | 12 | 102 | 55 | 40 | 1.86 |
| 2XDCSM1210A | 04648 | 12.1 | 14 | 107 | 60 | 43 | 1.87 |
| 2XDCSM1250A | 04652 | 12.5 | 14 | 107 | 60 | 43 | 1.94 |
| 2XDCSM1280A | 04656 | 12.8 | 14 | 107 | 60 | 43 | 1.98 |
| 2XDCSM1283A | 04658 | 12.83 | 14 | 107 | 60 | 43 | 1.99 |
| 2XDCSM1290A | 04660 | 12.9 | 14 | 107 | 60 | 43 | 2.00 |
| 2XDCSM1300A | 04662 | 13.0 | 14 | 107 | 60 | 43 | 2.01 |
| 2XDCSM1350A | 04666 | 13.5 | 14 | 107 | 60 | 43 | 2.09 |
| 2XDCSM1370A | 04668 | 13.7 | 14 | 107 | 60 | 43 | 2.12 |
| 2XDCSM1400A | 04672 | 14.0 | 14 | 107 | 60 | 43 | 2.17 |
| 2XDCSM1450A | 04676 | 14.5 | 16 | 115 | 65 | 45 | 2.25 |
| 2XDCSM1470A | 04678 | 14.7 | 16 | 115 | 65 | 45 | 2.28 |
| 2XDCSM1500A | 04680 | 15.0 | 16 | 115 | 65 | 45 | 2.32 |
| 2XDCSM1530A | 04684 | 15.3 | 16 | 115 | 65 | 45 | 2.37 |
| 2XDCSM1550A | 04686 | 15.5 | 16 | 115 | 65 | 45 | 2.40 |
| 2XDCSM1570A | 04688 | 15.7 | 16 | 115 | 65 | 45 | 2.43 |
| 2XDCSM1600A | 04692 | 16.0 | 16 | 115 | 65 | 45 | 2.48 |



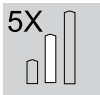
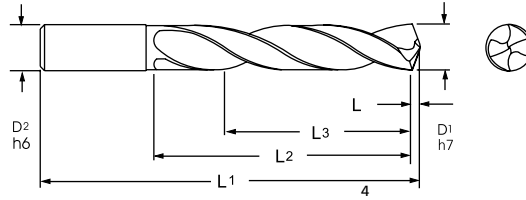
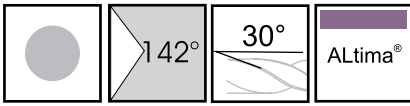
Twister Xtreme Drilling® 2XDSRM



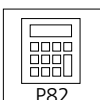
| Metric No. | EDP | D1 (Tol h7) | D2 (h6) | L1 | L2 | L3 | L4 |
|-------------|-------|-------------|---------|----|----|----|------|
| 2XDSRM0050A | 28001 | 0.5 | 0.5 | 26 | 6 | 5 | 0.08 |
| 2XDSRM0060A | 28006 | 0.6 | 0.6 | 26 | 7 | 5 | 0.09 |
| 2XDSRM0065A | 28011 | 0.65 | 0.65 | 26 | 8 | 6 | 0.10 |
| 2XDSRM0095A | 28016 | 0.95 | 0.95 | 32 | 11 | 8 | 0.15 |
| 2XDSRM0100A | 28021 | 1.0 | 1.0 | 34 | 12 | 9 | 0.16 |
| 2XDSRM0105A | 28026 | 1.05 | 1.05 | 34 | 12 | 9 | 0.16 |
| 2XDSRM0125A | 28031 | 1.25 | 1.25 | 38 | 16 | 12 | 0.19 |
| 2XDSRM0150A | 28036 | 1.5 | 1.5 | 40 | 18 | 14 | 0.23 |
| 2XDSRM0160A | 28041 | 1.6 | 1.6 | 43 | 20 | 15 | 0.25 |
| 2XDSRM0180A | 28046 | 1.8 | 1.8 | 46 | 22 | 17 | 0.28 |
| 2XDSRM0190A | 28051 | 1.9 | 1.9 | 46 | 22 | 17 | 0.29 |
| 2XDSRM0200A | 28056 | 2.0 | 2.0 | 49 | 24 | 18 | 0.31 |
| 2XDSRM0205A | 28058 | 2.05 | 2.05 | 49 | 24 | 18 | 0.32 |
| 2XDSRM0230A | 28061 | 2.3 | 2.3 | 53 | 27 | 20 | 0.36 |
| 2XDSRM0240A | 28066 | 2.4 | 2.4 | 57 | 30 | 23 | 0.37 |
| 2XDSRM0250A | 28071 | 2.5 | 2.5 | 57 | 30 | 23 | 0.39 |
| 2XDSRM0290A | 28073 | 2.9 | 2.9 | 61 | 33 | 25 | 0.45 |
| 2XDSRM0300A | 02346 | 3.0 | 3.0 | 63 | 24 | 19 | 0.46 |
| 2XDSRM0310A | 02349 | 3.1 | 4.0 | 69 | 32 | 26 | 0.48 |
| 2XDSRM0320A | 02352 | 3.2 | 4.0 | 69 | 32 | 26 | 0.50 |
| 2XDSRM0330A | 02356 | 3.3 | 4.0 | 69 | 32 | 26 | 0.51 |
| 2XDSRM0340A | 02358 | 3.4 | 4.0 | 69 | 32 | 26 | 0.53 |
| 2XDSRM0350A | 02362 | 3.5 | 4.0 | 69 | 32 | 26 | 0.54 |
| 2XDSRM0360A | 02365 | 3.6 | 4.0 | 69 | 32 | 26 | 0.56 |
| 2XDSRM0370A | 02366 | 3.7 | 4.0 | 69 | 32 | 26 | 0.57 |
| 2XDSRM0380A | 02368 | 3.8 | 4.0 | 69 | 32 | 26 | 0.59 |
| 2XDSRM0390A | 02369 | 3.9 | 4.0 | 69 | 32 | 26 | 0.60 |
| 2XDSRM0400A | 02372 | 4.0 | 4.0 | 69 | 32 | 26 | 0.62 |
| 2XDSRM0410A | 04006 | 4.1 | 5.0 | 80 | 38 | 30 | 0.64 |
| 2XDSRM0420A | 02374 | 4.2 | 5.0 | 80 | 38 | 30 | 0.65 |
| 2XDSRM0430A | 02375 | 4.3 | 5.0 | 80 | 38 | 30 | 0.67 |
| 2XDSRM0440A | 02377 | 4.4 | 5.0 | 80 | 38 | 30 | 0.68 |
| 2XDSRM0450A | 02378 | 4.5 | 5.0 | 80 | 38 | 30 | 0.70 |
| 2XDSRM0460A | 02380 | 4.6 | 5.0 | 80 | 38 | 30 | 0.71 |
| 2XDSRM0470A | 02381 | 4.7 | 5.0 | 80 | 38 | 30 | 0.73 |
| 2XDSRM0480A | 02384 | 4.8 | 5.0 | 80 | 38 | 30 | 0.74 |
| 2XDSRM0490A | 02386 | 4.9 | 5.0 | 80 | 38 | 30 | 0.76 |
| 2XDSRM0500A | 02388 | 5.0 | 5.0 | 80 | 38 | 30 | 0.77 |
| 2XDSRM0510A | 02390 | 5.1 | 6.0 | 82 | 40 | 32 | 0.79 |
| 2XDSRM0520A | 02394 | 5.2 | 6.0 | 82 | 40 | 32 | 0.81 |
| 2XDSRM0530A | 02396 | 5.3 | 6.0 | 82 | 40 | 32 | 0.82 |



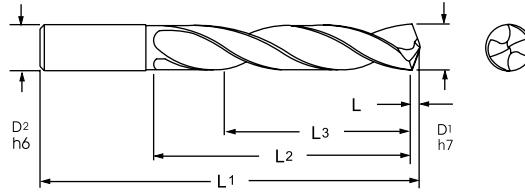
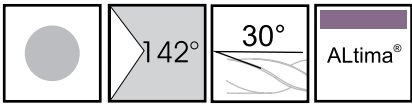
Twister X[®] Xtreme Drilling 2XDSRM



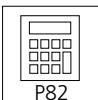
| Metric No. | EDP | D1 (Tol h7) | D2 (h6) | L1 | L2 | L3 | L4 |
|-------------|-------|-------------|---------|-----|----|----|------|
| 2XDSRM0540A | 02398 | 5.4 | 6 | 82 | 40 | 32 | 0.84 |
| 2XDSRM0550A | 02400 | 5.5 | 6 | 82 | 40 | 32 | 0.85 |
| 2XDSRM0570A | 02406 | 5.7 | 6 | 82 | 40 | 32 | 0.88 |
| 2XDSRM0580A | 02408 | 5.8 | 6 | 82 | 40 | 32 | 0.90 |
| 2XDSRM0590A | 02410 | 5.9 | 6 | 82 | 40 | 32 | 0.91 |
| 2XDSRM0600A | 02414 | 6.0 | 6 | 82 | 40 | 32 | 0.93 |
| 2XDSRM0610A | 02416 | 6.1 | 8 | 91 | 48 | 38 | 0.95 |
| 2XDSRM0620A | 02420 | 6.2 | 8 | 91 | 48 | 38 | 0.96 |
| 2XDSRM0630A | 02424 | 6.3 | 8 | 91 | 48 | 38 | 0.98 |
| 2XDSRM0640A | 02428 | 6.4 | 8 | 91 | 48 | 38 | 0.99 |
| 2XDSRM0650A | 02430 | 6.5 | 8 | 91 | 48 | 38 | 1.01 |
| 2XDSRM0660A | 02433 | 6.6 | 8 | 91 | 48 | 38 | 1.03 |
| 2XDSRM0670A | 02435 | 6.7 | 8 | 91 | 48 | 38 | 1.04 |
| 2XDSRM0680A | 02438 | 6.8 | 8 | 91 | 48 | 38 | 1.05 |
| 2XDSRM0690A | 02440 | 6.9 | 8 | 91 | 48 | 38 | 1.07 |
| 2XDSRM0700A | 02442 | 7.0 | 8 | 91 | 48 | 38 | 1.08 |
| 2XDSRM0710A | 02443 | 7.1 | 8 | 91 | 48 | 38 | 1.10 |
| 2XDSRM0720A | 02446 | 7.2 | 8 | 91 | 48 | 38 | 1.12 |
| 2XDSRM0730A | 02447 | 7.3 | 8 | 91 | 48 | 38 | 1.13 |
| 2XDSRM0740A | 02448 | 7.4 | 8 | 91 | 48 | 38 | 1.15 |
| 2XDSRM0750A | 02450 | 7.5 | 8 | 91 | 48 | 38 | 1.16 |
| 2XDSRM0760A | 02454 | 7.6 | 8 | 91 | 48 | 38 | 1.18 |
| 2XDSRM0770A | 02456 | 7.7 | 8 | 91 | 48 | 38 | 1.19 |
| 2XDSRM0780A | 02458 | 7.8 | 8 | 91 | 48 | 38 | 1.21 |
| 2XDSRM0790A | 02459 | 7.9 | 8 | 91 | 48 | 38 | 1.22 |
| 2XDSRM0800A | 02480 | 8.0 | 8 | 91 | 48 | 38 | 1.24 |
| 2XDSRM0810A | 02482 | 8.1 | 10 | 103 | 55 | 44 | 1.26 |
| 2XDSRM0820A | 02484 | 8.2 | 10 | 103 | 55 | 44 | 1.27 |
| 2XDSRM0830A | 02486 | 8.3 | 10 | 103 | 55 | 44 | 1.29 |
| 2XDSRM0840A | 02487 | 8.4 | 10 | 103 | 55 | 44 | 1.31 |
| 2XDSRM0850A | 02490 | 8.5 | 10 | 103 | 55 | 44 | 1.32 |
| 2XDSRM0860A | 02491 | 8.6 | 10 | 103 | 55 | 44 | 1.33 |
| 2XDSRM0870A | 04007 | 8.7 | 10 | 103 | 55 | 44 | 1.35 |
| 2XDSRM0880A | 02494 | 8.8 | 10 | 103 | 55 | 44 | 1.36 |
| 2XDSRM0890A | 02496 | 8.9 | 10 | 103 | 55 | 44 | 1.38 |
| 2XDSRM0900A | 02498 | 9.0 | 10 | 103 | 55 | 44 | 1.39 |
| 2XDSRM0910A | 02499 | 9.1 | 10 | 103 | 55 | 44 | 1.41 |
| 2XDSRM0920A | 02502 | 9.2 | 10 | 103 | 55 | 44 | 1.43 |
| 2XDSRM0925A | 02504 | 9.25 | 10 | 103 | 55 | 44 | 1.43 |
| 2XDSRM0930A | 02506 | 9.3 | 10 | 103 | 55 | 44 | 1.44 |
| 2XDSRM0940A | 02507 | 9.4 | 10 | 103 | 55 | 44 | 1.46 |



Twister Xtreme Drilling® 2XDSRM



| Metric No. | EDP | D1 (Tol h7) | D2 (h6) | L1 | L2 | L3 | L4 |
|-------------|-------|-------------|---------|-----|----|----|------|
| 2XDSRM0950A | 02508 | 9.5 | 10 | 103 | 55 | 44 | 1.47 |
| 2XDSRM0960A | 02511 | 9.6 | 10 | 103 | 55 | 44 | 1.49 |
| 2XDSRM0970A | 02512 | 9.7 | 10 | 103 | 55 | 44 | 1.50 |
| 2XDSRM0980A | 02514 | 9.8 | 10 | 103 | 55 | 44 | 1.52 |
| 2XDSRM0990A | 02515 | 9.9 | 10 | 103 | 55 | 44 | 1.53 |
| 2XDSRM1000A | 02518 | 10.0 | 10 | 103 | 55 | 44 | 1.55 |
| 2XDSRM1010A | 02519 | 10.1 | 12 | 120 | 60 | 48 | 1.56 |
| 2XDSRM1020A | 02520 | 10.2 | 12 | 120 | 60 | 48 | 1.58 |
| 2XDSRM1030A | 02521 | 10.3 | 12 | 120 | 60 | 48 | 1.60 |
| 2XDSRM1040A | 02523 | 10.4 | 12 | 120 | 60 | 48 | 1.61 |
| 2XDSRM1050A | 02524 | 10.5 | 12 | 120 | 60 | 48 | 1.63 |
| 2XDSRM1060A | 02525 | 10.6 | 12 | 120 | 60 | 48 | 1.64 |
| 2XDSRM1070A | 04008 | 10.7 | 12 | 120 | 60 | 48 | 1.66 |
| 2XDSRM1080A | 02527 | 10.8 | 12 | 120 | 60 | 48 | 1.67 |
| 2XDSRM1090A | 04009 | 10.9 | 12 | 120 | 60 | 48 | 1.69 |
| 2XDSRM1100A | 02528 | 11.0 | 12 | 120 | 60 | 48 | 1.70 |
| 2XDSRM1110A | 02529 | 11.1 | 12 | 120 | 66 | 53 | 1.72 |
| 2XDSRM1120A | 02532 | 11.2 | 12 | 120 | 66 | 53 | 1.74 |
| 2XDSRM1130A | 02533 | 11.3 | 12 | 120 | 66 | 53 | 1.75 |
| 2XDSRM1140A | 04010 | 11.4 | 12 | 120 | 66 | 53 | 1.77 |
| 2XDSRM1150A | 02534 | 11.5 | 12 | 120 | 66 | 53 | 1.78 |
| 2XDSRM1160A | 02535 | 11.6 | 12 | 120 | 66 | 53 | 1.80 |
| 2XDSRM1170A | 02536 | 11.7 | 12 | 120 | 66 | 53 | 1.81 |
| 2XDSRM1180A | 02537 | 11.8 | 12 | 120 | 66 | 53 | 1.83 |
| 2XDSRM1190A | 04011 | 11.9 | 12 | 120 | 66 | 53 | 1.84 |
| 2XDSRM1200A | 02540 | 12.0 | 12 | 120 | 66 | 53 | 1.86 |
| 2XDSRM1210A | 02542 | 12.1 | 14 | 126 | 72 | 58 | 1.87 |
| 2XDSRM1250A | 02546 | 12.5 | 14 | 126 | 72 | 58 | 1.94 |
| 2XDSRM1280A | 02550 | 12.8 | 14 | 126 | 72 | 58 | 1.98 |
| 2XDSRM1290A | 02551 | 12.9 | 14 | 126 | 72 | 58 | 2.00 |
| 2XDSRM1300A | 02552 | 13.0 | 14 | 126 | 72 | 58 | 2.01 |
| 2XDSRM1350A | 02556 | 13.5 | 14 | 134 | 77 | 62 | 2.09 |
| 2XDSRM1370A | 02558 | 13.7 | 14 | 134 | 77 | 62 | 2.12 |
| 2XDSRM1400A | 02562 | 14.0 | 14 | 134 | 77 | 62 | 2.17 |
| 2XDSRM1450A | 02566 | 14.5 | 16 | 140 | 80 | 64 | 2.25 |
| 2XDSRM1470A | 02568 | 14.7 | 16 | 140 | 80 | 64 | 2.28 |
| 2XDSRM1500A | 02570 | 15.0 | 16 | 140 | 80 | 64 | 2.32 |
| 2XDSRM1530A | 02573 | 15.3 | 16 | 146 | 82 | 66 | 2.37 |
| 2XDSRM1550A | 02574 | 15.5 | 16 | 146 | 82 | 66 | 2.40 |
| 2XDSRM1570A | 02576 | 15.7 | 16 | 146 | 82 | 66 | 2.43 |
| 2XDSRM1600A | 02580 | 16.0 | 16 | 146 | 82 | 66 | 2.48 |



TuffCut XR - XT

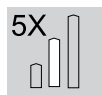
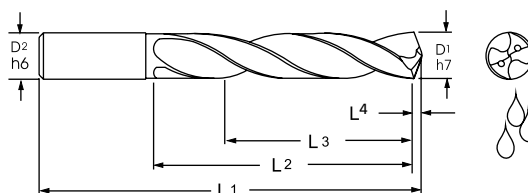
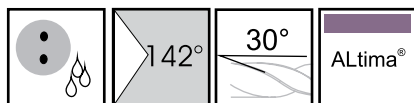
TuffCut X-AL

TuffCut Die & Mould

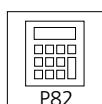
Twister Drills

Technical Section

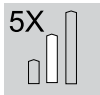
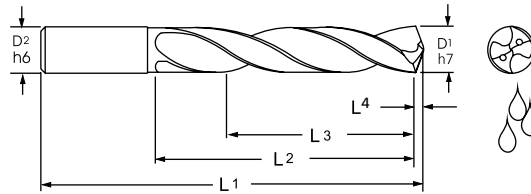
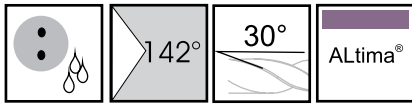
Twister ^{XTreme Drilling} 2XDCRM



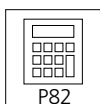
| Metric No. | EDP | D1 (Tol h7) | D2 (h6) | L1 | L2 | L3 | L4 |
|-------------|-------|-------------|---------|----|----|----|------|
| 2XDCRM0300A | 02582 | 3.0 | 3 | 75 | 24 | 19 | 0.46 |
| 2XDCRM0310A | 02585 | 3.1 | 4 | 80 | 32 | 26 | 0.48 |
| 2XDCRM0320A | 02590 | 3.2 | 4 | 80 | 32 | 26 | 0.50 |
| 2XDCRM0330A | 02594 | 3.3 | 4 | 80 | 32 | 26 | 0.51 |
| 2XDCRM0340A | 02596 | 3.4 | 4 | 80 | 32 | 26 | 0.53 |
| 2XDCRM0350A | 02600 | 3.5 | 4 | 80 | 32 | 26 | 0.54 |
| 2XDCRM0360A | 02603 | 3.6 | 4 | 80 | 32 | 26 | 0.56 |
| 2XDCRM0370A | 02604 | 3.7 | 4 | 80 | 32 | 26 | 0.57 |
| 2XDCRM0380A | 02606 | 3.8 | 4 | 80 | 32 | 26 | 0.59 |
| 2XDCRM0390A | 02607 | 3.9 | 4 | 80 | 32 | 26 | 0.60 |
| 2XDCRM0400A | 02610 | 4.0 | 4 | 80 | 32 | 26 | 0.62 |
| 2XDCRM0410A | 04012 | 4.1 | 5 | 82 | 38 | 30 | 0.64 |
| 2XDCRM0420A | 02612 | 4.2 | 5 | 82 | 38 | 30 | 0.65 |
| 2XDCRM0430A | 02613 | 4.3 | 5 | 82 | 38 | 30 | 0.67 |
| 2XDCRM0440A | 02615 | 4.4 | 5 | 82 | 38 | 30 | 0.68 |
| 2XDCRM0450A | 02616 | 4.5 | 5 | 82 | 38 | 30 | 0.70 |
| 2XDCRM0460A | 02618 | 4.6 | 5 | 82 | 38 | 30 | 0.71 |
| 2XDCRM0470A | 02619 | 4.7 | 5 | 82 | 38 | 30 | 0.73 |
| 2XDCRM0480A | 02622 | 4.8 | 5 | 82 | 38 | 30 | 0.74 |
| 2XDCRM0490A | 02624 | 4.9 | 5 | 82 | 38 | 30 | 0.76 |
| 2XDCRM0500A | 02626 | 5.0 | 5 | 82 | 38 | 30 | 0.77 |
| 2XDCRM0510A | 02628 | 5.1 | 6 | 82 | 40 | 32 | 0.79 |
| 2XDCRM0520A | 02632 | 5.2 | 6 | 82 | 40 | 32 | 0.81 |
| 2XDCRM0530A | 02634 | 5.3 | 6 | 82 | 40 | 32 | 0.82 |
| 2XDCRM0540A | 02636 | 5.4 | 6 | 82 | 40 | 32 | 0.84 |
| 2XDCRM0550A | 02638 | 5.5 | 6 | 82 | 40 | 32 | 0.85 |
| 2XDCRM0570A | 02644 | 5.7 | 6 | 82 | 40 | 32 | 0.88 |
| 2XDCRM0580A | 02646 | 5.8 | 6 | 82 | 40 | 32 | 0.90 |
| 2XDCRM0590A | 02648 | 5.9 | 6 | 82 | 40 | 32 | 0.91 |
| 2XDCRM0600A | 02652 | 6.0 | 6 | 82 | 40 | 32 | 0.93 |
| 2XDCRM0610A | 02654 | 6.1 | 8 | 91 | 48 | 38 | 0.95 |
| 2XDCRM0620A | 02658 | 6.2 | 8 | 91 | 48 | 38 | 0.96 |
| 2XDCRM0630A | 02662 | 6.3 | 8 | 91 | 48 | 38 | 0.98 |
| 2XDCRM0640A | 02666 | 6.4 | 8 | 91 | 48 | 38 | 0.99 |
| 2XDCRM0650A | 02668 | 6.5 | 8 | 91 | 48 | 38 | 1.01 |
| 2XDCRM0660A | 02671 | 6.6 | 8 | 91 | 48 | 38 | 1.03 |
| 2XDCRM0670A | 02673 | 6.7 | 8 | 91 | 48 | 38 | 1.04 |
| 2XDCRM0680A | 02676 | 6.8 | 8 | 91 | 48 | 38 | 1.05 |
| 2XDCRM0690A | 02678 | 6.9 | 8 | 91 | 48 | 38 | 1.07 |
| 2XDCRM0700A | 02680 | 7.0 | 8 | 91 | 48 | 38 | 1.08 |
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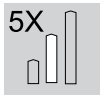
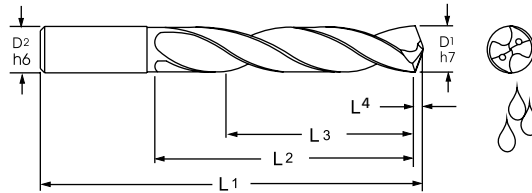
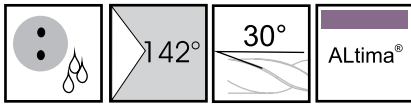
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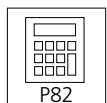
| Metric No. | EDP | D1 (Tol h7) | D2 (h6) | L1 | L2 | L3 | L4 |
|-------------|-------|-------------|---------|-----|----|----|------|
| 2XDCRM0720A | 02684 | 7.2 | 8 | 91 | 48 | 38 | 1.12 |
| 2XDCRM0730A | 02685 | 7.3 | 8 | 91 | 48 | 38 | 1.13 |
| 2XDCRM0740A | 02686 | 7.4 | 8 | 91 | 48 | 38 | 1.15 |
| 2XDCRM0750A | 02688 | 7.5 | 8 | 91 | 48 | 38 | 1.16 |
| 2XDCRM0760A | 02692 | 7.6 | 8 | 91 | 48 | 38 | 1.18 |
| 2XDCRM0770A | 02694 | 7.7 | 8 | 91 | 48 | 38 | 1.19 |
| 2XDCRM0780A | 02696 | 7.8 | 8 | 91 | 48 | 38 | 1.21 |
| 2XDCRM0790A | 02697 | 7.9 | 8 | 91 | 48 | 38 | 1.22 |
| 2XDCRM0800A | 02700 | 8.0 | 8 | 91 | 48 | 38 | 1.24 |
| 2XDCRM0810A | 02702 | 8.1 | 10 | 103 | 55 | 44 | 1.26 |
| 2XDCRM0820A | 02704 | 8.2 | 10 | 103 | 55 | 44 | 1.27 |
| 2XDCRM0830A | 02706 | 8.3 | 10 | 103 | 55 | 44 | 1.29 |
| 2XDCRM0840A | 02707 | 8.4 | 10 | 103 | 55 | 44 | 1.31 |
| 2XDCRM0850A | 02710 | 8.5 | 10 | 103 | 55 | 44 | 1.32 |
| 2XDCRM0860A | 02711 | 8.6 | 10 | 103 | 55 | 44 | 1.33 |
| 2XDCRM0870A | 04013 | 8.7 | 10 | 103 | 55 | 44 | 1.35 |
| 2XDCRM0880A | 02714 | 8.8 | 10 | 103 | 55 | 44 | 1.36 |
| 2XDCRM0890A | 02716 | 8.9 | 10 | 103 | 55 | 44 | 1.38 |
| 2XDCRM0900A | 02718 | 9.0 | 10 | 103 | 55 | 44 | 1.39 |
| 2XDCRM0910A | 02719 | 9.1 | 10 | 103 | 55 | 44 | 1.41 |
| 2XDCRM0920A | 02722 | 9.2 | 10 | 103 | 55 | 44 | 1.43 |
| 2XDCRM0925A | 02724 | 9.25 | 10 | 103 | 55 | 44 | 1.43 |
| 2XDCRM0930A | 02726 | 9.3 | 10 | 103 | 55 | 44 | 1.44 |
| 2XDCRM0940A | 02727 | 9.4 | 10 | 103 | 55 | 44 | 1.46 |
| 2XDCRM0950A | 02728 | 9.5 | 10 | 103 | 55 | 44 | 1.47 |
| 2XDCRM0960A | 02731 | 9.6 | 10 | 103 | 55 | 44 | 1.49 |
| 2XDCRM0970A | 02732 | 9.7 | 10 | 103 | 55 | 44 | 1.50 |
| 2XDCRM0980A | 02734 | 9.8 | 10 | 103 | 55 | 44 | 1.52 |
| 2XDCRM0990A | 02735 | 9.9 | 10 | 103 | 55 | 44 | 1.53 |
| 2XDCRM1000A | 02738 | 10.0 | 10 | 103 | 55 | 44 | 1.55 |
| 2XDCRM1010A | 02739 | 10.1 | 12 | 120 | 60 | 48 | 1.56 |
| 2XDCRM1020A | 02740 | 10.2 | 12 | 120 | 60 | 48 | 1.58 |
| 2XDCRM1030A | 02741 | 10.3 | 12 | 120 | 60 | 48 | 1.60 |
| 2XDCRM1040A | 02743 | 10.4 | 12 | 120 | 60 | 48 | 1.61 |
| 2XDCRM1050A | 02744 | 10.5 | 12 | 120 | 60 | 48 | 1.63 |
| 2XDCRM1060A | 02745 | 10.6 | 12 | 120 | 60 | 48 | 1.64 |
| 2XDCRM1070A | 04014 | 10.7 | 12 | 120 | 60 | 48 | 1.66 |
| 2XDCRM1080A | 02747 | 10.8 | 12 | 120 | 60 | 48 | 1.67 |
| 2XDCRM1090A | 04015 | 10.9 | 12 | 120 | 60 | 48 | 1.69 |
| 2XDCRM1100A | 02748 | 11.0 | 12 | 120 | 60 | 48 | 1.70 |
| 2XDCRM1110A | 02749 | 11.1 | 12 | 120 | 66 | 53 | 1.72 |



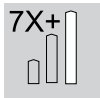
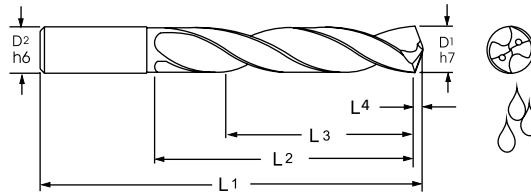
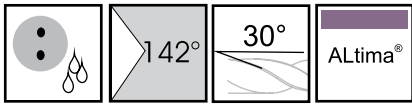
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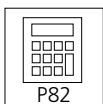
| Metric No. | EDP | D1 (Tol h7) | D2 (h6) | L1 | L2 | L3 | L4 |
|-------------|-------|-------------|---------|-----|-----|----|------|
| 2XDCRM1120A | 02752 | 11.2 | 12 | 120 | 66 | 53 | 1.74 |
| 2XDCRM1130A | 02753 | 11.3 | 12 | 120 | 66 | 53 | 1.75 |
| 2XDCRM1140A | 04016 | 11.4 | 12 | 120 | 66 | 53 | 1.77 |
| 2XDCRM1150A | 02754 | 11.5 | 12 | 120 | 66 | 53 | 1.78 |
| 2XDCRM1160A | 02755 | 11.6 | 12 | 120 | 66 | 53 | 1.80 |
| 2XDCRM1170A | 02756 | 11.7 | 12 | 120 | 66 | 53 | 1.81 |
| 2XDCRM1180A | 02757 | 11.8 | 12 | 120 | 66 | 53 | 1.83 |
| 2XDCRM1190A | 04017 | 11.9 | 12 | 120 | 66 | 53 | 1.84 |
| 2XDCRM1200A | 02760 | 12.0 | 12 | 120 | 66 | 53 | 1.86 |
| 2XDCRM1210A | 02762 | 12.1 | 14 | 126 | 72 | 58 | 1.87 |
| 2XDCRM1250A | 02766 | 12.5 | 14 | 126 | 72 | 58 | 1.94 |
| 2XDCRM1280A | 02770 | 12.8 | 14 | 126 | 72 | 58 | 1.98 |
| 2XDCRM1290A | 02771 | 12.9 | 14 | 126 | 72 | 58 | 2.00 |
| 2XDCRM1300A | 02772 | 13.0 | 14 | 126 | 72 | 58 | 2.01 |
| 2XDCRM1350A | 02776 | 13.5 | 14 | 134 | 77 | 62 | 2.09 |
| 2XDCRM1370A | 02778 | 13.7 | 14 | 134 | 77 | 62 | 2.12 |
| 2XDCRM1400A | 02782 | 14.0 | 14 | 134 | 77 | 62 | 2.17 |
| 2XDCRM1450A | 02786 | 14.5 | 16 | 140 | 80 | 64 | 2.25 |
| 2XDCRM1470A | 02788 | 14.7 | 16 | 140 | 80 | 64 | 2.28 |
| 2XDCRM1500A | 02790 | 15.0 | 16 | 140 | 80 | 64 | 2.32 |
| 2XDCRM1530A | 02793 | 15.3 | 16 | 146 | 82 | 66 | 2.37 |
| 2XDCRM1550A | 02794 | 15.5 | 16 | 146 | 82 | 66 | 2.40 |
| 2XDCRM1570A | 02796 | 15.7 | 16 | 146 | 82 | 66 | 2.43 |
| 2XDCRM1600A | 02800 | 16.0 | 16 | 146 | 82 | 66 | 2.48 |
| 2XDCRM1608A | 02802 | 16.08 | 18 | 158 | 90 | 72 | 2.49 |
| 2XDCRM1630A | 02803 | 16.3 | 18 | 158 | 90 | 72 | 2.53 |
| 2XDCRM1650A | 02804 | 16.5 | 18 | 158 | 90 | 72 | 2.56 |
| 2XDCRM1700A | 02808 | 17.0 | 18 | 158 | 90 | 72 | 2.63 |
| 2XDCRM1750A | 02812 | 17.5 | 18 | 158 | 95 | 76 | 2.71 |
| 2XDCRM1800A | 02814 | 18.0 | 18 | 158 | 95 | 76 | 2.79 |
| 2XDCRM1850A | 02816 | 18.5 | 20 | 160 | 100 | 80 | 2.87 |
| 2XDCRM1916A | 02820 | 19.16 | 20 | 160 | 100 | 80 | 2.97 |
| 2XDCRM1925A | 02822 | 19.25 | 20 | 160 | 100 | 80 | 2.98 |
| 2XDCRM1930A | 02824 | 19.3 | 20 | 160 | 100 | 80 | 2.99 |
| 2XDCRM1950A | 02826 | 19.5 | 20 | 160 | 100 | 80 | 3.02 |
| 2XDCRM2000A | 02828 | 20.0 | 20 | 160 | 100 | 80 | 3.10 |



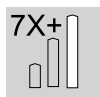
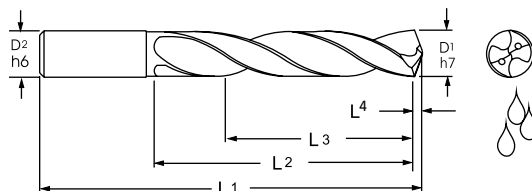
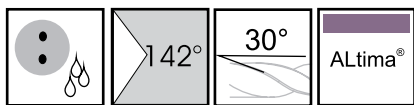
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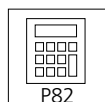
| Metric No. | EDP | D1 (Tol h7) | D2 (h6) | L1 | L2 | L3 | L4 |
|-------------|-------|-------------|---------|-----|----|----|------|
| 2XDCLM0300A | 02830 | 3.0 | 3 | 81 | 33 | 26 | 0.46 |
| 2XDCLM0310A | 02833 | 3.1 | 4 | 92 | 44 | 35 | 0.48 |
| 2XDCLM0320A | 02836 | 3.2 | 4 | 92 | 44 | 35 | 0.50 |
| 2XDCLM0330A | 02840 | 3.3 | 4 | 92 | 44 | 35 | 0.51 |
| 2XDCLM0340A | 02842 | 3.4 | 4 | 92 | 44 | 35 | 0.53 |
| 2XDCLM0350A | 02846 | 3.5 | 4 | 92 | 44 | 35 | 0.54 |
| 2XDCLM0360A | 02849 | 3.6 | 4 | 92 | 44 | 35 | 0.56 |
| 2XDCLM0370A | 02850 | 3.7 | 4 | 92 | 44 | 35 | 0.57 |
| 2XDCLM0380A | 02852 | 3.8 | 4 | 92 | 44 | 35 | 0.59 |
| 2XDCLM0390A | 02853 | 3.9 | 4 | 92 | 44 | 35 | 0.60 |
| 2XDCLM0400A | 02856 | 4.0 | 4 | 92 | 44 | 35 | 0.62 |
| 2XDCLM0410A | 04018 | 4.1 | 5 | 100 | 45 | 36 | 0.64 |
| 2XDCLM0420A | 02858 | 4.2 | 5 | 100 | 45 | 36 | 0.65 |
| 2XDCLM0430A | 02859 | 4.3 | 5 | 100 | 45 | 36 | 0.67 |
| 2XDCLM0440A | 02861 | 4.4 | 5 | 100 | 45 | 36 | 0.68 |
| 2XDCLM0450A | 02862 | 4.5 | 5 | 100 | 45 | 36 | 0.70 |
| 2XDCLM0460A | 02864 | 4.6 | 5 | 100 | 45 | 36 | 0.71 |
| 2XDCLM0470A | 02865 | 4.7 | 5 | 100 | 45 | 36 | 0.73 |
| 2XDCLM0480A | 02868 | 4.8 | 5 | 100 | 45 | 36 | 0.74 |
| 2XDCLM0490A | 02870 | 4.9 | 5 | 100 | 45 | 36 | 0.76 |
| 2XDCLM0500A | 02872 | 5.0 | 5 | 100 | 45 | 36 | 0.77 |
| 2XDCLM0510A | 02874 | 5.1 | 6 | 100 | 51 | 41 | 0.79 |
| 2XDCLM0520A | 02878 | 5.2 | 6 | 100 | 51 | 41 | 0.81 |
| 2XDCLM0530A | 02880 | 5.3 | 6 | 100 | 51 | 41 | 0.82 |
| 2XDCLM0540A | 02882 | 5.4 | 6 | 100 | 51 | 41 | 0.84 |
| 2XDCLM0550A | 02884 | 5.5 | 6 | 100 | 51 | 41 | 0.85 |
| 2XDCLM0570A | 02890 | 5.7 | 6 | 100 | 51 | 41 | 0.88 |
| 2XDCLM0580A | 02892 | 5.8 | 6 | 100 | 51 | 41 | 0.90 |
| 2XDCLM0590A | 02894 | 5.9 | 6 | 100 | 51 | 41 | 0.91 |
| 2XDCLM0600A | 02898 | 6.0 | 6 | 100 | 51 | 41 | 0.93 |
| 2XDCLM0610A | 02900 | 6.1 | 8 | 109 | 60 | 48 | 0.95 |
| 2XDCLM0620A | 02904 | 6.2 | 8 | 109 | 60 | 48 | 0.96 |
| 2XDCLM0630A | 02908 | 6.3 | 8 | 109 | 60 | 48 | 0.98 |
| 2XDCLM0640A | 02912 | 6.4 | 8 | 109 | 60 | 48 | 0.99 |
| 2XDCLM0650A | 02914 | 6.5 | 8 | 109 | 60 | 48 | 1.01 |
| 2XDCLM0660A | 02917 | 6.6 | 8 | 109 | 60 | 48 | 1.03 |
| 2XDCLM0670A | 02919 | 6.7 | 8 | 109 | 60 | 48 | 1.04 |
| 2XDCLM0680A | 02922 | 6.8 | 8 | 109 | 60 | 48 | 1.05 |
| 2XDCLM0690A | 02924 | 6.9 | 8 | 109 | 60 | 48 | 1.07 |



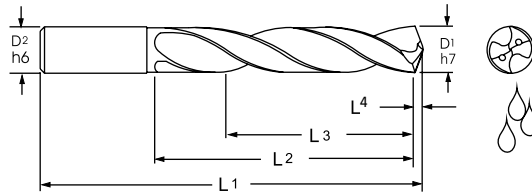
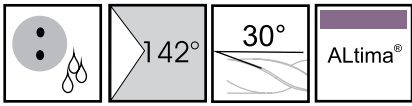
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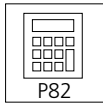
| Metric No. | EDP | D1 (Tol h7) | D2 (h6) | L1 | L2 | L3 | L4 |
|-------------|-------|-------------|---------|-----|----|----|------|
| 2XDCLM0700A | 02926 | 7.0 | 8 | 109 | 60 | 48 | 1.08 |
| 2XDCLM0710A | 02927 | 7.1 | 8 | 118 | 70 | 56 | 1.10 |
| 2XDCLM0720A | 02930 | 7.2 | 8 | 118 | 70 | 56 | 1.12 |
| 2XDCLM0730A | 02931 | 7.3 | 8 | 118 | 70 | 56 | 1.13 |
| 2XDCLM0740A | 02932 | 7.4 | 8 | 118 | 70 | 56 | 1.15 |
| 2XDCLM0750A | 02934 | 7.5 | 8 | 118 | 70 | 56 | 1.16 |
| 2XDCLM0760A | 02938 | 7.6 | 8 | 118 | 70 | 56 | 1.18 |
| 2XDCLM0770A | 02940 | 7.7 | 8 | 118 | 70 | 56 | 1.19 |
| 2XDCLM0780A | 02942 | 7.8 | 8 | 118 | 70 | 56 | 1.21 |
| 2XDCLM0790A | 02943 | 7.9 | 8 | 118 | 70 | 56 | 1.22 |
| 2XDCLM0800A | 02946 | 8.0 | 8 | 118 | 70 | 56 | 1.24 |
| 2XDCLM0810A | 02948 | 8.1 | 10 | 127 | 80 | 64 | 1.26 |
| 2XDCLM0820A | 02950 | 8.2 | 10 | 127 | 80 | 64 | 1.27 |
| 2XDCLM0830A | 02952 | 8.3 | 10 | 127 | 80 | 64 | 1.29 |
| 2XDCLM0840A | 02953 | 8.4 | 10 | 127 | 80 | 64 | 1.31 |
| 2XDCLM0850A | 02956 | 8.5 | 10 | 127 | 80 | 64 | 1.32 |
| 2XDCLM0860A | 02957 | 8.6 | 10 | 127 | 80 | 64 | 1.33 |
| 2XDCLM0870A | 04019 | 8.7 | 10 | 127 | 80 | 64 | 1.35 |
| 2XDCLM0880A | 02960 | 8.8 | 10 | 127 | 80 | 64 | 1.36 |
| 2XDCLM0890A | 02962 | 8.9 | 10 | 127 | 80 | 64 | 1.38 |
| 2XDCLM0900A | 02964 | 9.0 | 10 | 127 | 80 | 64 | 1.39 |
| 2XDCLM0910A | 02965 | 9.1 | 10 | 136 | 85 | 68 | 1.41 |
| 2XDCLM0920A | 02968 | 9.2 | 10 | 136 | 85 | 68 | 1.43 |
| 2XDCLM0925A | 02970 | 9.25 | 10 | 136 | 85 | 68 | 1.43 |
| 2XDCLM0930A | 02972 | 9.3 | 10 | 136 | 85 | 68 | 1.44 |
| 2XDCLM0940A | 02973 | 9.4 | 10 | 136 | 85 | 68 | 1.46 |
| 2XDCLM0950A | 02974 | 9.5 | 10 | 136 | 85 | 68 | 1.47 |
| 2XDCLM0960A | 02977 | 9.6 | 10 | 136 | 85 | 68 | 1.49 |
| 2XDCLM0970A | 02978 | 9.7 | 10 | 136 | 85 | 68 | 1.50 |
| 2XDCLM0980A | 02980 | 9.8 | 10 | 136 | 85 | 68 | 1.52 |
| 2XDCLM0990A | 04024 | 9.9 | 10 | 136 | 85 | 68 | 1.53 |
| 2XDCLM1000A | 02982 | 10.0 | 10 | 136 | 85 | 68 | 1.55 |
| 2XDCLM1010A | 04025 | 10.1 | 12 | 149 | 93 | 74 | 1.56 |
| 2XDCLM1020A | 02983 | 10.2 | 12 | 149 | 93 | 74 | 1.58 |
| 2XDCLM1030A | 04026 | 10.3 | 12 | 149 | 93 | 74 | 1.60 |
| 2XDCLM1040A | 02979 | 10.4 | 12 | 149 | 93 | 74 | 1.61 |
| 2XDCLM1050A | 02986 | 10.5 | 12 | 149 | 93 | 74 | 1.63 |
| 2XDCLM1060A | 02985 | 10.6 | 12 | 149 | 93 | 74 | 1.64 |
| 2XDCLM1070A | 04020 | 10.7 | 12 | 149 | 93 | 74 | 1.66 |



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| Metric No. | EDP | D1 (Tol h7) | D2 (h6) | L1 | L2 | L3 | L4 |
|-------------|-------|-------------|---------|-----|-----|----|------|
| 2XDCLM1080A | 96600 | 10.8 | 12 | 149 | 93 | 74 | 1.67 |
| 2XDCLM1090A | 04021 | 10.9 | 12 | 149 | 93 | 74 | 1.69 |
| 2XDCLM1100A | 02988 | 11.0 | 12 | 149 | 93 | 74 | 1.70 |
| 2XDCLM1110A | 04027 | 11.1 | 12 | 155 | 102 | 82 | 1.72 |
| 2XDCLM1120A | 02990 | 11.2 | 12 | 155 | 102 | 82 | 1.74 |
| 2XDCLM1130A | 04028 | 11.3 | 12 | 155 | 102 | 82 | 1.75 |
| 2XDCLM1140A | 04022 | 11.4 | 12 | 155 | 102 | 82 | 1.77 |
| 2XDCLM1150A | 02991 | 11.5 | 12 | 155 | 102 | 82 | 1.78 |
| 2XDCLM1160A | 04029 | 11.6 | 12 | 155 | 102 | 82 | 1.80 |
| 2XDCLM1170A | 02992 | 11.7 | 12 | 155 | 102 | 82 | 1.81 |
| 2XDCLM1180A | 96602 | 11.8 | 12 | 155 | 102 | 82 | 1.83 |
| 2XDCLM1190A | 04023 | 11.9 | 12 | 155 | 102 | 82 | 1.84 |
| 2XDCLM1200A | 02994 | 12.0 | 12 | 155 | 102 | 82 | 1.86 |



TuffCut XR - XT

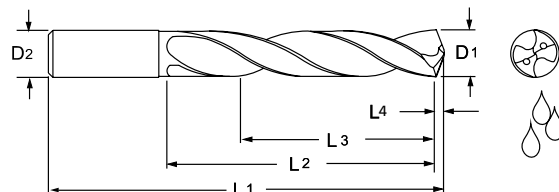
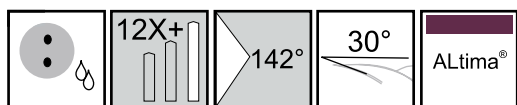
TuffCut X-AL

TuffCut Die & Mould

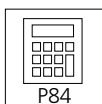
Twister Drills

Technical Section

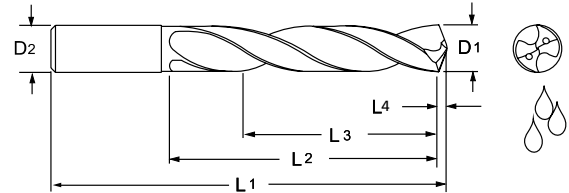
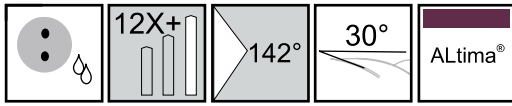
Twister ^{XTreme Drilling} 2XDCEM



| Metric No. | EDP | D1 h7 | D2 h6 | L1 | L2 | L3 Ref. | L4 | L2/D1 | L3/D1 |
|--------------|-------|-------|-------|-----|-----|---------|------|-------|-------|
| 2XDCEM 0300A | 04300 | 3.00 | 3 | 125 | 75 | 60 | 0.46 | 25 | 20 |
| 2XDCEM 0318A | 04302 | 3.18 | 4 | 163 | 100 | 80 | 0.49 | 31 | 25 |
| 2XDCEM 0320A | 04304 | 3.20 | 4 | 163 | 100 | 80 | 0.50 | 31 | 25 |
| 2XDCEM 0330A | 04306 | 3.30 | 4 | 163 | 100 | 80 | 0.51 | 30 | 24 |
| 2XDCEM 0340A | 04308 | 3.40 | 4 | 163 | 100 | 80 | 0.53 | 29 | 24 |
| 2XDCEM 0360A | 04310 | 3.60 | 4 | 163 | 100 | 80 | 0.56 | 28 | 22 |
| 2XDCEM 0380A | 04312 | 3.80 | 4 | 163 | 100 | 80 | 0.59 | 26 | 21 |
| 2XDCEM 0390A | 04314 | 3.90 | 4 | 163 | 100 | 80 | 0.60 | 26 | 21 |
| 2XDCEM 0400A | 04316 | 4.00 | 4 | 163 | 100 | 80 | 0.62 | 25 | 20 |
| 2XDCEM 0420A | 04318 | 4.20 | 5 | 163 | 105 | 84 | 0.65 | 25 | 20 |
| 2XDCEM 0430A | 04320 | 4.30 | 5 | 163 | 105 | 84 | 0.67 | 24 | 20 |
| 2XDCEM 0440A | 04322 | 4.40 | 5 | 163 | 105 | 84 | 0.68 | 24 | 19 |
| 2XDCEM 0460A | 04324 | 4.60 | 5 | 163 | 105 | 84 | 0.71 | 23 | 18 |
| 2XDCEM 0476A | 04326 | 4.76 | 5 | 163 | 105 | 84 | 0.74 | 22 | 18 |
| 2XDCEM 0480A | 04328 | 4.80 | 5 | 163 | 105 | 84 | 0.74 | 22 | 18 |
| 2XDCEM 0490A | 04330 | 4.90 | 5 | 163 | 105 | 84 | 0.76 | 21 | 17 |
| 2XDCEM 0500A | 04332 | 5.00 | 5 | 163 | 105 | 84 | 0.77 | 21 | 17 |
| 2XDCEM 0520A | 04334 | 5.20 | 6 | 163 | 110 | 88 | 0.81 | 21 | 17 |
| 2XDCEM 0540A | 04336 | 5.40 | 6 | 163 | 110 | 88 | 0.84 | 20 | 16 |
| 2XDCEM 0560A | 04338 | 5.60 | 6 | 163 | 110 | 88 | 0.87 | 20 | 16 |
| 2XDCEM 0580A | 04340 | 5.80 | 6 | 163 | 110 | 88 | 0.90 | 19 | 15 |
| 2XDCEM 0600A | 04342 | 6.00 | 6 | 163 | 110 | 88 | 0.93 | 18 | 15 |
| 2XDCEM 0620A | 04344 | 6.20 | 8 | 163 | 110 | 88 | 0.96 | 18 | 14 |
| 2XDCEM 0630A | 04346 | 6.30 | 8 | 163 | 110 | 88 | 0.98 | 17 | 14 |
| 2XDCEM 0635A | 04348 | 6.35 | 8 | 163 | 110 | 88 | 0.98 | 17 | 14 |
| 2XDCEM 0680A | 04350 | 6.80 | 8 | 163 | 110 | 88 | 1.05 | 16 | 13 |
| 2XDCEM 0700A | 04352 | 7.00 | 8 | 163 | 110 | 88 | 1.08 | 16 | 13 |
| 2XDCEM 0760A | 04354 | 7.60 | 8 | 163 | 120 | 96 | 1.18 | 16 | 13 |
| 2XDCEM 0780A | 04356 | 7.80 | 8 | 163 | 120 | 96 | 1.21 | 15 | 12 |
| 2XDCEM 0794A | 04358 | 7.94 | 8 | 163 | 120 | 96 | 1.23 | 15 | 12 |
| 2XDCEM 0800A | 04360 | 8.00 | 8 | 163 | 120 | 96 | 1.24 | 15 | 12 |
| 2XDCEM 0820A | 04362 | 8.20 | 10 | 180 | 135 | 108 | 1.27 | 16 | 13 |
| 2XDCEM 0850A | 04364 | 8.50 | 10 | 180 | 135 | 108 | 1.32 | 16 | 13 |
| 2XDCEM 0870A | 04366 | 8.70 | 10 | 180 | 135 | 108 | 1.35 | 16 | 12 |
| 2XDCEM 0900A | 04368 | 9.00 | 10 | 180 | 135 | 108 | 1.39 | 15 | 12 |
| 2XDCEM 0940A | 04370 | 9.40 | 10 | 195 | 150 | 120 | 1.46 | 16 | 13 |
| 2XDCEM 0953A | 04372 | 9.53 | 10 | 195 | 150 | 120 | 1.48 | 16 | 13 |
| 2XDCEM 0980A | 04374 | 9.80 | 10 | 195 | 150 | 120 | 1.52 | 15 | 12 |
| 2XDCEM 1000A | 04376 | 10.00 | 10 | 195 | 150 | 120 | 1.55 | 15 | 12 |



Twister ^{Xtreme Drilling} XD 2XDCEM



| Metric No. | EDP | D1 h7 | D2 h6 | L1 | L2 | L3 Ref. | L4 | L2/D1 | L3/D1 |
|--------------|-------|-------|-------|-----|-----|---------|------|-------|-------|
| 2XDCEM 1030A | 04378 | 10.30 | 12 | 210 | 160 | 128 | 1.60 | 16 | 12 |
| 2XDCEM 1050A | 04380 | 10.50 | 12 | 210 | 160 | 128 | 1.63 | 15 | 12 |
| 2XDCEM 1080A | 04382 | 10.80 | 12 | 210 | 160 | 128 | 1.67 | 15 | 12 |
| 2XDCEM 1100A | 04384 | 11.00 | 12 | 210 | 160 | 128 | 1.70 | 15 | 12 |
| 2XDCEM 1111A | 04386 | 11.11 | 12 | 210 | 160 | 128 | 1.72 | 14 | 12 |
| 2XDCEM 1150A | 04388 | 11.50 | 12 | 210 | 160 | 128 | 1.78 | 14 | 11 |
| 2XDCEM 1180A | 04390 | 11.80 | 12 | 210 | 160 | 128 | 1.83 | 14 | 11 |
| 2XDCEM 1200A | 04392 | 12.00 | 12 | 210 | 160 | 128 | 1.86 | 13 | 11 |
| 2XDCEM 1270A | 04394 | 12.70 | 14 | 230 | 180 | 144 | 1.97 | 14 | 11 |



TuffCut XR - XT

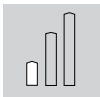
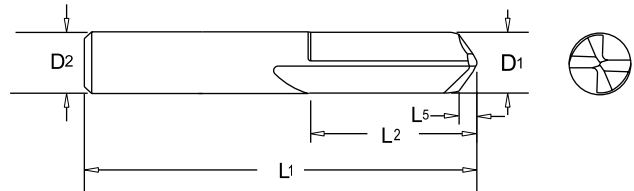
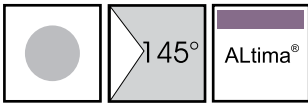
TuffCut X-AL

TuffCut Die & Mould

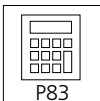
Twister Drills

Technical Section

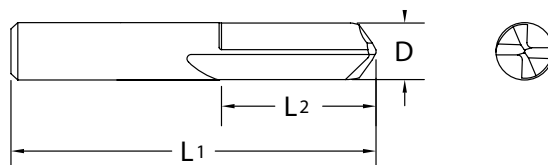
Twister 200S Spot Drill



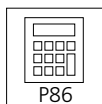
| Metric No. | EDP | D1 | D2 | L1 | L2 | L5 |
|------------|-------|----|----|----|----|------|
| 200S 0300A | 20221 | 3 | 3 | 38 | 16 | 0.41 |
| 200S 0600A | 20431 | 6 | 6 | 51 | 19 | 0.83 |
| 200S 0800A | 20545 | 8 | 8 | 64 | 19 | 1.10 |
| 200S 1000A | 20647 | 10 | 10 | 70 | 25 | 1.38 |
| 200S 1200A | 20731 | 12 | 12 | 76 | 25 | 1.65 |
| 200S 1600A | 20785 | 16 | 16 | 89 | 32 | 2.20 |



Twister 200A



| Tool No. | EDP | D | L1 | L2 |
|-----------|-------|------|----|------|
| 200 0100A | - | 1.0 | 38 | 6.5 |
| 200 0150A | - | 1.5 | 38 | 8.0 |
| 200 0200A | - | 2.00 | 38 | 9.5 |
| 200 0250A | - | 2.50 | 38 | 12.5 |
| 200 0300A | 96400 | 3.00 | 38 | 16.0 |
| 200 0310A | 96401 | 3.10 | 38 | 16.0 |
| 200 0320A | 96402 | 3.20 | 38 | 16.0 |
| 200 0330A | 96403 | 3.30 | 38 | 16.0 |
| 200 0340A | 96404 | 3.40 | 51 | 16.0 |
| 200 0350A | 96405 | 3.50 | 51 | 16.0 |
| 200 0360A | 96406 | 3.60 | 51 | 16.0 |
| 200 0370A | 96407 | 3.70 | 51 | 16.0 |
| 200 0380A | 96408 | 3.80 | 51 | 16.0 |
| 200 0390A | 96409 | 3.90 | 51 | 16.0 |
| 200 0400A | 96410 | 4.00 | 51 | 16.0 |
| 200 0410A | 96411 | 4.10 | 51 | 16.0 |
| 200 0420A | 96412 | 4.20 | 51 | 16.0 |
| 200 0430A | 96413 | 4.30 | 51 | 16.0 |
| 200 0440A | 96414 | 4.40 | 51 | 16.0 |
| 200 0450A | 96415 | 4.50 | 51 | 16.0 |
| 200 0460A | 96416 | 4.60 | 51 | 16.0 |
| 200 0470A | 96417 | 4.70 | 51 | 16.0 |
| 200 0480A | 96418 | 4.80 | 51 | 16.0 |
| 200 0490A | 96419 | 4.90 | 51 | 16.0 |
| 200 0500A | 96420 | 5.00 | 51 | 19.0 |
| 200 0510A | 96421 | 5.10 | 51 | 19.0 |
| 200 0520A | 96422 | 5.20 | 51 | 19.0 |
| 200 0530A | 96423 | 5.30 | 51 | 19.0 |
| 200 0540A | 96424 | 5.40 | 51 | 19.0 |
| 200 0550A | 96425 | 5.50 | 51 | 19.0 |
| 200 0560A | 96426 | 5.60 | 51 | 19.0 |
| 200 0570A | 96427 | 5.70 | 51 | 19.0 |
| 200 0580A | 96428 | 5.80 | 51 | 19.0 |
| 200 0590A | 96429 | 5.90 | 51 | 19.0 |
| 200 0600A | 96430 | 6.00 | 51 | 19.0 |
| 200 0610A | 96431 | 6.10 | 51 | 19.0 |



TuffCut XR - XT

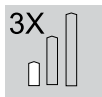
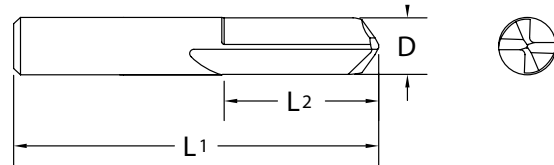
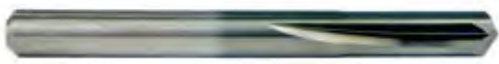
TuffCut X-AL

TuffCut Die & Mould

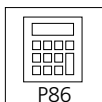
Twister Drills

Technical Section

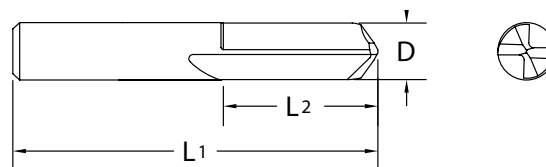
Twister 200A



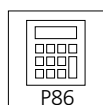
| Tool No. | EDP | D | L1 | L2 |
|-----------|-------|------|----|------|
| 200 0620A | 96432 | 6.20 | 51 | 19.0 |
| 200 0630A | 96433 | 6.30 | 51 | 19.0 |
| 200 0640A | 96434 | 6.40 | 51 | 19.0 |
| 200 0650A | 96435 | 6.50 | 51 | 19.0 |
| 200 0660A | 96436 | 6.60 | 64 | 19.0 |
| 200 0670A | 96437 | 6.70 | 64 | 19.0 |
| 200 0680A | 96438 | 6.80 | 64 | 19.0 |
| 200 0690A | 96439 | 6.90 | 64 | 19.0 |
| 200 0700A | 96440 | 7.00 | 64 | 19.0 |
| 200 0710A | 96441 | 7.10 | 64 | 19.0 |
| 200 0720A | 96442 | 7.20 | 64 | 19.0 |
| 200 0730A | 96443 | 7.30 | 64 | 19.0 |
| 200 0740A | 96444 | 7.40 | 64 | 19.0 |
| 200 0750A | 96445 | 7.50 | 64 | 19.0 |
| 200 0760A | 96446 | 7.60 | 64 | 19.0 |
| 200 0770A | 96447 | 7.70 | 64 | 19.0 |
| 200 0780A | 96448 | 7.80 | 64 | 19.0 |
| 200 0790A | 96449 | 7.90 | 64 | 19.0 |
| 200 0800A | 96450 | 8.00 | 64 | 19.0 |
| 200 0810A | 96451 | 8.10 | 64 | 19.0 |
| 200 0820A | 96452 | 8.20 | 64 | 25.5 |
| 200 0830A | 96453 | 8.30 | 64 | 25.5 |
| 200 0840A | 96454 | 8.40 | 64 | 25.5 |
| 200 0850A | 96455 | 8.50 | 64 | 25.5 |
| 200 0860A | 96456 | 8.60 | 64 | 25.5 |
| 200 0870A | 96457 | 8.70 | 64 | 25.5 |
| 200 0880A | 96458 | 8.80 | 64 | 25.5 |
| 200 0890A | 96459 | 8.90 | 64 | 25.5 |
| 200 0900A | 96460 | 9.00 | 64 | 25.5 |
| 200 0910A | 96461 | 9.10 | 64 | 25.5 |
| 200 0920A | 96462 | 9.20 | 64 | 25.5 |
| 200 0930A | 96463 | 9.30 | 64 | 25.5 |
| 200 0940A | 96464 | 9.40 | 64 | 25.5 |
| 200 0950A | 96465 | 9.50 | 64 | 25.5 |
| 200 0960A | 96466 | 9.60 | 64 | 25.5 |
| 200 0970A | 96467 | 9.70 | 70 | 25.5 |



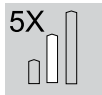
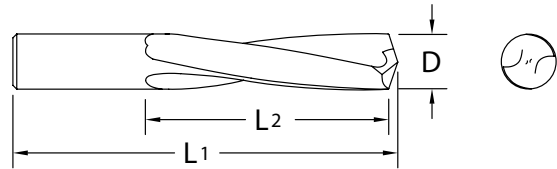
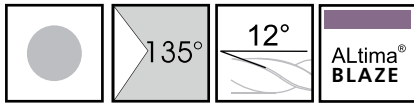
Twister 200A



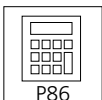
| Tool No. | EDP | D | L1 | L2 |
|-----------|-------|-------|----|------|
| 200 0980A | 96468 | 9.80 | 70 | 25.5 |
| 200 0990A | 96469 | 9.90 | 70 | 25.5 |
| 200 1000A | 96470 | 10.00 | 70 | 25.5 |
| 200 1010A | 96471 | 10.10 | 70 | 25.5 |
| 200 1020A | 96472 | 10.20 | 70 | 25.5 |
| 200 1030A | 96473 | 10.30 | 70 | 25.5 |
| 200 1040A | 96474 | 10.40 | 70 | 25.5 |
| 200 1050A | 96475 | 10.50 | 70 | 25.5 |
| 200 1060A | 96476 | 10.60 | 70 | 25.5 |
| 200 1070A | 96477 | 10.70 | 70 | 25.5 |
| 200 1080A | 96478 | 10.80 | 70 | 25.5 |
| 200 1090A | 96479 | 10.90 | 70 | 25.5 |
| 200 1100A | 96480 | 11.00 | 70 | 25.5 |
| 200 1110A | 96481 | 11.10 | 70 | 25.5 |
| 200 1120A | 96482 | 11.20 | 70 | 25.5 |
| 200 1130A | 96483 | 11.30 | 76 | 25.5 |
| 200 1140A | 96484 | 11.40 | 76 | 25.5 |
| 200 1150A | 96485 | 11.50 | 76 | 25.5 |
| 200 1160A | 96486 | 11.60 | 76 | 25.5 |
| 200 1170A | 96487 | 11.70 | 76 | 25.5 |
| 200 1180A | 96488 | 11.80 | 76 | 25.5 |
| 200 1190A | 96489 | 11.90 | 76 | 25.5 |
| 200 1200A | 96490 | 12.00 | 76 | 25.5 |
| 200 1250A | 96491 | 12.50 | 76 | 25.5 |
| 200 1300A | 96492 | 13.00 | 89 | 28.5 |
| 200 1350A | 96493 | 13.50 | 89 | 28.5 |
| 200 1400A | 96494 | 14.00 | 89 | 28.5 |
| 200 1450A | 96495 | 14.50 | 89 | 32.0 |
| 200 1500A | 96496 | 15.00 | 89 | 32.0 |
| 200 1550A | 96497 | 15.50 | 89 | 32.0 |
| 200 1600A | 96498 | 16.00 | 89 | 32.0 |



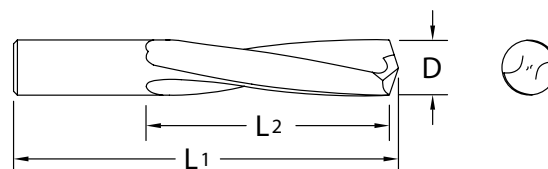
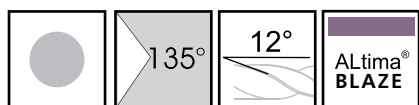
Twister 205B



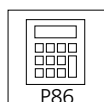
| Tool No. | EDP | D | L1 | L2 |
|-----------|-------|------|----|------|
| 205 0030B | 21686 | 0.30 | 38 | 5.0 |
| 205 0035B | 21687 | 0.35 | 38 | 5.0 |
| 205 0040B | 21688 | 0.40 | 38 | 5.0 |
| 205 0045B | 21689 | 0.45 | 38 | 5.0 |
| 205 0050B | 21690 | 0.50 | 38 | 6.5 |
| 205 0055B | 21691 | 0.55 | 38 | 6.5 |
| 205 0060B | 21692 | 0.60 | 38 | 6.5 |
| 205 0065B | 21693 | 0.65 | 38 | 8.0 |
| 205 0070B | 21694 | 0.70 | 38 | 8.0 |
| 205 0075B | 21695 | 0.75 | 38 | 8.0 |
| 205 0080B | 21696 | 0.80 | 38 | 9.5 |
| 205 0085B | 21697 | 0.85 | 38 | 9.5 |
| 205 0090B | 21698 | 0.90 | 38 | 11.0 |
| 205 0095B | 21699 | 0.95 | 38 | 11.0 |
| 205 0100B | 21701 | 1.00 | 38 | 12.5 |
| 205 0105B | 21702 | 1.05 | 38 | 12.5 |
| 205 0110B | 21703 | 1.10 | 38 | 12.5 |
| 205 0115B | 21704 | 1.15 | 38 | 12.5 |
| 205 0120B | 21706 | 1.20 | 38 | 12.5 |
| 205 0125B | 21707 | 1.25 | 41 | 16.0 |
| 205 0130B | 21708 | 1.30 | 41 | 16.0 |
| 205 0135B | 21709 | 1.35 | 41 | 16.0 |
| 205 0140B | 21710 | 1.40 | 41 | 16.0 |
| 205 0145B | 21711 | 1.45 | 41 | 16.0 |
| 205 0150B | 21712 | 1.50 | 41 | 16.0 |
| 205 0160B | 21714 | 1.60 | 41 | 16.0 |
| 205 0170B | 21715 | 1.70 | 43 | 17.5 |
| 205 0180B | 21717 | 1.80 | 43 | 17.5 |
| 205 0190B | 21718 | 1.90 | 43 | 17.5 |
| 205 0200B | 21720 | 2.00 | 44 | 19.0 |
| 205 0210B | 21721 | 2.10 | 44 | 19.0 |
| 205 0220B | 21722 | 2.20 | 44 | 19.0 |
| 205 0230B | 21724 | 2.30 | 44 | 19.0 |
| 205 0240B | 21726 | 2.40 | 44 | 19.0 |



Twister 205B



| Tool No. | EDP | D | L1 | L2 |
|-----------|-------|------|----|------|
| 205 0250B | 21727 | 2.50 | 46 | 21.0 |
| 205 0260B | 21729 | 2.60 | 46 | 20.5 |
| 205 0270B | 21730 | 2.70 | 46 | 20.5 |
| 205 0280B | 21731 | 2.80 | 48 | 22.0 |
| 205 0290B | 21732 | 2.90 | 48 | 22.0 |
| 205 0300B | 21733 | 3.00 | 48 | 22.0 |
| 205 0310B | 21734 | 3.10 | 48 | 22.0 |
| 205 0320B | 21736 | 3.20 | 48 | 22.0 |
| 205 0320B | 21737 | 3.30 | 49 | 24.0 |
| 205 0330B | 21738 | 3.40 | 49 | 24.0 |
| 205 0350B | 21739 | 3.50 | 49 | 24.0 |
| 205 0360B | 21740 | 3.60 | 49 | 24.0 |
| 205 0370B | 21742 | 3.70 | 52 | 25.5 |
| 205 0380B | 21743 | 3.80 | 52 | 25.5 |
| 205 0390B | 21744 | 3.90 | 52 | 25.5 |
| 205 0400B | 21746 | 4.00 | 54 | 27.0 |
| 205 0410B | 21747 | 4.10 | 54 | 27.0 |
| 205 0420B | 21748 | 4.20 | 54 | 27.0 |
| 205 0430B | 21749 | 4.30 | 54 | 27.0 |
| 205 0450B | 21751 | 4.50 | 56 | 28.5 |
| 205 0460B | 21752 | 4.60 | 56 | 28.5 |
| 205 0470B | 21753 | 4.70 | 57 | 30.0 |
| 205 0480B | 21755 | 4.80 | 57 | 30.0 |
| 205 0490B | 21756 | 4.90 | 57 | 30.0 |
| 205 0500B | 21757 | 5.00 | 57 | 30.0 |
| 205 0510B | 21758 | 5.10 | 57 | 30.0 |
| 205 0520B | 21760 | 5.20 | 60 | 32.0 |
| 205 0530B | 21761 | 5.30 | 60 | 32.0 |
| 205 0540B | 21762 | 5.40 | 60 | 32.0 |
| 205 0550B | 21763 | 5.50 | 60 | 32.0 |
| 205 0560B | 21765 | 5.60 | 62 | 33.4 |
| 205 0570B | 21766 | 5.70 | 62 | 33.4 |
| 205 0580B | 21767 | 5.80 | 62 | 33.4 |
| 205 0590B | 21768 | 5.90 | 62 | 33.4 |



TuffCut XR - XT

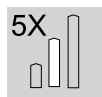
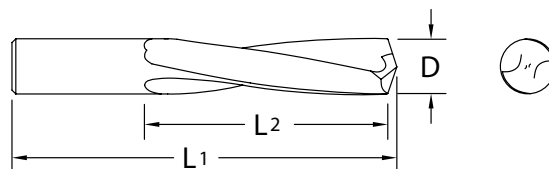
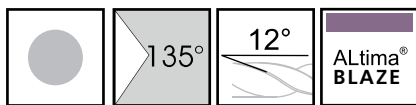
TuffCut X-AL

TuffCut Die & Mould

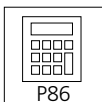
Twister Drills

Technical Section

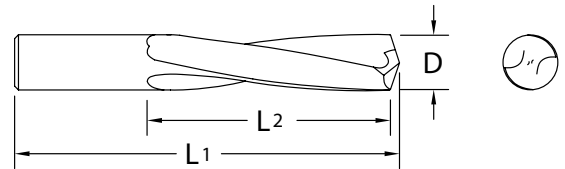
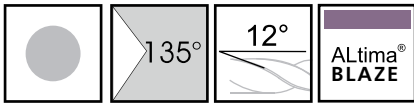
Twister 205B



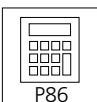
| Tool No. | EDP | D | L1 | L2 |
|-----------|-------|------|----|------|
| 205 0600B | 21770 | 6.0 | 64 | 35.0 |
| 205 0610B | 21771 | 6.1 | 64 | 35.0 |
| 205 0620B | 21772 | 6.2 | 64 | 35.0 |
| 205 0630B | 21773 | 6.3 | 64 | 35.0 |
| 205 0640B | 21775 | 6.4 | 64 | 35.0 |
| 205 0650B | 21776 | 6.5 | 67 | 36.5 |
| 205 0660B | 21777 | 6.6 | 67 | 36.5 |
| 205 0670B | 21778 | 6.7 | 67 | 36.5 |
| 205 0680B | 21780 | 6.8 | 68 | 38.0 |
| 205 0690B | 21781 | 6.9 | 68 | 38.0 |
| 205 0700B | 21782 | 7.0 | 68 | 38.0 |
| 205 0710B | 21783 | 7.10 | 68 | 38.0 |
| 205 0720B | 21785 | 7.20 | 68 | 38.0 |
| 205 0730B | 21786 | 7.30 | 68 | 38.0 |
| 205 0740B | 21787 | 7.40 | 70 | 39.5 |
| 205 0750B | 21788 | 7.5 | 70 | 40.0 |
| 205 0760B | 21790 | 7.6 | 70 | 39.5 |
| 205 0770B | 21791 | 7.7 | 71 | 41.5 |
| 205 0780B | 21792 | 7.8 | 71 | 41.5 |
| 205 0790B | 21793 | 7.9 | 71 | 41.5 |
| 205 0800B | 21795 | 8.0 | 71 | 41.5 |
| 205 0810B | 21796 | 8.10 | 75 | 43.0 |
| 205 0820B | 21797 | 8.20 | 75 | 43.0 |
| 205 0830B | 21798 | 8.30 | 75 | 43.0 |
| 205 0840B | 21800 | 8.40 | 75 | 43.0 |
| 205 0850B | 21801 | 8.5 | 75 | 43.0 |
| 205 0860B | 21802 | 8.6 | 75 | 43.0 |
| 205 0870B | 21803 | 8.7 | 75 | 43.0 |
| 205 0880B | 21805 | 8.8 | 75 | 43.0 |
| 205 0890B | 21806 | 8.9 | 78 | 44.5 |
| 205 0900B | 21807 | 9.0 | 78 | 44.5 |
| 205 0910B | 21808 | 9.1 | 78 | 44.5 |
| 205 0920B | 21810 | 9.2 | 78 | 44.5 |
| 205 0930B | 21811 | 9.3 | 79 | 46.0 |



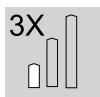
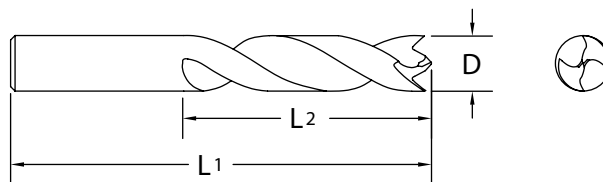
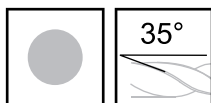
Twister 205B



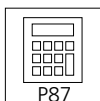
| Tool No. | EDP | D | L1 | L2 |
|-----------|-------|------|-----|------|
| 205 0940B | 21812 | 9.4 | 79 | 46.0 |
| 205 0950B | 21813 | 9.5 | 79 | 46.0 |
| 205 0960B | 21815 | 9.6 | 83 | 47.5 |
| 205 0970B | 21816 | 9.7 | 83 | 47.5 |
| 205 0980B | 21817 | 9.8 | 83 | 47.5 |
| 205 0990B | 21819 | 9.9 | 83 | 47.5 |
| 205 1000B | 21820 | 10.0 | 84 | 49.0 |
| 205 1010B | 21821 | 10.1 | 84 | 49.0 |
| 205 1020B | 21822 | 10.2 | 84 | 49.0 |
| 205 1030B | 21823 | 10.3 | 84 | 49.0 |
| 205 1040B | 21825 | 10.4 | 84 | 49.0 |
| 205 1050B | 21826 | 10.5 | 86 | 51.0 |
| 205 1060B | 21828 | 10.6 | 86 | 51.0 |
| 205 1070B | 21829 | 10.7 | 86 | 51.0 |
| 205 1080B | 21830 | 10.8 | 86 | 51.0 |
| 205 1090B | 21831 | 10.9 | 87 | 52.5 |
| 205 1100B | 21832 | 11.0 | 87 | 52.5 |
| 205 1110B | 21833 | 11.1 | 87 | 52.5 |
| 205 1120B | 21835 | 11.2 | 92 | 54.0 |
| 205 1130B | 21836 | 11.3 | 92 | 54.0 |
| 205 1140B | 21837 | 11.4 | 92 | 54.0 |
| 205 1150B | 21838 | 11.5 | 92 | 54.0 |
| 205 1160B | 21840 | 11.6 | 92 | 54.0 |
| 205 1170B | 21841 | 11.7 | 92 | 54.0 |
| 205 1180B | 21842 | 11.8 | 92 | 54.0 |
| 205 1190B | 21843 | 11.9 | 92 | 54.0 |
| 205 1200B | 21845 | 12.0 | 94 | 56.0 |
| 205 1300B | 21848 | 13.0 | 98 | 60.5 |
| 205 1400B | 21849 | 14.0 | 102 | 63.5 |
| 205 1500B | 21851 | 15.0 | 105 | 66.5 |
| 205 1600B | 21853 | 16.0 | 108 | 70.0 |
| 205 1700B | 21854 | 17.0 | 117 | 73.0 |
| 205 1800B | 21856 | 18.0 | 121 | 76.0 |
| 205 1900B | 21857 | 19.0 | 127 | 79.5 |
| 205 2000B | 21859 | 20.0 | 133 | 83.0 |



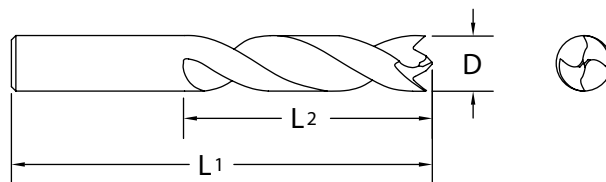
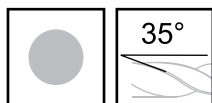
Twister 207



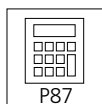
| Tool No. | EDP | D | L1 | L2 |
|----------|-------|------|----|------|
| 207 0240 | 27007 | 2.40 | 44 | 12.5 |
| 207 0250 | 27016 | 2.50 | 46 | 12.5 |
| 207 0260 | 27025 | 2.60 | 46 | 12.5 |
| 207 0270 | 27031 | 2.70 | 46 | 12.5 |
| 207 0280 | 27043 | 2.80 | 48 | 16.0 |
| 207 0290 | 27052 | 2.90 | 48 | 16.0 |
| 207 0300 | 27058 | 3.00 | 48 | 16.0 |
| 207 0310 | 27064 | 3.10 | 48 | 16.0 |
| 207 0320 | 27070 | 3.20 | 48 | 16.0 |
| 207 0330 | 27076 | 3.30 | 49 | 17.5 |
| 207 0340 | 27079 | 3.40 | 49 | 17.5 |
| 207 0350 | 27085 | 3.50 | 49 | 17.5 |
| 207 0360 | 27094 | 3.60 | 49 | 17.5 |
| 207 0370 | 27100 | 3.70 | 52 | 19.0 |
| 207 0380 | 27109 | 3.80 | 52 | 19.0 |
| 207 0390 | 27115 | 3.90 | 52 | 19.0 |
| 207 0400 | 27127 | 4.00 | 54 | 22.0 |
| 207 0410 | 27136 | 4.10 | 54 | 22.0 |
| 207 0420 | 27139 | 4.20 | 54 | 22.0 |
| 207 0430 | 27145 | 4.30 | 54 | 22.0 |
| 207 0440 | 27157 | 4.40 | 56 | 24.0 |
| 207 0450 | 27163 | 4.50 | 56 | 24.0 |
| 207 0460 | 27169 | 4.60 | 56 | 24.0 |
| 207 0480 | 27181 | 4.80 | 57 | 25.5 |
| 207 0490 | 27190 | 4.90 | 57 | 25.5 |
| 207 0500 | 27199 | 5.00 | 57 | 25.5 |
| 207 0510 | 27205 | 5.10 | 57 | 25.5 |
| 207 0520 | 27217 | 5.20 | 60 | 27.0 |
| 207 0530 | 27223 | 5.30 | 60 | 27.0 |
| 207 0540 | 27229 | 5.40 | 60 | 27.0 |
| 207 0550 | 27235 | 5.50 | 60 | 27.0 |
| 207 0560 | 27241 | 5.60 | 62 | 28.5 |
| 207 0570 | 27247 | 5.70 | 62 | 28.5 |
| 207 0580 | 27253 | 5.80 | 62 | 28.5 |
| 207 0590 | 27256 | 5.90 | 62 | 28.5 |
| 207 0600 | 27265 | 6.00 | 64 | 32.0 |



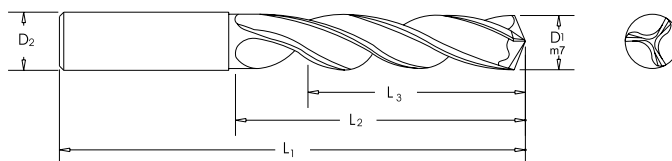
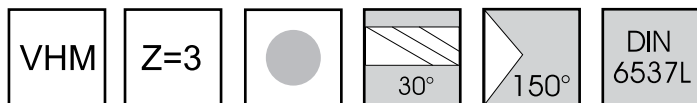
Twister 207



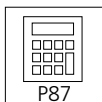
| Tool No. | EDP | D | L1 | L2 |
|----------|-------|-------|----|------|
| 207 0610 | 27271 | 6.10 | 64 | 32.0 |
| 207 0620 | 27277 | 6.20 | 64 | 32.0 |
| 207 0630 | 27283 | 6.30 | 64 | 32.0 |
| 207 0640 | 27289 | 6.40 | 64 | 32.0 |
| 207 0650 | 27292 | 6.50 | 67 | 33.5 |
| 207 0700 | 27310 | 7.00 | 68 | 35.0 |
| 207 0750 | 27328 | 7.50 | 70 | 35.0 |
| 207 0800 | 27340 | 8.00 | 71 | 38.0 |
| 207 0850 | 27355 | 8.50 | 75 | 39.5 |
| 207 0900 | 27367 | 9.00 | 78 | 39.5 |
| 207 0950 | 27379 | 9.50 | 79 | 41.5 |
| 207 1000 | 27394 | 10.00 | 84 | 44.5 |
| 207 1050 | 27409 | 10.50 | 86 | 46.0 |
| 207 1100 | 27415 | 11.00 | 87 | 47.5 |
| 207 1150 | 27421 | 11.50 | 92 | 51.0 |
| 207 1200 | 27430 | 12.00 | 94 | 54.0 |



Twister® X-AL Series 229

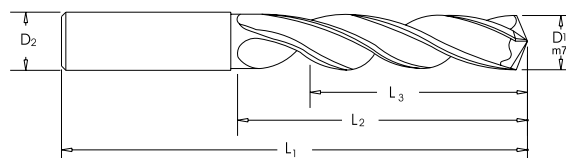
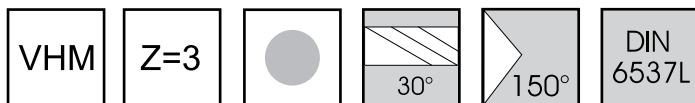


| Tool No. | EDP | D1 Tol m7 | D2 | L1 | L2 | L3 |
|----------|-------|-----------|-----|----|------|----|
| 229 0200 | 22950 | 2.0 | 2 | 38 | 16 | 12 |
| 229 0230 | 23058 | 2.3 | 2.3 | 43 | 20.5 | 15 |
| 229 0250 | 22951 | 2.5 | 2.5 | 43 | 20.5 | 15 |
| 229 0290 | 22952 | 2.9 | 2.9 | 46 | 25 | 19 |
| 229 0300 | 22953 | 3.0 | 6 | 66 | 28 | 23 |
| 229 0310 | 23063 | 3.1 | 6 | 66 | 28 | 23 |
| 229 0320 | 22945 | 3.2 | 6 | 66 | 28 | 23 |
| 229 0330 | 22954 | 3.3 | 6 | 66 | 28 | 23 |
| 229 0340 | 22949 | 3.4 | 6 | 66 | 28 | 23 |
| 229 0350 | 22955 | 3.5 | 6 | 66 | 28 | 23 |
| 229 0360 | 22992 | 3.6 | 6 | 66 | 28 | 23 |
| 229 0370 | 22994 | 3.7 | 6 | 66 | 28 | 23 |
| 229 0380 | 22996 | 3.8 | 6 | 74 | 36 | 29 |
| 229 0390 | 22997 | 3.9 | 6 | 74 | 36 | 29 |
| 229 0400 | 22956 | 4.0 | 6 | 74 | 36 | 29 |
| 229 0410 | 22998 | 4.1 | 6 | 74 | 36 | 29 |
| 229 0420 | 22957 | 4.2 | 6 | 74 | 36 | 29 |
| 229 0440 | 22999 | 4.4 | 6 | 74 | 36 | 29 |
| 229 0450 | 22958 | 4.5 | 6 | 74 | 36 | 29 |
| 229 0460 | 23000 | 4.6 | 6 | 74 | 36 | 29 |
| 229 0480 | 23001 | 4.8 | 6 | 82 | 44 | 35 |
| 229 0490 | 23002 | 4.9 | 6 | 82 | 44 | 35 |
| 229 0500 | 22959 | 5.0 | 6 | 82 | 44 | 35 |
| 229 0520 | 23003 | 5.2 | 6 | 82 | 44 | 35 |
| 229 0550 | 22960 | 5.5 | 6 | 82 | 44 | 35 |
| 229 0560 | 23004 | 5.6 | 6 | 82 | 44 | 35 |
| 229 0600 | 22961 | 6.0 | 6 | 82 | 44 | 35 |
| 229 0620 | 22980 | 6.2 | 8 | 91 | 53 | 43 |
| 229 0650 | 22962 | 6.5 | 8 | 91 | 53 | 43 |
| 229 0670 | 22979 | 6.7 | 8 | 91 | 53 | 43 |
| 229 0680 | 22963 | 6.8 | 8 | 91 | 53 | 43 |
| 229 0700 | 22964 | 7.0 | 8 | 91 | 53 | 43 |
| 229 0720 | 23005 | 7.2 | 8 | 91 | 53 | 43 |
| 229 0730 | 22940 | 7.3 | 8 | 91 | 53 | 43 |

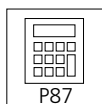


Available with Fordlube upon request.

Twister® X-AL Series 229



| Tool No. | EDP | D1 Tol m7 | D2 | L1 | L2 | L3 |
|----------|-------|-----------|----|-----|----|----|
| 229 0740 | 22965 | 7.4 | 8 | 91 | 53 | 43 |
| 229 0750 | 22966 | 7.5 | 8 | 91 | 53 | 43 |
| 229 0780 | 23006 | 7.8 | 8 | 91 | 53 | 43 |
| 229 0800 | 22967 | 8.0 | 8 | 91 | 53 | 43 |
| 229 0810 | 23008 | 8.1 | 10 | 103 | 61 | 49 |
| 229 0840 | 22985 | 8.4 | 10 | 103 | 61 | 49 |
| 229 0850 | 22968 | 8.5 | 10 | 103 | 61 | 49 |
| 229 0900 | 22989 | 9.0 | 10 | 103 | 61 | 49 |
| 229 0950 | 23009 | 9.5 | 10 | 103 | 61 | 49 |
| 229 0970 | 23011 | 9.7 | 10 | 103 | 61 | 49 |
| 229 1000 | 22969 | 10.0 | 10 | 103 | 61 | 49 |
| 229 1020 | 22970 | 10.2 | 12 | 118 | 71 | 56 |
| 229 1040 | 23012 | 10.4 | 12 | 118 | 71 | 56 |
| 229 1050 | 22986 | 10.5 | 12 | 118 | 71 | 56 |
| 229 1060 | 23013 | 10.6 | 12 | 118 | 71 | 56 |
| 229 1100 | 22993 | 11.0 | 12 | 118 | 71 | 56 |
| 229 1150 | 23014 | 11.5 | 12 | 118 | 71 | 56 |
| 229 1200 | 22971 | 12.0 | 12 | 118 | 71 | 56 |
| 229 1250 | 22988 | 12.5 | 14 | 124 | 77 | 60 |
| 229 1300 | 23015 | 13.0 | 14 | 124 | 77 | 60 |
| 229 1350 | 23017 | 13.5 | 14 | 124 | 77 | 60 |
| 229 1400 | 23018 | 14.0 | 14 | 124 | 77 | 60 |
| 229 1450 | 23020 | 14.5 | 16 | 133 | 83 | 63 |
| 229 1500 | 23021 | 15.0 | 16 | 133 | 83 | 63 |
| 229 1550 | 23022 | 15.5 | 16 | 133 | 83 | 63 |
| 229 1580 | 23023 | 15.8 | 16 | 133 | 83 | 63 |
| 229 1600 | 23024 | 16.0 | 16 | 133 | 83 | 63 |



Available with Fordlube upon request.

TuffCut XR - XT

TuffCut X-AL

TuffCut Die & Mould

Twister Drills

Technical Section

Icon Glossary

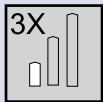
Drill Icons



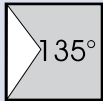
Solid Carbide



Coolant Fed



Drill Length



Drill Point Angle



Helix Angle



Coatings



DIN Specs

Workpiece Material Group



Steels



Hardened Steels (45-65Rc)



Stainless Steels



Cast Iron

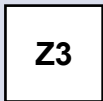


Special Alloys

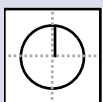


Non-Ferrous

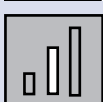
End Mill Icons



Number of Flutes



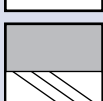
Center Cutting



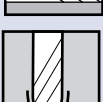
Lengths



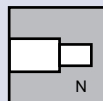
Coatings



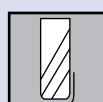
Helix Angle



Ball Nose



Neck Relief



Corner Radius



Shank



Shank/DIN



Chipbreaker

Workpiece Material Group



Steels



Hardened Steels (45-65Rc)



Stainless Steels



Cast Iron



Special Alloys



Non-Ferrous

Celebrating
90 Years
 1919 - 2009
M.A. Ford®

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TuffCut® XR Series 113A Recommended cutting data

| Workpiece Material Group | Material Type | Coolant | | | 0.05 x D 2 x D | 0.1 x D 2 x D | 0.25 x D 2 x D | 0.5 x D 1.5 x D | |
|--------------------------|---------------|----------------------------|-----|-----|-------------------|------------------|-------------------|--------------------|-----|
| | | Max | Air | MMS | Vc-M/Min | | | | |
| Steels | P | Low Carbon | ● | ● | ● | 280 | 240 | 200 | 160 |
| | | Medium Carbon | ● | ● | ● | 200 | 185 | 160 | 135 |
| | | Alloy Steels | ● | ● | ● | 185 | 170 | 145 | 120 |
| | | Die/Tool Steels | ● | ● | ● | 160 | 135 | 105 | 100 |
| Stainless Steels | M | Free Machining | ● | X | ○ | 120 | 100 | 85 | 80 |
| | | Austenitic | ● | X | ○ | 95 | 90 | 80 | 70 |
| | | Difficult Stainless | ● | X | ○ | 75 | 65 | 55 | 50 |
| | | PH Stainless | ● | X | ○ | 95 | 90 | 80 | 70 |
| | | Cobalt Chrome Alloys | ● | X | ○ | 70 | 65 | 55 | 50 |
| | | Duplex (22%) | ● | X | ○ | 70 | 65 | 55 | 50 |
| | | Super Duplex (25%) | ● | X | ○ | 45 | 40 | 35 | 30 |
| Special Alloys | S | High Temp Alloys | ● | X | X | 35 | 30 | 25 | 20 |
| | | Inconel 625/718 | ● | X | X | 35 | 30 | 25 | 20 |
| | | Titanium Alloys | ● | X | X | 95 | 70 | 60 | 50 |
| Cast Irons | K | Gray Cast Iron | ● | ○ | ○ | 290 | 190 | 150 | 130 |
| | | Ductile Cast Iron | ● | ○ | ○ | 215 | 150 | 135 | 120 |
| | | Malleable Iron | ● | ○ | ○ | 120 | 110 | 105 | 95 |
| Hardened Steels | H | Hardened Steels 45 - 50 Rc | ● | ○ | ○ | 110 | 70 | 40 | 35 |
| | | Hardened Steels 50 - 55 Rc | ● | ○ | ○ | 90 | 60 | 35 | 30 |

● Preferred ○ Possible X Not Possible

| Workpiece Material Group | Material Type | Tool Diameter | | | | | | | | | |
|----------------------------------|---------------|----------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| | | 3mm | 5mm | 6mm | 8mm | 10mm | 12mm | 16mm | 20mm | 25mm | |
| Peripheral Milling-fz mm / Tooth | | | | | | | | | | | |
| Steels | P | Low Carbon | 0.020 | 0.027 | 0.067 | 0.080 | 0.093 | 0.133 | 0.160 | 0.187 | 0.267 |
| | | Medium Carbon | | | | | | | | | |
| | | Alloy Steels | | | | | | | | | |
| | | Die/Tool Steels | | | | | | | | | |
| Stainless Steels | M | Free Machining | 0.020 | 0.027 | 0.067 | 0.080 | 0.093 | 0.133 | 0.160 | 0.187 | 0.267 |
| | | Austenitic | | | | | | | | | |
| | | Difficult Stainless | | | | | | | | | |
| | | PH Stainless | | | | | | | | | |
| | | Cobalt Chrome Alloys | | | | | | | | | |
| | | Duplex (22%) | | | | | | | | | |
| | | Super Duplex (25%) | | | | | | | | | |
| Special Alloys | S | High Temp Alloys | 0.009 | 0.013 | 0.033 | 0.040 | 0.047 | 0.067 | 0.080 | 0.093 | 0.133 |
| | | Inconel | | | | | | | | | |
| | | Titanium Alloys | | | | | | | | | |
| Cast Irons | K | Gray Cast Iron | 0.019 | 0.027 | 0.067 | 0.080 | 0.093 | 0.133 | 0.160 | 0.187 | 0.267 |
| | | Ductile Cast Iron | | | | | | | | | |
| | | Malleable Iron | | | | | | | | | |
| Hardened Steels | H | Hardened Steels 45 - 50 Rc | 0.017 | 0.024 | 0.060 | 0.072 | 0.084 | 0.120 | 0.144 | 0.168 | 0.240 |
| | | Hardened Steels 50 - 55 Rc | | | | | | | | | |

Please Note- Peripheral Milling only.

During profile milling less than 50% of the cutter diameter radial width, the actual chip thickness at the cutting edge is less than the programmed chipload. The accompanying table shows the increase in tooth load by given radial percentage engagement. Multiply your feed per tooth by the factor before finalising your table feed.

| Radial Cut (Ae) | Chip thickness Compensation factor |
|-----------------|------------------------------------|
| 30% | 1.10 |
| 20% | 1.20 |
| 15% | 1.40 |
| 10% | 1.80 |
| 5% | 2.30 |
| 1% | 5.00 |

TuffCut[®] XR Series 177, 178 & 179 Recommended cutting data

| Workpiece Material Group | Material Type | Coolant | | | 1 x D | 1 x D | 0.05 x D | 0.1 x D | 0.2 x D | 0.3 x D | 0.5 x D | |
|--------------------------|---------------|----------------------------|-----|-----|---------|-------|----------|---------|---------|---------|---------|-----|
| | | Max | Air | MMS | 0.5 x D | 1 x D | 2 x D | 2 x D | 2 x D | 1.5 x D | 1.5 x D | |
| Vc-M/Min | | | | | | | | | | | | |
| Steels | P | Low Carbon | ● | ● | ● | 210 | 200 | 450 | 350 | 300 | 250 | 200 |
| | | Medium Carbon | ● | ● | ● | 180 | 170 | 270 | 250 | 230 | 200 | 170 |
| | | Alloy Steels | ● | ● | ● | 160 | 150 | 250 | 230 | 210 | 180 | 150 |
| | | Die/Tool Steels | ● | ● | ● | 130 | 120 | 225 | 200 | 170 | 130 | 120 |
| Stainless Steels | M | Free Machining | ● | X | ○ | 110 | 100 | 150 | 150 | 120 | 105 | 100 |
| | | Austenitic | ● | X | ○ | 100 | 90 | 130 | 120 | 110 | 100 | 90 |
| | | Difficult Stainless | ● | X | ○ | 70 | 60 | 100 | 90 | 80 | 70 | 60 |
| | | PH Stainless | ● | X | ○ | 100 | 90 | 130 | 120 | 110 | 100 | 90 |
| | | Cobalt Chrome Alloys | ● | X | ○ | 70 | 60 | 100 | 90 | 80 | 70 | 60 |
| | | Duplex (22%) | ● | X | ○ | 70 | 60 | 100 | 90 | 80 | 70 | 60 |
| | | Super Duplex (25%) | ● | X | ○ | 50 | 40 | 60 | 55 | 50 | 45 | 40 |
| Special Alloys | S | High Temp Alloys | ● | X | X | 30 | 25 | 50 | 40 | 35 | 30 | 25 |
| | | Titanium Alloys | ● | X | X | 70 | 60 | 120 | 120 | 90 | 75 | 60 |
| Cast Irons | K | Gray Cast Iron | ● | ○ | ○ | 180 | 160 | 360 | 360 | 240 | 190 | 160 |
| | | Ductile Cast Iron | ● | ○ | ○ | 170 | 150 | 270 | 270 | 190 | 170 | 150 |
| | | Malleable Iron | ● | ○ | ○ | 130 | 120 | 160 | 150 | 140 | 130 | 120 |
| Hardened Steels | H | Hardened Steels 45 - 50 Rc | ● | ○ | ○ | 50 | 45 | 135 | 135 | 90 | 50 | 45 |
| | | Hardened Steels 50 - 55 Rc | ● | ○ | ○ | 45 | 40 | 115 | 115 | 75 | 45 | 40 |

● Preferred ○ Possible X Not Possible

| Workpiece Material Group | Machining type by series | Tool Diameter | | | | | | | | | | |
|--------------------------|--------------------------|-----------------------------|--------|--------|-------|-------|-------|-------|-------|-------|-------|-------|
| | | 1.5mm | 3mm | 5mm | 6mm | 8mm | 10mm | 12mm | 16mm | 20mm | 25mm | |
| fz-mm/tooth | | | | | | | | | | | | |
| Steels | P | Profiling-177-178-179 | 0.005 | 0.018 | 0.025 | 0.060 | 0.080 | 0.100 | 0.120 | 0.160 | 0.200 | 0.250 |
| | | Slotting-177/179 | 0.003 | 0.009 | 0.012 | 0.030 | 0.040 | 0.050 | 0.060 | 0.080 | 0.100 | 0.125 |
| Stainless Steels | M | Profiling-177-178-179 | 0.005 | 0.018 | 0.025 | 0.060 | 0.080 | 0.100 | 0.120 | 0.160 | 0.200 | 0.250 |
| | | Slotting-177/179 | 0.003 | 0.009 | 0.012 | 0.030 | 0.040 | 0.050 | 0.060 | 0.080 | 0.100 | 0.125 |
| Special Alloys | S | Profiling-177-178-179 | 0.003 | 0.009 | 0.013 | 0.032 | 0.038 | 0.044 | 0.064 | 0.076 | 0.089 | 0.127 |
| | | Slotting-177/179 | 0.0015 | 0.0045 | 0.007 | 0.016 | 0.019 | 0.022 | 0.032 | 0.038 | 0.045 | 0.065 |
| Titanium | S | Profiling-177-178-179 | 0.005 | 0.018 | 0.025 | 0.060 | 0.080 | 0.100 | 0.120 | 0.160 | 0.200 | 0.250 |
| | | Slotting-177/179 | 0.003 | 0.009 | 0.013 | 0.030 | 0.040 | 0.050 | 0.060 | 0.080 | 0.100 | 0.125 |
| Cast Irons | K | Profiling-177-178-179 | 0.005 | 0.018 | 0.025 | 0.060 | 0.080 | 0.100 | 0.120 | 0.160 | 0.200 | 0.250 |
| | | Slotting-177/179 | 0.003 | 0.009 | 0.013 | 0.030 | 0.040 | 0.050 | 0.060 | 0.080 | 0.100 | 0.125 |
| Hardened Steels | H | Profiling-177-178-179<50HRC | 0.005 | 0.016 | 0.023 | 0.057 | 0.069 | 0.080 | 0.114 | 0.137 | 0.160 | 0.229 |
| | | Slotting-177/179 <50HRC | 0.003 | 0.008 | 0.013 | 0.028 | 0.035 | 0.040 | 0.065 | 0.070 | 0.080 | 0.115 |
| | | Profiling-177-178-179>55HRC | 0.003 | 0.010 | 0.015 | 0.041 | 0.051 | 0.058 | 0.084 | 0.102 | 0.119 | 0.170 |
| | | Slotting-177/179 >55HRC | 0.002 | 0.005 | 0.008 | 0.020 | 0.025 | 0.028 | 0.042 | 0.050 | 0.060 | 0.080 |

Please Note- 178 series-5 flute to be used for Peripheral milling only.

During profile milling less than 50% of the cutter diameter radial width, the actual chip thickness at the cutting edge is less than the programmed chipload. The accompanying table shows the increase in tooth load by given radial percentage engagement. Multiply your feed per tooth by the factor before finalising your table feed.

| Radial Cut (Ae) | Chip thickness Compensation factor |
|-----------------|------------------------------------|
| 30% | 1.10 |
| 20% | 1.20 |
| 15% | 1.40 |
| 10% | 1.80 |
| 5% | 2.30 |
| 1% | 5.00 |

For 177L tools please use the following conditions

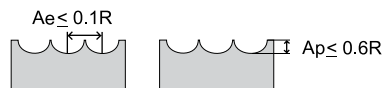
| | | |
|----|----------|-----------|
| Ap | 1 x D1 | 0.25 x D1 |
| Ae | 0.1 x D1 | 1.0 x D1 |

When using Long Series 178 - 1 Reduce speed by 20%

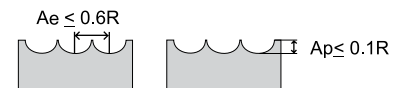
TuffCut® XR Series 179 Profiling

Découpage au profil Série 179

| Diameter mm | R mm | RPM trs | Semi Roughing / Roughing Steel (25-48 HRC) / Ebauche intermédiaire / Ebauche Acier (25-48 HRC) | | | | Semi Finishing / Finishing Steel (25-48 HRC) / Finition intermédiaire / Finition Acier (25-48 HRC) | | | |
|----------------|---------|------------|---|-----------------|---------|---------|---|-----------------|---------|---------|
| | | | f | fz | Ae Max. | Ap Max. | f | fz | Ae Max. | Ap Max. |
| | | | mm/min | mm/z | mm | mm | mm/min | mm/z | mm | mm |
| 1.5 | R 0.75 | 35,000 | 1,950 - 3,300 | 0.0139 - 0.0235 | 0.075 | 0.450 | 1,950 - 3,300 | 0.0139 - 0.0235 | 0.450 | 0.075 |
| 2.0 | R 1.0 | 30,000 | 2,100 - 3,600 | 0.0175 - 0.0300 | 0.100 | 0.600 | 2,100 - 3,600 | 0.0175 - 0.0300 | 0.600 | 0.100 |
| 2.5 | R 1.25 | 28,000 | 2,100 - 3,600 | 0.0185 - 0.0320 | 0.125 | 0.750 | 2,100 - 3,600 | 0.0185 - 0.0320 | 0.750 | 0.125 |
| 3.0 | R 1.5 | 26,500 | 2,100 - 3,600 | 0.0198 - 0.0330 | 0.150 | 0.900 | 2,100 - 3,600 | 0.0198 - 0.0330 | 0.900 | 0.150 |
| 3.5 | R 1.75 | 24,000 | 2,250 - 3,900 | 0.0230 - 0.0400 | 0.175 | 1.000 | 2,250 - 3,900 | 0.0230 - 0.0400 | 1.000 | 0.175 |
| 4.0 | R 2.0 | 23,000 | 2,250 - 3,900 | 0.0240 - 0.0420 | 0.200 | 1.200 | 2,250 - 3,900 | 0.0240 - 0.0420 | 1.200 | 0.200 |
| 4.5 | R 2.25 | 22,000 | 2,250 - 3,900 | 0.0250 - 0.0440 | 0.220 | 1.350 | 2,250 - 3,900 | 0.0250 - 0.0440 | 1.350 | 0.220 |
| 5.0 | R 2.5 | 20,000 | 1,800 - 5,500 | 0.0225 - 0.0687 | 0.250 | 1.500 | 1,800 - 5,500 | 0.0225 - 0.0687 | 1.500 | 0.250 |
| 6.0 | R 3.0 | 20,000 | 1,800 - 5,500 | 0.0225 - 0.0687 | 0.300 | 1.800 | 1,800 - 5,500 | 0.0225 - 0.0687 | 1.800 | 0.300 |
| 8.0 | R 4.0 | 15,000 | 2,200 - 5,000 | 0.0366 - 0.0833 | 0.400 | 2.400 | 2,200 - 5,000 | 0.0366 - 0.0833 | 2.400 | 0.400 |
| 10.0 | R 5.0 | 12,000 | 2,300 - 4,600 | 0.0479 - 0.0958 | 0.500 | 3.000 | 2,300 - 4,600 | 0.0479 - 0.0958 | 3.000 | 0.500 |
| 12.0 | R 6.0 | 10,000 | 1,900 - 4,100 | 0.0475 - 0.1025 | 0.600 | 3.600 | 1,900 - 4,100 | 0.0475 - 0.1025 | 3.600 | 0.600 |
| 16.0 | R 8.0 | 7,500 | 1,600 - 3,200 | 0.0533 - 0.1066 | 0.800 | 4.800 | 1,600 - 3,200 | 0.0533 - 0.1066 | 4.800 | 0.800 |



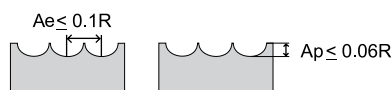
Arrosage - Air pulsé
Cooling Requirements - High Pressure Air Blast.



Arrosage - Air pulsé
Cooling Requirements - High Pressure Air Blast.

| Titanium / Titane | | | | |
|-------------------|---------|------------|-------------|------------|
| Diameter mm | R mm | RPM trs | f mm/min | fz mm/z |
| 1.5 | R 0.75 | 32,000 | 2,700 | 0.020 |
| 2.0 | R 1.0 | 24,000 | 2,400 | 0.025 |
| 2.5 | R 1.25 | 24,000 | 2,400 | 0.025 |
| 3.0 | R 1.5 | 16,000 | 1,950 | 0.030 |
| 3.5 | R 1.75 | 16,000 | 1,950 | 0.030 |
| 4.0 | R 2.0 | 12,000 | 1,950 | 0.040 |
| 4.5 | R 2.25 | 12,000 | 1,950 | 0.040 |
| 5.0 | R 2.5 | 10,000 | 1,650 | 0.040 |
| 6.0 | R 3.0 | 8,000 | 1,500 | 0.046 |
| 8.0 | R 4.0 | 6,000 | 1,650 | 0.068 |
| 10.0 | R 5.0 | 5,000 | 1,650 | 0.080 |
| 12.0 | R 6.0 | 4,000 | 1,500 | 0.093 |
| 16.0 | R 8.0 | 3,000 | 1,200 | 0.100 |

| High Temperature Alloys / Alliages Pour Hautes Tem | | | | | | |
|--|---------|------------|-------------|------------|---------------|---------------|
| Diameter mm | R mm | RPM trs | f mm/min | fz mm/z | Ae Max. mm | Ap Max. mm |
| 1.5 | R 0.75 | 10,000 | 825 | 0.020 | 0.075 | 0.05 |
| 2.0 | R 1.0 | 7,300 | 750 | 0.025 | 0.100 | 0.06 |
| 2.5 | R 1.25 | 6,000 | 700 | 0.029 | 0.125 | 0.08 |
| 3.0 | R 1.5 | 5,000 | 630 | 0.030 | 0.150 | 0.09 |
| 3.5 | R 1.75 | 4,100 | 575 | 0.035 | 0.175 | 0.11 |
| 4.0 | R 2.0 | 3,600 | 555 | 0.040 | 0.200 | 0.12 |
| 4.5 | R 2.25 | 3,200 | 510 | 0.040 | 0.220 | 0.14 |
| 5.0 | R 2.5 | 3,000 | 510 | 0.040 | 0.250 | 0.15 |
| 6.0 | R 3.0 | 2,500 | 495 | 0.046 | 0.300 | 0.18 |
| 8.0 | R 4.0 | 1,900 | 510 | 0.068 | 0.400 | 0.24 |
| 10.0 | R 5.0 | 1,500 | 510 | 0.080 | 0.500 | 0.30 |
| 12.0 | R 6.0 | 1,200 | 450 | 0.093 | 0.600 | 0.36 |
| 16.0 | R 8.0 | 900 | 360 | 0.100 | 0.800 | 0.48 |



Arrosage - débit/pression maximum
Cooling Requirements - Maximum coolant flow/pressure

TuffCut® XR Series 180 Recommended cutting data

| Workpiece Material Group | Material Type | Coolant | | | 0.05 x D 2 x D | 0.1 x D 2 x D | 0.2 x D 2 x D | |
|--------------------------|---------------|----------------------------|-----|-----|-------------------|------------------|------------------|-----|
| | | Max | Air | MMS | Vc-M/Min | | | |
| Steels | P | Low Carbon | ● | ● | ● | 480 | 385 | 330 |
| | | Medium Carbon | ● | ● | ● | 345 | 275 | 255 |
| | | Alloy Steels | ● | ● | ● | 315 | 255 | 230 |
| | | Die/Tool Steels | ● | ● | ● | 275 | 220 | 187 |
| Stainless Steels | M | Free Machining | ● | X | ○ | 205 | 165 | 130 |
| | | Austenitic | ● | X | ○ | 160 | 130 | 120 |
| | | Difficult Stainless | ● | X | ○ | 125 | 100 | 90 |
| | | PH Stainless | ● | X | ○ | 160 | 130 | 120 |
| | | Cobalt Chrome Alloys | ● | X | ○ | 125 | 100 | 90 |
| | | Duplex (22%) | ● | X | ○ | 125 | 100 | 90 |
| | | Super Duplex (25%) | ● | X | ○ | 75 | 60 | 55 |
| Special Alloys | S | High Temp Alloys | ● | X | X | 55 | 45 | 40 |
| | | Inconel | ● | X | X | 55 | 45 | 40 |
| | | Titanium Alloys | ● | X | X | 160 | 130 | 100 |
| Cast Irons | K | Gray Cast Iron | ● | ○ | ○ | 495 | 395 | 265 |
| | | Ductile Cast Iron | ● | ○ | ○ | 370 | 300 | 210 |
| | | Malleable Iron | ● | ○ | ○ | 205 | 165 | 155 |
| Hardened Steels | H | Hardened Steels 45 - 50 Rc | ● | ○ | ○ | 185 | 150 | 100 |
| | | Hardened Steels 50 - 55 Rc | ● | ○ | ○ | 155 | 125 | 85 |

● Preferred ○ Possible X Not Possible

| Workpiece Material Group | Material Type | Tool Diameter | | | | | | | | |
|--------------------------|---------------|--------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|
| | | 12mm | 16mm | 20mm | 25mm | | | | | |
| | | Peripheral Milling Fz-mm/Tooth | | | | | | | | |
| Steels | P | Low Carbon | 0.120 | 0.160 | 0.200 | 0.250 | | | | |
| | | Medium Carbon | | | | | | | | |
| | | Alloy Steels | | | | | | | | |
| | | Die/Tool Steels | | | | | | | | |
| Stainless Steels | M | Free Machining | 0.120 | 0.160 | 0.200 | 0.250 | | | | |
| | | Austenitic | | | | | | | | |
| | | Difficult Stainless | | | | | | | | |
| | | PH Stainless | | | | | | | | |
| | | Cobalt Chrome Alloys | | | | | 0.095 | 0.114 | 0.133 | 0.191 |
| | | Duplex (22%) | | | | | | | | |
| | | Super Duplex (25%) | | | | | | | | |
| Special Alloys | S | High Temp Alloys | 0.064 | 0.076 | 0.089 | 0.127 | | | | |
| | | Inconel | | | | | | | | |
| | | Titanium Alloys | | | | | | | | |
| Cast Irons | K | Gray Cast Iron | 0.120 | 0.160 | 0.200 | 0.250 | | | | |
| | | Ductile Cast Iron | | | | | | | | |
| | | Malleable Iron | | | | | | | | |
| Hardened Steels | H | Hardened Steels 45 - 50 Rc | 0.114 | 0.137 | 0.160 | 0.229 | | | | |
| | | Hardened Steels 50 - 55 Rc | 0.084 | 0.102 | 0.119 | 0.170 | | | | |

Please Note - Peripheral Milling only.

During profile milling less than 50% of the cutter diameter radial width, the actual chip thickness at the cutting edge is less than the programmed chipload. The accompanying table shows the increase in tooth load by given radial percentage engagement. Multiply your feed per tooth by the factor before finalising your table feed.

| Radial Cut (Ae) | Chip thickness Compensation factor |
|-----------------|------------------------------------|
| 30% | 1.10 |
| 20% | 1.20 |
| 15% | 1.40 |
| 10% | 1.80 |
| 5% | 2.30 |
| 1% | 5.00 |

TuffCut® XR Series 192 Recommended cutting data

| Workpiece Material Group | Material Type | Coolant | | | 1 x D 0.5 x D | 1 x D 1 x D | 0.05 x D 2 x D | 0.1 x D 2 x D | 0.2 x D 2 x D | 0.3 x D 1.5 x D | 0.5 x D | |
|--------------------------|---------------|----------------------------|-----|-----|------------------|----------------|-------------------|------------------|------------------|--------------------|---------|-----|
| | | Max | Air | MMS | Vc-M/Min | | | | | | | |
| Steels | P | Low Carbon | ● | ● | ● | 210 | 210 | 450 | 450 | 350 | 300 | 250 |
| | | Medium Carbon | ● | ● | ● | 180 | 180 | 270 | 270 | 250 | 230 | 200 |
| | | Alloy Steels | ● | ● | ● | 160 | 160 | 250 | 250 | 230 | 210 | 180 |
| | | Die/Tool Steels | ● | ● | ● | 130 | 130 | 225 | 225 | 200 | 170 | 130 |
| Stainless Steels | M | Free Machining | ● | X | ○ | 110 | 110 | 150 | 150 | 130 | 120 | 105 |
| | | Austenitic | ● | X | ○ | 100 | 100 | 130 | 130 | 120 | 110 | 100 |
| | | Difficult Stainless | ● | X | ○ | 70 | 70 | 100 | 100 | 90 | 80 | 70 |
| | | PH Stainless | ● | X | ○ | 100 | 100 | 130 | 130 | 120 | 110 | 100 |
| | | Cobalt Chrome Alloys | ● | X | ○ | 70 | 70 | 100 | 100 | 90 | 80 | 70 |
| | | Duplex (22%) | ● | X | ○ | 70 | 70 | 100 | 100 | 90 | 80 | 70 |
| | | Super Duplex (25%) | ● | X | ○ | 50 | 50 | 60 | 60 | 55 | 50 | 45 |
| | | High Temp Alloys | ● | X | X | 30 | 30 | 50 | 50 | 40 | 35 | 30 |
| Special Alloys | S | Inconel | ● | X | X | 30 | 30 | 50 | 50 | 40 | 35 | 30 |
| | | Titanium Alloys | ● | X | X | 70 | 70 | 120 | 120 | 110 | 90 | 75 |
| | | Gray Cast Iron | ● | ○ | ○ | 180 | 180 | 360 | 360 | 340 | 240 | 190 |
| Cast Irons | K | Ductile Cast Iron | ● | ○ | ○ | 170 | 170 | 270 | 270 | 240 | 190 | 170 |
| | | Malleable Iron | ● | ○ | ○ | 130 | 130 | 160 | 160 | 150 | 140 | 130 |
| Hardened Steels | H | Hardened Steels 35 - 45 Rc | ● | ○ | ○ | 55 | 55 | 135 | 135 | 125 | 90 | 50 |
| | | Hardened Steels 45 - 55 Rc | ● | ○ | ○ | 45 | 45 | 115 | 115 | 105 | 75 | 45 |

● Preferred ○ Possible X Not Possible

| Workpiece Material Group | Material Type | Type of machining | Tool Diameter | | | | | | | | | | |
|--------------------------|----------------------------|----------------------|-----------------|----------------------------|----------|------------------|----------------|-----------|-------|-------|-------|-------|-------|
| | | | 6mm | 8mm | 10mm | 12mm | 16mm | 20mm | 25mm | | | | |
| | | | fz-mm/tooth | | | | | | | | | | |
| Steels | P | Low Carbon | Profiling | 0.085 | 0.100 | 0.120 | 0.170 | 0.200 | 0.230 | 0.330 | | | |
| | | Medium Carbon | | Slotting | 0.043 | 0.050 | 0.060 | 0.085 | 0.100 | 0.125 | 0.165 | | |
| | | Alloy Steels | Profiling | | 0.085 | 0.100 | 0.120 | 0.170 | 0.200 | 0.230 | 0.330 | | |
| | | Die/Tool Steels | | | Slotting | 0.043 | 0.050 | 0.060 | 0.085 | 0.100 | 0.125 | 0.165 | |
| Stainless Steels | M | Free Machining | Profiling | | | 0.085 | 0.100 | 0.120 | 0.170 | 0.200 | 0.230 | 0.330 | |
| | | Austenitic | | Profiling | | 0.064 | 0.076 | 0.086 | 0.125 | 0.150 | 0.175 | 0.250 | |
| | | Difficult Stainless | Slotting | | | 0.032 | 0.038 | 0.045 | 0.060 | 0.075 | 0.085 | 0.125 | |
| | | PH Stainless | | | | Profiling | 0.043 | 0.050 | 0.060 | 0.085 | 0.100 | 0.125 | 0.165 |
| | | Cobalt Chrome Alloys | Slotting | | | | 0.022 | 0.025 | 0.030 | 0.045 | 0.050 | 0.060 | 0.080 |
| | | Special Alloys | | S | | High Temp Alloys | Profiling | 0.085 | 0.100 | 0.120 | 0.170 | 0.200 | 0.230 |
| | | | Titanium Alloys | | | Slotting | | 0.022 | 0.025 | 0.030 | 0.045 | 0.050 | 0.060 |
| | | | Cast Irons | | K | | Gray Cast Iron | Profiling | 0.085 | 0.100 | 0.120 | 0.170 | 0.200 |
| Ductile Cast Iron | Slotting | | | | | | 0.043 | | 0.050 | 0.060 | 0.085 | 0.100 | 0.125 |
| Malleable Iron | | Profiling | | 0.076 | | | 0.090 | 0.100 | 0.150 | 0.180 | 0.200 | 0.300 | |
| Hardened Steels | | | H | Hardened Steels 35 - 45 Rc | Slotting | 0.035 | 0.045 | 0.050 | 0.075 | 0.090 | 0.100 | 0.150 | |
| | Hardened Steels 45 - 55 Rc | | | Slotting | | 0.025 | 0.033 | 0.036 | 0.050 | 0.065 | 0.080 | 0.110 | |

During profile milling less than 50% of the cutter diameter radial width, the actual chip thickness at the cutting edge is less than the programmed chipload. The accompanying table shows the increase in tooth load by given radial percentage engagement. Multiply your feed per tooth by the factor before finalising your table feed.

| Radial Cut (Ae) | Chip thickness Compensation factor |
|-----------------|------------------------------------|
| 30% | 1.10 |
| 20% | 1.20 |
| 15% | 1.40 |
| 10% | 1.80 |
| 5% | 2.30 |
| 1% | 5.00 |

TuffCut® XT Series 277 Recommended cutting data

| Workpiece Material Group | Material Type | Coolant | | | Vc-M/Min | | | | | | | |
|--------------------------|---------------|----------------------------|-----|-----|------------------|----------------|-------------------|------------------|------------------|--------------------|--------------------|-----|
| | | Max | Air | MMS | 1 x D 0.5 x D | 1 x D 1 x D | 0.05 x D 2 x D | 0.1 x D 2 x D | 0.2 x D 2 x D | 0.3 x D 1.5 x D | 0.5 x D 1.5 x D | |
| Steels | P | Low Carbon | ● | ● | ● | 230 | 220 | 480 | 385 | 330 | 275 | 220 |
| | | Medium Carbon | ● | ● | ● | 200 | 185 | 345 | 275 | 255 | 220 | 185 |
| | | Alloy Steels | ● | ● | ● | 175 | 165 | 315 | 255 | 230 | 200 | 165 |
| | | Die/Tool Steels | ● | ● | ● | 145 | 130 | 275 | 220 | 187 | 145 | 130 |
| Stainless Steels | M | Free Machining | ● | X | ○ | 120 | 110 | 205 | 165 | 130 | 115 | 110 |
| | | Austenitic | ● | X | ○ | 110 | 100 | 160 | 130 | 120 | 110 | 100 |
| | | Difficult Stainless | ● | X | ○ | 75 | 65 | 125 | 100 | 90 | 75 | 65 |
| | | PH Stainless | ● | X | ○ | 110 | 100 | 160 | 130 | 120 | 110 | 100 |
| | | Cobalt Chrome Alloys | ● | X | ○ | 75 | 65 | 125 | 100 | 90 | 75 | 65 |
| | | Duplex (22%) | ● | X | ○ | 75 | 65 | 125 | 100 | 90 | 75 | 65 |
| | | Super Duplex (25%) | ● | X | ○ | 55 | 45 | 75 | 60 | 55 | 50 | 45 |
| Special Alloys | S | High Temp Alloys | ● | X | X | 35 | 28 | 55 | 45 | 40 | 35 | 28 |
| | | | ● | X | X | 35 | 28 | 55 | 45 | 40 | 35 | 28 |
| | | Titanium Alloys | ● | X | X | 75 | 66 | 160 | 130 | 100 | 85 | 65 |
| Cast Irons | K | Gray Cast Iron | ● | ○ | ○ | 200 | 175 | 495 | 395 | 265 | 210 | 175 |
| | | Ductile Cast Iron | ● | ○ | ○ | 185 | 165 | 370 | 300 | 210 | 185 | 165 |
| | | Malleable Iron | ● | ○ | ○ | 145 | 132 | 205 | 165 | 155 | 145 | 130 |
| Hardened Steels | H | Hardened Steels 35 - 45 Rc | ● | ○ | ○ | 60 | 50 | 185 | 150 | 100 | 55 | 50 |
| | | Hardened Steels 45 - 55 Rc | ● | ○ | ○ | 50 | 45 | 155 | 125 | 85 | 50 | 45 |

● Preferred ○ Possible X Not Possible

| Workpiece Material Group | Machining type | Tool Diameter | | | | | | | | | |
|--------------------------|----------------|----------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| | | 3mm | 5mm | 6mm | 8mm | 10mm | 12mm | 16mm | 20mm | 25mm | |
| Steels | P | Profiling | 0.030 | 0.050 | 0.060 | 0.080 | 0.100 | 0.120 | 0.160 | 0.200 | 0.250 |
| | | Slotting | 0.015 | 0.025 | 0.030 | 0.040 | 0.050 | 0.060 | 0.080 | 0.100 | 0.125 |
| Stainless Steels | M | Profiling | 0.030 | 0.050 | 0.060 | 0.080 | 0.100 | 0.120 | 0.160 | 0.200 | 0.250 |
| | | Slotting | 0.015 | 0.025 | 0.030 | 0.040 | 0.050 | 0.060 | 0.080 | 0.100 | 0.125 |
| Special Alloys | S | Profiling | 0.009 | 0.013 | 0.032 | 0.038 | 0.044 | 0.064 | 0.076 | 0.089 | 0.127 |
| | | Slotting | 0.005 | 0.007 | 0.016 | 0.019 | 0.022 | 0.032 | 0.038 | 0.045 | 0.065 |
| Titanium | S | Profiling | 0.030 | 0.050 | 0.060 | 0.080 | 0.100 | 0.120 | 0.160 | 0.200 | 0.250 |
| | | Slotting | 0.015 | 0.025 | 0.030 | 0.040 | 0.050 | 0.060 | 0.080 | 0.100 | 0.125 |
| Cast Irons | K | Profiling | 0.030 | 0.050 | 0.060 | 0.080 | 0.100 | 0.120 | 0.160 | 0.200 | 0.250 |
| | | Slotting | 0.015 | 0.025 | 0.030 | 0.040 | 0.050 | 0.060 | 0.080 | 0.100 | 0.125 |
| Hardened Steels | H | Profiling 35 - 45 Rc | 0.016 | 0.023 | 0.057 | 0.069 | 0.080 | 0.114 | 0.137 | 0.160 | 0.229 |
| | | Slotting 35 - 45 Rc | 0.010 | 0.015 | 0.025 | 0.035 | 0.045 | 0.065 | 0.070 | 0.075 | 0.100 |
| | | Profiling 45 - 55 Rc | 0.010 | 0.015 | 0.041 | 0.051 | 0.058 | 0.084 | 0.102 | 0.119 | 0.170 |
| | | Slotting 45 - 55 Rc | 0.008 | 0.011 | 0.020 | 0.030 | 0.040 | 0.050 | 0.055 | 0.080 | 0.090 |

During profile milling less than 50% of the cutter diameter radial width, the actual chip thickness at the cutting edge is less than the programmed chipload. The accompanying table shows the increase in tooth load by given radial percentage engagement. Multiply your feed per tooth by the factor before finalising your table feed.

| Radial Cut (Ae) | Chip thickness Compensation factor |
|-----------------|------------------------------------|
| 30% | 1.10 |
| 20% | 1.20 |
| 15% | 1.40 |
| 10% | 1.80 |
| 5% | 2.30 |
| 1% | 5.00 |

TuffCut® X-AL Series 135 Feed capability - Necked Tools

Série 135 Paramètres de Coupe. Outils Corps Passant

| RPM | Diameter - mm | | | | | Diamètre - mm | | | | |
|-------|---------------|-------------|-------------|------------|------------|---------------|------------|------------|-------------|------------|
| | 3 | 4 | 5 | 6 | 8 | 10 | 12 | 16 | 20 | 25 |
| | fz 0.035 | fz 0.035 | fz 0.084 | fz 0.12 | fz 0.26 | fz 0.61 | fz 0.77 | fz 0.79 | fz 0.762 | fz 0.76 |
| 4000 | 280 | 280 | 672 | 960 | 2080 | 4880 | 6160 | 6304 | 6096 | 6096 |
| 5000 | 350 | 350 | 840 | 1200 | 2600 | 6100 | 7700 | 7880 | 7620 | 7620 |
| 6000 | 420 | 420 | 1008 | 1440 | 3120 | 7320 | 9240 | 9456 | 9144 | 9144 |
| 7000 | 490 | 490 | 1176 | 1680 | 3640 | 8540 | 10780 | 11032 | 10668 | 10668 |
| 8000 | 560 | 560 | 1344 | 1920 | 4160 | 9760 | 12320 | 12608 | 12192 | 12192 |
| 9000 | 630 | 630 | 1512 | 2160 | 4680 | 10980 | 13860 | 14184 | 13716 | 13716 |
| 10000 | 700 | 700 | 1680 | 2400 | 5200 | 12200 | 15400 | 15760 | 15240 | 15240 |
| 11000 | 770 | 770 | 1848 | 2640 | 5720 | 13420 | 16940 | 17336 | 16764 | 16764 |
| 12000 | 840 | 840 | 2016 | 2880 | 6240 | 14640 | 18480 | 18912 | 18288 | 18288 |
| 13000 | 910 | 910 | 2184 | 3120 | 6760 | 15860 | 20020 | 20488 | 19812 | 19812 |
| 14000 | 980 | 980 | 2352 | 3360 | 7280 | 17080 | 21560 | 22064 | 21336 | 21336 |
| 15000 | 1050 | 1050 | 2520 | 3600 | 7800 | 18300 | 23100 | 23640 | 22860 | 22860 |
| 16000 | 1120 | 1120 | 2688 | 3840 | 8320 | 19520 | 24640 | 25216 | 24384 | 24384 |
| 17000 | 1190 | 1190 | 2856 | 4080 | 8840 | 20740 | 26180 | 26792 | 25908 | 25908 |
| 18000 | 1260 | 1260 | 3024 | 4320 | 9360 | 21960 | 27720 | 28368 | 27432 | 27432 |
| 19000 | 1330 | 1330 | 3192 | 4560 | 9880 | 23180 | 29260 | 29944 | 28956 | 28956 |
| 20000 | 1400 | 1400 | 3360 | 4800 | 10400 | 24400 | 30800 | 31520 | 30480 | 30480 |
| 21000 | 1470 | 1470 | 3528 | 5040 | 10920 | 25620 | 32340 | 33096 | 32004 | 32004 |
| 22000 | 1540 | 1540 | 3696 | 5280 | 11440 | 26840 | 33880 | 34672 | 33528 | 33528 |
| 23000 | 1610 | 1610 | 3864 | 5520 | 11960 | 28060 | 35420 | 36248 | 35052 | 35052 |
| 24000 | 1680 | 1680 | 4032 | 5760 | 12480 | 29280 | 36960 | 37824 | 36576 | 36576 |
| 25000 | 1750 | 1750 | 4200 | 6000 | 13000 | 30500 | 38500 | 39400 | 38100 | 38100 |
| 30000 | 2100 | 2100 | 5040 | 7200 | 15600 | 36600 | 46200 | 47280 | 45720 | 45720 |

FEED Shown in mm/min AVANCE indiquée en mm/min

Feed rate allowance for length

| Part no. example | length | Fz | Ae | Ap |
|---------------------|--------|-------|---------|----------|
| 135 12N3 | Short | 1 | 1 x D | 1 X D |
| 135 12N5 | Medium | x 0.7 | 1 x D | 0.25 X D |
| 135 1202N | Long | x 0.6 | 0.1 x D | 1 X D |

Feed rate for un-necked tools

Please calculate feed rate based upon length from table above - then apply the following factors:

| Diameter | Factor |
|-----------|--------------------|
| 3 - 8mm | Feed mm/min x 2.0 |
| 10 - 25mm | Feed mm/min x 1.35 |

Surcote sur avance pour la longueur









| Article no. exemple | longueur | Fz | Ae | Ap |
|------------------------|----------|-------|---------|----------|
| 135 12N3 | Court | 1 | 1 x D | 1 X D |
| 135 12N5 | Moyen | x 0.7 | 1 x D | 0.25 X D |
| 135 1202N | Long | x 0.6 | 0.1 x D | 1 X D |

Avance pour outils décolletés

Veillez calculer l'avance en fonction de la longueur indiquée dans le tableau ci-dessus - puis appliquer la formule suivante:

| Coefficient diamètre |
|---------------------------------|
| 3 - 8mm Avance mm/min x 2.0 |
| 10 - 25 mm Avance mm/min x 1.35 |

TuffCut® X-AL Recommended cutting data - Al / Al-Si Alloys

| Series | Type of cut | Type of cut | | Vc | Diameter - mm Diamètre - mm | | | | |
|--------|---|-------------|---------|---------|--------------------------------|-------|------------|-----------|-----------|
| | | Ae | Ap | | M/Min | 2 - 3 | 4 | 5 | 6 |
| | | | | | fz | fz | fz | fz | fz |
| 134 |  | 1 x D | 0.5 x D | 250-300 | - | - | 0.063 | 0.063 | 0.094 |
| | | 1 x D | 1 x D | 250-300 | - | - | 0.052 | 0.052 | 0.084 |
| |  | 0.2 x D | 1 x D | 250-300 | - | - | 0.075 | 0.075 | 0.125 |
| | | 0.5 x D | 1 x D | 250-300 | - | - | 0.063 | 0.063 | 0.094 |
| 135 |  | 1 x D | 0.5 x D | 300-425 | 0.035 | 0.035 | 0.075-0.1 | 0.1-0.23 | 0.175-0.3 |
| | | 1 x D | 1 x D | 250-365 | 0.030 | 0.030 | 0.025-0.05 | 0.1-0.15 | 0.1-0.15 |
| |  | 0.2 x D | 1 x D | 300-425 | 0.030 | 0.030 | 0.05-0.1 | 0.1-0.23 | 0.1-0.23 |
| | | 0.5 x D | 1 x D | 300-425 | 0.030 | 0.030 | 0.05-0.1 | 0.1-0.23 | 0.1-0.23 |
| | | 1 x D | 1 x D | 250-365 | 0.025 | 0.025 | 0.025-0.05 | 0.1-0.15 | 0.1-0.15 |
| 136 |  | 0.05 x D | 1 x D | 215-300 | 0.030 | 0.030 | 0.025-0.08 | 0.05-0.10 | 0.08-0.13 |
| | | 0.1 x D | 1 x D | 215-300 | 0.030 | 0.030 | 0.025-0.05 | 0.05-0.10 | 0.08-0.13 |
| | | 0.2 x D | 1 x D | 215-300 | 0.025 | 0.025 | 0.025-0.04 | 0.05-0.08 | 0.05-0.10 |
| 138 |  | 0.3 X D | 1x D | 425-610 | 0.03 | 0.04 | 0.05 | 0.06 | 0.08 |
| | | 1 x D | 1 X D | 425-610 | 0.06 | 0.08 | 0.09 | 0.13 | 0.16 |
| 135B |  | 1 x D | 0.5 x D | 150 | 0.050 | 0.080 | 0.12 | 0.16 | 0.20 |
| 138B |  | 0.1 x D | 1 x D | 300 | 0.050 | 0.080 | 0.12 | 0.16 | 0.20 |

TuffCut XR - XT









TuffCut X-AL

TuffCut Die & Mould

Twister Drills

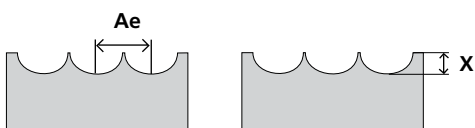
Technical Section

TuffCut® X-AL Recommended cutting data - Al / Al-Si Alloys

| Series | Type of cut | Vc | | Diameter - mm | | Diamètre - mm | | | |
|--------|---|----------|---------|---------------|-----------|---------------|-----------|-----------|-----------|
| | | Ae | Ap | M/Min | 10 | 12 | 16 | 20 | 25 |
| | | | | | fz | fz | fz | fz | fz |
| 134 |  | 1 x D | 0.5 x D | 250-300 | 0.094 | 0.127 | 0.19 | 0.19 | 0.25 |
| | | 1 x D | 1 x D | 250-300 | 0.084 | 0.1 | 0.14 | 0.14 | 0.21 |
| |  | 0.2 x D | 1 x D | 250-300 | 0.125 | 0.135 | 0.225 | 0.225 | 0.275 |
| | | 0.5 x D | 1 x D | 250-300 | 0.094 | 0.127 | 0.19 | 0.19 | 0.25 |
| 135 |  | 1 x D | 0.5 x D | 300-425 | 0.175-0.3 | 0.25-1.15 | 0.38-1.02 | 0.38-1.02 | 0.38-1.02 |
| | | 1 x D | 1 x D | 250-365 | 0.1-0.15 | 0.25-0.75 | 0.38-0.75 | 0.38-0.75 | 0.38-0.75 |
| |  | 0.2 x D | 1 x D | 300-425 | 0.1-0.23 | 0.25-1.15 | 0.38-1.02 | 0.38-1.02 | 0.38-1.02 |
| | | 0.5 x D | 1 x D | 300-425 | 0.1-0.23 | 0.25-0.89 | 0.38-0.89 | 0.38-0.89 | 0.38-0.89 |
| | | 1 x D | 1 x D | 250-365 | 0.1-0.15 | 0.25-0.75 | 0.38-0.75 | 0.38-0.75 | 0.38-0.75 |
| | | 1 x D | 1 x D | 250-365 | 0.1-0.15 | 0.25-0.75 | 0.38-0.75 | 0.38-0.75 | 0.38-0.75 |
| 136 |  | 0.05 x D | 1 x D | 215-300 | 0.08-0.13 | 0.1-0.15 | 0.15-0.2 | 0.15-0.2 | 0.2-0.25 |
| | | 0.1 x D | 1 x D | 215-300 | 0.08-0.13 | 0.1-0.15 | 0.15-0.2 | 0.15-0.2 | 0.2-0.25 |
| | | 0.2 x D | 1 x D | 215-300 | 0.05-0.10 | 0.08-0.13 | 0.10-0.15 | 0.10-0.15 | 0.15-0.20 |
| 138 |  | 0.3 x D | 1 x D | 425-610 | 0.1 | 0.13 | 0.17 | 0.2 | 0.25 |
| | | 1 x D | 1 x D | 425-610 | 0.19 | 0.25 | 0.3 | 0.36 | 0.5 |
| 135B |  | 1 x D | 0.5 x D | 150 | 0.25 | 0.50 | 0.50 | - | - |
| 138B |  | 0.1 x D | 1 x D | 300 | 0.25 | 0.50 | 0.50 | - | - |

Profile Height-X (µm) / Surface finish

| Ae mm | Diameter - mm | | | | Diamètre - mm | | | |
|-------|---------------|------|------|------|---------------|------|------|------|
| | 1 | 2 | 4 | 6 | 8 | 10 | 12 | 16 |
| 0.06 | 0.9 | 0.45 | 0.23 | 0.15 | 0.11 | 0.09 | 0.08 | 0.06 |
| 0.08 | 1.6 | 0.8 | 0.4 | 0.27 | 0.2 | 0.16 | 0.13 | 0.1 |
| 0.11 | 3 | 1.5 | 0.76 | 0.5 | 0.38 | 0.3 | 0.25 | 0.19 |
| 0.15 | 5.7 | 2.8 | 1.4 | 0.94 | 0.7 | 0.56 | 0.47 | 0.35 |
| 0.2 | 10 | 5 | 2.5 | 1.7 | 1.3 | 1 | 0.83 | 0.63 |
| 0.3 | 23 | 11 | 5.6 | 3.8 | 2.8 | 2.3 | 1.9 | 1.41 |
| 0.45 | 53 | 26 | 13 | 8.4 | 6.3 | 5.1 | 4.2 | 3.16 |



TuffCut® DM Series 156 Recommended cutting data

| Material Group | | Carbon/Alloy/ Tool steels | | Ferritic/martensitic/ PH stainless steel | | Hardened tool steel | | Hardened tool steel | | Hardened tool steel | | | |
|------------------------|-----------|---------------------------|-----------|--|-----------|---------------------|-----------|---------------------|-----------|---------------------|-----------|--|--|
| Hardness HRC | | 30-40 HRC | | <40 HRC | | 40-45 HRC | | 45-55 HRC | | 55-60 HRC | | | |
| Dia. mm | Radius mm | Vc RPM | Vf mm/min | Vc RPM | Vf mm/min | Vc RPM | Vf mm/min | Vc RPM | Vf mm/min | Vc RPM | Vf mm/min | | |
| 0.5 | 0.25 | 30,000 | 508 | 30,000 | 508 | 30,000 | 508 | 30,000 | 308 | 30,000 | 250 | | |
| 1 | 0.5 | 30,000 | 683 | 30,000 | 683 | 30,000 | 608 | 30,000 | 458 | 30,000 | 383 | | |
| 1.5 | 0.75 | 30,000 | 1575 | 30,000 | 1575 | 23,500 | 1450 | 23,500 | 942 | 15,000 | 383 | | |
| 2 | 1 | 25,000 | 2133 | 25,000 | 2133 | 22,000 | 2442 | 20,000 | 892 | 10,000 | 383 | | |
| 3 | 1.5 | 17,500 | 2392 | 17,500 | 2392 | 14,500 | 2283 | 12,000 | 892 | 7,000 | 383 | | |
| 4 | 2 | 14,000 | 3050 | 14,000 | 3050 | 11,500 | 2233 | 9,600 | 942 | 5,600 | 508 | | |
| 6 | 3 | 8,750 | 3558 | 8,750 | 3558 | 7,250 | 1775 | 6,000 | 967 | 3,500 | 458 | | |
| 8 | 4 | 7,000 | 4267 | 7,000 | 4267 | 5,800 | 1725 | 4,800 | 892 | 2,800 | 383 | | |
| 10 | 5 | 5,800 | 3175 | 5,800 | 3175 | 4,800 | 1292 | 4,000 | 758 | 2,300 | 383 | | |
| 12 | 6 | 4,300 | 3558 | 4,300 | 3558 | 3,625 | 1167 | 3,000 | 633 | 1,750 | 250 | | |
| Application conditions | | | | | | | | | | | | | |

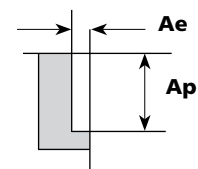
TuffCut® DM Series 157 Recommended cutting data

| Material Group | Hardened tool steel | | Hardened tool steel | | Hardened tool steel | |
|------------------------|---------------------|-----------|---------------------|-----------|---------------------|-----------|
| Hardness HRC | 40-45 HRC | | 45-55 HRC | | 55-60 HRC | |
| Diameter mm | Vc RPM | Vf mm/min | Vc RPM | Vf mm/min | Vc RPM | Vf mm/min |
| 3 | 14,500 | 2283 | 12,000 | 892 | 7,000 | 383 |
| 4 | 11,500 | 2233 | 9,600 | 942 | 5,600 | 508 |
| 6 | 7,250 | 1775 | 6,000 | 967 | 3,500 | 458 |
| 8 | 5,800 | 1725 | 4,800 | 892 | 2,800 | 383 |
| 10 | 4,800 | 1292 | 4,000 | 758 | 2,300 | 383 |
| 12 | 3,625 | 1167 | 3,000 | 633 | 1,750 | 250 |
| 16 | 3,625 | 1167 | 3,000 | 633 | 1,750 | 250 |
| Application conditions | | | | | | |

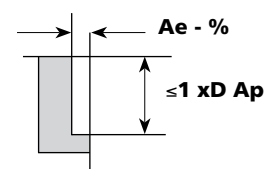
TuffCut® DM Series 158 Recommended cutting data

| Material | HRC | Machining type | Diameter (mm) | | corner radius | | Diameter (mm) | | corner radius | | Diameter (mm) | | corner radius | |
|--|-------|----------------|---------------|-------|---------------|-------------|---------------|-------|---------------|-------------|---------------|------|---------------|-------------|
| | | | 3 | | 0.8 | | 6 | | 1.5 | | 8 | | 2 | |
| | | | Ae | Ap | n (rpm) | Vf (mm/min) | Ae | Ap | n (rpm) | Vf (mm/min) | Ae | Ap | n (rpm) | Vf (mm/min) |
| Cast Iron Carbon Steel Alloy Steel | 15-25 | 1 | 0.7 | 0.24 | 8000 | 6000 | 1.5 | 0.45 | 4000 | 6700 | 2 | 0.6 | 3000 | 6700 |
| | | 2 | 0.7 | 0.192 | 13500 | 10000 | 1.5 | 0.36 | 6600 | 11000 | 2 | 0.48 | 5000 | 11200 |
| | | 3 | 0.7 | 0.48 | 8000 | 2800 | 1.5 | 0.9 | 4000 | 3050 | 2 | 1.2 | 3000 | 3050 |
| | | 4 | 0.7 | 0.24 | 10100 | 5900 | 1.5 | 0.45 | 5000 | 6500 | 2 | 0.6 | 3800 | 6600 |
| | | 5 | 0.05-0.1 | 0.08 | 19100 | 2050 | 0.05-0.1 | 0.15 | 9500 | 2300 | 0.05-0.1 | 0.2 | 7200 | 230 |
| Tool steels PH Stainless steel | 25-35 | 1 | 0.7 | 0.24 | 7400 | 5100 | 1.5 | 0.45 | 3700 | 5700 | 2 | 0.6 | 2800 | 5700 |
| | | 2 | 0.7 | 0.192 | 11700 | 8100 | 1.5 | 0.36 | 5800 | 8900 | 2 | 0.48 | 4400 | 9000 |
| | | 3 | 0.7 | 0.432 | 7400 | 2400 | 1.5 | 0.81 | 3700 | 2650 | 2 | 1.08 | 2800 | 2700 |
| | | 4 | 0.7 | 0.24 | 9500 | 4950 | 1.5 | 0.45 | 4800 | 5550 | 2 | 0.6 | 3600 | 5550 |
| | | 5 | 0.05-0.1 | 0.08 | 16000 | 1370 | 0.05-0.1 | 0.15 | 8000 | 1600 | 0.05-0.1 | 0.2 | 6000 | 1550 |
| Hardened steel PH Stainless steel | 35-45 | 1 | 0.7 | 0.24 | 6900 | 3700 | 1.5 | 0.45 | 3400 | 4100 | 2 | 0.6 | 2600 | 4200 |
| | | 2 | 0.7 | 0.168 | 10600 | 5700 | 1.5 | 0.315 | 5300 | 6350 | 2 | 0.42 | 4000 | 6400 |
| | | 3 | 0.7 | 0.384 | 6900 | 1860 | 1.5 | 0.72 | 3400 | 2050 | 2 | 0.96 | 2600 | 2080 |
| | | 4 | 0.7 | 0.24 | 9000 | 3700 | 1.5 | 0.45 | 4500 | 4100 | 2 | 0.6 | 3400 | 4150 |
| | | 5 | 0.05-0.1 | 0.08 | 12700 | 820 | 0.05-0.1 | 0.15 | 6400 | 920 | 0.05-0.1 | 0.2 | 4800 | 920 |
| Hardened steel | 45-55 | 1 | 0.7 | 0.168 | 5300 | 2900 | 1.5 | 0.315 | 2700 | 3250 | 2 | 0.42 | 2000 | 3200 |
| | | 2 | 0.7 | 0.144 | 8500 | 4600 | 1.5 | 0.27 | 4200 | 5050 | 2 | 0.36 | 3200 | 5150 |
| | | 3 | 0.7 | 0.288 | 5300 | 1440 | 1.5 | 0.54 | 2700 | 1630 | 2 | 0.72 | 2000 | 1600 |
| | | 4 | 0.7 | 0.168 | 6900 | 2600 | 1.5 | 0.315 | 3400 | 2900 | 2 | 0.42 | 2600 | 2900 |
| | | 5 | 0.05-0.1 | 0.08 | 9500 | 510 | 0.05-0.1 | 0.15 | 4800 | 580 | 0.05-0.1 | 0.2 | 3600 | 580 |
| Hardened steel | 55-60 | 1 | 0.7 | 0.12 | 5300 | 1150 | 1.5 | 0.225 | 2700 | 1300 | 2 | 0.3 | 2000 | 1300 |
| | | 2 | 0.7 | 0.096 | 7400 | 1600 | 1.5 | 0.18 | 3700 | 1790 | 2 | 0.24 | 2800 | 1800 |
| | | 3 | 0.7 | 0.168 | 5300 | 690 | 1.5 | 0.315 | 2700 | 780 | 2 | 0.42 | 2000 | 770 |
| | | 4 | 0.7 | 0.12 | 6400 | 1050 | 1.5 | 0.225 | 3200 | 1150 | 2 | 0.3 | 2400 | 1150 |
| | | 5 | 0.05-0.1 | 0.08 | 7400 | 320 | 0.05-0.1 | 0.15 | 3700 | 360 | 0.05-0.1 | 0.2 | 2800 | 360 |

- 1 Standard cutting conditions. First choice starting conditions. High efficiency-longest life.
- 2 High Speed condition. Machine stable, capable of high feeds, high spindle speeds. Ultra high efficiency.
- 3 High depth of cut. Rigid machines without high speed spindles.
- 4 Low Load conditions. Low rigidity machines, hence lower speed / feed.
- 5 Finishing conditions



| Material Groups | TuffCut® DM Endmill Diameter (mm) | | | | | | | |
|--|------------------------------------|--------|------------|--------|------------|--------|------------|--------|
| | 3.0 | | 4.0 | | 5.0 | | 6.0 | |
| | Radial Cut | | Radial Cut | | Radial Cut | | Radial Cut | |
| | Ae 10% | Ae 20% | Ae 10% | Ae 20% | Ae 10% | Ae 20% | Ae 10% | Ae 20% |
| Structural-Alloy-Low carbon steel | 37100 | | 27825 | | 22260 | | 18550 | |
| | 7791 | 5565 | 7791 | 5565 | 7791 | 5565 | 7791 | 5565 |
| Die-Mould / Tool Steels | 26500 | | 19875 | | 15900 | | 13250 | |
| | 2783 | 2783 | 5565 | 5565 | 5565 | 5565 | 5565 | 5565 |
| Austenitic Stainless Steels and Precipitation Hardened & Martensitic Stainless Steels 32 HRC+ | 15900 | | 11925 | | 9540 | | 7950 | |
| | 1113 | 795 | 1002 | 716 | 1068 | 763 | 1169 | 835 |



TuffCut® DM Series 158 Recommended cutting data

| Diameter (mm) | | corner radius | | Diameter (mm) | | corner radius | | Diameter (mm) | | corner radius | | Diameter (mm) | | corner radius | |
|---------------|------|---------------|-------------|---------------|------|---------------|-------------|---------------|------|---------------|-------------|---------------|------|---------------|-------------|
| 10 | | 2 | | 12 | | 2 | | 16 | | 3 | | 20 | | 3 | |
| Ae | Ap | n (rpm) | Vf (mm/min) | Ae | Ap | n (rpm) | Vf (mm/min) | Ae | Ap | n (rpm) | Vf (mm/min) | Ae | Ap | n (rpm) | Vf (mm/min) |
| 3 | 0.6 | 2400 | 6700 | 4 | 0.6 | 2000 | 6400 | 5 | 0.9 | 1500 | 5400 | 7 | 0.9 | 1200 | 4400 |
| 3 | 0.48 | 4000 | 11200 | 4 | 0.48 | 3300 | 10550 | 5 | 0.72 | 2500 | 9000 | 7 | 0.72 | 2000 | 7300 |
| 3 | 1.2 | 2400 | 3050 | 4 | 1.2 | 2000 | 2950 | 5 | 1.8 | 1500 | 2500 | 7 | 1.8 | 1200 | 2000 |
| 3 | 0.6 | 3000 | 6500 | 4 | 0.6 | 2500 | 6200 | 5 | 0.9 | 1900 | 5250 | 7 | 0.9 | 1500 | 4200 |
| 0.05-0.1 | 0.2 | 5700 | 2300 | 0.05-0.1 | 0.2 | 4800 | 2200 | 0.05-0.1 | 0.3 | 3600 | 1850 | 0.05-0.1 | 0.3 | 2900 | 1510 |
| 3 | 0.6 | 2200 | 5600 | 4 | 0.6 | 1900 | 5550 | 5 | 0.9 | 1400 | 4600 | 7 | 0.9 | 1100 | 3700 |
| 3 | 0.48 | 3500 | 9000 | 4 | 0.48 | 2900 | 8450 | 5 | 0.72 | 2200 | 7200 | 7 | 0.72 | 1800 | 6000 |
| 3 | 1.08 | 2200 | 2650 | 4 | 1.08 | 1900 | 2600 | 5 | 1.62 | 1400 | 2150 | 7 | 1.62 | 1100 | 1730 |
| 3 | 0.6 | 2900 | 5570 | 4 | 0.6 | 2400 | 5300 | 5 | 0.9 | 1800 | 4420 | 7 | 0.9 | 1400 | 3500 |
| 0.05-0.1 | 0.2 | 4800 | 1550 | 0.05-0.1 | 0.2 | 4000 | 1470 | 0.05-0.1 | 0.3 | 3000 | 1250 | 0.05-0.1 | 0.3 | 2400 | 1000 |
| 3 | 0.6 | 2100 | 4200 | 4 | 0.6 | 1700 | 3900 | 5 | 0.9 | 1300 | 3300 | 7 | 0.9 | 1000 | 2600 |
| 3 | 0.42 | 3200 | 6400 | 4 | 0.42 | 2700 | 6200 | 5 | 0.63 | 2000 | 5100 | 7 | 0.63 | 1600 | 4200 |
| 3 | 0.96 | 2100 | 2100 | 4 | 0.96 | 1700 | 1950 | 5 | 1.44 | 1300 | 1700 | 7 | 1.44 | 1000 | 1300 |
| 3 | 0.6 | 2700 | 4100 | 4 | 0.6 | 2300 | 4000 | 5 | 0.9 | 1700 | 3300 | 7 | 0.9 | 1400 | 2800 |
| 0.05-0.1 | 0.2 | 3800 | 910 | 0.05-0.1 | 0.2 | 3200 | 900 | 0.05-0.1 | 0.3 | 2400 | 740 | 0.05-0.1 | 0.3 | 1900 | 600 |
| 3 | 0.42 | 1600 | 3200 | 4 | 0.42 | 1300 | 3000 | 5 | 0.63 | 1000 | 2600 | 7 | 0.63 | 800 | 2100 |
| 3 | 0.36 | 2500 | 5000 | 4 | 0.36 | 2100 | 4800 | 5 | 0.54 | 1600 | 4100 | 7 | 0.54 | 1300 | 3400 |
| 3 | 0.72 | 1600 | 1600 | 4 | 0.72 | 1300 | 1500 | 5 | 1.08 | 1000 | 1280 | 7 | 1.08 | 800 | 1050 |
| 3 | 0.42 | 2100 | 2950 | 4 | 0.42 | 1700 | 2700 | 5 | 0.63 | 1300 | 2350 | 7 | 0.63 | 1000 | 1830 |
| 0.05-0.1 | 0.2 | 2900 | 580 | 0.05-0.1 | 0.2 | 2400 | 550 | 0.05-0.1 | 0.3 | 1800 | 460 | 0.05-0.1 | 0.3 | 1400 | 360 |
| 3 | 0.3 | 1600 | 1300 | 4 | 0.3 | 1300 | 1200 | 5 | 0.45 | 1000 | 1000 | 7 | 0.45 | 800 | 830 |
| 3 | 0.24 | 2200 | 1750 | 4 | 0.24 | 1900 | 1750 | 5 | 0.36 | 1400 | 1450 | 7 | 0.36 | 1100 | 1140 |
| 3 | 0.42 | 1600 | 770 | 4 | 0.42 | 1300 | 710 | 5 | 0.63 | 1000 | 610 | 7 | 0.63 | 800 | 500 |
| 3 | 0.3 | 1900 | 1150 | 4 | 0.3 | 1600 | 1100 | 5 | 0.45 | 1200 | 920 | 7 | 0.45 | 1000 | 780 |
| 0.05-0.1 | 0.2 | 2200 | 350 | 0.05-0.1 | 0.2 | 1900 | 350 | 0.05-0.1 | 0.3 | 1400 | 290 | 0.05-0.1 | 0.3 | 1100 | 230 |

| TuffCut® DM Endmill Diameter (mm) | | | | | | | | | | |
|------------------------------------|--------|------------|--------|------------|--------|------------|--------|------------|--------|---------------|
| 8.0 | | 10.0 | | 12.0 | | 16.0 | | 20.0 | | |
| Radial Cut | | Radial Cut | | Radial Cut | | Radial Cut | | Radial Cut | | |
| Ae 10% | Ae 20% | Ae 10% | Ae 20% | Ae 10% | Ae 20% | Ae 10% | Ae 20% | Ae 10% | Ae 20% | |
| 13913 | | 11130 | | 9275 | | 6956 | | 5565 | | RPM (n) |
| 7791 | 5565 | 7791 | 5565 | 7791 | 5565 | 7791 | 5565 | 7791 | 5565 | FEED (mm/min) |
| 9938 | | 7950 | | 6625 | | 4969 | | 3975 | | RPM (n) |
| 5565 | 5565 | 5565 | 5565 | 5565 | 5565 | 5565 | 5565 | 5565 | 5565 | FEED (mm/min) |
| 5963 | | 4770 | | 3975 | | 2981 | | 2385 | | RPM (n) |
| 1043 | 745 | 1670 | 1193 | 2226 | 1590 | 1878 | 1342 | 1503 | 1073 | FEED (mm/min) |

Recommended speed - all drills

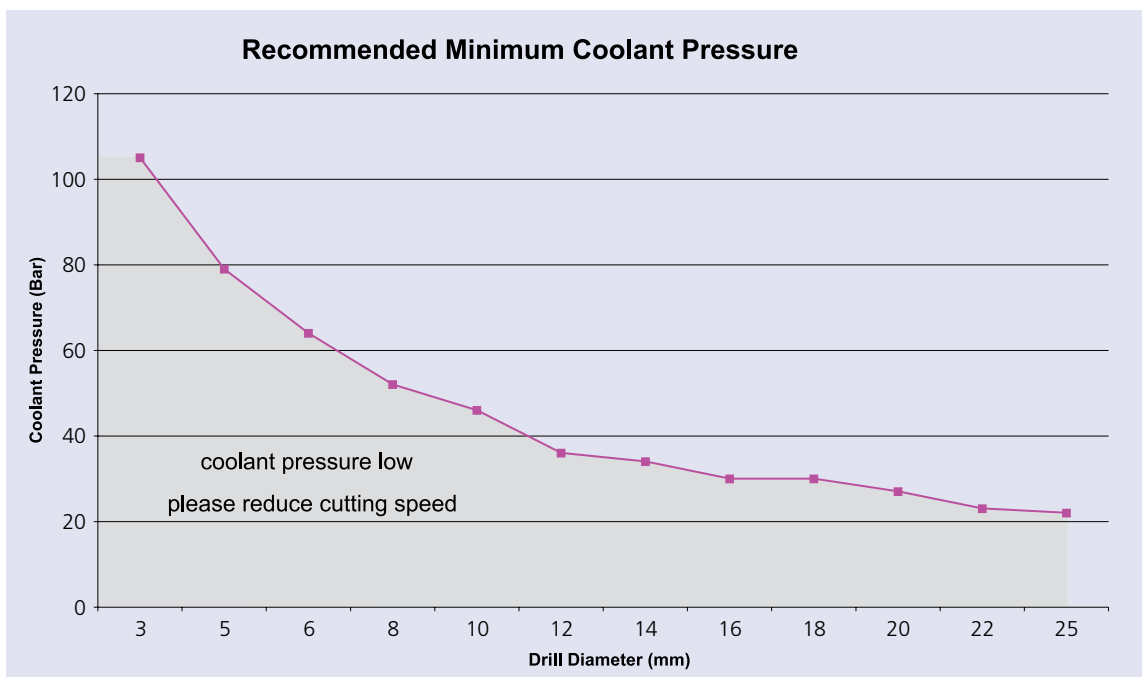
| Materials | SPEED - M/MIN | | | | | |
|-------------------------|-----------------------|------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| | 2XDSSM 3 X D SOLID | 2XD SRM 5 X D SOLID | 2XD CSM 3 X D COOLANT | 2XD CRM 5 X D COOLANT | 2XD CLM 7 X D COOLANT | 2MDCLM 10 X D COOLANT |
| Low Carbon Steel <0.3%C | 80-120 | 75-100 | 150-200 | 150-200 | 130-145 | 80-90 |
| Medium Carbon Steel | 75-100 | 65-90 | 125-175 | 125-175 | 100-130 | 80-90 |
| Alloy Steel ≤ 35hrc | 60-75 | 50-70 | 75-105 | 75-105 | 70-90 | 80-90 |
| Alloy Steel 36- 45hrc | 45-60 | 40-55 | 45-70 | 45-70 | 40-55 | 60-80 |
| Alloy Steel 45-50hrc | 30-35 | 25-30 | 35-50 | 35-50 | 35-45 | 40-60 |
| Grey Cast Iron | 100-120 | 80-100 | 150-200 | 150-200 | 110-140 | 80-90 |
| Ductile Cast Iron | 75-90 | 65-80 | 135-150 | 135-150 | 130-145 | 60-80 |
| Austenitic Stainless | 30-45 | 25-40 | 80-150 | 80-150 | 45-65 | 60-70 |
| Ph Stainless | 20-35 | 15-30 | 50-80 | 50-80 | 30-45 | 40-50 |
| High Temp Alloys | 15-30 | 10-25 | 15-35 | 15-35 | 20-30 | 20-25 |
| Titanium Alloys | 35-45 | 30-40 | 55-70 | 55-70 | 50-65 | 40-50 |

Series 2XD drill - Recommended feed 0.5 - 6mm diameter

| Materials | FEED MM/REV | | | | | |
|-------------------------|-------------|------------|-------------|-----------|-----------|-----------|
| | 0.5 | 1.5 | 3 | 4 | 5 | 6 |
| Low Carbon Steel <0.3%C | 0.025-0.05 | 0.05-0.075 | 0.075-0.12 | 0.1-0.15 | 0.12-0.18 | 0.14-0.2 |
| Medium Carbon Steel | 0.025-0.05 | 0.05-0.075 | 0.075-0.12 | 0.1-0.15 | 0.12-0.18 | 0.14-0.2 |
| Alloy Steel ≤ 35hrc | 0.025-0.05 | 0.05-0.075 | 0.075-0.12 | 0.1-0.15 | 0.12-0.18 | 0.14-0.2 |
| Alloy Steel 36- 45hrc | 0.01-0.025 | 0.025-0.04 | 0.05-0.11 | 0.08-0.13 | 0.12-0.18 | 0.14-0.2 |
| Alloy Steel 45-50hrc | 0.01-0.02 | 0.02-0.03 | 0.035-0.075 | 0.06-0.1 | 0.08-0.12 | 0.09-0.15 |
| Grey Cast Iron | 0.025-0.05 | 0.05-0.075 | 0.075-0.12 | 0.1-0.15 | 0.12-0.18 | 0.14-0.2 |
| Ductile CaSt Iron | 0.025-0.05 | 0.05-0.075 | 0.075-0.12 | 0.1-0.15 | 0.12-0.18 | 0.14-0.2 |
| Austenitic Stainless | 0.025-0.05 | 0.05-0.075 | 0.075-0.12 | 0.1-0.15 | 0.12-0.18 | 0.14-0.2 |
| Ph Stainless | 0.01-0.03 | 0.025-0.05 | 0.05-0.085 | 0.06-0.09 | 0.07-0.11 | 0.08-0.12 |
| High Temp Alloys | 0.01-0.03 | 0.025-0.05 | 0.035-0.085 | 0.04-0.09 | 0.05-0.10 | 0.06-0.11 |
| Titanium Alloys | 0.01-0.03 | 0.025-0.05 | 0.075-0.12 | 0.1-0.15 | 0.12-0.18 | 0.14-0.2 |

Series 2MDCL micro coolant drills - Recommended feed

| Materials | FEED MM/REV | | |
|-------------------------|-------------|-------|-------|
| | Diameter | | |
| | 2 | 2.5 | 2.9 |
| Low Carbon Steel <0.3%C | 0.046 | 0.051 | 0.056 |
| Medium Carbon Steel | 0.046 | 0.051 | 0.056 |
| Alloy Steel ≤ 35hrc | 0.046 | 0.051 | 0.056 |
| Alloy Steel 36- 45hrc | 0.046 | 0.046 | 0.051 |
| Alloy Steel 45-50hrc | 0.025 | 0.033 | 0.046 |
| Grey Cast Iron | 0.046 | 0.051 | 0.056 |
| Ductile Cast Iron | 0.046 | 0.051 | 0.056 |
| Austenitic Stainless | 0.033 | 0.038 | 0.043 |
| Ph Stainless | 0.025 | 0.027 | 0.038 |
| High Temp Alloys | 0.025 | 0.027 | 0.036 |
| Titanium Alloys | 0.025 | 0.027 | 0.036 |



Series 2XD drill - Recommended feed 8 - 20mm diameter

| Materials | FEED MM/REV | | | | | | |
|-------------------------|-------------|-----------|-----------|-----------|-----------|-----------|-----------|
| | 8 | 10 | 12 | 14 | 16 | 18 | 20 |
| Low Carbon Steel <0.3%C | 0.16-0.24 | 0.18-0.27 | 0.2-0.3 | 0.22-0.35 | 0.25-0.36 | 0.28-0.38 | 0.3-0.4 |
| Medium Carbon Steel | 0.16-0.24 | 0.18-0.27 | 0.2-0.3 | 0.22-0.35 | 0.25-0.36 | 0.28-0.38 | 0.3-0.4 |
| Alloy Steel ≤ 35hrc | 0.16-0.24 | 0.18-0.27 | 0.2-0.3 | 0.22-0.35 | 0.25-0.36 | 0.28-0.38 | 0.3-0.4 |
| Alloy Steel 36- 45hrc | 0.16-0.24 | 0.18-0.27 | 0.2-0.3 | 0.22-0.35 | 0.25-0.36 | 0.28-0.38 | 0.3-0.4 |
| Alloy Steel 45-50hrc | 0.12-0.2 | 0.13-0.23 | 0.13-0.23 | 0.15-0.26 | 0.16-0.26 | 0.18-0.28 | 0.2-0.3 |
| Grey Cast Iron | 0.16-0.24 | 0.18-0.27 | 0.2-0.3 | 0.22-0.35 | 0.25-0.36 | 0.28-0.38 | 0.3-0.4 |
| Ductile Cast Iron | 0.16-0.24 | 0.18-0.27 | 0.2-0.3 | 0.22-0.35 | 0.25-0.36 | 0.28-0.38 | 0.3-0.4 |
| Austenitic Stainless | 0.16-0.24 | 0.18-0.27 | 0.2-0.3 | 0.22-0.35 | 0.25-0.36 | 0.28-0.38 | 0.3-0.4 |
| Ph Stainless | 0.1-0.15 | 0.13-0.23 | 0.18-0.25 | 0.2-0.27 | 0.22-0.3 | 0.25-0.33 | 0.28-0.35 |
| High Temp Alloys | 0.08-0.13 | 0.1-0.15 | 0.12-0.17 | 0.14-0.19 | 0.16-0.21 | 0.18-0.25 | 0.23-0.28 |
| Titanium Alloys | 0.16-0.24 | 0.18-0.27 | 0.2-0.3 | 0.22-0.35 | 0.25-0.36 | 0.28-0.38 | 0.3-0.4 |

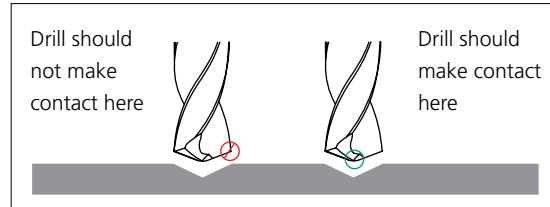
Series 200S Spot drill - Recommended Cutting Data

| Materials | Speed-Vc M/min | Diameter | | | | |
|-------------------------|-------------------|-------------|-----|------|------|------|
| | | 6 | 8 | 10 | 12 | 16 |
| | | FEED MM/REV | | | | |
| Low Carbon Steel <0.3%C | 100 | 0.076 | 0.1 | 0.13 | 0.16 | 0.16 |
| Medium Carbon Steel | 80 | 0.076 | 0.1 | 0.13 | 0.16 | 0.16 |
| Alloy Steel ≤ 35hrc | 70 | 0.076 | 0.1 | 0.13 | 0.16 | 0.16 |
| Alloy Steel 36- 45hrc | 45 | 0.076 | 0.1 | 0.13 | 0.16 | 0.16 |
| Alloy Steel 45-50hrc | 40 | 0.076 | 0.1 | 0.13 | 0.16 | 0.16 |
| Grey Cast Iron | 110 | 0.076 | 0.1 | 0.13 | 0.16 | 0.16 |
| Ductile Cast Iron | 80 | 0.076 | 0.1 | 0.13 | 0.16 | 0.16 |
| Austenitic Stainless | 45 | 0.076 | 0.1 | 0.13 | 0.16 | 0.16 |
| Ph Stainless | 30 | 0.076 | 0.1 | 0.13 | 0.16 | 0.16 |
| High Temp Alloys | 20 | 0.076 | 0.1 | 0.13 | 0.16 | 0.16 |
| Titanium Alloys | 55 | 0.076 | 0.1 | 0.13 | 0.16 | 0.16 |

Twister Drills Series 2XDCE Technical Information

Process For Successful Deep Hole Drilling:

1. Start by producing a 1.5 x diameter to 3 x diameter pilot hole using a coolant or non-coolant pilot drill. Typically this tool will have a point angle the same as or greater than the deep hole drill. Run this drill at 100% of the final drill speed and 1/2 the normal IPM.
2. Retract and tool change to the final deep hole (2XDCE MA Ford® Series) drill.
3. Rapid to clearance plane and enter the pilot hole at 25% (don't exceed 400 to 500 RPM) of the final speed and 25 - 50 mm/min. This will help with true position by eliminating drill whip. Once into the hole, turn on the coolant and advance to the material start. At this point, you can add a dwell to clear any chips that have been left from the previous drill and let the spindle get to full speed. Increase the speed and feed to final drilling parameters.
4. Drill one shot to the final hole depth or through.
5. Should you experience any squeaking you may need to retract the drill and increase your feed. Chip packing is occurring and will need to be addressed.
6. Once through the material, it may be necessary to reduce the RPM to eliminate breakage of the drill due to drill whip. Then retract to the clearance plane.



Machine Requirements

High Pressure Pump System (70 Bar)
Machine runout of 0.008mm Max.



Due to the conditions of equipment, tool holders, and conditions beyond MA Ford's control, your results may vary.

Should your application require more in depth discussion or a special tool, please contact M.A. Ford's Application Engineering Department at +44(0) 1332 267960.

Safety Note

Always wear the appropriate personal protective equipment such as safety glasses and protective clothing when using solid carbide or HSS cutting tools. Machines should be fully guarded. Technical data provided should be considered advisory only as variations may be necessary depending on the particular application.

Twister Drills Series 2XDCE Recommended cutting data

| Workpiece material | SPEED Vc-M/Min | Diameter | | | | | | | | |
|----------------------------|-------------------|-------------|-------|-------|-------|-------|-------|-------|-------|-------|
| | | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 12 |
| | | FEED MM/REV | | | | | | | | |
| Low Carbon Steel <0.3%C | 105 | 0.05 | 0.075 | 0.088 | 0.106 | 0.127 | 0.193 | 0.215 | 0.238 | 0.254 |
| Structural Steel | 120 | 0.05 | 0.075 | 0.088 | 0.106 | 0.127 | 0.193 | 0.215 | 0.238 | 0.254 |
| Medium Carbon Steel | 80 | 0.05 | 0.075 | 0.088 | 0.106 | 0.127 | 0.193 | 0.215 | 0.238 | 0.254 |
| Tool & Die Steel | 80 | 0.05 | 0.075 | 0.088 | 0.106 | 0.127 | 0.193 | 0.215 | 0.238 | 0.254 |
| Alloy Steel | 80 | 0.05 | 0.075 | 0.088 | 0.106 | 0.127 | 0.193 | 0.215 | 0.238 | 0.254 |
| Grey Cast Iron | 120 | 0.06 | 0.078 | 0.1 | 0.12 | 0.14 | 0.2 | 0.215 | 0.24 | 0.254 |
| Ductile Cast Iron | 80 | 0.06 | 0.078 | 0.1 | 0.12 | 0.14 | 0.2 | 0.215 | 0.24 | 0.254 |
| Austenitic Stainless | 55 | 0.05 | 0.071 | 0.09 | 0.105 | 0.127 | 0.193 | 0.215 | 0.238 | 0.254 |
| Ph Stainless | 40 | 0.05 | 0.071 | 0.09 | 0.105 | 0.127 | 0.193 | 0.215 | 0.238 | 0.254 |
| Martensitic Stainless | 40 | 0.05 | 0.071 | 0.09 | 0.105 | 0.127 | 0.193 | 0.215 | 0.238 | 0.254 |
| Ferritic Stainless | 75 | 0.05 | 0.071 | 0.09 | 0.105 | 0.127 | 0.193 | 0.215 | 0.238 | 0.254 |
| High Temp Alloys | 20-25 | 0.017 | 0.022 | 0.03 | 0.035 | 0.048 | 0.063 | 0.071 | 0.078 | 0.085 |
| Titanium Alloys | 45 | 0.03 | 0.04 | 0.05 | 0.06 | 0.071 | 0.12 | 0.127 | 0.14 | 0.152 |
| Hardened Steel (35-45 Hrc) | 35 | 0.012 | 0.015 | 0.02 | 0.022 | 0.027 | 0.048 | 0.053 | 0.06 | 0.066 |
| Hardened Steel (46-55 Hrc) | 25 | 0.012 | 0.015 | 0.02 | 0.022 | 0.027 | 0.048 | 0.053 | 0.06 | 0.066 |
| Non Ferrous-Al<14%Si | 150 | 0.083 | 0.11 | 0.14 | 0.17 | 0.195 | 0.28 | 0.314 | 0.35 | 0.378 |
| Non Ferrous-Al>14%Si | 105 | 0.083 | 0.11 | 0.14 | 0.17 | 0.195 | 0.28 | 0.314 | 0.35 | 0.378 |
| Non Ferrous-Brass | 120 | 0.053 | 0.071 | 0.088 | 0.106 | 0.127 | 0.279 | 0.314 | 0.35 | 0.378 |
| Cu/Cu Alloys/Magnesium | 90 | 0.053 | 0.071 | 0.088 | 0.106 | 0.127 | 0.279 | 0.314 | 0.35 | 0.378 |

TuffCut XR - XT

TuffCut X-AL

TuffCut Die & Mould

Twister Drills

Technical Section

Twister Drills Series 200A Recommended cutting data

| Workpiece Material Group | Material Type | Speed Vc-M/min | Diameter | | | | | | | | |
|--------------------------|---------------|---------------------------|-------------|-------|--------|-------|-------|-------|-------|-------|-------|
| | | | 1 | 1.5 | 3 | 6 | 10 | 12 | 16 | 20 | |
| | | | FEED MM/REV | | | | | | | | |
| Steels | P | Low Carbon | 70 | 0.006 | 0.013 | 0.051 | 0.1 | 0.127 | 0.152 | 0.175 | 0.2 |
| | | Alloy Steels < 35 HRC | 60 | 0.006 | 0.013 | 0.051 | 0.1 | 0.127 | 0.152 | 0.175 | 0.2 |
| | | Alloy Steels 35-45 HRC | 50 | 0.006 | 0.0127 | 0.005 | 0.076 | 0.1 | 0.152 | 0.2 | 0.225 |
| Stainless Steels | M | Austenetic | 50 | 0.006 | 0.0127 | 0.005 | 0.076 | 0.1 | 0.152 | 0.2 | 0.225 |
| | | PH Stainless | 35 | 0.006 | 0.0127 | 0.005 | 0.076 | 0.1 | 0.152 | 0.2 | 0.225 |
| | | Duplex / Super duplex | 30 | 0.006 | 0.0127 | 0.005 | 0.076 | 0.1 | 0.152 | 0.2 | 0.225 |
| Special Alloys | S | High Temp Alloys | 30 | 0.006 | 0.0127 | 0.005 | 0.076 | 0.1 | 0.152 | 0.2 | 0.225 |
| | | Titanium Alloys | 40 | 0.006 | 0.0127 | 0.005 | 0.076 | 0.1 | 0.152 | 0.2 | 0.225 |
| Cast Irons | K | Gray /Ductile Cast Iron | 85 | 0.006 | 0.0127 | 0.005 | 0.076 | 0.1 | 0.152 | 0.2 | 0.225 |
| Hardened Steels | H | Hardened Steels 45-55 HRC | 45 | 0.013 | 0.025 | 0.025 | 0.025 | 0.05 | 0.05 | 0.05 | 0.076 |
| | | Hardened Steels 55-65 HRC | 35 | 0.013 | 0.025 | 0.025 | 0.025 | 0.05 | 0.05 | 0.05 | 0.076 |
| Non-Ferrous | H | Plastic | 90 | 0.006 | 0.0127 | 0.005 | 0.076 | 0.1 | 0.152 | 0.2 | 0.225 |
| | | Kevlar/Graphite/Composite | 115 | 0.006 | 0.0127 | 0.005 | 0.076 | 0.1 | 0.152 | 0.2 | 0.225 |
| | | Glass/Ceramic | 25 | 0.013 | 0.025 | 0.025 | 0.025 | 0.05 | 0.05 | 0.05 | 0.076 |

Twister Drills Series 205B Recommended cutting data

| Workpiece Material Group | Material Type | Speed-M/min | Diameter | | | | | | | | |
|--------------------------|---------------|---------------------------|-------------|-------|--------|-------|-------|-------|-------|-------|-------|
| | | | 1 | 1.5 | 3 | 6 | 10 | 12 | 16 | 20 | |
| | | | FEED MM/REV | | | | | | | | |
| Steels | P | Low Carbon | 70 | 0.025 | 0.05 | 0.076 | 0.152 | 0.203 | 0.254 | 0.275 | 0.3 |
| | | Alloy Steels < 35 HRC | 60 | 0.025 | 0.05 | 0.076 | 0.152 | 0.203 | 0.254 | 0.275 | 0.3 |
| | | Alloy Steels 35-45 HRC | 50 | 0.025 | 0.05 | 0.076 | 0.152 | 0.203 | 0.254 | 0.275 | 0.3 |
| Stainless Steels | M | Austenetic | 50 | 0.025 | 0.05 | 0.076 | 0.152 | 0.203 | 0.254 | 0.275 | 0.3 |
| | | PH Stainless | 35 | 0.06 | 0.0127 | 0.05 | 0.076 | 0.1 | 0.152 | 0.2 | 0.225 |
| | | Duplex / Super duplex | 30 | 0.06 | 0.0127 | 0.05 | 0.076 | 0.1 | 0.152 | 0.2 | 0.225 |
| Special Alloys | S | High Temp Alloys | 30 | 0.06 | 0.0127 | 0.05 | 0.076 | 0.1 | 0.152 | 0.2 | 0.225 |
| | | Titanium Alloys | 40 | 0.06 | 0.0127 | 0.05 | 0.076 | 0.1 | 0.152 | 0.2 | 0.225 |
| Cast Irons | K | Gray /Ductile Cast Iron | 85 | 0.025 | 0.05 | 0.076 | 0.152 | 0.203 | 0.254 | 0.275 | 0.3 |
| Hardened Steels | H | Hardened Steels 45-55 HRC | 45 | 0.06 | 0.0127 | 0.05 | 0.076 | 0.1 | 0.152 | 0.2 | 0.225 |
| Non-Ferrous | H | Plastic | 120 | 0.06 | 0.0127 | 0.05 | 0.076 | 0.1 | 0.152 | 0.2 | 0.225 |
| | | Kevlar/Graphite/Composite | 120 | 0.06 | 0.0127 | 0.05 | 0.076 | 0.1 | 0.152 | 0.2 | 0.225 |
| | | Glass/Ceramic | 25 | 0.06 | 0.0127 | 0.05 | 0.076 | 0.1 | 0.152 | 0.2 | 0.225 |







Twister Drills Series 207 Recommended cutting data

| Workpiece Material Group | Material Type | Speed-M/min | Diameter | | | | | | | | |
|--------------------------|---------------|---------------------------|-------------|------|--------|------|-------|-----|-------|-----|-------|
| | | | 1 | 1.5 | 3 | 6 | 10 | 12 | 16 | 20 | |
| | | | FEED MM/REV | | | | | | | | |
| Non-Ferrous | K | Plastic | 90 | 0.06 | 0.0127 | 0.05 | 0.076 | 0.1 | 0.152 | 0.2 | 0.225 |
| | | Kevlar/Graphite/Composite | 115 | 0.06 | 0.0127 | 0.05 | 0.076 | 0.1 | 0.152 | 0.2 | 0.225 |







Twister Drills Series 229 Recommended cutting data

| Material group | Example | Vc m/min | Diameter | | | | | |
|--------------------|-----------|----------|-------------|------|------|------|------|------|
| | | | 1.5 | 3 | 6 | 12 | 20 | 25 |
| | | | FEED MM/REV | | | | | |
| Titanium Alloys | Ti6Al4V | 30 | 0.013 | 0.05 | 0.11 | 0.15 | 0.2 | 0.25 |
| Aluminium < 10% Si | 6061/7075 | 215 | 0.08 | 0.20 | 0.31 | 0.45 | 0.61 | 0.76 |
| Aluminium > 10% Si | | 155 | 0.05 | 0.08 | 0.15 | 0.25 | 0.31 | 0.35 |
| Brass/Copper | | 120 | 0.05 | 0.08 | 0.15 | 0.25 | 0.31 | 0.35 |
| Plastics | | 90 | 0.05 | 0.08 | 0.15 | 0.25 | 0.31 | 0.35 |

Material cross reference chart

| |  |  |  |  |  |  | |
|-----------------------------|---|---|---|---|---|---|----------------|
| | UK | German DIN | French | Swedish | Spanish | USA | |
| FREE MACHINING STEEL | 1.0718 | 9SMnPb28 | S250Pb | 1914 | F.2112 - 11SMnPb28 | 12L13 | |
| | 210M15 | 1.0721 | 10S20 | 10F1 | | F.2121 - 10 S 20 | 1108 |
| | 210A15 | 1.0723 | 15S20 | | 1922 | F.210F | |
| | 240M07 | 1.0736 | 9SMn36 | S300 | | F.2113- 12 SMn 35 | 1215 |
| | | 1.0737 | 9MnPb36 | S300Pb | 1926 | F.2114 - 12 SMnPb 35 | 12L14 |
| | 1.7022 | 10SPb20 | 10PbF2 | | F.2122 - 10 SPb 20 | 11L08 | |
| LOW CARBON STEEL | 045M10 | 1.0301 | C10 | AF34C10/XC10 | | | 1010 |
| | 080M15;040A15 | 1.0401 | C15 | AF37C12/XC18 | 1350 | F.111 | 1015 |
| | 050A20/055M15 | 1.0402 | C22 | AF42C20/XC25 | 1450 | F.112 | 1020 |
| | 070M26 | 1.0406 | C25 | AF50C30 | | F.221 | 1025 |
| | 220M07 | 1.0711 | 9S20 | | | | 1212 |
| | 230M07 | 1.0715 | 9SMn28 | S250 | 1912 | F.2111 - 11SMn28 | 1213 |
| | 040A10 | 1.1121 | CK10 | XC10 | 1265 | F.1510 - C 10 k | 1010 |
| | 120M19 | 1.1133 | 20Mn5 | 20M5 | | F.1515 - 20 Mn 6 | 1022/1518 |
| | 080M15 | 1.1141 | CK15 | XC15 / C15E | 1370 | F.1511 - C 16 k | 1015 |
| | 050A20 | 1.1151 | CK22 | XC25 / C22E | | F.1120 - C 25 k | 1020/1023 |
| | 070M26 | 1.1158 | CK25 | XC25 / C25E | | F.1120 - C 25 k | 1025 |
| | | 1.5419 | 22Mo4 | | | | 4419 |
| | | 1.5622 | 14Ni6 | 15N6 / 15Ni6 | | F.2641 - 15 Ni 6 | A350-LF5 |
| | 655M13/A12 | 1.5752 | 14NiCr14 | 12NC15 | | | 3310/9314 |
| 523M15 | 1.7015 | 15Cr3 | 12C3 | | | 5015 | |
| STRUCTURAL STEEL | 4360-40C | 1.0038 | RSt37-2 | E24-2NE / S235JRG2 | 1312 | | A570 (36) |
| | 4360-43B | 1.0044 | St44-2 | E28-2 / S275JR | 1412 | A 430B | A570 (40) |
| | 4360-50B | 1.005 | St50-2 | A50-2 / E295 | 2172 | | A570 (50) |
| | 4360-55E | 1.006 | St60-2 | A60-2 / E355 | | | |
| | 4360-40C/D-1449-37C | 1.0116 | St37-3 | E24-3;-4 / S235J2G3 | 1313 | A360 C;D | A284/A573/A611 |
| | 1449 -2/3/4CR | 1.033 | St12 | DC01 | | AP 00 | A366/1012/A619 |
| | 1449 2CR; 3CR | 1.0333 | St13 | | | AP 02 | 1008 |
| | 1449 1CR; 2CR | 1.0338 | St14 | DC04 | | AP 04 | A620 |
| | 1501Gr.161-360/400 | 1.0345 | H I | A37CP;AP / P235GH | 1330 | A 37 RC I;RA II | A516Gr.65;-55; |
| | 3CR | 1.0347 | RRSt13 | DC03 | | | A619 |
| | 161-400; | 1.0425 | H II | A42CP;AP / P265GH | 1430 | A42 RC I | |
| | | 1.0473 | 19Mn6 | A52CP;AP / P335GH | 2101/2102 | A 47 RB II | A537 |
| | | 1.0481 | 17Mn4 | A48CP;AP / P295GH | | A 47 RC I; RA II | A516 (70) |
| | | 1.0562 | StE355 | E355R/FP / S355N | 2132 | AE 355 KG; DD | A633 (C) |
| | 4360-50B;50C;50D | 1.057 | St52-3 | E36-3;E36-4 / S355J2G3 | 2132 | A 510 C;D | |
| | 1501-240 | 1.5415 | 15Mo3 | 15D3 / 15Mo3 | 2912 | F.2601 - 16 Mo 3 | A204 (A) |
| | 1503-245-420 | 1.5423 | 16Mo5 | | | F.2602 - 16 Mo 5 | 4520 |
| | 1501-503-690 | 1.5637 | 10Ni14 | 12N14 / 12Ni14 | | F.152 | A350-LF3 |
| | | 1.5713 | 13NiCr6 | 10NC6 | | | 3115 |
| | | 1.5732 | 14NiCr10 | 14NC11 | | F.1540 - 15 NiCr 11 | 3415 |
| | 620Gr.27;31 | 1.7335 | 13CrMo44 | 15CD3.05 | 2216 | F.2631 - 14 CrMo 4 5 | A182-F11;F12 |
| | 4360-55E | 1.8902 | StE420 | E420RIFP / S420N | | AE 420 KG | A633Gr.E |
| | | 1.8905 | StE460 | E460RIFP / S460N | | AE 460 KG | A633Gr.E |
| | | 1.007 | St70-2 | A70-2 / E360 | | | |
| 620Gr.27 | 1.7337 | 16CrMo44 | 15CD4.5 | 2216 | | A387 (12) | |
| 622Gr.31;45 | 1.738 | 10CrMo910 | 12CD9.10 / 10CrMo9-10 | 2218 | TU.H | A182F22 | |
| 660/440 | 1.7715 | 14MoV63 | | | F.2621 - 13 MoCrV6 | | |
| MEDIUM CARBON STEEL | 060A35 | 1.0501 | C35 | AF55C35 /XC38 | 1550 | F.113 | 1035 |
| | 212M36 | 1.0726 | 35S20 | 35MF6 | 1957 | F.210G. | 1140 |
| | 120M36/150M28 | 1.1165 | 30Mn5 | 35M5 / 30Mn5 | | F.1203 - 36 Mn5 | 1330 |
| | | 1.1166 | 34Mn5 | 35M5 / 34Mn5 | | F.8211 - 30 Mn5 | 1536 |
| | 150M36 | 1.1167 | 36Mn5 | 40M5 / 36Mn5 | 2120 | F.1203 - 36 Mn5 | 1335 |
| | 150M28 | 1.117 | 28Mn6 | 20M5 / 28Mn6 | | | 1330 |
| | 080M36 | 1.118 | Cm35 | XC32 / C35R | 1572 | F.1135 - C 35 k-1 | 1035 |
| | 080M36 | 1.1181 | CK35 | XC38H1 / C35E | 1572 | F.1130 - C 35 k | 1035 |
| | 060A35 | 1.1183 | CF35 | XC38H1TS | 1572 | | 1035 |
| | 080M46 | 1.0503 | C45 | AF65C45 /C45 | 1650 | F.114 | 1045 |
| | 070M55 | 1.0535 | C55 | C55 | 1655 | | 1055 |
| | 080A62 | 1.0601 | C60 | AF70C55 / C60 | | F.115 | 1060 |
| | 070A72 | 1.0605 | C75 | C75 | | | |
| | 212M44 | 1.0727 | 45S20 | 45MF4 | 1973 | | 1146 |
| | 250A53 | 1.0903 | 51Si7 | 51S7 | 2090 | F.1450 - 50 Si 7 | 9255 |
| | 250A53 | 1.0904 | 55Si7 | 55S7 | 2085 | F.1440- 56 Si 7 | 9255 |
| | 150M36 | 1.1157 | 40Mn4 | 35M5 | | | 1039 |
| | 060A40/080A40 | 1.1186 | CK40 | XC42H1 / C40E | | | 1040 |
| | 080M46/060A47 | 1.1191 | CK45 | XC42H1 / C45/XC45 | 1672 | F.1140 - C 45 k | 1045 |
| | 060A47 | 1.1193 | CF45 | XC42H1TS | 1672 | | 1045 |
| | 080M46 | 1.1201 | Cm45 | XC42H1 /C45R | 1660 | F.1145 - C 45 k | 1045 |
| | 060A57/070M55 | 1.1203 | CK55 | XC55H1 / C55E | | F.1150 - C 55 k | 1055 |
| | 080M50 | 1.1206 | CK50 | XC48H1 / C50E | | | 1050 |
| | 070M55 | 1.1209 | Cm55 | XC55H1 / C55R / 3C55 | | F.1150 - C 55 k | 1055 |
| | 060A52 | 1.1213 | CF53 | XC48H1TS | 1674 | | 1050 |
| | 060A62 | 1.1221 | CK60 | XC60 / C60E/2C60 | 1665/1678 | F.511/F.512 | 1060 |
| | 060A67 | 1.1231 | CK67 | XC68 | 1770 | | 1070 |
| | 250A58 | 1.0909 | 60Si7 | 60S7 | | F.1441 - 60 Si 7 | 9260 |
| | 250A61 | 1.0961 | 60SiCr7 | 60SC7 | | F.1442 - 60 SiCr 8 | 9262 |

Material cross reference chart

| |  |  |  |  |  |  | |
|-------------|---|---|---|--|---|---|---------------------|
| | UK | German DIN | French | Swedish | Spanish | USA | |
| ALLOY STEEL | 805M20 | 1.6523 | 21NiCrMo2 | 20NCD2 | 2506 | F.1522 - 20 NiCrMo 2 | 8620 |
| | 805A20 | 1.6543 | 21NiCrMo22 | | | F.1534 - 20 NiCrMo 3 | 8720 |
| | 060A78 | 1.1248 | Ck75 | XC75 / C75E | 1774/1778 | F.513/514/515 | 1080/1078 |
| | 640A35 | 1.571 | 36NiCr6 | 35NC6 | | | 3135 |
| | 640M40 | 1.5711 | 40NiCr6 | | | | 3140 |
| | 311-Type7 | 1.6546 | 40NiCrMo22 | 40NCD2 | | F.1204 - 40 NiCrMo2 | 8740 |
| | 820A16 | 1.6587 | 17CrNiMo8 | 18NCD6 | | F.1560 - 14 NiCrMo13 | |
| | 832M13 | 1.6657 | 14NiCrMo134 | 16NCD13 | | F.1569 - 14 NiCrMo 131 | |
| | | 1.7006 | 46Cr2 | 42C2 / 46Cr2 | | | 5045/5046 |
| | 530A32 | 1.7033 | 34Cr4 | 32C4 / 34Cr4 | | F.8221 - 35 Cr 4/F.224 | 5132 |
| | 530A36 | 1.7034 | 37Cr4 | 38C4 / 37Cr4 | | F.1201 - 38 Cr 4 | 5135 |
| | 527M17 | 1.7131 | 16MnCr5 | 16MC5 | 2511 | F.1515 - 16 MnCr 5 | 5115 |
| | | 1.7147 | 20MnCr5 | 20MC5 | | F.150.D | 5120 |
| | 1717CDS110 | 1.7218 | 25CrMo4 | 25CD4 / 25CrMo4 | 2225 | F.8330 - AM 25 CrMo4 | 4130 |
| | 905M31 | 1.8507 | 34CrAlMo5 | 30CAD6.12 | | F.1741 - 34 CrAlMo5 | A355Cl.D |
| | 905M39 | 1.8509 | 41CrAlMo7 | 40CAD6.12 | 2940 | F.1740 - 41 CrAlMo7 | A355Cl.A |
| | 708A37 | 1.233 | 35CrMo4 | 34CD4 / 35CrMo4 | 2234 | | 4135 |
| | 708M40 | 1.2332 | 47CrMo4 | 42CD4 | 2244 | | 4142 |
| | 530M40/530A40 | 1.7035 | 41Cr4 | 42C4 / 41Cr4 | | F.1202 - 42 Cr4 | 5140 |
| | 530A40 | 1.7045 | 42Cr4 | 42C4TS | 2245 | F.1202 - 42 Cr 4 | 5140 |
| | 527A60 | 1.7176 | 55Cr3 | 55C3 | 2253 | F.1431 - 55 Cr3 | 5155 |
| | 708A37 | 1.722 | 34CrMo4 | 35CD4 / 34CrMo4 | 2234 | F.8231 - AM 34 CrMo4 | 4135/4137 |
| | 708M40 | 1.7223 | 41CrMo4 | 42CD4TS | 2244 | F.8232 - 42 CrMo4 | 4142/4140 |
| | 708M40 | 1.7225 | 42CrMo4 | 42CD4 / 42CrMo4 | 2244 | F.8232 - 42 CrMo4 | 4140 |
| | 708A47 | 1.7228 | 50CrMo4 | 50CrMo4 | | | 4150 |
| | 735A50 | 1.8159 | 50CrV4 | 50CV4 / 51CrV4 | 2230 | F.1430 - 51 CrV4 | 6150 |
| | 060A96 | 1.1274 | Ck101 | XC100 | 1870 | | 1095 |
| | HIGH STRENGTH ALLOY STEEL | 816M40 | 1.6511 | 36CrNiMo4 | 40NCD3 / 36CrNiMo4 | | F.1280 - 35 NiCrMo4 |
| 817M40 | | 1.6562 | 40NiCrMo73 | | | | 4340 |
| 311-Type6 | | 1.6565 | 40NiCrMo6 | | | F.1272 - 40 NiCrMo 7 | 4340 |
| 823M30 | | 1.658 | 30CrNiMo8 | 30CND8 / 30CrNiMo8 | | | |
| 817M40 | | 1.6582 | 34CrNiMo8 | 35NCD6 / 34CrNiMo6 | 2541 | F.1272 - 40 NiCrMo 7 | 4340 |
| 830M31 | | 1.6746 | 32NiCrMo145 | 35NCD14 | | F.1262 - 32 NiCrMo 12 | |
| 835M30 | | 1.6747 | 30NiCrMo166 | 35NCD16 | | F.1260 - 32 NiCrMo16 | |
| 722M24 | | 1.8515 | 31CrMoV139 | 30CD12 | 2240 | F.1712 - 31 CrMo 12 | |
| 722M24 | 1.7361 | 32CrMo12 | 30CD12 | 2240 | F.124.A | | |
| TOOL STEELS | | 1.1525 | C80W1 | Y190;Y180 | | | W108 |
| | | 1.1545 | C105W1 | Y1105 | 1880 | | W110 |
| | BW1B | 1.1625 | C80W2 | | | F.1507 C80 | W1 |
| | | 1.1663 | C125W | Y2120 | | F.5123 C120 | W112 |
| | BW1A | 1.175 | C75W | | | | W1 |
| | BL3 | 1.2067 | 100Cr6 | Y100C6 | | F.5230 100 Cr6 | L3 |
| | | 1.221 | 115CrV3 | | | | L2 |
| | BO1 | 1.251 | 100MnCrW4 | | 2140 | F.5220 95 MnCrW5 | O1 |
| | BS1 | 1.2542 | 45WCrV7 | | 2710 | F.5241 45 WCrSi 8 | S1 |
| | BW2 | 1.2833 | 100V1 | Y1105V | | | W210 |
| | BO2 | 1.2842 | 90MnCrV8 | 90MV8 | | | 2 |
| | 534A99 | 1.3505 | 100Cr6 | 100C6 | 2258 | F.1310 - 100 Cr 6 | 52100 |
| | | 1.2713 | 55NiCrMoV6 | 55NCDV7 | | F.528 | L6 |
| | Grade2A | 0.962 | G-X260NiCr42 | | | | A532IBNiCr-LC |
| | Grade2B | 0.9625 | G-X330NiCr42 | | | | A532IANiCr-HC |
| | Grade2C;D;E | 0.963 | G-X300CrNiSi952 | | | | A532IDNi-HiCr |
| | Grade3A;B | 0.964 | G-X300CrMoNi1521 | | | | |
| | Grade3C | 0.9645 | G-X260CrMoNi2021 | | | | A532IID20%CrMo-LC |
| | Grade3D | 0.965 | G-X260Cr27 | | | | A532IIIA25%Cr |
| | Grade3E | 0.9655 | G-X300CrMo271 | | | | A532IIIA25%Cr |
| | BD3 | 1.208 | X210Cr12 | Z200C12 | | F.5212 X210 Cr12 | D3 |
| | BH11 | 1.2343 | X38CrMoV51 | Z38CDV5 | | F.5317 X37 CrMoV5 | H11 |
| | BH13 | 1.2344 | X40CrMoV51 | Z40CDV5 | 2242 | F.5318 X40 CrMoV5 | H13 |
| | BA2 | 1.2363 | X100CrMoV51 | Z100CDV5 | 2260 | F.5227 X100 CrMoV5 | A2 |
| | BH10 | 1.2365 | X32CrMoV33 | 32DCV28 | | F.5313 CrMoV 12 | H10 |
| | BD2 | 1.2379 | X155CrVMo121 | Z160CDV12 | | | D2 |
| | | 1.2436 | X210CrW12 | | 2312 | F.5213 X210 CrW12 | |
| | | 1.2567 | X30WCrV53 | Z32WCV5 | | | |
| | BH21 | 1.2581 | X30WCrV93 | Z30WCV9 | | F.5323 X30 WCrV9 | H21 |
| | | 1.2601 | X165CrMoV12 | | 2310 | F.5211 X160 CrMoV12 | |
| | BH12 | 1.2606 | X37CrMoV51 | Z35CWDV5 | | | H12 |
| | BT15 | 1.3202 | S12-1-4-5 | | | F.5563 12-1-5-5 | T15 |
| | 1.3207 | S10-4-3-10 | Z130WKCDV10-10-04-03 | | F.553 10-4-3-10 | | |
| | 1.3243 | S6-5-2-5 | Z85WDKCV06-05-05-04-02 | 2723 | F.5613 6-5-2-5 | | |
| | 1.3246 | S7-4-2-5 | Z110WKCDV07-05-04-04-02 | | F.5613 6-5-2-5 | M41 | |
| BT42 | 1.3247 | S2-10-1-8 | Z110DKCWV09-08-04-02-01 | | F.5615 7-4-2-5 | M42 | |
| BM34 | 1.3249 | S2-9-2-8 | | | F.5611 2-9-2-8 | M33/M34 | |
| BT4 | 1.3255 | S18-1-2-5 | Z80WKCV18-05-04-01 | | F.5530 18-1-1-5 | T4 | |
| BT5 | 1.3265 | S18-1-2-10 | | | F.5540 18-0-2-10 | T5 | |
| | 1.3342 | SC6-5-2 | Z90WDCV06-05-04-03 | | | M3 | |
| BM2 | 1.3343 | S6-5-2 | Z85WDCV06-05-04-02 | 2722 | F.5603 6-5-2 | M2 | |

TuffCut XR - XT







TuffCut X-AL

TuffCut Die & Mould







Twister Drills

Technical Section







Material cross reference chart

| |  |  |  |  |  |  | |
|--------------------------------|---|---|---|---|---|---|--------------------|
| | UK | German DIN | French | Swedish | Spanish | USA | |
| TOOL STEELS | BM1 | 1.3344 1.3346 1.3348 | S6-5-3 S2-9-1 S2-9-2 | Z130WDCV06-05-04-04 Z85DCWV08-04-02-01 Z100DCWV09-04-02-02 | | F.5605 6-5-3 | M3Class2 H41/M1 |
| | BT1 | 1.3355 1.3401 | S18-0-1 X120Mn12 | Z80WCV18-04-01 Z120M12 / Z120Mn12 | | F.5520 18-0-1 F.82551-AM-X 120 Mn 12 | T1 A128(A) |
| | 443S65 | 1.4747 | X80CrNiSi20 | Z80CSN20.02 | | F.3222-X 80CrSiNi20-02 | HNV6 |
| | 403S17 | 1.4 | X6Cr13 | Z6013 / Z6Cr13 | 2301 | F.3110-X6 Cr 13 | 403 |
| 403S17 | 1.4001 | X7Cr14 | Z3014 | 2301 | F.8401-AM-X12 Cr 13 | 410S | |
| 405S17 | 1.4002 | X6CrAl13 | Z6CA13 / Z6CrAl13 | 2302 | F.3111-X6 CrAl13 | 405 | |
| 416S21 | 1.4005 | X12CrS13 | Z12CF13 / Z12CrS13 | 2380 | F.3411-X12 CrS13 | 416 | |
| 410S21 | 1.4006 | X10Cr13 | Z12C13 / Z12Cr13 | 2302 | F.3401-X12 Cr 13 | 410/CA-15 | |
| 410C21 | 1.4008 | G-X8Cr14 | Z12CN13M | | | 410 | |
| 430S15 | 1.4016 | X6Cr17 | Z8C17 / Z6Cr17 | 2320 | F.3113-X8 Cr17 | 430 | |
| 420S37 | 1.4021 | X20Cr13 | Z20C13 / Z20Cr13 | 2303 | F.3402-X20 Cr 13 | 420 | |
| 420S45 | 1.4028 | X30Cr13 | Z20C13 / Z20Cr13 | 2304 | F.3403-X30 Cr 13 | 420 | |
| | 1.4031 | X38Cr13 | Z40C14 / Z40Cr14 | 2304 | F.3404-X40 Cr 13 | | |
| 420S45 | 1.4034 | X46Cr13 | Z40C14 / Z40Cr14 | | F.3405-X46 Cr 13 | 420 | |
| 431S29 | 1.4057 | X20CrNi172 | Z15CN16.02 | 2321 | F.3427-X15 CrNi16 | 431 | |
| | 1.4104 | X12CrMoS17 | Z10CF17 | 2383 | F.3117-X10 CrS17 | 430F | |
| 434S17 | 1.4113 | X6CrMo17 | Z8CD17.01 | 2325 | | 434 | |
| | 1.4125 | X105CrMo17 | Z100CD17 | | | 440C | |
| | 1.451 | X6CrTi17 | Z8CT17 | | F.3114-X8CrTi17 | XM8/430Ti | |
| 409S19 | 1.4512 | X5CrTi12 | Z6CT12 | | | 409 | |
| | 1.4534 | | | | | 13-8 PH Mo | |
| | 1.4545 | | | | | 15-5 PH | |
| | | | | | | 15-7 PH Mo | |
| | | | | | | 17-4 PH | |
| | 1.4504 | | | | | 17-4 PH ,CH900 | |
| | 1.4548 | | Z7CNU17-04 | | | HNV3 | |
| 401S45 | 1.4718 | X45CrSi93 | Z45CS9 | | F.3220-X 4 CrSi 09-03 | | |
| 403S17 | 1.4724 | X10CrAl13 | Z10C13 | | F.13152-X 10 CrAl13 | | |
| | 1.4731 | X40CrSiMo102 | Z40CSD10 | | F.3221-X 40 CrSiMo 10-02 | | |
| 430S15 | 1.4742 | X10CrAl18 | Z10CA518 | | F.3153-X 10 CrAl 18 | 430 | |
| | 1.4762 | X10CrAl24 | Z10CA524 | | F.3154-X 10 CrAl24 | 446 | |
| 303S21 | 1.4305 | X10CrNiS189 | Z10CNF18.09 | 2346 | F.3508-X10CrNiS18-09 | 303 | |
| 304S15 | 1.4301 | X5CrNi1810 | Z6CN18.09 | 2332 | F.3451-X5 CrNi18-10 | 304/304H | |
| 305S19 | 1.4303 | X5CrNi1812 | Z8CN18.12 | | F.3513-X8CrNi18-12 | 308; 305 | |
| 304S12/S11/C12 | 1.4306 | G-X2CrNi189/1911 | Z2CN18.10/Z3CN19.10M | 2333/52 | F.3503-X 2CrNi19-10 | 304L | |
| 304C15 | 1.4308 | G-X6CrNi189 | Z6CN18.10M | 2333 | | CF-8 | |
| 301S21 | 1.431 | X12CrNi177 | Z12CN17.07 | | F.3517-X12CrNi17 07 | 301 | |
| 304S62 | 1.4311 | X2CrNiN1810 | Z2CN18.10Az | 2371 | | 304LN | |
| 425C11 | 1.4313 | G-X5CrNi134 | Z4CND13.4M | 2385 | | CA6-NM | |
| 316S16/S31 | 1.4401 | X5CrNiMo17122 | Z6CND17.11 | 2347 | F.3543-X5CrNiMo17-12-03 | 316/316L | |
| 316S11/S12 | 1.4404 | X2CrNiMo17132 | Z2CND 18.13 | 2348 | F.3533-X 2CrNiMo17 12-03 | 316L | |
| 316S61 | 1.4406 | ZCrNiMoN17122 | Z2CND 17.12Az | | | 316LN | |
| 316C16 | 1.4408 | G-X6CrNiMo1810 | | 2343 | F.8414-AM-X7 CrNiMo20 10 | CF-8M | |
| 316S62 | 1.4429 | X2CrNiMo17133 | Z2CND17.13Az | 2375 | | 316LN | |
| 316S11/S12 | 1.4435 | X2CrNiMo18143 | Z2CND17.13 | 2353 | F.3533-X 2 CrNiMo 17-12-03 | 316L | |
| 316S16 | 1.4436 | X5CrNiMo17133 | Z6CND17.12 | 2343 | F.3534-X 6 CrNiMo 17-12-03 | 316 | |
| 317S12 | 1.4438 | X2CrNiMo18164 | Z2CND19.15 | 2367 | | 317L | |
| 317S16 | 1.4449 | X5CrNiMo1713 | | | | 317 | |
| 347C17 | 1.4452 | G-X5CrNiNb189 | Z6NNb18.10M | | | | |
| | 1.446 | X8CrNiMo275 | | 2324 | F.3309-X 8CrNiMo27-05 | 329 | |
| 321S12S31 | 1.4541 | X6CrNiTi1810 | Z6CNT18.10 | 2337 | F.3553-X 7 CrNiTi 18-11 | 321 | |
| | 1.4542 | X5CrNiCuNb1714 | Z6CNU17.04 | | | 630 | |
| 347S17/S18 | 1.4546 | X5CrNiNb1810 | | | | 348 | |
| 347S17/S31 | 1.455 | X6CrNiNb1810 | Z6CNNb18.10 | 2338 | F.3552-X 7 CrNiNb 18-11 | 347 | |
| 320S31/S17 | 1.4571 | X6CrNiMoTi17122 | Z6CNDT17.12 | 2350 | F.3552-X 6 CrNiMoTi17-12-03 | 316Ti | |
| 318S17 | 1.458 | X6CrNiMoNb17122 | Z6CNDNb17.12/19.13 | | | 316Cb | |
| 318C17 | 1.4581 | G-X5CrNiMiNb1810 | Z4CNDNb18.12M | | | | |
| 309S24 | 1.4828 | X15CrNiSi2012 | Z15CNS20.12 | | | 309 | |
| 309S24 | 1.4833 | X7CrNi2314 | Z15CN24.13 | | | 309S | |
| 309C30 | 1.4837 | G-X40CrNiSi2520 | | | | | |
| | 1.4841 | X15CrNiSi2520 | Z15CNS25.20 | | F.3310-X15 CrNiSi 25-20 | 314/310 | |
| 310S24 | 1.4845 | X12CrNi2521 | Z12CN25.20 | 2361 | F.331 | 310S | |
| 310C40 | 1.4848 | G-X40CrNiSi2520 | | | F.8452-AM-X 40 CrNi25 20 | HK | |
| 349S54 | 1.4871 | X53CrMnNiN219 | Z52CMN21.09 | | F.3217-X 53 CrMnNiN 21-09 | EV8 | |
| 331S40 | 1.4873 | X45CrNiW189 | Z35CNWS14.14 | | F.3211-X45 CrNiSiW 28-09 | | |
| 321S20 | 1.4878 | X12CrNiTi189 | T6CNT18.12(B) | 2337 | F.3523-X 6CrNiTi 18 11 | 321 | |
| 1501-509;510 | 1.5662 | X8Ni9 | Z8N9 | | F.2645 - X 8 Ni 09 | A353 | |
| | 1.568 | 12Ni19 | Z18N5 | | | 2515 | |
| HIGH TEMPERATURE ALLOYS | NA 18 | 2.4375 | NiCu30 Al | NU 30 AT | | Monel k-500 | |
| | | 2.4685 | G-NiMo28 | | | Hastelloy B | |
| | | 2.481 | G-NiMo30 | | | Hastelloy C | |
| | | 2.461 | NiMo16Cr16Ti | | | Hastelloy C-4 | |
| | NA 16/3072-76 | 2.4858 | NiCr21Mo | NC 21 Fe DU | | Incoloy 825 | |
| | | 2.4694 | NiCr16Fe7TiAl | | | Inconel | |
| NA 21 | 2.4856 | NiCr22Mo9Nb | NC 22 FeDnb | | Inconel 625 | | |

Material cross reference chart

| |  |  |  |  |  |  |
|--------------------------------|---|---|---|--|---|---|
| | UK | German DIN | French | Swedish | Spanish | USA |
| HIGH TEMPERATURE ALLOYS | | 2.4856 | | | | Inconel 625 |
| | | 2.4642 | NiCr29Fe | Nnc 30 Fe | | Inconel 690 |
| | | 2.4668 | NiCr19FeNbMo | NC 19 Fe Nb | | Inconel 718 |
| | | 2.4669 | NiCr15Fe7TiAl | NC 15 TNb A | | Inconel X-750 |
| | | | | | | Invar 36-36 Alloy |
| | | | | | | Invar Super 32-5 |
| | | | | | | Invar Super 32-5 |
| | NA 13 | 2.436 | NiCu30Fe | NU 30 | | Monel 400 |
| | X5NiCrTi26 15 | | | | HR650 | A286 |
| | | | Co28Cr6Mo | Z6CNU15-5 | | Co Chrome ASTM F-75 |
| | NA17 | 1.4864 | X12NiCrSi3616 | Z12NCS37.18 | | 330 |
| | NA15(H) | 1.4876 | X10NiCrAlTi3320 | Z8NC3221 | | F.3313-X 12 CrNi 36-16 |
| | 3072-76/NA13 | 2.436 | NiCu30Fe | NU30 | | F.3545-X 9NiCr 33-21 |
| | 3072-76/NA18/3146 | 2.4375 | NiCu30Al | | | B163 |
| | | 2.4602 | NiCr17Mo17FeW | NC 17 DWY | | 4544/SB127/164 |
| | HR5/203-4/703-B | 2.463 | Ni-Cr20Ti | NC 20 T | | 4676 |
| | HR 10 | 2.465 | NiCr20Co19MoTi | NCK 20 D | MH-05 | 5388 C |
| | | 2.4662 | NiCr15MoTi | Z8 NCDT 42 | | Nimonic 75 |
| | HR 6/204 | 2.4665 | NiCr22Fe18Mo | Nc 22 FeD | MH-16 | 5660C |
| | HC 203 | 2.467 | G-NiCr13Al6MoNb | NC 13 AD | MH-03 | 5536E |
| | HC 204 | 2.4674 | NiCo15Cr10MoAlTi | NK 15 CAT | MH-31 | 5391A |
| | 3072-76 | 2.4816 | NiCr15Fe | NC 15 Fe | | 5540 |
| | | 2.4856 | NiCr22Mo9Nb | NC 22 FeDNB | | 5581 |
| | 3072-76 | 2.4858 | NiCr21Mo | NC 21 FeDU | | |
| | HR 207/5047 | | NiFe33Cr17Mo | NW 11 AC | | |
| | | | NiCo32Cr26Mo | KC 20 WN | | |
| | | | NiCo28Cr15MoAlTi | NK 27 CADT | | |
| | HR 3/5007 | 2.4634 | NiCo20Cr15MoAlTi | NCKD 20 ATV | MH-14 | |
| | | 2.4654 | NiCr20Co14MoTi | NC 20 K 14 | | |
| | HR 505 | 2.4669 | NiCr16FeTi | NC 15 Fe TNb | | 5542G |
| | 2.4676 | NiCo10W10Cr9AlTi | | | | |
| | | NiCr20Co16MoTi | NC 19 KDU/V | | | |
| | | NiW13Co10Cr9AlTi | NKW 10 CAT aHf | | | |
| | | NiCr16Co10WAlTi | | | | |
| HR 401HR601/736B | 2.4631 | NiCr20TiAl | NC 20 TA | MH-07 | | |
| | 2.4636 | NiCo15Cr15MoAlTi | NCKD 20 AT | | 687 | |
| | 2.4662 | NiFe35Cr14MoTi | Z8 NCDT 42 | | | |
| HR 8 | 2.4668 | NiCr19Fe19NbMo | NC 19 FeNb | MH-06 | | |
| | 2.4916 | NiCr19Co11MoTi | | | | |
| | 2.4983 | NiCr18Co18MoAlTi | NCK 19 DAT | | 684 | |
| | | NiCo22Cr16WAlTi | NC 14 K8 | | | |
| TITANIUM | TA.1 | 3.7024/25 | Ti 99,8 | T-35 | | Ti-PO1 |
| | TA.2/3/4/5 | 3.7034/35 | Ti 99,7 | T-40 | | Ti-PO2 |
| | TA.6/7/8/9 | 3.7064/65 | Ti99,5 | T-60 | | 4941/42/51/4902 |
| | TA.21-24/52-55/58 | 3.7124 | TiCu2 | T-U2 | | 4901/21 |
| | DTD 5023/5273/5283 | | | T-50 | | 4900 |
| | | 3.7114 | TiAl5Sn2 | | | Ti-5Al-2.5Sn |
| | | | 5553 | | | Ti-5Al-5V-5Mo-3Cr |
| | TA.43/44 | 3.7154 | TiAl6Zr5Mo0,5Si0,2 | T-A6ZD | | Ti-P67 |
| TA.10-13/28/56 | 3.7164/65 | TiAl6V4 | T-A6V | | Ti-P63 | |
| TA.45-51/57 | 3.7184 | TiAl4Mo4Sn2Si0,5 | T-A4DE | | Ti-P68 | |
| NODULAR CAST IRON | 420/12 | 0.704 | GGG-40 | FGS-400-12 | 0717-02 | 60-40-18 |
| | 370/17 | 0.7043 | GGG-40.3 | FGS370-17 | 0717-15 | |
| | 500/7 | 0.705 | GGG-50 | FGS500-7 | 0727-02 | 65-45-12 |
| | 600/3 | 0.706 | GGG-60 | FGS 600-3 | 0732-03 | 80-55-06 |
| | 700/2 | 0.707 | GGG-70 | FGS 700-2 | 0737-01 | 100-70-03 |
| | 800/2 | 0.708 | GGG-80 | FGS 800-2 | | 120-90-02 |
| | W 340/3 | 0.8035 | GTW-35-04 | MB 35-7 | | |
| | W 410/4 | 0.804 | GTW-40-05 | MB 40-10 | | |
| | B 340/12 | 0.8135 | GTS-35-10 | MIN 35-10 | SIS 08 15-00 | 32 510 |
| | P 440/7 | 0.8145 | GTS-45-06 | MP 50-5 | SIS 08 54-00 | |
| | P 540/5 | 0.8155 | GTS-55-04 | MP 60-3 | SIS 08 56-00 | |
| | P 690/2 | 0.817 | GTS 70-02 | MP 70-2 | SIS 08 62-03 | 70 003 |
| B 290/6 | | | MIN 32-8/38-18 | SIS 08 14-00 | | |
| GREY CAST IRON | | 0.601 | GG10 | Ft10D / FGL100 | 0110-00 | FG 10 |
| | Grade 150 | 0.6015 | GG15 | Ft15D / FGL150 | 0115-00 | FG 15 |
| | Grade 220 | 0.602 | GG20 | Ft20D / FGL200 | 0120-00 | FG20 |
| | Grade 260 | 0.0625 | GG25 | Ft25D / FGL250 | 0125-00 | FG 25 |
| | Grade 300 | 0.603 | GG30 | Ft30D / FGL300 | 0130-00 | FG 30 |
| | Grade 350 | 0.6035 | GG35 | Ft35D / FGL350 | 0135-00 | FG35 |
| | Grade 400 | 0.604 | GG40 | Ft40D / FGL400 | 0140-00 | A48-60B |
| ALUMINIUM ALLOYS | LM4/LM22 | 3.2151 | G-ALSi6Cu4 | A-55U | 4230 | L-2660 |
| | 2L99/LM25 | 3.2371 | G-ALSi7Mg | A-57G0,3 | 4244 | 319,2 |
| | LM24 | 3.2161 | G-ALSi8Cu3 | A-59U3 | 4252 | A356.2 |
| | LM9 | 3.2381 | G-ALSi10Mg | A-510G | 4253 | 380,1 |
| | LM20 | 3.2583 | G-ALSi12Cu | A-S12U | 4260 | L-2560 |
| | LM6 | 3.3581 | G-ALSi12 | A-S13 | 4261 | L-2530 |
| | | | | | L-2520 | A413 |

Material cross reference chart

| |  |  |  |  |  |  | |
|-------------------------|---|---|---|---|---|---|----------|
| | UK | German DIN | French | Swedish | Spanish | USA | |
| ALUMINIUM ALLOYS | LM28/LM29 | | AlSi18-25CuNiMg | | | 393 | |
| | 1C | 3.0205 | Al99 | A4 | 144010 | 1200 | |
| | 1B | 3.0255 | Al99,5 | A5 | 144007 | 1050A | |
| | 1E | 3.0257 | E-Al | A5/L | 144008 | 1350A | |
| | 1A | 3.0285 | Al99,8 | A8 | 144004 | 1080A | |
| | 1 | 3.0385 | Al99,98R | A99 | | 1199 | |
| | N31 | 3.0505 | AlMn0,5Mg0,5 | | | 3105 | |
| | N3 | 3.0515 | AlMn | | 144054 | L-3810 | 3103 |
| | | 3.0525 | AlMn1Mg0,5 | A-M1G0,5 | | | 3005 |
| | N4 | 3.0526 | AlMnMg1 | A-M1G | | L-3820 | 3004 |
| | | 3.0915 | AlFeSi | A-FeS | | | 8011A |
| | H15 | 3.1255 | AlCuSiMn | A-U4SG | 144338 | L-3130 | 2014 |
| | | 3.1303 | AlCu2Mg0,5 | | | | 2036 |
| | 3L86/HR13 | 3.1305 | AlCu2,5Mg0,5 | A-U2G | | L-3180 | 2117 |
| | H14 | 3.1325 | AlCuMg1 | A-U4G | | L-3120 | 2017A |
| | 2L98 | 3.1355 | AlCuMg2 | A-U4G1 | | L3140 | 2024 |
| | | 3.1645 | AlCuMgPb | A-U4Pb | 144335 | L-3121 | 2003 |
| | FC1 | 3.1655 | AlCuBiPb | A-U5PbBi | 144355 | L-3182 | 2011 |
| | 2L91/92 | 3.1841 | G-AlCu4Ti | | | | 295.1/.2 |
| | 91E | 3.2305 | E-AlMgSi | | | L-3431 | 6101B |
| | BTR6 | 3.2307 | Al99,85MgSi | A85-GS | | | 6463 |
| | H30 | 3.2315 | Al-Si1 Mg | A-SGMO,7 | 144212 | L-3451 | 6181 |
| | H9 | 3.3206 | AlMGSi0,5 | | 144103 | L-3441 | 6060 |
| | BTR6 | 3.3207 | E-AlMgSi0,5 | A-GS/L | 144102 | | 6101C |
| | | 3.3241 | G-AlMg3Si | A-G3T | | | F/B514.0 |
| | N41 | 3.3315 | AlMg1 | A-G0,6 | 144106 | L-3350 | 5005A |
| | 3L44 | 3.3316 | AlMg1,5 | A-G1,5 | | L-3380 | 5050B |
| | BTR2 | 3.3317 | Al99,85Mg1 | A85-G1 | | | |
| | | 3.3326 | AlMg1,8 | | | | 5051A |
| | | 3.3345 | AlMg4,5 | | | | 5082 |
| | N5Mg3,5 | 3.3523 | AlMg2,5 | A-G2,5C | 144120 | L-3360 | 5052 |
| | N4 | 3.3525 | AlMg2Mn0,3 | A-G2M | | | 5251 |
| | | 3.3527 | AlMg2Mn0,8 | | | | 5049 |
| | | 3.3535 | AlMg3 | A-G3M | 144133 | L-3390 | 5754 |
| | N51 | 3.3537 | AlMg2,7Mn | A-G2,5MC | | | 5454 |
| | | 3.3541 | G-AlMg3 | A-G3T | | L-2341 | 514 |
| | | 3.3545 | AlMg4Mn | A-G4MC | | L-3322 | 5086 |
| | N8 | 3.3547 | AlMg4,5Mn | 5083 | 144140 | L-3321 | 5083 |
| N6 | 3.3555 | AlMg5 | | 144146 | L-3320 | 5056A | |
| LM5 | 3.3561 | G-AlMg5 | A-G6 | | | 514.1 | |
| LM10 | 3.3591 | G-AlMg10 | A-G10-Y4 | | L-2310 | 520 | |
| H17 | 3.4335 | AlZn4,5Mg1 | A-Z5G | 144425 | L-3741 | 7020 | |
| | 3.4345 | AlZnMgCu0,5 | A-Z5GU0,6 | | | 7022 | |
| 2L95 | 3.4365 | AlZnMgCu1,5 | A-Z5GU | | L-3710 | 7075 | |
| | 3.4415 | AlZn1 | | | L-3721 | 7072 | |
| COPPER ALLOYS | Pb2 | 2.1052 | G-CuSn12 | CuSn12 | | C 90800 | |
| | CT2 | 2.106 | G-CuSn12Ni | | | C 91700 | |
| | CT1 | 2.1086 | G-CuSn10 | | | C 90250 | |
| | | 2.109 | G-CuSn7ZnPb | CuSn7Pb6Zn4 | | C 93200 | |
| | LG4 | 2.1093 | G-CuSn6ZnNi | | | C 92410 | |
| | LG2 | 2.1096 | G-CuSn5ZnPb/RG5 | CuPb5Sn5Zn5 | | C 83600 | |
| | LG1 | 2.1098 | G-CuSn2ZnPb | | | C 83810 | |
| | LB2 | 2.1176 | G-CuPb10Sn | CuPb10Sn10 | | C 93700 | |
| | LB1 | 2.1182 | G-CuPb15Sn | | | C 93800 | |
| | LB5 | 2.1188 | G-CuPb20Sn | CuPb20Sn5 | | C 94100 | |
| | | 2.0918 | CuAl5As | CuAl6 | | C 60 800 | |
| | | 2.092 | CuAl8 | CuAl8 | | C 61 000 | |
| | CA 106 | 2.0932 | CuAl8Fe3 | CuAl7Fe2 | | C 61 400 | |
| | CA 105 | 2.0936 | CuAl10Fe3Mn2 | CuAl9Fe3Mn2 | | C 62 300 | |
| | AB 1 | 2.094 | CuAl10Fe | CuAl9Fe3 | | C 95 200 | |
| | CA 104 | 2.0966 | CuAl10Ni5Fe4 | CuAl9Ni5Fe3Mn | | C 63 200 | |
| | AB 2 | 2.097 | G-NiAlBzF50 | CuAl9Ni5Fe | | C 95 800 | |
| | CC 102 | 2.1293 | CuCrZr | | | C 18100 | |
| | C 112 | 2.1285 | CuCo2Be | | | C 17500 | |
| | CB 101 | 2.1245 | CuBe1,7 | CuBe1,7 | | C 17000 | |

Custom Tool Division

Engineering and Manufacturing Excellence

The true value of a tool is measured by its ability to increase productivity through superior craftsmanship, performance and tool life.

The M.A. Ford® Custom Tool Division focuses on meeting the growing need for unique and increasingly complex special cutting tools. By partnering with select machine tool users the Custom Tool Division develops and supplies custom engineered carbide tools of unmatched quality which meet or exceed their productivity, delivery and utilized cost expectations. Custom tools are proven to increase speeds and feeds, save setup and handling time which in turn leads to faster run times, more efficient manufacturing and most importantly, INCREASED PROFITS.

Meeting the growing need for unique and increasingly complex high performance custom cutting tools in today's industry

To support your productivity improvement efforts, we offer the following services:

- Technical assistance in prototype custom tool design.
- Re-engineering of existing custom tooling to optimize tool performance.
- Tool manufacturing lead times which meet or exceed your delivery requirements.
- Immediate response to quotation request.
- Readily available technical phone support.
- Field representative support service.
- Emergency tool service.
- Custom tools of the highest quality.

We offer application development, design and manufacturing expertise in the following product classifications:

- High Performance Drills
- G-Drills
- Step Drill Reamers
- Coolant Thru Specials
- Step Reamers
- Coolant Thru Reamers
- Custom End Mills
- Custom Form Tools

Optimised Cutting-High Performance Cutting (HPC)

Since producing its first cutting tools in 1919, M.A.Ford has always strived to improve its customers productivity and hence lower costs.

The Tuffcut XR-XT range of end mills is the latest step in this process, offering unique Heli-pitch geometry, proprietary substrates and state of the art AlTima coatings.

High Speed Machining or HSM has long been characterised by cutting conditions that are 4 to 10 times higher than conventional machining. The machine tools widely available today to 95% of customers are not capable of these cutting speeds nor do they have the rigidity required.

High Performance Cutting techniques (HPC) use cutting speeds that are 2 times+ that of standard or conventional techniques. In conjunction with the increase in surface speed, by controlling the engagement angle of the cutting tool during the milling process and the use of chip thickness compensation-vastly increased cutting data can be achieved.

Before using these techniques there are several required pre-requisites:-

- Rigid machine tools with modern control systems with a HSM function..
- High performance, high technology cutting tools.
- High gripping strength, rigid tool holders.
- Air or powerful coolant delivery system-according to material being machined.
- Cad Cam software to control the engagement angle of the tool.

M.A.Ford has partnered with OneCNC Cad/Cam software company to provide this service to its customers. In conjunction with their XR3/XR4 software with its HSM function the radial engagement of the tool during the milling process can be guaranteed never to exceed the set percentage. A step over of 10% of the cutter diameter requires a chip thickness compensation factor of 1.8 to be applied. 20% radial engagement requires a compensation of 1.2 times. However, care must be taken when using these rates for tight corner internal machining.

Due to the small radial cuts, large axial cuts – typically 2 times the tool diameter can be used. The combination of these factors enables most steels up to 40HRC to be machined at feeds of up to 13 metres/min. An example of this HPC cutting data can be seen on the facing page in a direct comparison with conventional programming techniques.

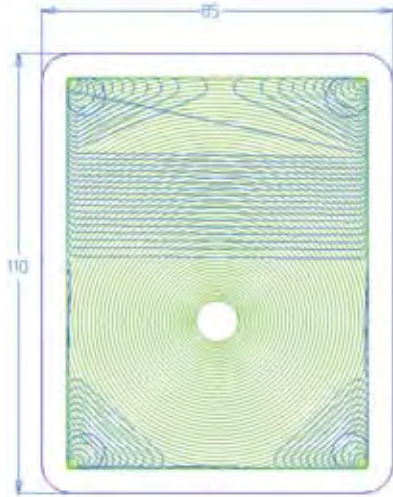
Benefits of HPC using OneCNC software-

- Decreased cycle time
- Reduced costs
- Potentially reduced cutting tool diameter and hence cost
- Improved process reliability
- Improved cutting tool life
- Reduced coolant consumption



Benefits of Enhanced cutting parameters with HSM toolpaths

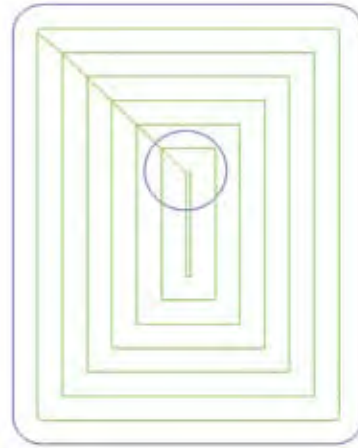
HSM tool path



Tool diameter-12 mm
Entry-Helical ramp-2 degrees
Axial depth Ap-24 mm-1cut
Radial step over Ae-10%-1.2 mm

177 1200-0.5RA

Conventional tool path



Tool diameter-12 mm
Entry-Via drilled hole.
Axial depth Ap-24 mm-2 cuts of 12 mm
Radial step over Ae-50%-6 mm

177 1200-0.5RA

Cutting data and cycle time by material

| Steel | | |
|--------------------|---------------|---------|
| RPM | 8000 | 3200 |
| Feed mm/min | 6700 | 765 |
| Cycle time | 1 min-40 secs | 4 mins |
| Metal removal rate | 193 Cm-3 | 55 Cm-3 |
| Expected tool life | 2-3hrs | 1-2hrs |

| Stainless steel | | |
|--------------------|---------------|---------|
| RPM | 4000 | 1855 |
| Feed mm/min | 3400 | 450 |
| Cycle time | 3 min-20 secs | 7 mins |
| Metal removal rate | 98 Cm-3 | 32 Cm-3 |
| Expected tool life | 2-3hrs | 1-2hrs |

| Titanium | | |
|--------------------|---------------|---------|
| RPM | 2600 | 1600 |
| Feed mm/min | 2100 | 380 |
| Cycle time | 5 min-15 secs | 8 mins |
| Metal removal rate | 61 Cm-3 | 27 Cm-3 |
| Expected tool life | 2-3hrs | 1-2hrs |

| Inconel 625 | | |
|--------------------|--------------|------------|
| RPM | 930 | 660 |
| Feed mm/min | 470 | 80 |
| Cycle time | 21 mins | 37 mins |
| Metal removal rate | 14 Cm-3 | 6 Cm-3 |
| Expected tool life | 30 mins-1 hr | 15-30 mins |

M.A. FORD Quality Policy

Ultimately we are judged by our customer. The product that we supply must satisfy our customers needs and meet their requirements, or they will find an alternate source. The customer will define quality. It therefore becomes everyone's quality mission to know their customer, to fully understand their requirements, and to commit to continued improvement in satisfying those needs and requirements.



Certificate of Registration



The following organization's quality management system has been assessed and registered by Intertek Testing Services NA, Inc. as conforming to the requirements of:

ISO 9001:2008

Organization:
M.A. Ford Manufacturing Company, Inc.
Main Site: 7737 N.W. Boulevard, Davenport, Iowa, 52808, USA

The Quality Management System is applicable to:
The design and manufacture of precision rotary cutting tools.

In the issuance of this certificate, Intertek assumes no liability to any party other than to the Client, and then only in accordance with the agreed upon Certification Agreement.



[Signature]
Intertek Testing Services NA, Inc. – Kentwood, MI, USA

GF106-US-QMS4-2008 – Issue Date 15/11/2008 Project No. 4633

The M.A. Ford Quality Policy is:

*Know our customers.
Know their requirements.
Make continual improvements in satisfying those requirements.*

These are the responsibilities of every individual who works at M.A. Ford.

[Signature]

Steve Morency, President

 **M.A.FORD**
High Performance Cutting Tools

Coatings

ALtima®

Aluminum Titanium Nitride (AlTiN). ALtima® is the original high performance coating. This coating allows tools to be run at higher speeds and feeds in a wide array of materials. Also, it allows the option of running tools dry due to the high oxidation temperature of the coating.

ALtima® 52

Aluminum Titanium Nitride (AlTiN). ALtima® 52 is specially designed for milling hardened steels 52 Rc and above. It has very high hardness and the oxidation temperature of the coating makes this the absolute best choice for hardened steel milling. ALtima® 52 is designed to allow for dry machining.

ALtima® Blaze

Aluminum Chromium Nitride (AlCrN). ALtima® Blaze is designed to allow higher material removal rates. This coating has a higher oxidation temperature than a typical TiAlN coating. It has shown very good results in nickel alloys, titanium, and other difficult to machine materials. Tools coated with ALtima® Blaze can be used in dry machining.

Fordlube

Titanium DiBoride (TiB₂) is a unique coating with low Aluminum affinity, smooth surface finish and high hardness. It is ideal for Aluminum and Magnesium alloys as it prevents build-up on cutting edge, provides superior chip flow along with extended wear resistance.

Special Coatings

Upon request, M.A. Ford® can provide any commercially available coating. Any standard M.A. Ford® cutting tool can be provided with coating if requested.

Coating Properties

| MA Ford® Coating | MA Ford® Tool Number Designation | Microhardness (HV) | Maximum Service Temp. | Friction Coefficient |
|------------------|----------------------------------|--------------------|-----------------------|----------------------|
| ALtima® | A | 3100 | 1100° C / 2012° F | 0.42 |
| ALtima® 52 | A | 3600 | 1200° C / 2192° F | 0.40 |
| ALtima® Blaze | B | 3200 | 1100° C / 2012° F | 0.35 |
| Fordlube | F | 4000 | 700° C / 1292° F | 0.30 |

ISO 9001:2008 Certified



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