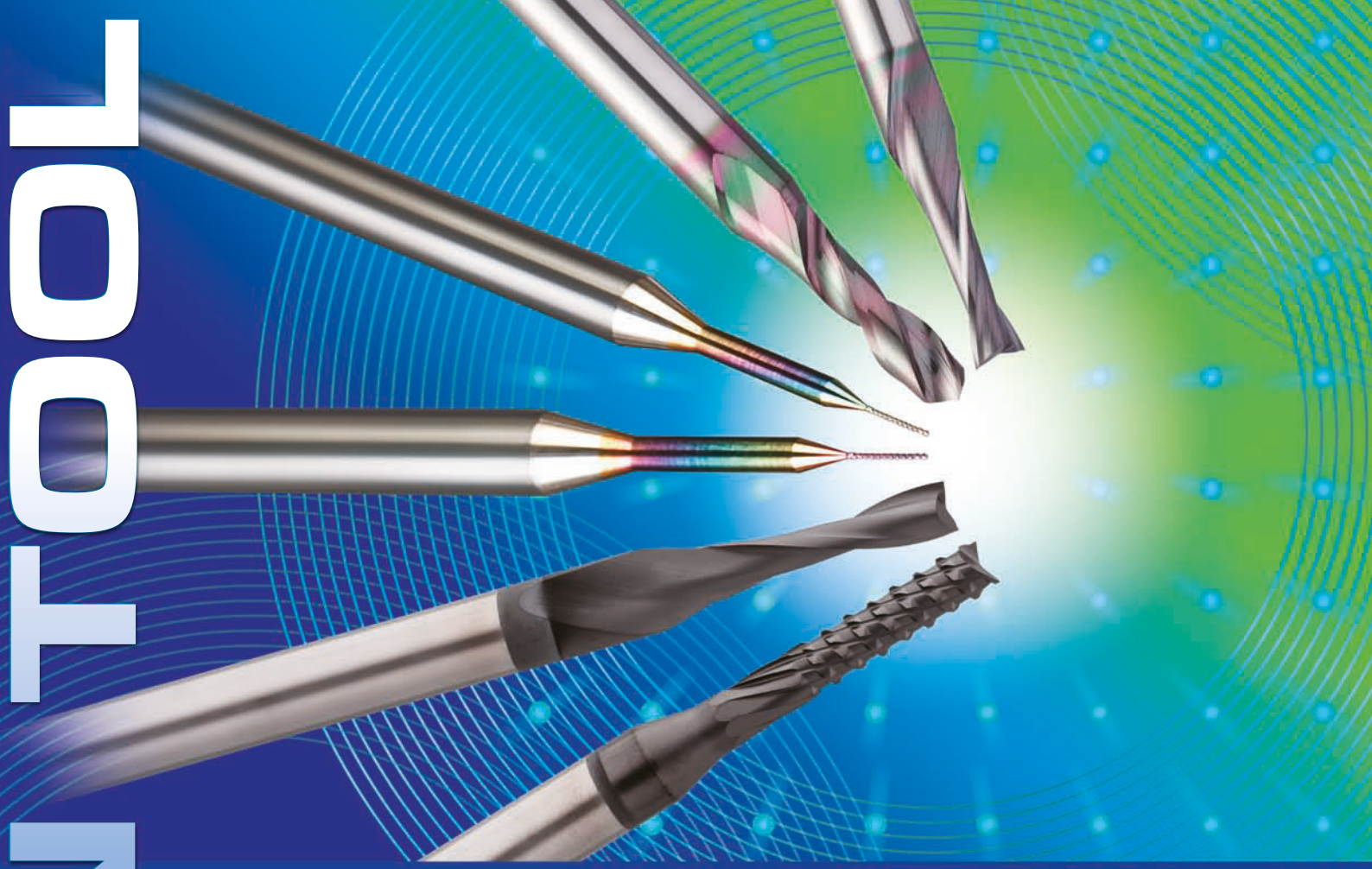
UNION TOOL



# Tungsten Carbide Cutting Tools for Electronic Printed Circuit Boards and Equipment for Service and Support 2016

UNION TOOL

*Exceeding your expectations*

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# DRILLS / SPIRALBOHER
# FORET / PUNTE / BROCAS

## introduction / einleitung / introduction / introduzione / introducción

The UNION TOOL range of PCB drills and routers are produced on proprietary equipment that is both designed and built in-house. This strategy has enabled our engineers to design in the highest levels of product quality, utilizing over 40 years of knowledge and experience. This advantage has enabled us to install innovative, industry leading equipment such as the DIS (Automatic Optical Inspection System for drill point control) much earlier than our competitors. It also ensures we adapt much quicker to the demands of technology and capacity, such as the growth in micro drills. Through this strategy UNION TOOL has attained and maintains its number one market position.

UNION TOOL's gesamte Palette an Leiterplattenbohrern und -fräsern wird ausschließlich auf eigenen Maschinen und Geräten produziert, welche "In-House" konzipiert, entwickelt und hergestellt werden. Diese Strategie sowie über 40 Jahre Wissen und Erfahrung ermöglicht unseren Ingenieuren von Anfang an das höchste Niveau an Produktqualität mit einfließen zu lassen. Dieser Vorteil erlaubte UNION TOOL bereits weitaus früher als seiner Konkurrenz, innovative Spitzengeräte wie z.B. das DIS (automatisch, optisches Kontrollinspektions-System für Bohrerspitzen) herzustellen. Somit stellen wir auch sicher, dass wesentlich schneller auf die sich stetig ändernde technologische und mengenmäßige Nachfrage reagiert werden kann, wie z.B. im Bereich Mikrobohrer. Dank dieser Strategie konnte UNION TOOL die Marktposition Nr. 1 erreichen und diese auch bis jetzt erfolgreich behaupten.

Les forets et fraises UNION TOOL conçus pour le perçage et le détourage des circuits imprimés sont produits sur les équipements développés et fabriqués entièrement à l'interne. Cette stratégie a permis à nos ingénieurs d'assurer le plus haut niveau de qualité pour tous nos produits, fruit d'un savoir-faire de plus de 40 ans d'expérience. Cet avantage nous a permis d'installer des équipements de mesure et de contrôle à l'avant-garde en la matière bien avant nos concurrents tel le DIS (système automatique de contrôle de la géométrie du foret). Ceci nous assure une rapide adaptation à la demande technologique et la productivité telle que celle exigée par la demande croissante des micro forets.
Fort de cette philosophie, UNION TOOL a atteint et reste le numéro un en matière d'outillage pour circuits imprimés.

Le punte e frese della UNION TOOL per la microforatura dei circuiti stampati sono prodotte con l'equipaggiamento progettato e costruito al nostro interno. Questa strategia ha permesso ai nostri ingegneri di assicurare il più alto livello di qualità per tutti i nostri prodotti, frutto del know-how acquisito in più di 40 anni di riconosciuta esperienza. Inoltre ci ha assicurato di essere al vertice dell'innovazione e promotori nell'equipaggiamento come il DIS (sistema automatico di controllo della geometria della punta). Ciò favorisce una rapida risposta tecnologica e produttiva come per lo sviluppo delle micro punte.
Forte di questa strategia, la UNION TOOL ha raggiunto e rimane il numero uno nel campo dei circuiti stampati.

Las brocas y fresas UNION TOOL concebidas para el taladrado y fresado de los circuitos impresos, se producen con máquinas y equipos propios, desarrollados y fabricados internamente en su totalidad. Esta estrategia ha permitido a nuestros ingenieros asegurarse el mayor nivel de calidad para todos nuestros productos, fruto de una destreza basada en más de 40 años de experiencia. Esta ventaja nos ha permitido la instalación de equipos de medida y de control de vanguardia, mucho antes que la competencia, como el sistema DIS (sistema automático de control de la geometría de la broca). Esto nos asegura una rápida adaptación a la demanda de tecnología y de productividad que exige el actual desarrollo de las microbrocas. Con esta estrategia UNION TOOL ha alcanzado y se mantiene en el primer puesto en el campo del circuito impreso.

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## HARTMETALL SPIRAL-BOHRER

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## BROCAS DE CARBURO DE TUNGSTENO


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| | **MC** | ø 0.105 ~ ø 0.25 mm | |
| | **MV** | ø 0.105 ~ ø 0.15 mm | |
| | **MCV** | ø 0.12 ~ ø 0.25 mm | |
| | **MH** | ø 0.20 ~ ø 0.25 mm | |
| Small Drill Series | **UC** | ø 0.30 ~ ø 0.55 mm | 06 - 07 |
| | **UV** | ø 0.30 ~ ø 0.75 mm | |
| | **UH** | ø 0.30 ~ ø 0.65 mm | |
| Medium & Inverse Drill Series | **ST** | ø 0.60 ~ ø 3.175 mm | 08 - 09 |
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| | **ID30C** | ø 3.20 ~ ø 8.00 mm | |
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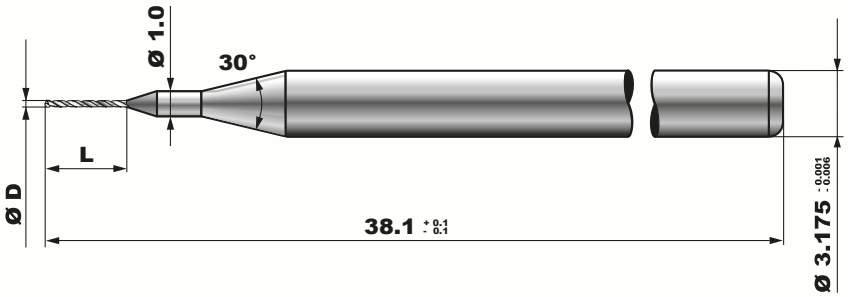



**MD**
ø 0.05 ~ ø 0.15 mm

**MC**
ø 0.105 ~ ø 0.25 mm

**MV**
ø 0.105 ~ ø 0.15 mm

**MCV**
ø 0.12 ~ ø 0.25 mm

**MH**
ø 0.20 ~ ø 0.25 mm

## DRILLS

Meeting the demands of surface mount technology (SMT) electric printed circuit boards, these micro drill series are used for through holes and blind via hole drilling. Made from hyper fine grain carbide alloy, this is an extremely robust product range.

## SPIRALBOHRER

Trifft die Anforderungen der SMT (Surface Mount Technology) bei Leiterplatten. Der Mikrobohrer ist für Durchgangslöcher sowie “blind vias” entwickelt worden. Das extra feine Karbid-Granulat ermöglicht dem Bohrer längere Standzeiten und weniger Bohrerbrüche.

## FORETS

Répond aux exigences de la technologie de montage en surface (SMT) des circuits imprimés. La série des micro forets est conçue pour percer des trous passants de petits diamètres ainsi que des trous borgnes. Ces outils sont fabriqués dans un alliage composé de “micro grains” de carbure de tungstène qui leur confèrent une excellente résistance aux détériorations.

## PUNTE

Incontra le esigenze della tecnologia con montaggio superficiale (SMT) sui circuiti stampati. Questa serie di micro punte viene utilizzata per fori passanti e fori ciechi. Gli utensili vengono prodotti con una lega avente micrograni di carburo di tungsteno che permette una notevole resistenza alle scheggiature.

## BROCAS

Responde a las exigencias de la tecnología con montaje superficial (SMT) de circuitos impresos. La serie de microbrocas está concebida para realizar taladros pasantes de pequeños diámetros así como taladros ciegos. Estas herramientas están fabricadas en una aleación compuesta de “microgranos” de carburo de tungsteno que le confieren una excelente resistencia al deterioro.

## ULTRA MICRO & MICRO DRILLS FOR HIGH DENSITY MULTI-LAYER BOARDS

| Ø mm | L mm | Drill type | Label description | Straight | | Under cut | | | Advantages | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | regular | variable web | regular | optimized design for low CTE, halogen free & high Tg materials | variable web | Hole positionning accuracy | Accuracy & hole wall quality balance | Hole wall quality |
| 0.050 | 0.9 | MD | MD J780AW | ■ | | | | | | ■ | |
| 0.075 | 1.2 | MD | MD J932W | ■ | | | | | | ■ | |
| 0.080 | 1.2 | MD | MD J933W | ■ | | | | | | ■ | |
| 0.105 | 1.5 | MV | MV J676W | | ■ | | | | ■ | | |
| | 1.8 | MV | MV J272W | | ■ | | | | ■ | | |
| | | MC | MC L517AW | | | ■ | | | | | ■ |
| | | MC | MC L517DW | | | ■ | | | | ■ | |
| 0.12 | 1.7 | MD | MD M312W | ■ | | | | | ■ | | |
| | 1.8 | MCV | MCV L938W | | | | | ■ | | ■ | |
| | 2.0 | MD | MD J602BW | ■ | | | | | | | ■ |
| 0.15 | 2.0 | MD | MD J422BW | ■ | | | | | ■ | | |
| | 2.5 | MC | NEU L004W | | | ■ | | | | ■ | |
| | | MV | NEV E962W | | ■ | | | | ■ | | |
| | 2.7 | MC | MC L247W | | | ■ | | | | ■ | |
| | | MC | MC L692BW | | | ■ | | | | ■ | |
| | 3.0 | MC | NEU L088BW | | | ■ | | | | | ■ |
| | | MC | MC L434W | | | ■ | | | | ■ | |
| 0.20 | 3.0 | MC | MC L173AW | | | ■ | | | | ■ | |
| | 3.5 | MC | MC L273W | | | ■ | | | | ■ | |
| | | MC | MC L795BW | | | ■ | | | | ■ | |
| | | MCV | MCV L604W | | | | | ■ | ■ | | |
| | | *MH* | *MHW* | | | | ■ | | | ■ | |
| | 4.0 | MC | NEU L009W | | | ■ | | | ■ | | |
| | | MC | MC L897W | | | ■ | | | | ■ | |
| | | *MH* | *MHW* | | | | ■ | | | ■ | |
| 0.25 | 4.0 | MC | MC L139W | | | ■ | | | | ■ | |
| | | MCV | NEUV L032W | | | | | ■ | ■ | | |
| | | *MH* | *MHW* | | | | ■ | | | ■ | |
| | 4.5 | MC | NEU L026W | | | ■ | | | | ■ | |
| | | MCV | MCV L199AW | | | | | ■ | ■ | | |
| | | MC | MC L476W | | | ■ | | | | ■ | |
| | | MC | MC L702CW | | | ■ | | | | ■ | |
| | | *MH* | *MHW* | | | | ■ | | | ■ | |
| | 4.7 | MC | MC L670GW | | | ■ | | | | ■ | |
| | | *MH* | *MHW* | | | | ■ | | | ■ | |

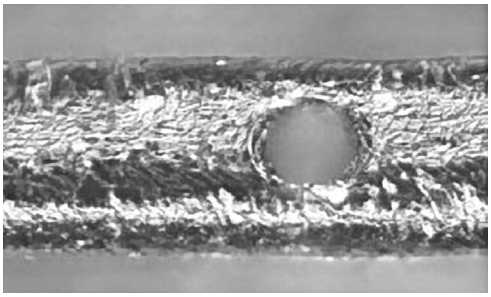
Comparison between our smallest drill diameter and a drilled human hair

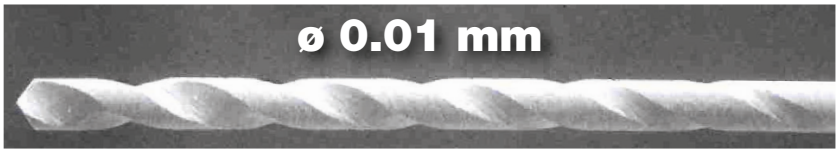
Vergleich zwischen unserem kleinsten Bohrer-Durchmesser und einem durchbohrten Haar

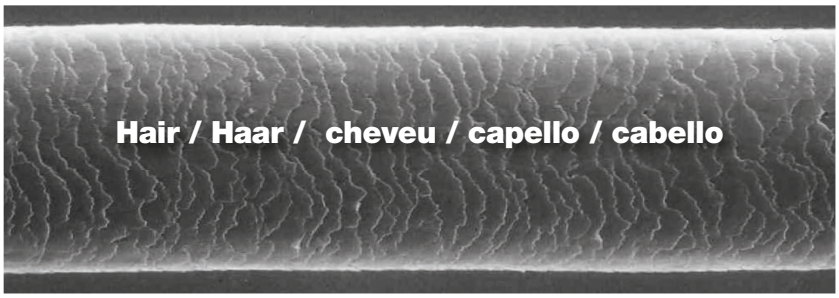
Comparaison entre notre plus petit foret et un cheveu percé

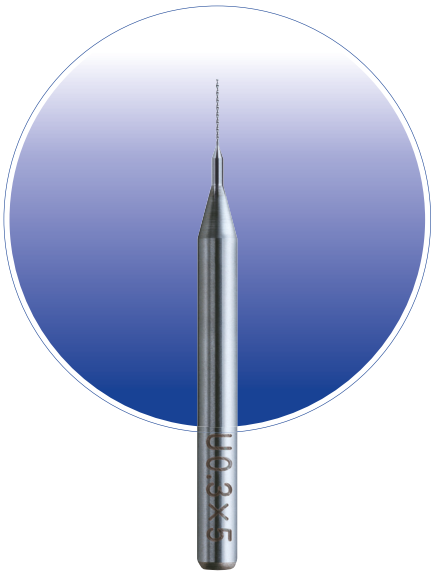
Confronto tra nostra più piccola punta e un capello forato

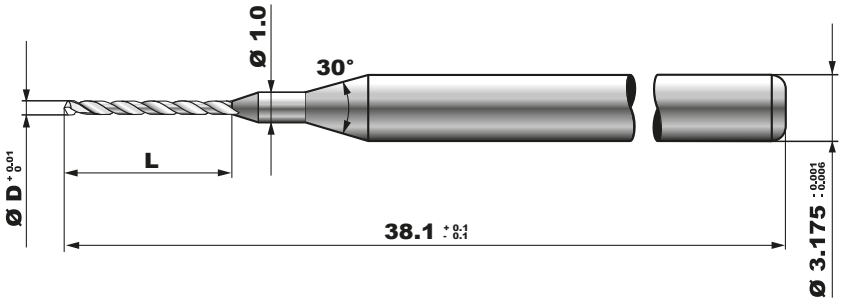
Comparación entre nuestra broca más pequeña y un cabello taladrado








**UC**
ø 0.30 ~ ø 0.55 mm

**UV**
ø 0.30 ~ ø 0.75 mm

**UH**
ø 0.30 ~ ø 0.65 mm

## DRILLS

Under cut type drills for a wide range of applications that need either small through holes or via interconnects. The design balances the needs for improved inner hole wall quality, while maintaining good hole registration accuracy. Made from a tungsten carbide alloy with a high modulus of elasticity, this range is perfect for today's demanding high density multi-layer boards.

## SPIRALBOHRER

Die Köpfchenbohrer werden vor allem bei Durchgangs- und Sacklöchern eingesetzt. Dank der modifizierten Geometrie erzeugen sie weniger Smear, Lochwandrauigkeit usw. und besitzen eine höhere Positioniergenauigkeit. Durch den grossen Elastizitätsgrad sind die Vollhartmetallbohrer besonders für hohe Multilagen geeignet.

## FORETS

Les séries des forets UC/UV sont conçues pour le perçage de petits diamètres. Leur géométrie à tête détalonnée permet d'améliorer considérablement la qualité des parois du trou (rugosité, smear, etc.) tout en maintenant un positionnement très précis. L'utilisation d'un alliage de carbure de tungstène à haut coefficient d'élasticité répond aux plus hautes exigences des circuits multicouches à haute densité.

## PUNTE

Questi utensili sono disponibili per piccoli fori e per varie applicazioni. Il loro particolare disegno permette una migliore qualità all'interno del foro (rugosità, smear, etc.) mantenendo una eccellente accuratezza. Una lega a base di carburo di tungsteno, avente un alto coefficiente di elasticità, viene utilizzata in queste punte, che le rendono disponibili alle richieste odierne nell'ambito di multistrato ad alta densità.

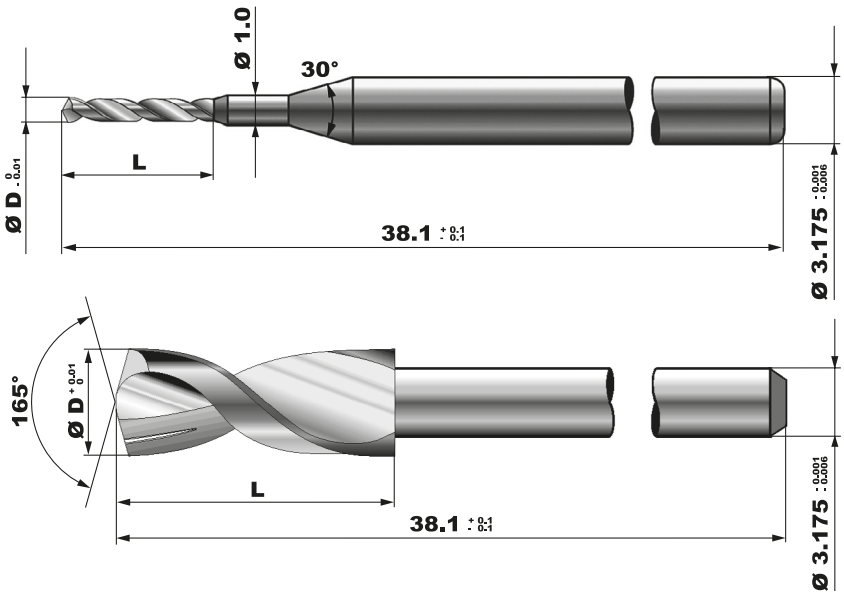
## BROCAS

Las series de brocas UC/UV están diseñadas para el taladrado de pequeños diámetros. Su flauta parcialmente destalonada mejora la calidad de las paredes del taladro (rugosidad, smear, etc.) manteniendo una excelente precisión en el posicionamiento del taladro. En estas herramientas se emplea una aleación de carburo de tungsteno con un elevado grado de elasticidad para responder a las más altas exigencias en el campo de los circuitos multicapa de alta densidad.

## SMALL DRILLS FOR HIGH DENSITY MULTI-LAYER BOARDS

| Ø mm | L mm | Drill type | Label description | Straight | | Under cut | | | Advantages | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | regular | variable web | regular | optimized design for low CTE, halogen free & high Tg materials | variable web | Hole positionning accuracy | Accuracy & hole wall quality balance | Hole wall quality |
| 0.30 | 5.0 | UV | UV L095DW | | | | | ■ | | ■ | |
| | 5.5 | UC | UC L558CW | | | ■ | | | | ■ | |
| | | UC | NHU L020W | | | ■ | | | | ■ | |
| | | UH | UHW | | | | ■ | | | ■ | |
| | 6 (5.8) | UC | NHU L042W | | | ■ | | | | | ■ |
| | 6.5 | UV | UV L238DW | | | | | ■ | | ■ | |
| | | UH | UHW | | | | ■ | | | ■ | |
| 0.35 | 5.0 | UV | UV J194W | | | | | ■ | | ■ | |
| | 5.5 | UC | UC L658BW | | | ■ | | | | ■ | |
| | | UH | UHW | | | | ■ | | | ■ | |
| | 5.6 | UC | NHU L025CW | | | ■ | | | | ■ | |
| | 5.5 (6) | UV | UV L069FW | | | | | ■ | | ■ | |
| | 6.5 | UV | NHUV L087W | | | | | ■ | | ■ | |
| | | UH | UHW | | | | ■ | | | ■ | |
| | 7.0 | UV | UV L287W | | | | | ■ | | ■ | |
| 0.40 | 6.5 | UV | UV L092AW | | | | | ■ | | ■ | |
| | | UC | NHU L036W | | | ■ | | | | ■ | |
| | 7.0 | UH | UHW | | | | ■ | | | ■ | |
| | 8.5 | UH | UHW | | | | ■ | | | ■ | |
| 0.45 | 6.5 | UV | UV L119BW | | | | | ■ | | ■ | |
| | | UC | UC L212W | | | ■ | | | | | ■ |
| | 7.0 | UH | UHW | | | | ■ | | | ■ | |
| | 8.5 | UH | UHW | | | | ■ | | | ■ | |
| 0.50 | 6.5 | UC | UC L155EW | | | ■ | | | | | ■ |
| | 7.0 | UV | UV L083BW | | | | | ■ | | ■ | |
| | | UH | UHW | | | | ■ | | | ■ | |
| | 8.5 | UV | UV L359DW | | | | | ■ | | ■ | |
| | | UH | UHW | | | | ■ | | | ■ | |
| 0.55 | 6.5 | UC | UC L214W | | | ■ | | | | | ■ |
| | 7.0 | UV | UV L207W | | | | | ■ | | ■ | |
| | | UH | UHW | | | | ■ | | | ■ | |
| | 8.5 | UV | UV L359W | | | | | ■ | | ■ | |
| | | UH | UHW | | | | ■ | | | ■ | |
| 0.60 | 8.5 | UV | UV J293BW | | | | | ■ | | ■ | |
| | | UH | UHW | | | | ■ | | | ■ | |
| 0.65 | 8.5 | UV | UV J323W | | | | | ■ | | ■ | |
| | | UH | UHW | | | | ■ | | | ■ | |
| 0.70 | 8.5 | UV | UV J323 | | | | | ■ | | ■ | |
| 0.75 | 8.5 | UV | UV J323 | | | | | ■ | | ■ | |

Nagaoka factory

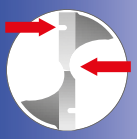



## ST
ø 0.60 ~ ø 3.175 mm

## UM
ø 0.80 ~ ø 1.60 mm

## ID30C
ø 3.20 ~ ø 8.00 mm

Chip breaker
Spanbrecher
Brise-copeaux
Rompi-truciolo
Rompe-virutas



Web thinning
Ausgespitzte Querschneide
Amincissement de l'âme
Assottigliamento del nocciolo
Adelgazamiento del alma

## DRILLS
ST series: universal and economical drill for a wide range of materials. UM series: to improve the hole wall quality in multi-layer boards. ID series: a unique drill with a “chip breaker” to help prevent “bird nesting” and a web thinning that greatly reduces the thrust load on the spindle.

## SPIRALBOHRER
ST-Serie: ökonomischer Allzweck-Standardbohrer. UM-Serie: verbesserte Lochwandqualität der Multilagen-Leiterplatten. ID-Serie: ein einmaliger Bohrer, der dank dessen “Spanbrecher” sowie der Ausspitzung ein problemloses Bohren gewährleistet.

## FORETS
Série ST: foret universel et économique pour le perçage d’une large gamme de matériaux. Série UM: pour améliorer la qualité des parois de perçage. Série ID: foret avec “brise-copeaux” ainsi qu’un amincissement de l’âme permettant de réduire la force axiale de la broche.

## PUNTE
Serie ST: punta universale ed economica per forare una vasta gamma di materiali. Serie UM: per migliorare le qualità all’interno del foro. Serie ID: punta con "rompi-truciolo" ed un assottigliamento del nocciolo per ridurre il carico di spinta.

## BROCAS
Serie ST: broca universal y económica para el taladro de una amplia gama de materiales. Serie UM: para mejorar la calidad de las paredes del taladro. Serie ID: broca con “rompe-virutas” y un adelgazamiento del alma para reducir la fuerza axial del cabezal.

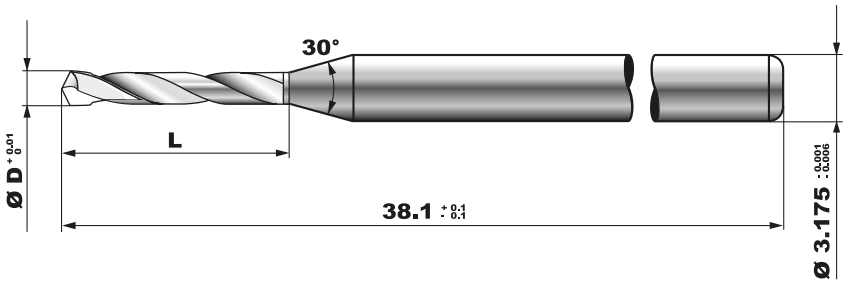
### MEDIUM RANGE DRILLS

| Ø mm | L mm | Drill type | Label description | Straight | Under cut | Advantages / Applications: Reduced bird nesting | For standard products / Double sided - ML 4 layers | For high layer boards / Hole wall quality |
|---|---|---|---|---|---|---|---|---|
| 0.60 / 0.65 | 7.0 | ST | ST30 | ■ | | | ■ | |
| 0.70 ~ 1.60 | 10.0 | ST | ST30 | ■ | | | ■ | |
| 1.65 ~ 3.175 | 10.0 | ST | ST | ■ | | ■ | ■ | |
| 0.80 ~ 1.60 | 10.0 | UM | UM35 | | ■ | | | ■ |

### INVERSE DIAMETER DRILLS

| Ø mm | L mm | Drill type | Label description | No chip breaker and no web thinning | No chip breaker with web thinning | With chip breaker and web thinning | Advantages: Reduced "bird nesting" | Reduced thrust load on the spindle |
|---|---|---|---|---|---|---|---|---|
| 3.20 ~ 3.95 | 12.0 | ID | ID30C | | ■ | | | ■ |
| 4.00 ~ 6.50 | 12.0 | ID | ID30C | | | ■ | ■ | ■ |
| *6.55 ~ 8.00 | 12.0 | ID | ID30 | ■ | | | | |

* upon request | auf Anfrage | sur demande | su richiesta | bajo pedido



## SX
ø 0.50 ~ ø 3.175 mm

## DRILLS
This under cut drill has special geometry designed for slot drilling. Using a web taper design for maximum rigidity, the drill can be used at high in-feed rates for increased productivity. Even when slots requiring length two times of drill diameter, this range of high precision drills gives excellent results.

## SPIRALBOHRER
Der Bohrer mit Hinterschliff wurde eigens für das Nippelbohren entwickelt. Seine verbesserte Bohrseele erlaubt höhere Vorschübe, was die Produktivität verbessert. Seine Eigenschaften verhelfen selbst bei zwei Bohrerdurchmessern zu hoher Präzision.

## FORETS
Les forets SX ont été conçus avec la même technologie que les forets de type UC et spécialement développés pour la production des trous oblongs. Leur rigidité a été maximisée. Une optimisation de l'âme du foret permet de percer à des vitesses élevées, augmentant ainsi la productivité. Ces caractéristiques contribuent à une meilleure précision même lors de la production de trous oblongs avec deux diamètres de forets.

## PUNTE
Queste punte, la cui tecnologia è come le UC, sono state sviluppate specialmente per la foratura di cave. La loro rigidità è stata massimizzata. Inoltre è stata migliorata la parte conica del nocciolo permettendo così una più alta velocità di entrata che si traduce in una maggior produttività. Queste caratteristiche contribuiscono ad una più alta precisione, anche per fare cave con due diametri di punte.

## BROCAS
Las brocas SX han sido concebidas con la misma tecnología que las brocas del tipo UC y están especialmente desarrolladas para hacer ranuras. La rigidez ha sido maximizada, el alma de la broca permite trabajar con parámetros de velocidad de avance elevados, aumentando la productividad. Estas características contribuyen a una mayor precisión, incluso superior a la que se obtiene cuando se utilizan dos diámetros de broca.

### SLOT DRILLING DRILLS

| Ø mm | L mm | Drill type | Label description | Straight | Under cut | Applications |
|---|---|---|---|---|---|---|
| | | | | | | For slot drilling |
| 0.50 ~ 0.65 | 4.7/*6.7 | SX | SX24S / SX24M | | | |
| 0.70 ~ 1.60 | *6.7/8.7 | SX | SX24M / SX24L | | | |
| 1.65 ~ 3.175 | 10.0 | SX | SX | | | |

* upon request | auf Anfrage | sur demande | su richiesta | bajo pedido

# PARAMETERS / PARAMETER / PARAMÈTRES / PARAMETRI / PARÁMETROS

| PCB materials | Leiterplatten-materialien | Matériaux de CI | Materiali di CS | Materiales de CI | V 170 m/min | V 150 m/min |
|---|---|---|---|---|---|---|
| CEM 1 / 3 | CEM 1 / 3 | CEM 1 / 3 | CEM 1 / 3 | CEM 1 / 3 | < Ø 0.8 ● | => Ø 0.8 ● |
| FR 2 / 3 | FR 2 / 3 | FR 2 / 3 | FR 2 / 3 | FR 2 / 3 | < Ø 0.8 ● | => Ø 0.8 ● |
| SS-FR4 | ES-FR4 | SF-FR4 | MF-FR4 | MC-FR4 | ● | |
| DS-FR4 | DS-FR4 | DF-FR4 | DF-FR4 | DC-FR4 | ● | ● |
| ML | ML | MC | MS | MC | | ● |
| | | | | | | |
| | | | | | | |

| PCB materials | Leiterplatten-materialien | Matériaux de CI | Materiali di CS | Materiales de CI | V 120 m/min | V 100 m/min |
|---|---|---|---|---|---|---|
| ML | ML | MC | MS | MC | ● | |
| ML > 8 | ML > 8 | MC > 8 | MS > 8 | MC > 8 | ● | |
| High Tg | Hoch-Tg | Haut Tg | Alto Tg | Alto Tg | ● | ● |
| BT resins | BT-Harze | Résines BT | Resine BT | Resinas BT | ● | ● |
| Polyimide | Polyimid | Polyimide | Polyimide | Poliamida | ● | ● |
| PE / PTFE | PE / PTFE | PE / PTFE | PE / PTFE | PE / PTFE | ● | ● |
| Halogen free | Ohne Halogen | Non halogéné | Senza alogeno | Sin alógeno | | ● |

## FR-4 — 2 ~ 4 layers / 2 ~ 4 Lagen / 2 ~ 4 couches / 2 ~ 4 strati / 2 ~ 4 capas

| Ø | N | F | f | R | Board thickness and stack height / Plattendicke und Stapelhöhe / Epaisseur du circuit et de l'empilage / Spessore del circuito e spessore del pacco / Espesor del circuito y espesor de la pila | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| mm | min⁻¹ | m/min | µm/rev. | m/min | 0.1 mm | 0.2 mm | 0.4 mm | 0.8 mm | 1.0 ~ 1.2 mm | 1.6 mm |
| 0.050 | 160 000 | 0.8 | 5 | 4.0 | 1 ~ 2 | 1 | 1 | - | - | - |
| | 180 000 | 0.9 | | | | | | | | |
| | 200 000 | 1.0 | | | | | | | | |
| | 250 000 | 1.25 | | | | | | | | |
| | 300 000 | 1.5 | | | | | | | | |
| 0.075<br>0.080 | 160 000 | 0.9 | 5.6 | 5.0 | 2 ~ 3 | 2 | | | | |
| | 180 000 | 1.0 | | | | | | | | |
| | 200 000 | 1.1 | 5.5 | | | | | | | |
| | 250 000 | 1.4 | 5.6 | | | | | | | |
| | 300 000 | 1.7 | 5.7 | | | | | | | |
| 0.105 | 160 000 | 1.1 | 6.9 | | 4 ~ 6 | 3 ~ 4 | 2 ~ 3 | 1 | 1 | - |
| | 180 000 | 1.2 | 6.7 | | | | | | | |
| | 200 000 | 1.4 | 7 | | | | | | | |
| | 250 000 | 1.7 | 6.8 | | | | | | | |
| | 300 000 | 2.1 | 7 | | | | | | | |
| 0.12 | 160 000 | 1.3 | 8.1 | 6.0 | 5 ~ 7 | | | | | |
| | 180 000 | 1.5 | 8.3 | | | | | | | |
| | 200 000 | 1.6 | 8 | | | | | | | |
| | 250 000 | 2.0 | | | | | | | | |
| | 300 000 | 2.4 | | | | | | | | |
| 0.15 | 125 000 | 1.3 | 10.4 | | 5 ~ 8 | | 3 ~ 4 | 1 ~ 2 | | 1 |
| | 160 000 | 1.6 | 10 | | | | | | | |
| | 180 000 | 1.8 | | | | | | | | |
| | 200 000 | 2.0 | | | | | | | | |
| | 250 000 | 2.5 | | | | | | | | |
| | 300 000 | 3.0 | | | | | | | | |
| 0.20 | 125 000 | 1.9 | 15.2 | 8.0 | 6 ~ 10 | 5 ~ 8 | | 2 ~ 3 | 1 ~ 2 | |
| | 160 000 | 2.4 | 15 | | | | | | | |
| | 180 000 | 2.7 | | | | | | | | |
| | 200 000 | 3.0 | | | | | | | | |
| | 239 000 | 3.6 | 15.1 | | | | | | | |
| 0.25 | 125 000 | 2.5 | 20 | 10.0 | 7 ~ 10 | 6 ~ 8 | 4 ~ 5 | | 2 ~ 3 | 1 ~ 2 |
| | 160 000 | 3.2 | | | | | | | | |
| | 180 000 | 3.6 | | | | | | | | |
| | 191 000 | 3.8 | 19.9 | | | | | | | |

## FR-4 — 6 ~ 8 layers / 6 ~ 8 Lagen / 6 ~ 8 couches / 6 ~ 8 strati / 6 ~ 8 capas

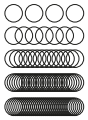
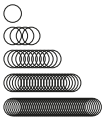
| mm | min⁻¹ | m/min | µm/rev. | m/min | 0.8 mm | 1.0 ~ 1.2 mm | 1.6 mm |
|---|---|---|---|---|---|---|---|
| 0.105 | 160 000 | 1.1 | 6.9 | 5.0 | 1 | 1 | - |
| | 180 000 | 1.2 | 6.7 | | | | |
| | 200 000 | 1.4 | 7 | | | | |
| | 250 000 | 1.7 | 6.8 | | | | |
| | 300 000 | 2.1 | 7 | | | | |
| 0.12 | 160 000 | 1.3 | 8.1 | 6.0 | | | |
| | 180 000 | 1.5 | 8.3 | | | | |
| | 200 000 | 1.6 | 8 | | | | |
| | 250 000 | 2.0 | | | | | |
| | 300 000 | 2.4 | | | | | |
| 0.15 | 125 000 | 1.3 | 10.4 | | | | 1 |
| | 160 000 | 1.6 | 10 | | | | |
| | 180 000 | 1.8 | | | | | |
| | 200 000 | 2.0 | | | | | |
| | 250 000 | 2.5 | | | | | |
| | 300 000 | 3.0 | | | | | |
| 0.20 | 125 000 | 1.9 | 15.2 | 8.0 | 1 ~ 2 | 1 ~ 2 | |
| | 160 000 | 2.4 | 15 | | | | |
| | 180 000 | 2.7 | | | | | |
| | 200 000 | 3.0 | | | | | |
| | 239 000 | 3.6 | 15.1 | | | | |
| 0.25 | 125 000 | 2.5 | 20 | 10.0 | 2 ~ 3 | 2 | 1 ~ 2 |
| | 160 000 | 3.2 | | | | | |
| | 180 000 | 3.6 | | | | | |
| | 191 000 | 3.8 | 19.9 | | | | |

| FR-4 | Double sided ~ 4 layers / Doppelseitig ~ 4 Lagen<br>Double face ~ 4 couches / Doppia faccia ~ 4 strati<br>Doble cara ~ 4 capas | | | 6 ~ 8 layers / 6 ~ 8 Lagen / 6 ~ 8 couches /<br>6 ~ 8 strati / 6 ~ 8 capas | | | R | Board thickness and stack height<br>Plattendicke und Stapelhöhe<br>Epaisseur du circuit et de l'empilage<br>Spessore del circuito e spessore del pacco<br>Espesor del circuito y espesor de la pila |
|---|---|---|---|---|---|---|---|---|
| Ø | N | F | f | N | F | f | R | |
| mm | min ¹ | m/min | µm/rev. | min ¹ | m/min | µm/rev. | m/min | 1.6 mm |
| 0.30 | 125 000 | 2.8 | 22 | 125 000 | 2.5 | 20 | 12.0 | 2 |
| | 160 000 | 3.6 | 23 | 160 000 | 3.2 | 20 | 12.0 | |
| | 180 000 | 4.0 | 22 | - | - | - | - | - |
| 0.35 | 125 000 | 3.0 | 24 | 125 000 | 2.8 | 22 | 12.0 | 2 |
| | 155 000 | 3.7 | 24 | 137 000 | 3.1 | 23 | 12.0 | |
| 0.40 | 125 000 | 3.4 | 27 | 120 000 | 2.9 | 24 | 15.0 | 2 ~ 3 |
| | 135 000 | 3.7 | 27 | - | - | - | - | - |
| 0.45 | 120 000 | 3.5 | 29 | 106 000 | 2.9 | 27 | 18.0 | 3 |
| 0.50 | 108 000 | 3.4 | 32 | 95 000 | | 31 | 25.0 | |
| 0.55 | 98 000 | 3.6 | 37 | 87 000 | | 33 | | |
| 0.60 | 90 000 | | 40 | 80 000 | 3.0 | 38 | | |
| 0.65 | 83 000 | 3.7 | 45 | 73 000 | | 41 | | |
| 0.70 | 77 000 | | 48 | 68 000 | 3.1 | 46 | | 4 |
| 0.75 | 72 000 | 3.8 | 53 | 64 000 | | 48 | | |
| 0.80 | 68 000 | 3.6 | | 60 000 | 3.0 | 50 | | |
| 0.85 | 64 000 | 3.4 | | 56 000 | 2.9 | 52 | | |
| 0.90 | 60 000 | 3.3 | 55 | 53 000 | 2.8 | 53 | | |
| 0.95 | 57 000 | 3.2 | 56 | 50 000 | 2.7 | 54 | | |
| 1.00 | 54 000 | 3.1 | 57 | 48 000 | 2.6 | | | |
| 1.05 | 51 000 | 3.0 | 59 | 45 000 | 2.5 | 56 | | |
| 1.10 | 49 000 | 2.9 | 59 | 43 000 | 2.4 | | | |
| 1.15 | 47 000 | 2.8 | 60 | 42 000 | | 57 | | |
| 1.20 | 45 000 | 2.7 | | 40 000 | 2.3 | 58 | | |
| 1.25 | 43 000 | 2.6 | 61 | 38 000 | 2.2 | | | |
| 1.30 | 42 000 | 2.5 | 60 | 37 000 | | 59 | | |
| 1.35 | 40 000 | 2.4 | | 35 000 | 2.1 | 60 | | |
| 1.40 | 39 000 | 2.3 | 59 | 34 000 | 2.0 | 59 | | |
| 1.45 | 37 000 | 2.2 | 60 | 33 000 | 1.9 | 58 | | |
| 1.50 | 36 000 | 2.1 | 58 | 32 000 | | 59 | | |
| 1.55 | 35 000 | | 60 | 31 000 | 1.8 | 58 | | |
| 1.60 | 34 000 | 2.0 | 59 | 30 000 | 1.7 | 57 | | |
| 1.65 | 33 000 | 1.9 | 58 | 29 000 | | 59 | | |
| 1.70 | 32 000 | | 59 | 28 000 | | 57 | | |
| 1.75 | 31 000 | 1.8 | 58 | 27 000 | 1.6 | 59 | | |
| 1.80 | 30 000 | 1.7 | 57 | | | | | |
| 1.85 | 29 000 | | 59 | 26 000 | 1.5 | 58 | | |
| 1.90 | 28 000 | 1.6 | 57 | 25 000 | 1.4 | 56 | | |
| 1.95 | | | | 24 000 | | 58 | | |
| 2.00 | 27 000 | | 59 | | | | | |
| 2.05 | 26 000 | 1.5 | 58 | 23 000 | 1.3 | 57 | | |
| 2.10 | | | | | | | | |
| 2.15 | 25 000 | 1.4 | 56 | 22 000 | 1.2 | 55 | | |
| 2.20 | | | | | | | | |
| 2.25 | 24 000 | | 58 | 21 000 | | 57 | | |
| 2.30 | | | | | | | | |
| 2.35 | 23 000 | 1.3 | 57 | 20 000 | 1.1 | 55 | | |
| 2.40 | | | | | | | | |
| 2.45 | 22 000 | | 59 | | | | | |
| 2.50 | | | | | | | | |
| 2.55 | 21 000 | 1.2 | 57 | | | | | |
| 2.60 | | | | | | | | |
| 2.65 ~ 3.175 | 20 000 | 1.1 | 55 | | | | | |
| 3.20 ~ 3.95 | 25 000 | 0.8 | 32 | 25 000 | 0.8 | 32 | | 2 ~ 4 |
| 4.00 ~ 4.95 | 20 000 | 0.7 | 35 | 20 000 | 0.7 | 35 | | |
| 5.00 ~ 5.95 | | 0.8 | 40 | | 0.8 | 40 | | |
| 6.00 ~ 8.00 | | 0.7 | 35 | | 0.7 | 35 | | |

# PARAMETERS / PARAMETER / PARAMÈTRES / PARAMETRI / PARÁMETROS

| SX series Ø | L | | | Stack height / Stapelhöhe / Épaisseur d'empilage / Spessore del pacco / Espesor del paquete | Slot / Langloch / Trou oblong / Cava / Ranura > 2.5 x Ø | | Slot / Langloch / Trou oblong / Cava / Ranura =/< 2.5 x Ø | |
|---|---|---|---|---|---|---|---|---|
| | S | M | L | 1.6 mm x | N (min⁻¹) | f (µm/rev.) | N (min⁻¹) | f (µm/rev.) |
| 0.50 ~ 0.65 | 4.7 | 6.7 | - | S: 1 ~ 2<br>M: 2 ~ 3<br>L: 3 ~ 4 | 65 ~ 75 000 | 20 ~ 30 | 60 ~ 75 000 | 10 ~ 20 |
| 0.70 ~ 0.85 | - | | 8.7 | | 60 ~ 70 000 | 20 ~ 35 | 60 ~ 70 000 | 15 ~ 25 |
| 0.90 ~ 1.25 | | | | | 50 ~ 65 000 | 30 ~ 50 | 50 ~ 65 000 | 15 ~ 25 |
| 1.30 ~ 1.60 | | | | | 50 ~ 60 000 | 40 ~ 70 | 50 ~ 60 000 | 30 ~ 50 |
| 1.65 ~ 3.175 | | - | 10 | | 35 ~ 50 000 | 50 ~ 90 | 35 ~ 50 000 | 40 ~ 70 |

**Method of slot drilling | Methode zur Langlochbohrung | Méthode pour la production des trous oblongs | Metodo per la foratura di cave | Método de taladrado de ranuras**

| | | | | | |
|---|---|---|---|---|---|
| Suitable (high precision)<br>Geeignet (hoche Präzision)<br>Approprié (haute précision)<br>Appropriato (alta precisione)<br>Apropiado (alta precisión) |  | Lenght of slot drilling<br>Länge der Langlochbohrung<br>Longueur du trou oblong<br>Lunghezza della cava<br>Longitud de la ranura | Unsuitable (bends easily)<br>Nicht geeignet (verbiegt leicht)<br>Pas approprié (plie facilement)<br>Non appropriato (piega facilmente)<br>Inapropiado (dobla fácilmente) |  | Length of slot drilling<br>Länge der Langlochbohrung<br>Longueur du trou oblong<br>Lunghezza della cava<br>Longitud de la ranura |

## FORMULAS FOR CALCULATING DRILLING CONDITIONS

## FORMELN FÜR BOHRPARAMETER

## FORMULES POUR CALCULER LES PARAMÈTRES DE PERÇAGE

## FORMULE PER CALCOLARE PARAMETRI DI FARATURA

## FÓRMULAS PARA CALCULAR LOS PARÁMETROS DE TALADRADO

**V** (m/min)

Cutting speed
Schnittgeschwindigkeit
Vitesse de coupe
Velocità di taglio
Velocidad del corte

$$V = \frac{N \times \pi \times \varnothing}{1000}$$

**F** (m/min)

Infeed rate
Vorschubsgeschwindigkeit
Vitesse de descente
Velocità di discesa
Velocidad de avance

$$F = \frac{f \times N}{1000}$$

**N** (min⁻¹)

Sprindle speed
Drehzahl
Vitesse de rotation
Velocità del mandrino
Velocidad de rotación

$$N = \frac{V \times 1000}{\pi \times \varnothing \text{ (mm)}}$$

**f** (mm/rev.)

Chip load
Vorschub pro Umdrehung
Avance par tour
Asportazione per giro
Avance por vuelta

$$f = \frac{F \times 1000}{N}$$

## PRINTED CIRCUIT BOARD SIZE SHANK MARKING
## TECHNICAL TERMINOLOGY

The size of drills is identifiable at a glance. No need to check the sizes each time, allows for work efficiency.
Prevents defects deriving from size mistakes and maintains quality assurance.
“S” indicates straight type / “U” indicates undercut type.

## LEITERPLATTENBOHRER MIT SCHAFTMARKIERUNG
## TECHNISCHE TERMINOLOGIE

Die Masse der Bohrer sind auf einen Blick zu erkennen. Kein zeitraubendes Suchen der Grösse mehr, effizientes Arbeiten.
Beugt Fehlern vor, die von falschen Bohrergrössen herrühren und unterstützt somit die Qualitätssicherung.
“S” zeigt Standardbohrer / “U” zeigt Köpfchenbohrer.

## MARQUAGE DES DIMENSIONS DES FORETS SUR LA QUEUE
## TERMINOLOGIE TECHNIQUE

La dimension du foret est identifiable en un clin d’œil. Pas besoin de la vérifier lors de chaque utilisation (favorise votre efficacité). Prévient les défauts liés aux erreurs de diamètres et maintient l’assurance qualité.
“S” indique le type standard / “U” indique le type détalonné.

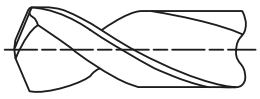
## MARCATURA DEL GAMBO DELLA PUNTA CON L’INDICAZIONE DELLE DIMENSIONI
## TERMINOLOGIA TECNICA

La dimensione della punta è identificabile immediatamente. In questo modo si evita di effettuare un controllo ad ogni utilizzo, ogni eventuale errore di diametro con una migliore qualità del prodotto.
“S” indica il tipo standard / “U” indica il tipo scaricato.

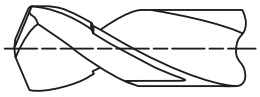
## MARCADO DE LAS DIMENSIONES DE LA BROCA EN EL MANGO
## TERMINOLOGÍA TÉCNICA

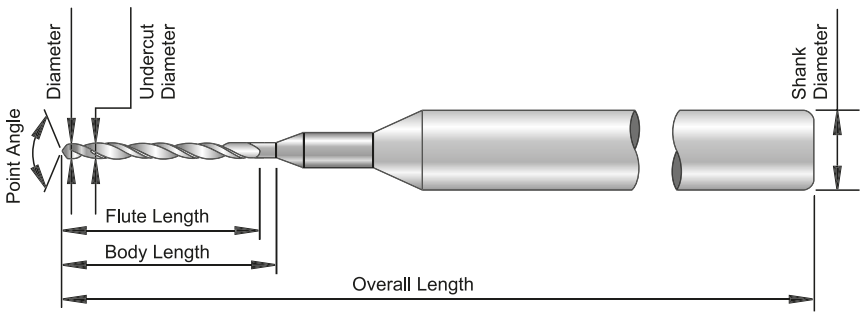
La broca se identifica visualmente. No es preciso medir el diámetro cada vez que vaya a ser usada (eficiencia).
Previene defectos derivados de errores en la medida y mantiene el aseguramiento de la calidad.
“S” indica el tipo estándar / “U” indica el tipo destalonado.

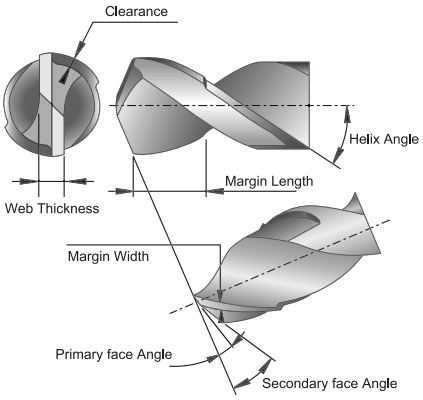
Straight Type
Standardbohrer
Type standard
Tipo standard
Tipo estándar



Under cut type
Köpfchenbohrer
Type détalonné
Tipo scaricato
Tipo destalonado





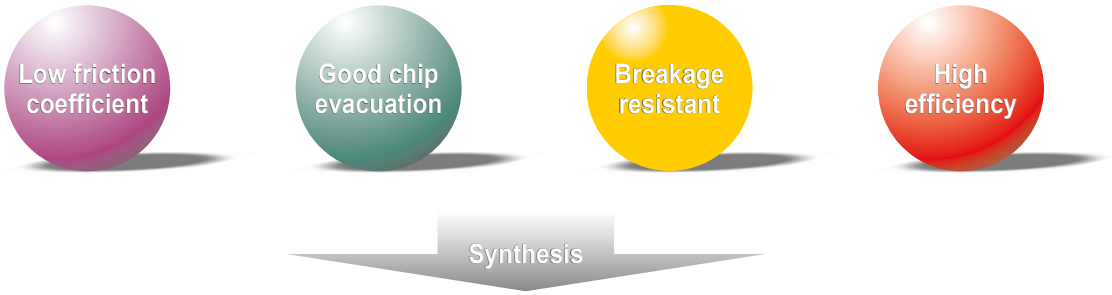



# ULF coating/Beschichtung/ revêtement/rivestimento/revestimiento

## ULF: Union Tool Lubricant Film, Ultra Long-life Film

**Union tool's ULF coted drills overturns the conventional wisdom for ultra micro PCB drills**

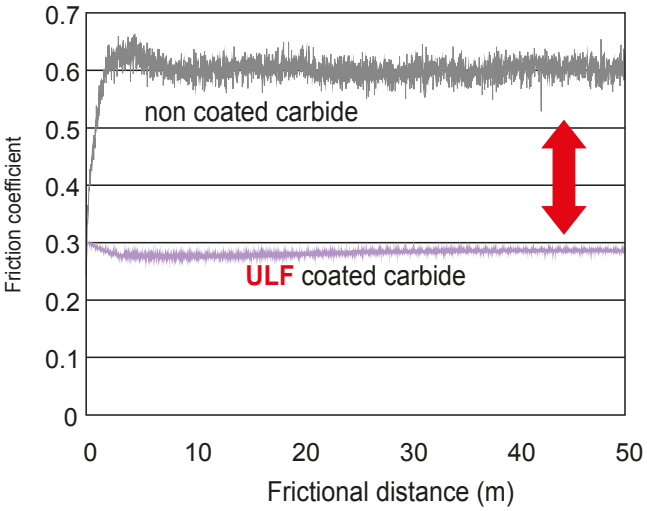
**ULF** ➡ **Low Friction Coefficient** ➡ **Breakage Resistant** ➡ **Ultra long life**




**Attains longer tool life, excellent hole quality and high aspect ratio!**

### Comparison of friction coefficient between ULF and non coated carbide

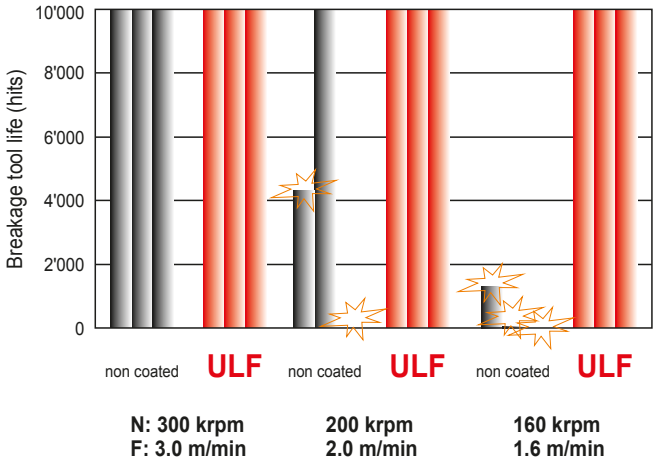
Ball on disk test
Substrate: MCL-E-679FGR t0.8 mm without Cu layer
Used sphere: W-Co S6 mm
Turning radius: 2.5 mm
Velocity: 100 mm/s
Sampling: 5 Hz
Test load: 5 N




**Friction coefficient decreased on base material surface Improved surface lubrication**

### Comparison of tool breakage life between non coated and ULF coated drill

Drilling conditions
Drill: Ø 0.105 x 1.7 mm
PCB: MCL-E-679FGM t0.11 mm (double sided) x 7 boards
Entry board: LE900
Backup board: t1.5 mm Bake




**N: 300 krpm F: 3.0 m/min** | **200 krpm 2.0 m/min** | **160 krpm 1.6 m/min**

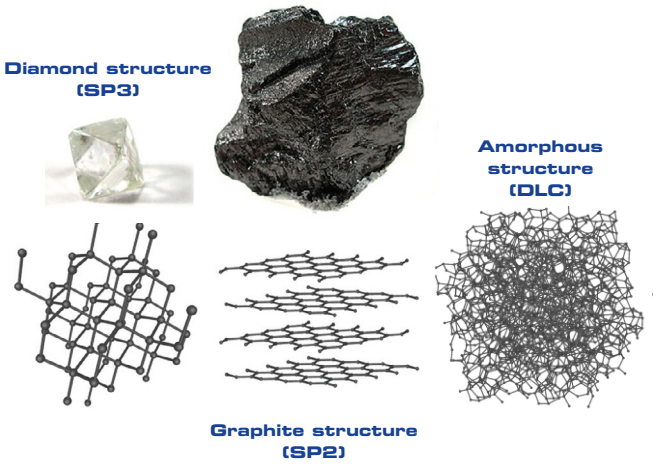
**Breakage resistance of ultra micro drills is improved by ULF coating**

**ULF coating will take micro drill bit design to the next stage.**
We will develop drill bit geometries in accordance with the characteristics of **ULF** to meet further long life and increased stack height requests.

# DIAMOND coating/Beschichtung/ revêtement/rivestimento/revestimiento

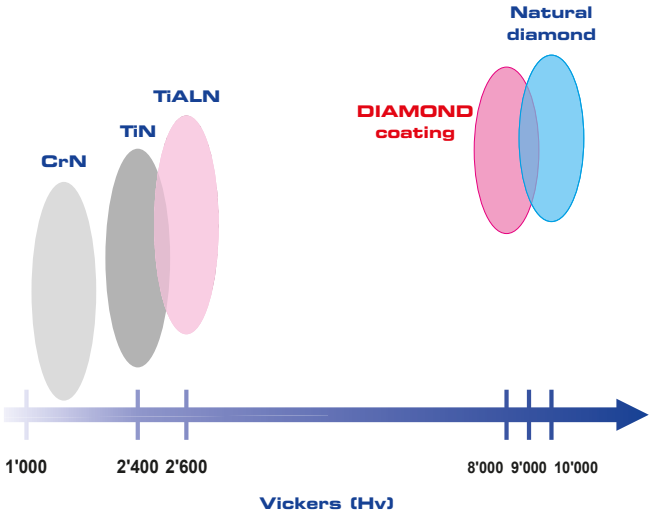
## Characteristics of diamond

Diamond and graphite are both composed of carbon elements, but due to the ionic bonding structure, diamond has hard characteristics.



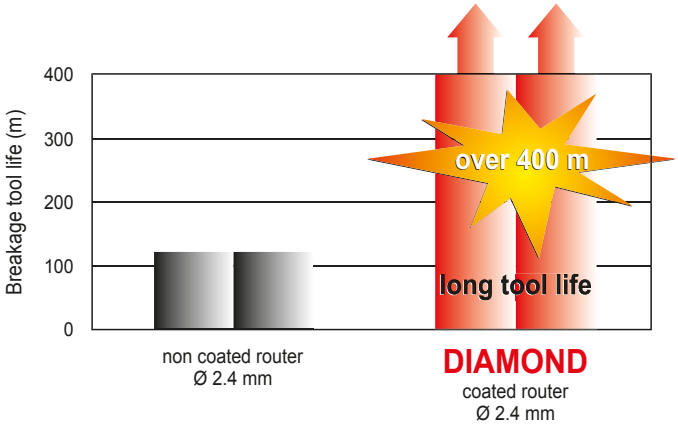

## Hardness comparison of coating

The newly developed routers coated with diamond have an extremely higher degree of hardness when compared to other types of coatings.



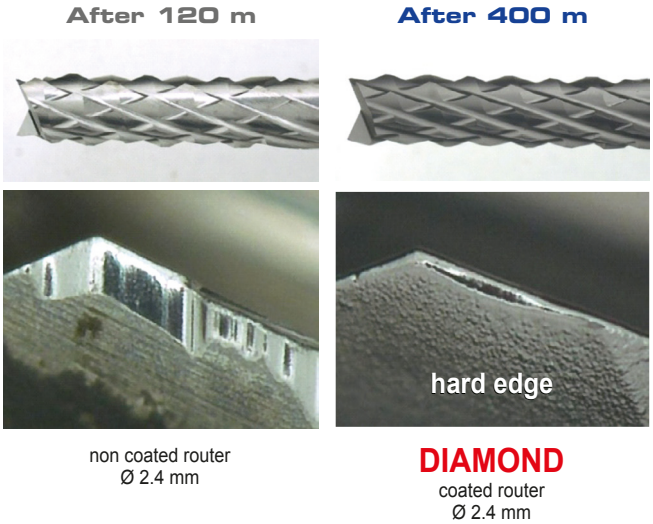

### Tool life until breakage

Routing conditions
Router: Ø 2.4 x 10.5 mm
PCB: R1705UX t1.6 mm (no copper) x 4 boards
N: 30'000 min-1
F: 1.04 m/min
f: 34.7 µm/rev




**«DC series» achieved 400 m long routing distance without any breakage**

### Cutting Edge Wearing




**The wearing of the cutting edges for the «DC series» is extremely small**

# ROUTERS / FRÄSER
# FRAISES / FRESE / FRESAS

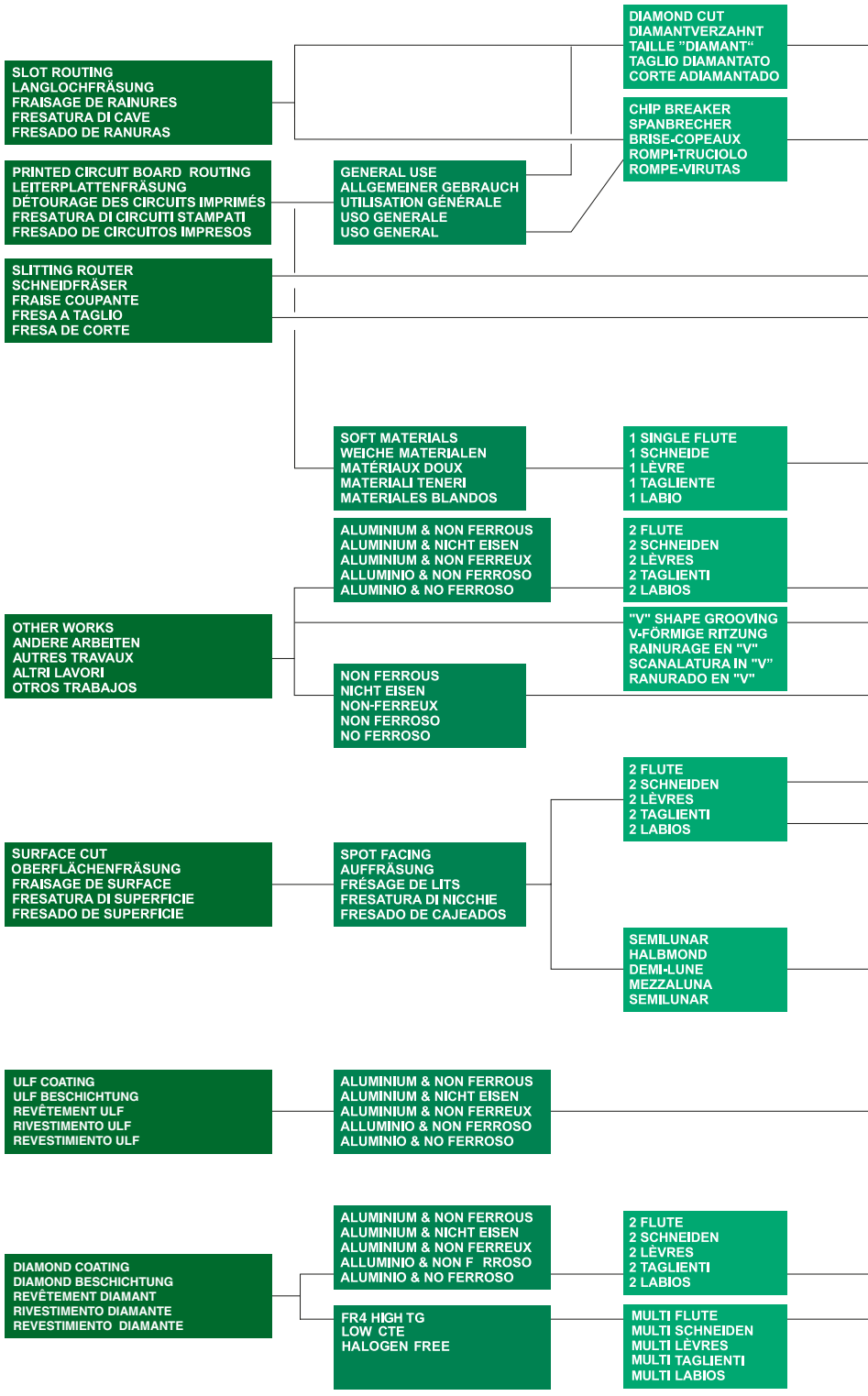
## SELECTION CHART FOR ROUTING WORK

## AUSWAHL-DIAGRAMM FÜR FRÄS-ARBEITEN

## DIAGRAMME DE SÉLECTION SUIVANT L'APPLICATION

## SCHEMA DI SELEZIONE SECONDO L'AP-PLICAZIONE

## DIAGRAMA DE SELECCIÓN SEGÚN LA APLICACIÓN



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| DOWN DRAFT CHIP REMOVAL<br>SPANABFLUSS NACH UNTEN<br>ÉVACUATION VERS LE BAS<br>AZIONE DI SPINTA<br>EVACUACIÓN HACIA ABAJO | **RHM** ø 0.6 ~ 3.175 mm | |
| UP DRAFT CHIP REMOVAL<br>SPANABFLUSS NACH OBEN<br>ÉVACUATION VERS LE HAUT<br>AZIONE DI TIRAGGIO<br>EVACUACIÓN HACIA ARRIBA | **SC** ø 0.5 ~ 3.175 mm<br>**RLE** ø 0.8 ~ 2.4 mm | 20 - 21 |
| UP DRAFT CHIP REMOVAL<br>SPANABFLUSS NACH OBEN<br>ÉVACUATION VERS LE HAUT<br>AZIONE DI TIRAGGIO<br>EVACUACIÓN HACIA ARRIBA | **RP** ø 0.4 ~ 3.175 mm<br>**RS** ø 0.8 ~ 3.0 mm | 22 |
| DOWN DRAFT CHIP REMOVAL<br>SPANABFLUSS NACH UNTEN<br>ÉVACUATION VERS LE BAS<br>AZIONE DI SPINTA<br>EVACUACIÓN HACIA ABAJO | | |
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| 1 SINGLE STRAIGHT FLUTE<br>1 GERADE SCHNEIDE<br>1 LÈVRE DROITE<br>1 TAGLIENTE DRITTO<br>1 LABIO RECTO | **SM** ø 1.0 ~ 3.0 mm | 25 |
| CONTOURING<br>KONTURIERUNG<br>DETOURAGE<br>SCONTORNATURA<br>CONTORNEADO | **RPU** ø 0.6 ~ 3.0 mm<br>**RAU** ø 2.0 ~ 2.4 mm | 26 - 27 |
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| CONTOURING<br>KONTURIRUNG<br>DETOURAGE<br>SCONTORNATURA<br>CONTORNEADO | **DCRP** ø 2.0 mm<br>**DCET** ø 0.8 ~ 2.5 mm | 28 - 29 |
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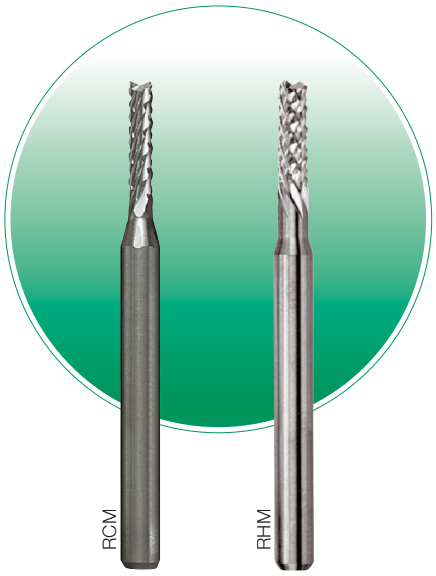
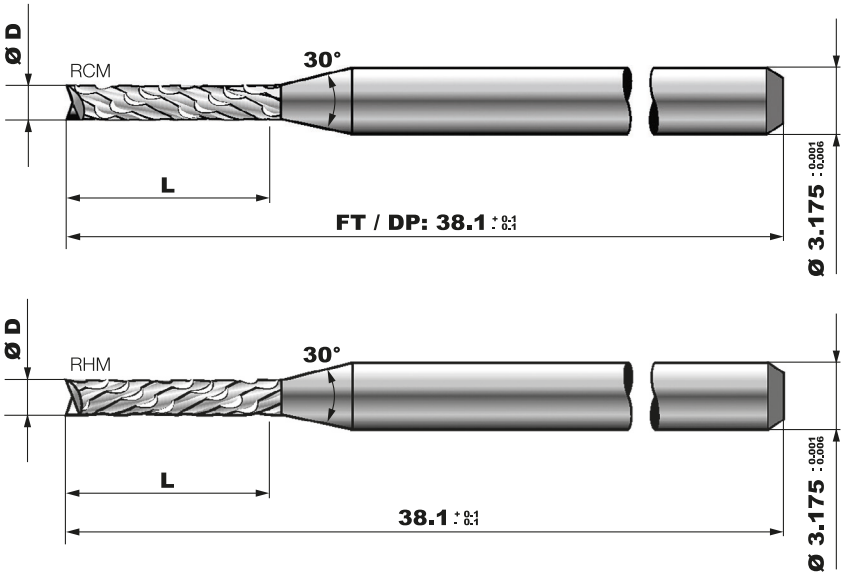



## RCM
ø 0.6 ~ ø 3.175 mm

## RHM
ø 0.6 ~ ø 3.175 mm

## ROUTERS
RCM/RHM router bits have diamond cut geometry and can be used for contour routing on most general electronic printed circuit boards.

## FRÄSER
Die RCM/RHM-Fräser sind diamantverzahnt und werden für alle üblichen Fräse-Anwendungen empfohlen.

## FRAISES
Les séries des fraises RCM/RHM sont “taillées en diamant". Elles sont recommandées pour toutes les applications de détourage conventionnel.

## FRESE
Le serie di frese RCM/RHM sono di tipo diamantato. Sono consigliate per tutte le applicazioni di fresatura convenzionale.

## FRESAS
Las series de fresas RCM/RHM están talladas en forma adiamantada. Se recomiendan para todas las aplicaciones de fresado convencional.

## STANDARD RIGHT HAND DIAMOND CUT ROUTERS FOR GENERAL CONTOUR ROUTING

| Ø mm | L mm | Router type | Label description | FT | DP | Applications (up draft chip evacuation) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | FR4 | FR2/3 | CEM1/3 | PE/PTFE | PMMA | POLYIMIDE | Al | Cu |
| 0.6 / 0.7 | 4.0 | RCM | RCM FT | ■ | | ■ | ■ | ■ | | | | | |
| 0.8 | 4.5 / 5.5 | RCM | RCM FT / RCM DP | ■ | ■ | ■ | ■ | ■ | | | | | |
| 0.9 | 4.5 / 5.5 | RCM | RCM FT | ■ | | ■ | ■ | ■ | | | | | |
| 1.0 / 1.1 | 4.5 / 6.5 | RCM | RCM FT / RCM DP | ■ | ■ | ■ | ■ | ■ | | | | | |
| 1.2 | 5.0 / 6.5 | RCM | RCM FT / RCM DP | ■ | ■ | ■ | ■ | ■ | | | | | |
| 1.3 | 5.0 / 6.5 | RCM | RCM FT | ■ | | ■ | ■ | ■ | | | | | |
| 1.4 | 5.0 / 6.5 | RCM | RCM FT | ■ | | ■ | ■ | ■ | | | | | |
| 1.5 | 6.5 / 8.0 | RCM | RCM FT | ■ | | ■ | ■ | ■ | | | | | |
| 1.6 | 6.5 / 8.0 | RCM | RCM FTH / RCM DP | ■ | ■ | ■ | ■ | ■ | | | | | |
| 1.7 / 1.8 | 6.5 / 8.0 | RCM | RCM FT | ■ | | ■ | ■ | ■ | | | | | |
| 1.9 | 8.0 | RCM | RCM FT | ■ | | ■ | ■ | ■ | | | | | |
| 2.0 | 8.0 / 9.5 | RCM | RCM FTH / RCM DP | ■ | ■ | ■ | ■ | ■ | | | | | |
| 2.1 / 2.2 | 8.0 | RCM | RCM FT | ■ | | ■ | ■ | ■ | | | | | |
| 2.3 | 9.5 | RCM | RCM FTH | ■ | | ■ | ■ | ■ | | | | | |
| 2.4 | 9.5 | RCM | RCM FTH / RCM DP | ■ | ■ | ■ | ■ | ■ | | | | | |
| 2.5 | 9.5 | RCM | RCM FT / RCM DP | ■ | ■ | ■ | ■ | ■ | | | | | |
| 2.6 ~ 2.9 | 9.5 | RCM | RCM FT | ■ | | ■ | ■ | ■ | | | | | |
| 3.0 | 10.0 | RCM | RCM FT / RCM DP | ■ | ■ | ■ | ■ | ■ | | | | | |
| 3.1 | 10.0 | RCM | RCM FT | ■ | | ■ | ■ | ■ | | | | | |
| 3.175 | 10.0 | RCM | RCM FT / RCM DP | ■ | ■ | ■ | ■ | ■ | | | | | |

## LEFT HAND DIAMOND CUT ROUTERS FOR A REDUCED LEVEL OF BURRS ON GENERAL CONTOUR ROUTING

| Ø mm | L mm | Router type | Label description | FT | DP (not available) | Applications (down draft chip evacuation) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | FR4 | FR2/3 | CEM1/3 | PE/PTFE | PMMA | POLYIMIDE | Al | Cu |
| 0.6 | 4.0 | RHM | RHM FT | ■ | | ■ | ■ | ■ | | | | | |
| 0.8 / 0.9 | 4.5 | RHM | RHM FT | ■ | | ■ | ■ | ■ | | | | | |
| 1.0 / 1.1 | 4.5 / 6.5 | RHM | RHM FT | ■ | | ■ | ■ | ■ | | | | | |
| 1.2 ~ 1.4 | 5.0 / 6.5 | RHM | RHM FT | ■ | | ■ | ■ | ■ | | | | | |
| 1.5 ~ 1.8 | 6.5 / 8.0 | RHM | RHM FT | ■ | | ■ | ■ | ■ | | | | | |
| 1.9 ~ 2.2 | 8.0 / 9.5 | RHM | RHM FT | ■ | | ■ | ■ | ■ | | | | | |
| 2.3 ~ 2.9 | 9.5 | RHM | RHM FT | ■ | | ■ | ■ | ■ | | | | | |
| 3.0 ~ 3.175 | 10.0 | RHM | RHM FT | ■ | | ■ | ■ | ■ | | | | | |

**FT**

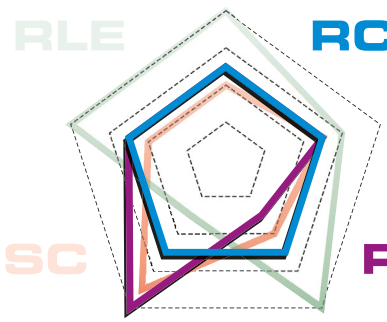
Fishtail
Fischschwanz-Anschliff
Bout en queue de poisson
Testa a coda di pesce
Punta ayen cola de pez

**DP**

Drill point
Bohrspitzenanschliff
Bout en pointe
Testa a forare
Punta de broca

Dimensional accuracy
Massgenauigkeit
Précision dimensionnelle
Precisione dimensionale
Precisión dimensional

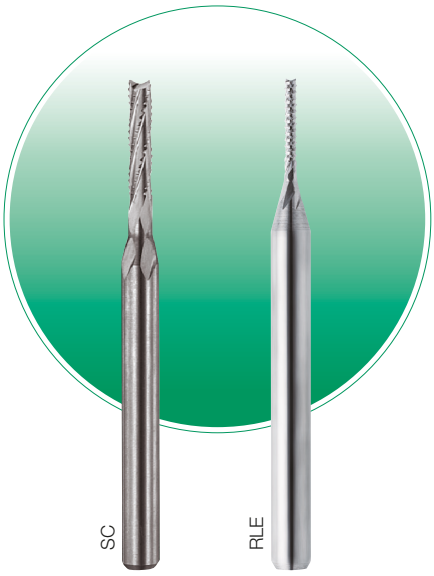
Breakage resistance
Bruchfestigkeit
Résistance à la rupture
Resistenza alla rottura
Resistencia a la rotura

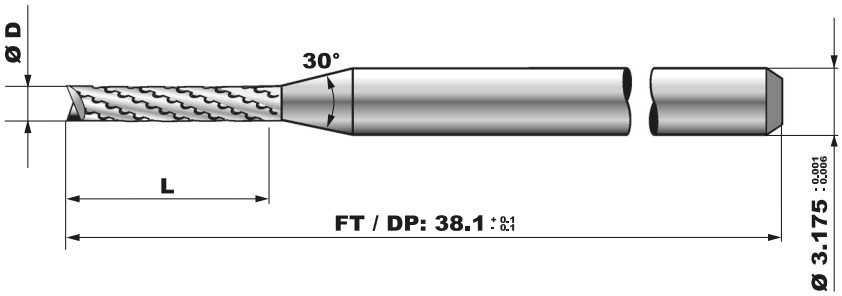



Wear resistance
Verschleisswiderstand
Résistance à l'usure
Resistenza all'usura
Resistencia al desgaste

Burr control
Gratreduktion
Réduction de la bavure
Riduzione della bava
Reducción de la rebaba

Swarf evacuation
Spanabfuhr
Evacuation des copeaux
Evacuazione truciolo
Evacuación de virutas




## SC
ø 0.5 ~ ø 3.175 mm

## RLE
ø 0.8 ~ ø 2.4 mm

## ROUTERS
The SC/RLE router bits are a right hand, up draft design with a "chip breaker" geometry and can be used for contour routing on most general electronic printed circuit boards.

## FRÄSER
Die SC/RLE-Fräser sind spiralverzahnt und haben eine Spanabfuhr nach oben. Sie werden für alle üblichen Fräse-Anwendungen empfohlen.

## FRAISES
Les séries des fraises SC/RLE possèdent une taille en forme de “brise-copeaux" avec une évacuation de ceux-ci vers le haut. Elles sont recommandées pour toutes les applications de détourage conventionnel.

## FRESE
Le serie di frese SC/RLE sono di tipo "spiralate" con un' evacuazione del truciolo verso sopra. Sono consigliate per tutte le applicazioni di fresatura convenzionale.

## FRESAS
Las series de fresas SC/RLE poseen un tallado con "rompe-virutas" y una evacuación de ellas hacia arriba. Se recomiendan para todas las aplicaciones de fresado convencional.

## STANDARD CHIP BREAKER ROUTERS FOR GENERAL CONTOUR ROUTING

| Ø mm | L mm | Router type | Label description | FT | DP | Applications | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | FR4 | FR2/3 | CEM1/3 | PE/PTFE | PMMA | POLYIMIDE | Al | Cu |
| 0.5 | 2.5 | SC | SC FT | ■ | | ■ | ■ | ■ | | | | | |
| 0.6 | 3.0 | SC | SC FT | ■ | | ■ | ■ | ■ | | | | | |
| 0.7 | 4.0 | SC | SC FT | ■ | | ■ | ■ | ■ | | | | | |
| 0.8 | 4.0 / 5.5 | SC | SC FT / SC DP | ■ | ■ ■ | ■ | ■ | ■ | | | | | |
| 0.9 | 4.0 / 5.5 | SC | SC FT / SC DP | ■ | ■ | ■ | ■ | ■ | | | | | |
| 1.0 / 1.1 | 4.5 / 6.5 | SC | SC FT / SC DP | ■ | ■ ■ | ■ | ■ | ■ | | | | | |
| 1.2 | 5.0 / 6.5 | SC | SC FT / SC DP | ■ | ■ ■ | ■ | ■ | ■ | | | | | |
| 1.3 | 5.0 / 6.5 | SC | SC FT / SC DP | ■ | ■ | ■ | ■ | ■ | | | | | |
| 1.4 | 5.0 / 6.5 | SC | SC FT / SC DP | ■ | ■ | ■ | ■ | ■ | | | | | |
| 1.5 | 6.5 / 8.0 | SC | SC FT / SC DP | ■ | ■ | ■ | ■ | ■ | | | | | |
| 1.6 | 6.5 / 8.0 | SC | SC FT / SC DP | ■ | ■ ■ | ■ | ■ | ■ | | | | | |
| 1.7 / 1.8 | 6.5 / 8.0 | SC | SC FT / SC DP | ■ | ■ | ■ | ■ | ■ | | | | | |
| 1.9 | 8.0 | SC | SC FT | ■ | | ■ | ■ | ■ | | | | | |
| 2.0 | 8.0 / 9.5 | SC | SC FT / SC DP | ■ | ■ | ■ | ■ | ■ | | | | | |
| 2.1 | 8.0 | SC | SC FT | ■ | | ■ | ■ | ■ | | | | | |
| 2.2 | 8.0 | SC | SC FT / SC DP | ■ | ■ ■ | ■ | ■ | ■ | | | | | |
| 2.3 | 9.5 | SC | SC FT | ■ | | ■ | ■ | ■ | | | | | |
| 2.4 / 2.5 | 9.5 | SC | SC FT / SC DP | ■ | ■ ■ | ■ | ■ | ■ | | | | | |
| 2.6 ~ 2.8 | 9.5 | SC | SC FT | ■ | | ■ | ■ | ■ | | | | | |
| 3.0 ~ 3.175 | 10.0 | SC | SC FT | ■ | | ■ | ■ | ■ | | | | | |

## IMPROVED CHIP BREAKER ROUTERS FOR A BETTER CHIP EVACUATION AND IMPROVED ACCURACY

| Ø mm | L mm | Router type | Label description | FT | DP (not available) | Applications | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | FR4 | FR2/3 | CEM1/3 | PE/PTFE | PMMA | POLYIMIDE | Al | Cu |
| 0.8 / 0.9 | 4.5 | RLE | RLE FT | ■ | | ■ | ■ | ■ | | | | | |
| 1.0 | 4.5 / 6.5 | RLE | RLE FT | ■ | | ■ | ■ | ■ | | | | | |
| 1.2 / 1.4 | 5.0 / 6.5 | RLE | RLE FT | ■ | | ■ | ■ | ■ | | | | | |
| 1.5 / 1.6 | 6.5 / 8.0 | RLE | RLE FT / RLES FT | ■ | | ■ | ■ | ■ | | | | | |
| 1.8 | 8.0 | RLE | RLES FT | ■ | | ■ | ■ | ■ | | | | | |
| 2.0 | 8.0 / 9.5 | RLE | RLES FT | ■ | | ■ | ■ | ■ | | | | | |
| 2.4 | 9.5 | RLE | RLES FT | ■ | | ■ | ■ | ■ | | | | | |

**FT**

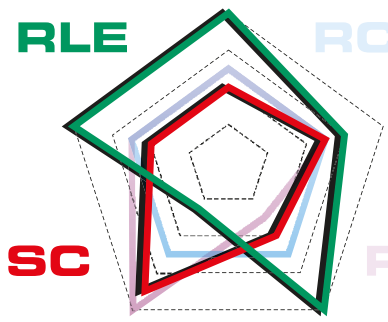
Fishtail
Fischschwanz-Anschliff
Bout en queue de poisson
Testa a coda di pesce
Punta en cola de pez

**DP**

Drill point
Bohrspitzenanschliff
Bout en pointe
Testa a forare
Punta de broca

Dimensional accuracy
Massgenauigkeit
Précision dimensionnelle
Precisione dimensionale
Precisión dimensional

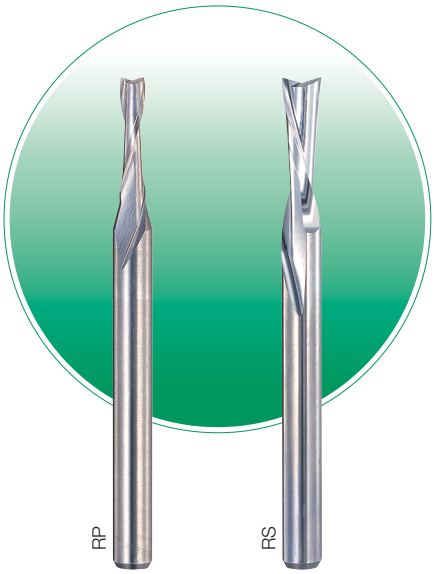
Breakage resistance
Bruchfestigkeit
Résistance à la rupture
Resistenza alla rottura
Resistencia a la rotura

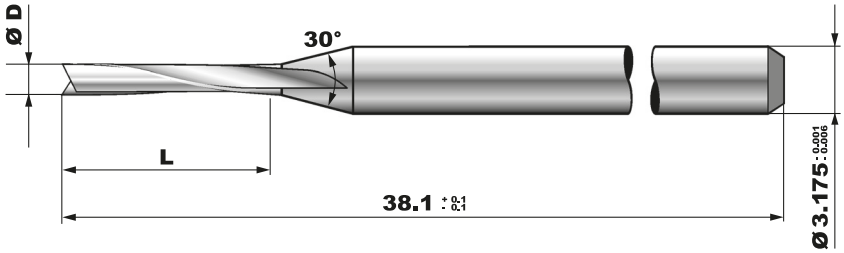



Wear resistance
Verschleisswiderstand
Résistance à l'usure
Resistenza all'usura
Resistencia al desgaste

Burr control
Gratreduktion
Réduction de la bavure
Riduzione della bava
Reducción de la rebaba

Swarf evacuation
Spanabfuhr
Evacuation des copeaux
Evacuazione truciolo
Evacuación de virutas




## RP
ø 0.4 ~ ø 3.175 mm

## RS
ø 0.8 ~ ø 3.0 mm

## ROUTERS
RP series: up draft routers designed for routing prepreg and soft base materials. RS series: down draft routers for a burr-free routing even with a reduced pressure-foot pressure and used on the same materials as the RP series.

## FRÄSER
RP-Serie: Spanabfuhr nach oben für Prepreg und weiches Basismaterial. RS-Serie: Spanabfuhr nach unten für gratfreie Fräsen auch mit reduziertem Druck des Niederhalters und derselben Materialien wie für die RP-Serien.

## FRAISES
Série RP: fraise avec évacuation des copeaux vers le haut et conçue pour l'usinage de matériaux doux comme le "prepreg" et flexibles. Série RS: fraise avec les mêmes applications que la série RP mais avec une évacuation des copeaux vers le bas permettant d'obtenir un fraisage sans bavures.

## FRESE
Serie RP: fresa con un' evacuazione del truciolo verso sopra e progettate per lavorare materiali teneri tipo "prepreg" e flessibili. Serie RS: fresa utilizzata sugli stessi materiali delle frese RP ma con un' evacuazione del truciolo verso il basso per evitare la creazione di bava.

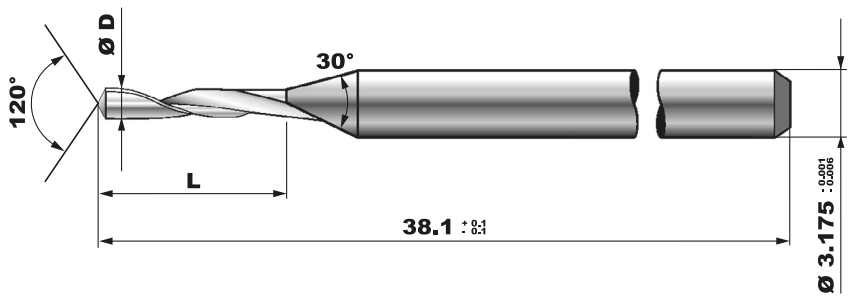
## FRESAS
Serie RP: fresa con evacuación de viruta hacia arriba diseñada para ser utilizada en materiales blandos como el "prepreg" y flexibles. Serie RS: fresa utilizada en los mismos materiales que la fresa RP pero con una evacuación de la viruta hacia abajo. Esta característica propicia un fresado sin rebabas.

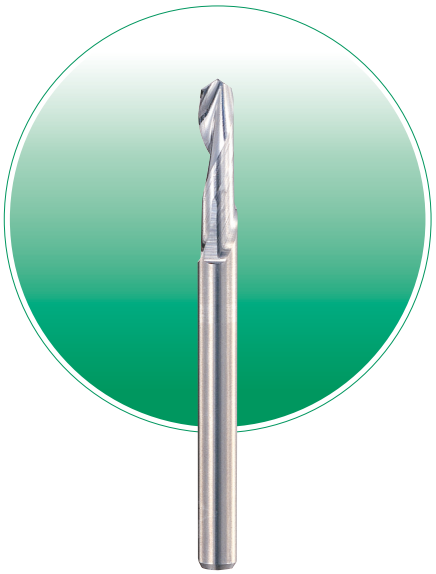
### RIGHT HAND 2 FLUTE SLITTING ROUTERS

| Ø mm | L mm | Router type | Label description | Applications (up draft chip evacuation) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | FR4 | FR2/3 | CEM1/3 | PE/PTFE | PMMA | POLYIMIDE | Al | Cu |
| 0.4 | 2.5 | RP | RP20 | | | | | | | | |
| 0.5 | 3.0 | RP | RP20 | | | | | | | | |
| 0.6 | 3.0 | RP | RP20 | | | | | | | | |
| 0.7 | 4.0 | RP | RP20 | | | | | | | | |
| 0.8 / 0.9 | 4.5 | RP | RP20 | | | | | | | | |
| 1.0 | 4.5 / 6.5 | RP | RP20 | | | | | | | | |
| 1.1 | 6.5 | RP | RP20 | | | | | | | | |
| 1.2 | 5.0 / 6.5 | RP | RP20 | | | | | | | | |
| 1.3 | 5.0 | RP | RP20 | | | | | | | | |
| 1.4 | 5.0 | RP | RP20 | | | | | | | | |
| 1.5 / 1.6 | 6.5 / 8.0 | RP | RP20 | | | | | | | | |
| 1.7 | 6.0 | RP | RP20 | | | | | | | | |
| 1.8 | 6.5 | RP | RP20 | | | | | | | | |
| 2.0 / 2.2 / 2.4 / 2.5 | 8.0 | RP | RP20 | | | | | | | | |
| 3.0 / 3.175 | 9.5 | RP | RP20 | | | | | | | | |

### LEFT HAND 2 FLUTE SLITTING ROUTERS

| Ø mm | L mm | Router type | Label description | Applications (down draft chip evacuation) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | FR4 | FR2/3 | CEM1/3 | PE/PTFE | PMMA | POLYIMIDE | Al | Cu |
| 0.8 / 1.0 | 4.5 | RS | RS20 | | | | | | | | |
| 1.2 | 5.0 | RS | RS20 | | | | | | | | |
| 1.5 | 4.0 / 6.5 | RS | RS20 | | | | | | | | |
| 1.6 / 1.8 | 6.5 | RS | RS20 | | | | | | | | |
| 2.0 / 2.4 / 2.5 | 8.0 | RS | RS20 | | | | | | | | |
| 3.0 | 9.5 | RS | RS20 | | | | | | | | |



## SF
ø 0.5 ~ ø 3.175 mm

## ROUTERS
The SF router bit is an up draft spiral single flute router bit with a big chip pocket design. This prevents chip heating and provides excellent routing performance in soft materials such as teflon and flexible boards. Please ensure stack integrity and suitable pressure foot clamping when routing stacks of thin materials to avoid cutter chatter that might cause burring.

## FRÄSER
Der SF-Fräser wurde zum Fräsen von weichen Materialien wie Teflon und Flexplatten entwickelt. Die einschneidige Geometrie lässt eine hervorragende Spanabfuhr zu.

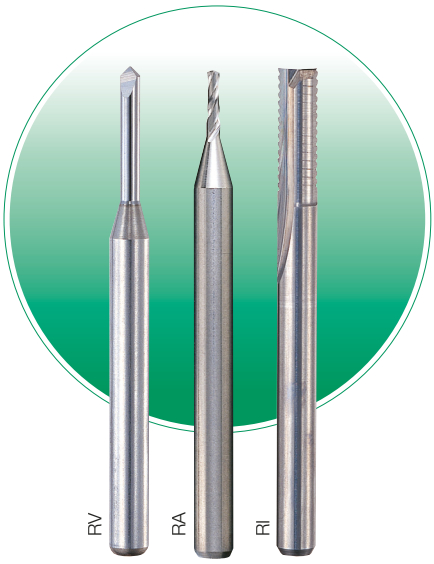
## FRAISES
La série des fraises SF est conçue pour usiner des matériaux doux tels que le téflon et les matériaux flexibles. La géométrie avec une lèvre garantit une parfaite évacuation des copeaux.

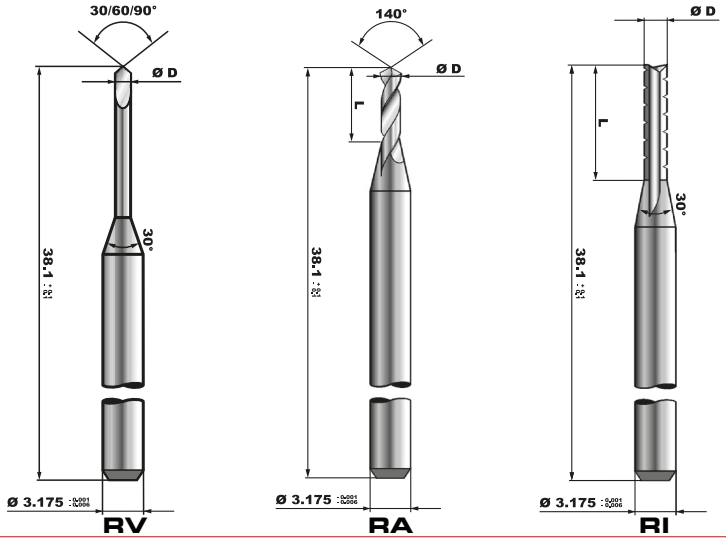
## FRESE
Queste frese vengono utilizzate per la lavorazione di materiali teneri (vedi teflon e circuiti flessibili). La geometria con singola elica permette un'eccellente aspirazione del materiale.

## FRESAS
La serie de fresas SF está concebida para contornear materiales blandos como el teflón y materiales flexibles. La geometría con un solo labio de corte garantiza una perfecta evacuación de las virutas.

### SINGLE FLUTE SLITTING ROUTERS

| Ø mm | L mm | Router type | Label description | Applications | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | FR4 | FR2/3 | CEM1/3 | PE/PTFE | PMMA | POLYIMIDE | Al | Cu |
| 0.5 | 2.0 | SF | SF | | | | | | | | |
| 0.8 / 0.9 | 4.0 | SF | SF | | | | | | | | |
| 1.0 / 1.1 | 4.5 | SF | SF | | | | | | | | |
| 1.2 / 1.3 / 1.4 | 5.0 | SF | SF | | | | | | | | |
| 1.5 / 1.6 / 1.8 | 6.5 | SF | SF | | | | | | | | |
| 2.0 | 8.0 | SF | SF | | | | | | | | |
| 2.4 / 2.5 / 3.0 / 3.175 | 9.5 | SF | SF | | | | | | | | |




## RV
ø 1.0 ~ ø 3.175 mm

## RA
ø 0.8 ~ ø 3.0 mm

## RI
ø 0.8 ~ ø 3.175 mm

## ROUTERS
RV series: a special V-groove router for standard electric printed circuit boards enables stable routing without burring or unevenness.
RA series: a sharp helix angle and is suitable for nonferrous metal such as aluminum and copper, etc.
RI series: is a suitable router for contouring the general glass epoxy and non ferrous metallic boards and offers an excellent surface finish.

## FRÄSER
RV-Serie: der Fräser kommt immer dann zum Zuge, wenn die Oberseite von Leiterplatten mit V-förmigen Kerben versehen werden muss. Der RA-Fräser kommt bei der Bearbeitung von Aluminium zum Einsatz. Die sehr guten Schneideigenschaften erzielen eine erstklassige Oberfl äche des gefrästen Materials. RI-Serie: die Geometrie ermöglicht ein spanloses Fräsen von Kupfer-Invar-Kupfer-Material.

## FRAISES
Série RV: spécialement conçue pour le rainurage des circuits imprimés.
Série RA: spécialement été développée pour usiner l'aluminium.
Série RI: spécialement étudiée pour usiner le cuivre-invar-cuivre sans bavure.

## FRESE
Serie RV: progettate per eseguire lo scoring sulla superfi cie dei circuiti stampati.
Serie RA: sviluppate specialmente per applicazioni su alluminio
Serie RI: progettate per lavorare, senza creazione di bava, materiale tipo rame-invar-rame.

## FRESAS
Serie RV: la fresa RV esta especialmente diseñada para el ranurado o scoring de los circuitos impresos. Serie RI: la fresa RI esta especialmente estudiada para fresar cobre-invar-cobre sin rebabas.

### V-GROOVE ROUTERS

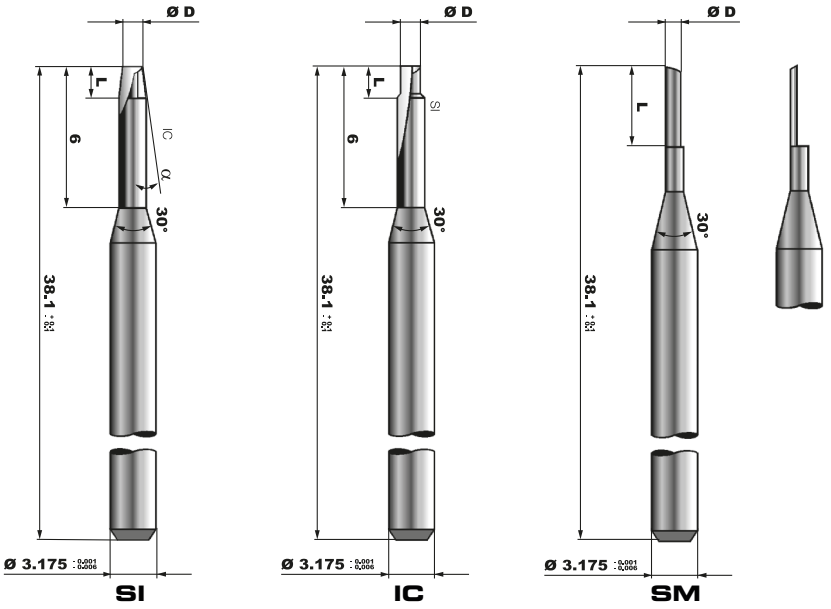
| Ø mm | Point angle | Router type | Label description | Applications | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | FR4 | FR2/3 | CEM1/3 | PE/PTFE | PMMA | POLYIMIDE | Al | Cu |
| 1.0 | 30° / 60° / 90° | RV | RV | | | | | | | | |
| 1.5 | 60° / 90° | RV | RV | | | | | | | | |
| 1.6 / 2.0 / 3.0 / 3.175 | 30° / 60° / 90° | RV | RV | | | | | | | | |

### 2 FLUTE ROUTERS FOR NON FERROUS METALS

| Ø mm | L mm | Router type | Label description | Applications | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | FR4 | FR2/3 | CEM1/3 | PE/PTFE | PMMA | POLYIMIDE | Al | Cu |
| 0.8 | 3.0 | RA | RA | | | | | | | | |
| 1.0 | 4.0 | RA | RA | | | | | | | | |
| 1.2 | 5.0 | RA | RA | | | | | | | | |
| 1.6 | 6.5 | RA | RA | | | | | | | | |
| 2.0 / 2.4 / 3.0 | 8.0 | RA | RA | | | | | | | | |

### NOTCHED STRAIGHT 3 FLUTE ROUTERS

| Ø mm | L mm | Router type | Label description | Applications | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | FR4 | FR2/3 | CEM1/3 | PE/PTFE | PMMA | POLYIMIDE | Al | Cu |
| 0.8 | 4.0 | RI | RI | | | | | | | | |
| 1.0 | 4.5 | RI | RI | | | | | | | | |
| 1.5 / 1.6 / 2.0 / 2.4 | 6.5 | RI | RI | | | | | | | | |
| 3.175 | 10.0 | RI | RI | | | | | | | | |



## ROUTERS

SI series: improved quality for the recess surface after spot facing .
IC series: these 2 flute routers have a taper geometry on the top cutting edge.
SM Series: This semilunar router is suitable for small spot facing on the surface of electronic printed circuit boards for surface mounted components.

## FRÄSER

SI-Serie: der Fräser wird zur Herstellung von Plattformen für die SMD-Komponenten verwendet.
IC-Serie: diese Fräser wird gleich wie der SI-Fräser eingesetzt. Durch die konische Form wird eine Abschrägung in der Aussparung erzielt, was die platzierung von SMD-Komponenten erleichtert.
SM-Serie: diese Fräser wird für vertikale Ausfräsungen bei Leiterplatten verwendet.

## FRAISES

Série SI: la fraise SI est conçue pour les applications SMD.
Série IC: la fraise est utilisée pour la même application que les fraises SI. Sa forme cônique permet le fraisage de lits à parois obliques pour composants SMD.
Série SM: conçue pour détourer des parties inférieures dans les plaques avec paroi verticale. Cet outil permet aussi d'exécuter des avant-trous.

## FRESE

Serie SI: le frese SI sono utilizzate per produrre "nicchie" per schede con componenti SMD.
Serie IC: le frese IC sono utilizzate per le stesse applicazione che le SI. La forma conica produce una parete tale da facilitare il posizionamento di coponenti SMD. Serie SM: sono progettate per lavorazione verticale (nicccomponenti superfi ciali montati.hie) su schede con

## FRESAS

Serie SI: las fresas SI son utilizadas para realizar cajeados para componentes SMD.
Serie IC: las fresas IC se utilizan para la misma aplicación que las fresas SI. Producen cajeados con la pared oblicua para componentes SMD.
Serie SM: está diseñada para realizar rebajes en la pared vertical de circuitos con componentes SMD.

**SI**
ø 0.8 ~ ø 3.0 mm

**IC**
ø 1.0 ~ ø 3.0 mm

**SM**
ø 1.0 ~ ø 3.0 mm

### STRAIGHT 2 FLUTE ROUTERS

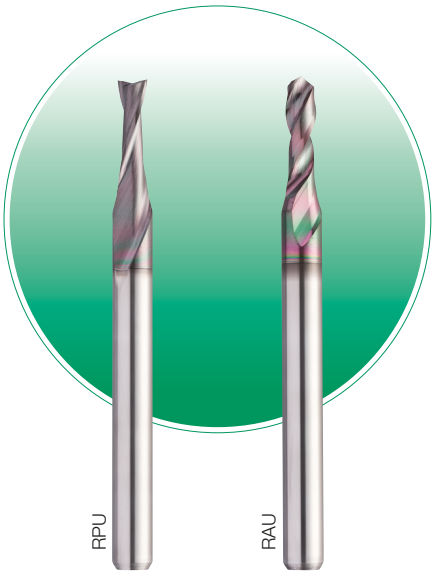
| Ø mm | L mm | Router type | Label description | Applications (spot facing) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | FR4 | FR2/3 | CEM1/3 | PE/PTFE | PMMA | POLYIMIDE | Al | Cu |
| 0.8 | 2.0 | SI | SI | | | | | | | | |
| 1.0 / 1.1 | 3.0 | SI | SI | | | | | | | | |
| 1.5 / 1.6 | 4.0 | SI | SI | | | | | | | | |
| 2.0 / 2.5 / 3.0 | 6.0 | SI | SI | | | | | | | | |

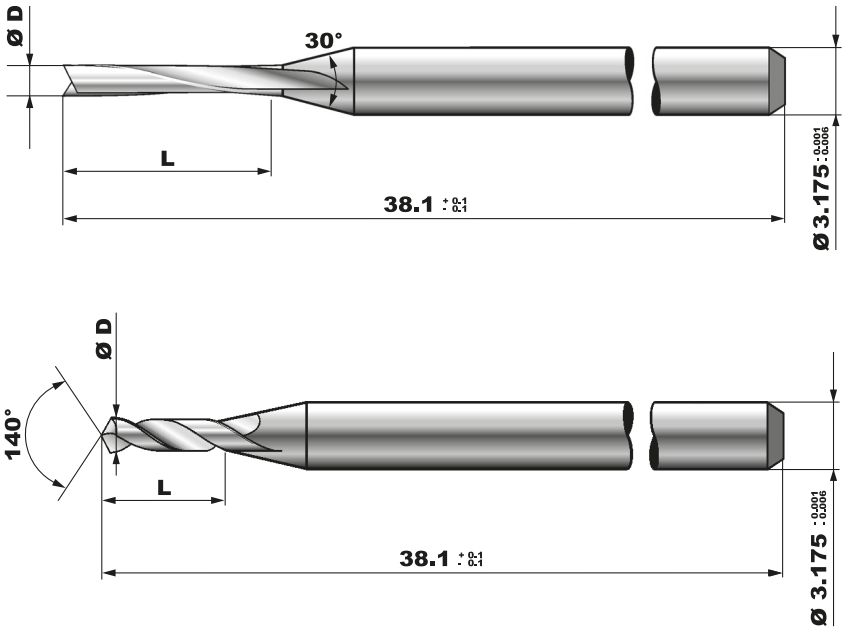
### TAPER 2 FLUTE ROUTERS

| Ø mm | L mm | Router type | Label description | Applications (spot facing) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | FR4 | FR2/3 | CEM1/3 | PE/PTFE | PMMA | POLYIMIDE | Al | Cu |
| 1.0 | 4.0 | IC | IC | | | | | | | | |
| 1.5 | 2.6 | IC | IC | | | | | | | | |
| 2.0 | 3.3 | IC | IC | | | | | | | | |
| 3.0 | 1.4 | IC | IC | | | | | | | | |

### SEMILUNAR ROUTERS

| Ø mm | L mm | Router type | Label description | Applications | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | FR4 | FR2/3 | CEM1/3 | PE/PTFE | PMMA | POLYIMIDE | Al | Cu |
| 1.0 | 3.0 | SM | SM | | | | | | | | |
| 2.0 / 2.5 / 3.0 | 6.0 | SM | SM | | | | | | | | |




## RPU
ø 0.6 ~ ø 3.0 mm

## RAU
ø 2.0 ~ ø 2.4 mm

## ROUTERS
2 flute ULF coated routers with excellent self-lubricating performances for aluminium and non-ferrous metals achieving a smooth and burr free surface. RPU series are used when routing boards with a thickness up to 1.6 mm whereas the RAU series (with drill point) are used when routing thicker boards or when a large amount of holes need to be drilled.

## FRÄSER
2-schneidige ULF-beschichtete Fräser mit ausgezeichneten selbst schmierenden Leistungen für Aluminium und eisenfreien Metallen zur Erhaltung einer glatten und gratfreien Oberfläche. RPU-Serien kommen beim Fräsen von Leiterplatten bis zu 1.6 mm Dicke zur Anwendung; RAU-Serien (mit Bohrerspitze) hingegen werden für das Fräsen von dickeren Leiterplatten oder zur Bohrung einer grossen Anzahl Löcher eingesetzt.

## FRAISES
Fraises à double hélice avec revêtement ULF dotées d'excellentes performances autolubrifiantes pour l'aluminium et les métaux non-ferreux afin d'obtenir une surface lisse et sans bavures. Les séries RPU sont utilisées pour fraiser des circuits allant jusqu'à une épaisseur de 1.6 mm tandis que les séries RAU (avec la tête en "pointe de foret") sont utilisées pour fraiser des circuits d'une épaisseur supérieur ou lorsqu'un grand nombre de trous doivent être effectué.

## FRESE
Frese doppia elica rivestite ULF con eccellenti doti di autolubrificazione per alluminio a metalli non ferrosi per ottenere una superficie liscia e senza bava. Le serie RPU viene utilizzata quando si lavorano pannelli con spessori fino a 1.6 mm, le serie RAU (con testa “Drill Point”) è invece utilizzata quando si lavorano pannelli spessi o quando devono essere eseguiti un grande numero di fori.

## FRESAS
Fresas de doble hélice con recubrimiento ULF dotadas de excelentes propiedades de auto lubrificación para el fresado del aluminio y metales no ferrosos permitiendo así conseguir una superficie lisa y sin rebabas. Las series RPU se utilizan para el fresado de circuitos hasta un espesor de 1.6 mm, mientras que las series RAU (con la cabeza en "punta de broca") se utilizan para el fresado de circuitos de un mayor espesor o cuando un gran número de agujeros deben de ser taladrados.

# new RPU/RAU Series

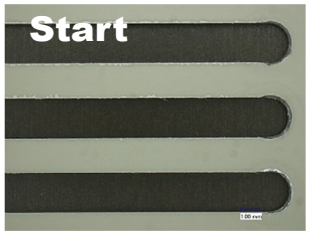
## ALUMINIUM ROUTING PERFORMANCE OF ULF COATED ROUTER

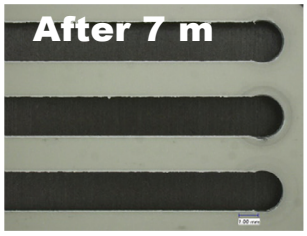
## Routing Conditions — RPU Ø 2.0 X 8 MM

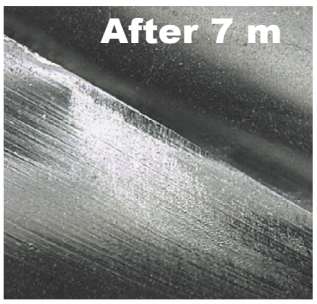
**Work material: aluminium (A5052) + insulating layer 0.08 mm, 1 x 1.08 mm N: 30'000 rpm - F: 0.5 m/min**

**LESS BURRS & HIGH SPEED MACHINING** | **CUTTING EDGE**

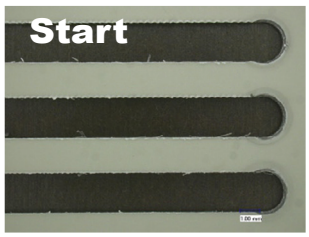
**ULF coated**

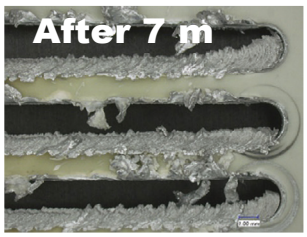


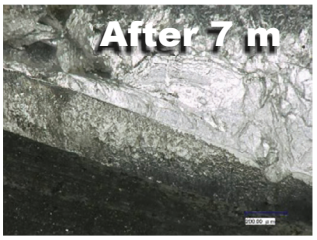




**Conventional non coated**

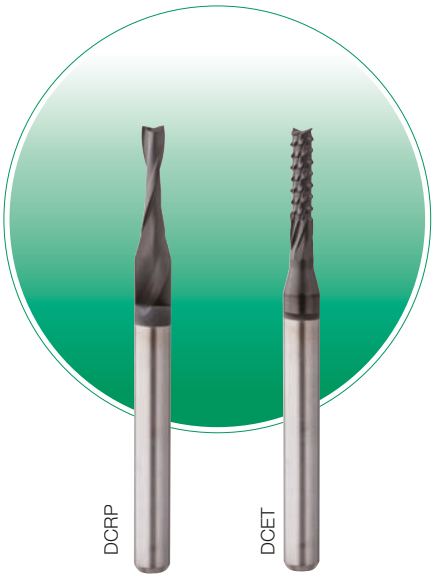


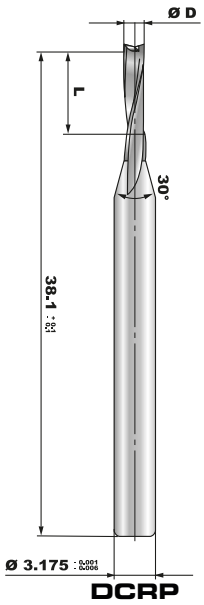



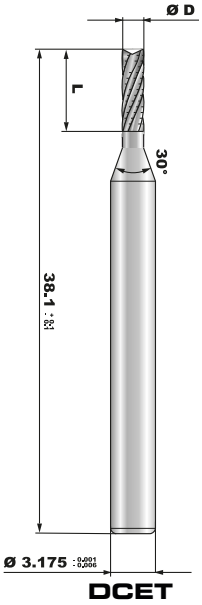




### 2 FLUTE "ULF" COATED ROUTERS FOR NON FERROUS METALS

| Ø mm | L mm | Router type: FT point | Router type: EM point | Router type: DP point | Label description | Applications: Aluminium (Al) ≤ 1.6 mm thick | Applications: Aluminium (Al) ≥ 1.6 mm thick | Applications: Copper (Cu) |
|---|---|---|---|---|---|---|---|---|
| 0.6 | 3.0 | RPU | RPU EM | | RPU20 / RPU EM | | | |
| 1.2 | 6.5 | RPU | | | RPU20 | | | |
| 1.5 | 6.5 | RPU | | | RPU20 F987 | | | |
| | | | RPU EM | | RPU20 EM | | | |
| 1.6 | 6.0 | | RPU EM | | RPU20 EM | | | |
| | 6.5 | RPU | | | RPU20 | | | |
| 2.0 | 8.0 | RPU | | | RPU20 | | | |
| | | | | RAU | RAU | | | |
| | 9.0 | | RPU EM | | RPU20 EM | | | |
| 2.1 | 8.0 | RPU | | | RPU20 | | | |
| 2.4 | 8.0 | RPU | | | RPU20 | | | |
| | | | | RAU | RAU | | | |
| 3.0 | 9.5 | RPU | | | RPU20 | | | |
| | 12.0 | | RPU EM | | RPU20 EM | | | |




## DCRP
ø 2.0 mm

## DCET
ø 0.8 ~ ø 2.5 mm

## ROUTERS
DCRP Series: Ideally designed for IMS, Aluminium and Copper routing. The new geometry combined with the diamond coating offer an excellent dimensional accuracy as well as a high quality surface finish.
DCET Series: Developed for Carbon Fibre, CFRP and FR4 hg Tg routing, these new routers allow outstanding dimensional accuracy and a tool life.

## FRÄSER
DCRP Serie:Ideal zur Bearbeitung von IMS-Leiterplatten, Aluminium und Kupfer. Die neue Geometrie in Kombination mit der Diamantbeschichtung bietet eine ausgezeichnete Maßgenauigkeit sowie eine hohe Oberflächengüte.
DCET Serie: Entwickelt für die Bearbeitung von keramisch gefüllten Basismaterialien sowie CFK und FR4 Hoch TG Leiterplatten. Mit diesen neuen Fräsern wird eine hervorragende Maßgenauigkeit und eine sehr gute Standzeit erzielt.

## FRAISES
Série DCRP: Idéalement conçues pour le fraisage des "IMS", de l'aluminium et du cuivre. La nouvelle géométrie combinée avec le revêtement en diamant offrent une excellente précision dimensionnelle ainsi qu'une finition de surface de haute qualité.
Série DCET: Développées pour usiner la fibre de carbone, les "CFRP" et le FR4 Hg Tg , ces nouvelles fraises offrent une précision dimensionnelle de fraisage exceptionnelle et une très longue durée de vie.

## FRESE
Serie DCRP: Idealmente progettate per la fresatura dei "IMS", dell' alluminio e del rame. La nuova geometria abbinata al rivestimento diamante offrono un'ottima precisione dimensionale, nonché una finitura superficiale di alta qualità.
Serie DCET: Sviluppate per la fibra di carbonio, per i "IMS" e per i FR4 Hg Tg, queste nuove frese consentono un'eccezionale precisione dimensionale di fresatura e una lungha durata di vita del utensile.

## FRESAS
Serie DCRP: Idealmente diseñada para el fresado de los "IMS", del valuminio y del cobre. La nueva geometría combinada con el recubrimiento de diamante ofrecen une precisión dimensional excelente, así como un acabado superficial de alta calidad.
Serie DCET: Desarrollada para la fibra de carbono, para los "IMS" y para el FR4 de Alto Tg, estas nuevas fresas permiten un fresado de precisión dimensional excepcional y una larga duración de la herramienta.

| Ø mm | L mm | Router type | | Label description | Applications | |
|---|---|---|---|---|---|---|
| | | | | | for Carbon Fibre, CFRP, FR4, FR4 Hg Tg, Halogen free | Aluminium with ceramic dielectric layer |
| 0.8 | 4.5 | DCET | | DCET FT | | |
| 1.0 | 4.5 | DCET | | DCET FT | | |
| | 6.5 | DCET | | DCET FT | | |
| 1.2 | 6.5 | DCET | | DCET FT | | |
| 1.5 | 8.0 | DCET | | DCET FT | | |
| 1.6 | 6.5 | DCET | | DCET FT | | |
| 1.8 | 8.0 | DCET | | DCET FT | | |
| 2.0 | 6.0 | | DCRP | DCRP N134 | | |
| | 8.0 | DCET | | DCET FT | | |
| 2.4 | 10.5 | DCET | | DCET FT | | |
| 2.5 | | DCET | | DCET FT | | |

# new DCRP/DCET Series

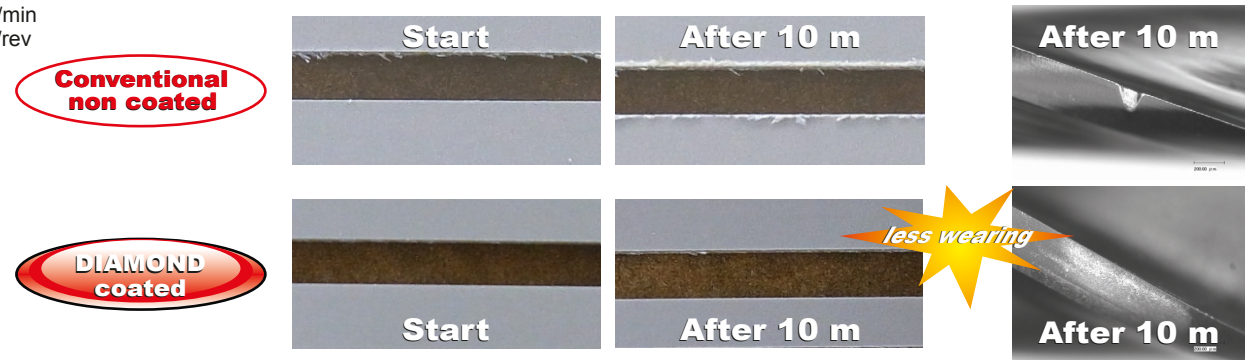
## ROUTING PERFORMANCE DIAMOND COATED ROUTER

## Routing Conditions DCRP SERIES

### Burrs & Cutting Edge Wearing

Routing conditions
Router: Ø 2.0 x 6 mm
PCB: 5052 aluminium t1.5 mm + t0.1 mm ceramic dielectric layer
N: 30'000 min-1
F: 0.6 m/min
f: 20 µm/rev

DCRP series ensures a lower level of burring and a reduced cutting edge wearing, while improving the production costs on highly abrasive work materials as the tool life is greatly improved

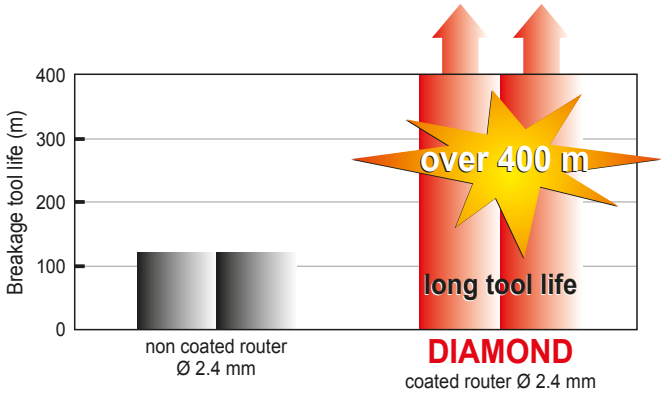



- *DCRP SERIES FOR A LONGER TOOL LIFE AND BETTER DIMENSIONAL ACCURACY WHEN ROUTING ALUMINIUM WITH CERAMIC DIELECTRIC LAYERS*

## Routing Conditions DCET SERIES

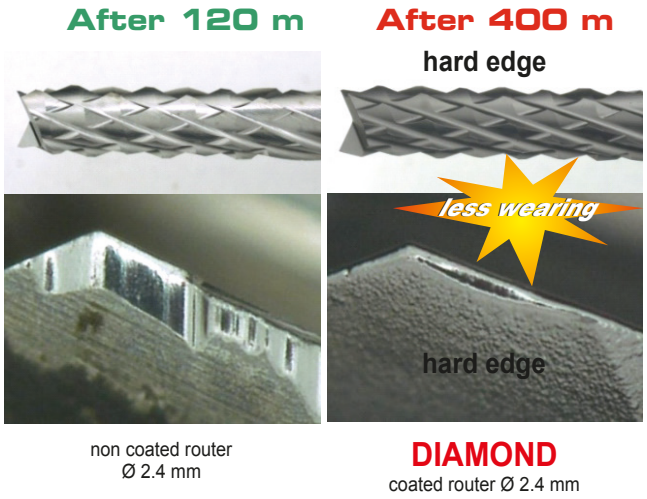
### Tool life until breakage

Routing conditions
Router: Ø 2.4 x 10.5 mm
PCB: R1705UX t1.6 mm (no copper) x 4 boards
N: 30'000 min-1
F: 1.04 m/min
f: 34.7 µm/rev




### Cutting Edge Wearing

DC series ensure good dimensional accuracy while routing long distances




- *DCET SERIES FOR A LONGER TOOL LIFE AND BETTER DIMENSIONAL ACCURACY WHEN ROUTING LOW CTE, HALOGEN FREE, HIGH TG AND FR4 MATERIALS*

# PARAMETERS / PARAMETER / PARAMÈTRES / PARAMETRI / PARÁMETROS

| Materials / Materialien<br>Matériaux / Materiali / Materiales | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Router / Fräser<br>Fraises / Frese<br>Fresas | FR4 | FR 2 / 3 | CEM 1 / 3 | High Tg<br>Hoch-Tg<br>Haut Tg<br>Alto Tg<br>Alto Tg | BT resins<br>BT-Harze<br>Résines BT<br>Resine BT<br>Resinas BT | Halogen free<br>Ohne Halogen<br>Non halogéné<br>Senza alogeno<br>Sin alógeno | PE / PTFE | PMMA | Polyimide<br>Polyimid<br>Polyimide<br>Polyimide<br>Poliamida | Al | Cu |
| RCM / RHS | ● | ● | ● | ● | | ● | | | | | |
| SC | ● | ● | ● | | | | | | | | |
| RP / RS | | | | | | | ● | ● | ● | ● | ● |
| SF | | ● | ● | | ● | | ● | ● | ● | | |
| RA | ● | ● | ● | | | | | | | ● | ● |
| RPU / RAU | ● | ● | ● | | | | | | | ● | ● |
| Cutting speed / Schnittgeschwindigkeit<br>Vitesse de coupe / Velocità di taglio / Velocidad del corte | | | | | | | | | | | |
| V (m/min) | 180 ~ 210 | 160 ~ 180 | 160 ~ 180 | 100 ~ 150 | 100 ~ 150 | 100 ~ 150 | 100 ~ 200 | 120 ~ 210 | 100 ~ 150 | 100 ~ 190 | |

| Ø | RP, RPU & RS series<br>N (min⁻¹) | <br>F (m/min) | SF series<br>N (min⁻¹) | <br>F (m/min) | SM series<br>N (min⁻¹) | <br>F (m/min) |
|---|---|---|---|---|---|---|
| 0.8 | 35 000 ~ 40 000 | 0.15 ~ 0.3 | 30 000 ~ 35 000 | 0.1 ~ 0.2 | 30 ~ 35 000 | 0.1 ~ 0.3 |
| 0.9 | | 0.2 ~ 0.4 | | | | 0.3 ~ 0.5 |
| 1.0 | | | | | | |
| 1.1 | | | | | | |
| 1.2 | | | | | | |
| 1.3 | | | | 0.2 ~ 0.4 | 25 ~ 30 000 | 0.5 ~ 0.8 |
| 1.4 | 30 000 ~ 35 000 | 0.3 ~ 0.6 | | | | |
| 1.5 | | | | | | |
| 1.6 | | | | | | |
| 1.8 | | | | | | 0.8 ~ 1.0 |
| 2.0 | 15 000 ~ 30 000 | 0.4 ~ 0.6 | | 0.4 ~ 0.8 | | |
| 2.2 | | | | | | |
| 2.3 | | | | | | |
| 2.4 | | | | | 20 ~ 27 000 | |
| 2.5 | | | | | | |
| 3.0 | | | | | | |
| 3.175 | | | | | | |

| Ø | SI & IC series<br>N (min⁻¹) | <br>F (m/min) | RV series<br>N (min⁻¹) | <br>F (m/min) | RI series<br>N (min⁻¹) | <br>F (m/min) | RA & RAU series<br>N (min⁻¹) | <br>F (m/min) |
|---|---|---|---|---|---|---|---|---|
| 0.8 | 30 000 ~ 35 000 | 0.2 ~ 0.6 | 30 000 ~ 35 000 | 0.6 ~ 0.8 | 34 000 ~ 35 000 | 0.1 ~ 0.2 | 25 000 ~ 30 000 | 0.05 ~ 0.3 |
| 1.0 | | | | | | | | |
| 1.1 | | | | | | | | |
| 1.2 | | | | | | | | |
| 1.3 | 25 000 ~ 30 000 | 0.6 ~ 0.8 | | 0.8 ~ 1.0 | | | | |
| 1.5 | | | | | | | | |
| 1.6 | | | | | 30 000 ~ 25 000 | 0.3 ~ 0.8 | | 0.3 ~ 0.6 |
| 1.9 | | | | | | | | |
| 2.0 | | | | | | | | |
| 2.4 | | | | | | | | |
| 2.5 | 20 000 ~ 27 000 | 0.8 ~ 1.0 | 25 000 ~ 30 000 | | 15 000 ~ 25 000 | 0.5 ~ 0.8 | 15 000 ~ 25 000 | 0.5 ~ 0.8 |
| 2.8 | | | | | | | | |
| 3.0 | | | | | | | | |
| 3.175 | | | | | | | | |

| Ø | RCM & RHM / SC & RLE / DCRP & DCET Series N (min⁻¹) | F (m/min) | Fz (m/min) | L / stack height / Stapelhöhe / épaisseur d'empilage / spessore del pacco / espesor de la pila |
|---|---|---|---|---|
| 0.6 | 50 000 | 0.4 | 0.1 | 4.0, 4.5, 5.0 / 1~2 x 1.6 mm |
| 0.7 | | | | |
| 0.8 | | | | |
| 0.9 | | 0.6 | | |
| 1.0 | | 0.8 | | 4.5, 6.5 / 1~3 x 1.6 mm |
| 1.1 | | 0.9 | | |
| 1.2 | | 0.8 ~ 1.0 | | 5.0, 6.5 / 2~3 x 1.6 mm |
| 1.3 | 47 ~ 50 000 | | | |
| 1.4 | 44 ~ 47 000 | 0.9 ~ 1.1<br>0.6 (DCRP) | | |
| 1.5 | 40 ~ 45 000 | | 0.2 | 6.5, 8.0 / 2~3 x 1.6 mm |
| 1.6 | 38 ~ 41 000 | 0.9 ~ 1.2<br>0.6 (DCRP) | | |
| 1.7 | 38 ~ 40 000 | | | |
| 1.8 | 33 ~ 38 000 | | | |
| 1.9 | 34 ~ 36 000 | | 0.3 | 8.0, 9.5 / 3~4 x 1.6 mm |
| 2.0 | 30 ~ 34 000 | | | |
| 2.1 | 30 ~ 32 000 | | | |
| 2.2 | 29 ~ 31 000 | 1.25 | | |
| 2.3 | 25 ~ 29 000 | | | 9.5 / 3~4 x 1.6 mm |
| 2.4 | | 1.0 ~ 1.3 | 0.2 | |
| 2.5 | 24 ~ 27 000 | | | |
| 2.6 | | | | |
| 2.7 | 23 ~ 25 000 | | | |
| 2.8 | | | | |
| 2.9 | 21 ~ 23 000 | | | |
| 3.0 | | | 0.1 | 10 / 3~4 x 1.6 mm |
| 3.1 | 20 ~ 22 000 | | | |
| 3.175 | | | | |

UNION TOOL application engineered router bits are designed to perform within the above general range of operating parameters. These ranges are not absolute limits and will vary with differing workpiece materials and levels of rigidity in the machine tool and fixtures.
Note: this table of routing conditions for the RCM/RHM and SC/RLE routers refers to an FR4, PCB thickness of 1.6 mm, without copper cladding and may not be applicable to other materials.

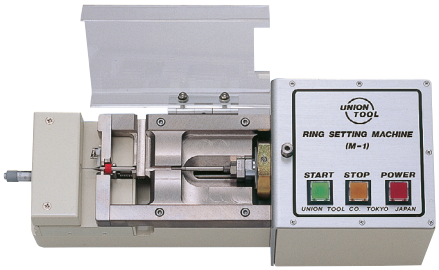
Die obige Tabelle enthält Anwendungsrichtlinien für UNION TOOL-Fräser. Die Grenzwerte können in verschiedenen Fällen über- oder unterschritten werden. Dies richtet sich nach Materialbeschaffenheit, Steifheit der Bohrmaschine, Plattenaufspannung etc.
Anmerkung: die Tabelle mit Fräskonditionen für die Fräser RCM/RHM und SC/RLE gilt für ein FR4 Material, Leiterplatten mit einer Stärke von 1,6 mm, ohne Kupfer und kann möglicherweise nicht auf andere Materialien angewandt werden.

UNION TOOL préconise des paramètres de détourage pouvant être appliqués dans des conditions générales de travail. Ces parmètres doivent être adaptés selon l'environnement spécifique de chaque atelier et selon les machines et les matériaux utilisés.
Note: les paramètres de fraisage concernant les fraises RCM/RHM et SC/RLE se rapportent à une matière FR4 d'une épaisseur de 1,6 mm, sans cuivre et ne peuvent pas être appliqués à d'autres matériaux.

Le frese UNION TOOL per applicazioni speciali sono progettate per operare entro i sopracilati parametri di lavoro. Questi campi di utilizzo non sono da considerarsi dei limiti assoluti poichè possono variare a seconda dei materiali da lavorare e delle caratteristiche della macchina utensile utilizzata.
Nota: questa tabella di parametri di fresatura per le frese RCM/RHM e SC/RLE si riferisce ad un materiale FR4, di uno spessore di 1,6 mm, senza rame e non può essere applicabile ad altri materiali.

UNION TOOL recomienda unos parámetros de fresado que pueden ser utilizados en condiciones generales de trabajo. Estos parámetros deben ser adaptados según el entorno específico de cada taller y de acuerdo a las máquinas y a los materiales que se utilicen.
Nota: los parámetros de fresado de las fresas RCM/RHM y SC/RLE se refieren a un material FR4 de un espesor de 1,6 mm, sin cobre y pueden no ser aplicable a otros materiales.

# EQUIPEMENT / EQUIPMENT / ÈQUIPEMENT / STRUMENTI / EQUIPAMIENTO

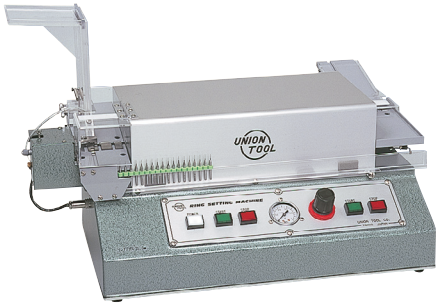



## RSM-M1 ø 0.2 ~ 3.0 mm

- Semi-automatic ring setting machine for drills.
- Halbautomatische Ringsetzungsmaschine für Bohrer.
- Machine semi-automatique de baguage pour forets.
- Macchina semi-automatica per inserimento anellini su punte.
- Máquina semiautomática de anillado de brocas.

## RSM-M2 > ø 3.0 mm

- Semi-automatic ring setting machine for drills.
- Halbautomatische Ringsetzungsmaschine für Bohrer.
- Machine semi-automatique de baguage pour forets.
- Macchina semi-automatica per inserimento anellini su punte.
- Máquina semiautomática de anillado de brocas.

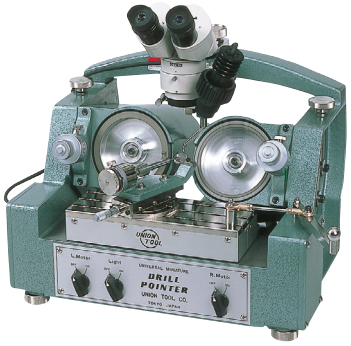



## RSM-4 ø 0.2 ~ 3.0 mm

- Automatic ring setting machine for drills and routers.
- Automatische Ringsetzungsmaschine für Bohrer und Fräser.
- Machine automatique à baguer pour forets et fraises.
- Macchina automatica per inserimento anellini su punte e frese.
- Máquina automática de anillado de brocas y fresas.

## RSM-L-II ø 0.05 ~ 2.8 mm

- Non-contact automatic ring setting machine for drills and routers.
- Automatische, kontaktfreie Ringsetzungsmaschine für Bohrer und Fräser.
- Machine automatique à baguer sans contact pour forets et fraises.
- Macchina automatica senza contatto per inserimento di anellini su punte e frese.
- Máquina automática de anillado sin contacto de brocas y fresas.




## MDP-5 ø 0.3 ~ 6.5 mm

- Repointing machine for tungsten carbide drills.
- Nachschleifmaschine für Hartmetallbohrer.
- Machine à affûter les forets en carbure de tungstène.
- Macchina di riaffilatura per punte in carburo di tungsteno.
- Máquina de afilar brocas en carburo de tungsteno.

## MDP-10 ø 0.2 ~ 1.0 mm

- Repointing machine for tungsten carbide drills.
- Nachschleifmaschine für Hartmetallbohrer.
- Machine à affûter les forets en carbure de tungstène.
- Macchina di riaffilatura per punte in carburo di tungsteno.
- Máquina de afilar brocas en carburo de tungsteno.

## OPTECH-M/MA

- Optical non-contact drill/router diameter measuring device.
- Optisches, kontaktfreies Messgerät für Bohrer-/Fräserdurchmesser.
- Instrument optique sans contact de mesure du diamètre des forets/fraises.
- Strumento ottico senza contatto per misurare il diametro delle punte/frese.
- Instrumento óptico de medida del diámetro sin contacto físico de la broca/fresa.

## OPTECH-RI-V/V plus 300 ~ 500'000 min-1

- Compact, cordless, high precision spindle runout indicator. The OPTECH-RI-V plus adds a spindle speed measurement feature up to 500'000 min-1.
- Handlich, anschlussfreies Spindelrundlauf-Messgerät. Das OPTECH-RI-V plus erlaubt Rotationsgeschwindigkeitsmessungen der Spindeln bis zu 500'000 min-1.
- Appareil de mesure du faux rond des broches de haute précision, compact et sans fil. L'OPTECH-RI-V plus permet une mesure de la vitesse de rotation des broches jusqu'à 500'000 min-1.
- Strumento di alta precisione, compatto e senza filo, per misurare l'eccentricità dei mandrini. L'OPTECH-RI-V plus fornisce una misura della velocità di rotazione dei mandrini fino a 500'000 min-1.
- Instrumento de medida de alta precisión, compacto e inalámbrico para la medida de la excentricidad de los cabezales. El OPTECH-RI-V plus permite además una medida de la velocidad de rotación de los cabezales hasta 500'000 min-1.

## PV-CHECKER

- Pressure-foot pressure and vacuum measuring device.
- Vakuum-Messgerät für Niederhaltungsdruck.
- Instrument de mesure de la pression du pied de pression et de l'aspiration.
- Strumento per misurare la pressione del premipezzo e l'aspirazione.
- Instrumento de medida de aspiración y presión del pisa.

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