

Bohren Drilling | Fräsen Routing

**HP**TEC

## **PCB Line**

**Werkzeuge zur Bearbeitung von  
Leiterplatten** Tools for processing  
printed circuit boards



**MORE THAN JUST TOOLS**





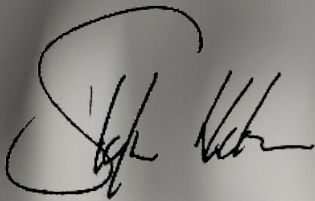


# Mehr als nur Werkzeuge

## More than just tools

Seit 1977 sind wir stolz darauf, hochpräzise Werkzeuge für die spannende Industrie herzustellen. Unser Produktionsstandort im Süden Deutschlands steht für Qualität und Zuverlässigkeit – Made in Germany. Mit einem Team von rund 80 engagierten Mitarbeitern beliefern wir Kunden weltweit. Mit unseren Werkzeugen ab Ø 0,05 mm erhalten Sie mehr als nur ein Werkzeug – Sie erhalten eine maßgeschneiderte, innovative Lösung.

We have been proud to manufacture high-precision tools for the machining industry since 1977. Our production site in the south of Germany stands for quality and reliability - Made in Germany. With a team of around 80 dedicated employees, we supply customers worldwide. With our tools from Ø 0.05 mm, you get more than just a tool - you get a customized, innovative solution.



**Stefan Netzer**  
Geschäftsführung Management





## BOHREN DRILLING

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# ÜBERSICHT BOHREN

## OVERVIEW DRILLING

| Ø<br>[mm] | DS - ML 4 layers | ML ≥ 6 layers | ML ≥ 70 µm copper | Filled / HTg | Backpanels | (Rigid) Flex | IC-Substrate ABFM | Polyimides (PI) | Teflon (PTFE) | Metal core ML | Copper / Brass (Cu / CuZn) | Plexiglas (PMMA) | Seite<br>Page |
|-----------|------------------|---------------|-------------------|--------------|------------|--------------|-------------------|-----------------|---------------|---------------|----------------------------|------------------|---------------|
|-----------|------------------|---------------|-------------------|--------------|------------|--------------|-------------------|-----------------|---------------|---------------|----------------------------|------------------|---------------|

### Multilayerbohrer Multilayer drill

|                                                                                                |            |   |   |   |   |   |   |   |   |   |   |   |   |    |
|------------------------------------------------------------------------------------------------|------------|---|---|---|---|---|---|---|---|---|---|---|---|----|
| <b>212</b>    | 0,20-0,635 | ● | ● | ● | ○ | ● | ○ | — | ● | ● | ○ | ○ | ● | 7  |
| <b>230</b>    | 0,20-3,00  | ● | ● | ● | ● | ● | ○ | ○ | ● | ● | ○ | ○ | ● | 8  |
| <b>242</b>    | 0,20-0,65  | ● | ● | ● | ● | ● | ○ | — | ● | ● | ○ | ○ | ○ | 10 |
| <b>271</b>   | 0,075-0,65 | ● | ● | ● | ● | ● | ○ | ● | ● | ● | ○ | ○ | ○ | 11 |
| <b>272</b>  | 0,05-0,45  | ● | ● | ● | ● | ● | ○ | ● | ● | ● | ○ | ○ | ○ | 12 |
| <b>540</b>  | 0,20-1,15  | ● | ● | ● | ○ | ● | ● | — | ● | ● | ● | ● | ● | 13 |

### Langlochbohrer Slot drill

|                                                                                                |           |   |   |   |   |   |   |   |   |   |   |   |   |    |
|------------------------------------------------------------------------------------------------|-----------|---|---|---|---|---|---|---|---|---|---|---|---|----|
| <b>250</b>  | 0,30-3,00 | ● | ● | ○ | ● | ○ | ○ | — | ○ | ○ | ○ | ○ | ○ | 14 |
|------------------------------------------------------------------------------------------------|-----------|---|---|---|---|---|---|---|---|---|---|---|---|----|

### Flexbohrer Flex drill

|                                                                                                |           |   |   |   |   |   |   |   |   |   |   |   |   |    |
|------------------------------------------------------------------------------------------------|-----------|---|---|---|---|---|---|---|---|---|---|---|---|----|
| <b>512</b>  | 0,15-0,50 | — | — | — | — | — | ● | — | ● | ○ | — | — | — | 16 |
|------------------------------------------------------------------------------------------------|-----------|---|---|---|---|---|---|---|---|---|---|---|---|----|

### Standardbohrer Standard drill

|                                                                                                |           |   |   |   |   |   |   |   |   |   |   |   |   |    |
|------------------------------------------------------------------------------------------------|-----------|---|---|---|---|---|---|---|---|---|---|---|---|----|
| <b>519</b>  | 0,05-0,15 | ● | ● | ● | ● | ● | ● | — | ● | ● | ● | ● | ● | 17 |
| <b>530</b>  | 0,20-6,35 | ● | ● | ○ | ○ | ● | ● | ● | ● | ● | ○ | ● | ● | 18 |
| <b>543</b>  | 0,20-0,50 | ○ | ● | ● | ● | ● | ● | — | ● | ● | ○ | ○ | ● | 21 |

### Standardbohrer mit Spanbrecher Standard drill with chip breaker

|                                                                                                |           |   |   |   |   |   |   |   |   |   |   |   |   |    |
|------------------------------------------------------------------------------------------------|-----------|---|---|---|---|---|---|---|---|---|---|---|---|----|
| <b>532</b>  | 3,20-6,35 | ● | ● | ● | ● | ● | ● | — | ○ | ○ | ○ | ● | ○ | 22 |
|------------------------------------------------------------------------------------------------|-----------|---|---|---|---|---|---|---|---|---|---|---|---|----|



| Ø<br>[mm] | DS - ML 4 layers | ML ≥ 6 layers | ML ≥ 70 µm copper | Filled / HTg | Backpanels | (Rigid) Flex | IC-Substrate ABFM | Polyimides (PI) | Teflon (PTFE) | Metal core ML | Copper / Brass (Cu / CuZn) | Plexiglas (PMMA) | Seite<br>Page |
|-----------|------------------|---------------|-------------------|--------------|------------|--------------|-------------------|-----------------|---------------|---------------|----------------------------|------------------|---------------|
|-----------|------------------|---------------|-------------------|--------------|------------|--------------|-------------------|-----------------|---------------|---------------|----------------------------|------------------|---------------|

Microvia-Bohrer Microvia drill

|            |                                                                                   |             |   |   |   |   |   |   |   |   |   |   |   |    |
|------------|-----------------------------------------------------------------------------------|-------------|---|---|---|---|---|---|---|---|---|---|---|----|
| <b>596</b> |  | 0,12 - 0,60 | ● | ● | ● | ● | ● | ● | ○ | ○ | ○ | ○ | ○ | 24 |
|------------|-----------------------------------------------------------------------------------|-------------|---|---|---|---|---|---|---|---|---|---|---|----|

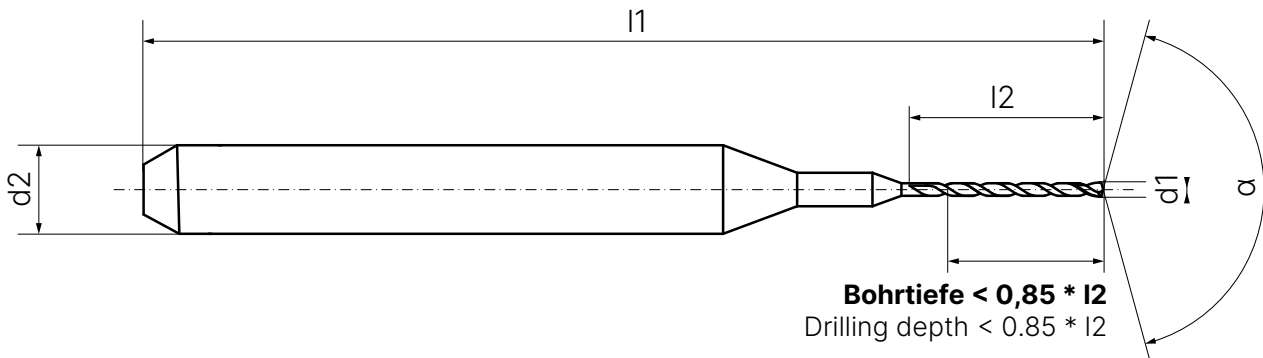
PKD-Bohrer PCD drill

|            |                                                                                   |              |   |   |   |   |   |   |   |   |   |   |   |   |    |
|------------|-----------------------------------------------------------------------------------|--------------|---|---|---|---|---|---|---|---|---|---|---|---|----|
| <b>298</b> |  | 3,50 - 12,50 | ● | ● | ● | ● | ● | ○ | ○ | ○ | ○ | ● | ● | ○ | 25 |
|------------|-----------------------------------------------------------------------------------|--------------|---|---|---|---|---|---|---|---|---|---|---|---|----|

● optimal optimum    ○ geeignet suitable    — nicht empfehlenswert not recommendable    ⚠ Letzte Chance last chance

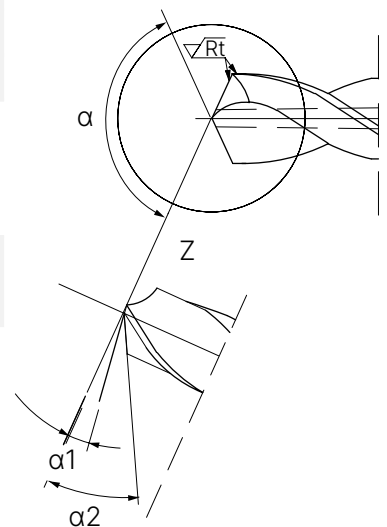
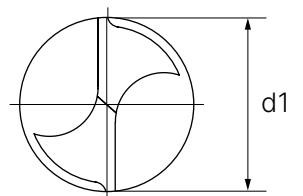
# SPEZIFIKATIONEN BOHRER

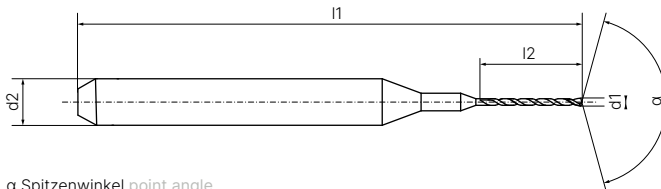
## SPECIFICATIONS DRILLS



|                                                                                | 0,05 < d <sub>1</sub> < d <sub>2</sub> | d <sub>1</sub> > d <sub>2</sub> |
|--------------------------------------------------------------------------------|----------------------------------------|---------------------------------|
| <b>Gesamtlänge l<sub>1</sub></b> Total length l <sub>1</sub>                   | 38,2 - 0,2                             | 38,2 - 0,3                      |
| <b>Spirallänge l<sub>2</sub></b> Flute length l <sub>2</sub>                   |                                        |                                 |
| l <sub>2</sub> ≤ 2                                                             | +0,2 / -0,1                            |                                 |
| 2 < l <sub>2</sub> < 10                                                        | +0,4 / -0,2                            | +0,5 / -0,3                     |
| l <sub>2</sub> ≥ 10                                                            | +0,4 / -0,2                            |                                 |
| <b>Schneidenrauhtiefe R<sub>t</sub></b> Roughness R <sub>t</sub>               | < 0,003                                | < 0,005                         |
| <b>Schaftdurchmesser d<sub>2</sub></b> Shank diameter d <sub>2</sub>           | -0,001 / -0,007                        | -0,001 / -0,01                  |
| <b>Nenn Durchmesser d<sub>1</sub></b> Nominal diameter d <sub>1</sub>          |                                        |                                 |
| 0,05 ≤ 0,25                                                                    | +0,000 / +0,008                        |                                 |
| 0,26 ≤ 1,65                                                                    | +0,000 / -0,008                        |                                 |
| 1,66 - 3,175                                                                   | +0,000 / -0,012                        |                                 |
| ≥ 3,20                                                                         | +0,000 / -0,015                        |                                 |
| <b>Spitzenwinkel α</b> Point angle α                                           |                                        |                                 |
| 0,05 > d <sub>1</sub> ≤ 0,12                                                   | 130° - 5°                              |                                 |
| 0,13 ≥ d <sub>1</sub> ≤ 0,20                                                   | 120° - 5°                              |                                 |
| 0,21 ≥ d <sub>1</sub> ≤ 3,175                                                  | 130° - 5°                              |                                 |
| d <sub>1</sub> > 3,175                                                         | 165° - 5°                              |                                 |
| Typ 250                                                                        | 150° - 5°                              |                                 |
| <b>Primärer Freiwinkel α<sub>1</sub></b> Primary face angle α <sub>1</sub>     |                                        |                                 |
| d <sub>1</sub> 0,05 - 0,20                                                     | 10° - 3°                               |                                 |
| 0,21 - 6,50                                                                    | 15° - 5°                               |                                 |
| <b>Sekundärer Freiwinkel α<sub>2</sub></b> Secondary face angle α <sub>2</sub> |                                        |                                 |
| d <sub>1</sub> 0,05 - 6,50                                                     | 30° - 5°                               |                                 |

Angaben in [mm] data in [mm]





α Spitzenwinkel point angle

**l1**  
**38,1**
**d2**  
**3,175**
**α**  
**120/130°**


|              |                |              |              |
|--------------|----------------|--------------|--------------|
| ● DS-ML 4    | ● ML ≥ 6       | ● ML ≥ 70 μm | ○ Filled/HTg |
| ● Backpanels | ○ (Rigid) Flex | — IC-Substr. | ● PI         |
| ● PTFE       | ○ Mc ML        | ○ Cu/CuZn    | ● PMMA       |

| d <sub>1</sub> | l <sub>2</sub> | 212          |
|----------------|----------------|--------------|
| 0,200          | 3,5            | *            |
| 0,250          | 4,0            | 82120250040X |
| 0,300          | 5,5            | 82120300055X |
| 0,300          | 6,5            | *            |
| 0,350          | 5,5            | 82120350055X |
| 0,350          | 7,0            | 82120350070X |
| 0,400          | 5,5            | *            |
| 0,400          | 7,0            | *            |
| 0,400          | 8,5            | *            |

| d <sub>1</sub> | l <sub>2</sub> | 212          |
|----------------|----------------|--------------|
| 0,450          | 7,0            | 82120450070X |
| 0,450          | 8,5            | *            |
| 0,500          | 5,5            | 82120550055X |
| 0,500          | 7,0            | *            |
| 0,500          | 8,5            | *            |
| 0,550          | 8,5            | *            |
| 0,600          | 8,5            | *            |
| 0,635          | 8,5            | 82120635085X |

\* Artikel auf Anfrage article on request

### Anwendungen & Vorteile

Applications &amp; advantages

- › **Bohren von hochlagigen Multilayern**  
Drilling of high layer multilayers
- › **Verbesserung der Lochqualität**  
Improvement of the hole quality

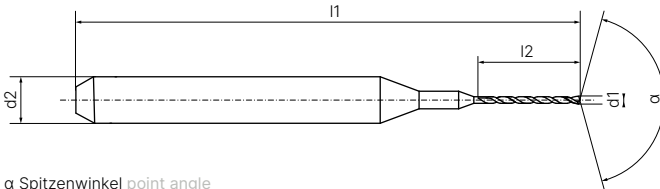
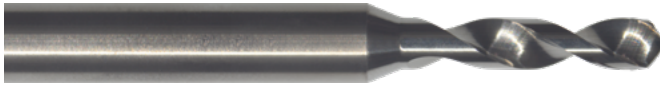
**Auslaufartikel nur noch 2026 erhältlich**  
 Discontinued article only available in 2026

- › **Alternative Typ 242**  
Alternative type 242



# 230

## Multilayerbohrer Multilayer drill



$\alpha$  Spitzwinkel point angle

$l_1$   
38,1

$d_2$   
3,175

$\alpha$   
130°



|              |                |                            |              |
|--------------|----------------|----------------------------|--------------|
| ● DS-ML 4    | ● ML $\geq 6$  | ● ML $\geq 70 \mu\text{m}$ | ● Filled/HTg |
| ● Backpanels | ○ (Rigid) Flex | ○ IC-Substr.               | ● PI         |
| ● PTFE       | ○ Mc ML        | ○ Cu/CuZn                  | ● PMMA       |

| $d_1$ | $l_2$ | 230          |
|-------|-------|--------------|
| 0,200 | 3,2   | 82300200032X |
| 0,250 | 4,0   | 82300250040X |
| 0,300 | 5,5   | 82300300055X |
| 0,350 | 7,0   | 82300350070X |
| 0,400 | 7,0   | 82300400055X |
| 0,450 | 7,0   | 82300450070X |
| 0,500 | 8,5   | 82300500085X |
| 0,550 | 8,5   | 82300550085X |
| 0,600 | 8,5   | 82300600085X |
| 0,650 | 8,5   | 82300650085X |
| 0,700 | 10,0  | 82300700100X |
| 0,750 | 10,0  | 82300750100X |
| 0,800 | 10,0  | 82300800100X |
| 0,850 | 10,0  | 82300850100X |
| 0,900 | 10,0  | 82300900100X |

| $d_1$ | $l_2$ | 230          |
|-------|-------|--------------|
| 0,950 | 10,0  | 82300950100X |
| 1,000 | 10,0  | 82301000100X |
| 1,050 | 10,0  | 82301050100X |
| 1,100 | 10,0  | 82301100100X |
| 1,150 | 10,0  | 82301150100X |
| 1,200 | 10,0  | 82301200100X |
| 1,250 | 10,0  | 82301250100X |
| 1,300 | 10,0  | 82301300100X |
| 1,350 | 10,0  | 82301350100X |
| 1,400 | 10,0  | 82301400100X |
| 1,450 | 10,0  | 82301450100X |
| 1,500 | 10,0  | 82301500100X |
| 1,550 | 10,0  | 82301550100X |
| 1,600 | 10,0  | 82301600100X |
| 1,650 | 10,0  | 82301650100X |

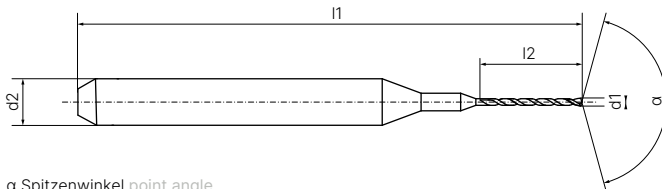
### Anwendungen & Vorteile

Applications & advantages

- › **Bohren von anspruchsvollen Multilayern**  
Drilling of high-quality multilayer boards
- › **Sehr gute Lochqualität bei geringem Bohrer-  
verlauf durch optimierte Geometrie** Excel-  
lent hole quality by less drill deflection due to  
optimised geometry

# 230

## Multilayerbohrer Multilayer drill



$\alpha$  Spitzenwinkel point angle

$l_1$   
38,1

$d_2$   
3,175

$\alpha$   
130°



|              |                |                            |              |
|--------------|----------------|----------------------------|--------------|
| ● DS-ML 4    | ● ML $\geq 6$  | ● ML $\geq 70 \mu\text{m}$ | ● Filled/HTg |
| ● Backpanels | ○ (Rigid) Flex | ○ IC-Substr.               | ● PI         |
| ● PTFE       | ○ Mc ML        | ○ Cu/CuZn                  | ● PMMA       |

| $d_1$ | $l_2$ | 230          |
|-------|-------|--------------|
| 1,700 | 10,0  | 82301700100X |
| 1,750 | 10,0  | 82301750100X |
| 1,800 | 10,0  | 82301800100X |
| 1,850 | 10,0  | 82301850100X |
| 1,900 | 10,0  | 82301900100X |
| 1,950 | 10,0  | 82301950100X |
| 2,000 | 10,0  | 82302000100X |
| 2,050 | 10,0  | *            |
| 2,100 | 10,0  | *            |
| 2,150 | 10,0  | *            |
| 2,200 | 10,0  | *            |
| 2,250 | 10,0  | *            |
| 2,300 | 10,0  | *            |
| 2,350 | 10,0  | *            |

| $d_1$ | $l_2$ | 230 |
|-------|-------|-----|
| 2,400 | 10,0  | *   |
| 2,450 | 10,0  | *   |
| 2,500 | 10,0  | *   |
| 2,550 | 10,0  | *   |
| 2,600 | 10,0  | *   |
| 2,650 | 10,0  | *   |
| 2,700 | 10,0  | *   |
| 2,750 | 10,0  | *   |
| 2,800 | 10,0  | *   |
| 2,850 | 10,0  | *   |
| 2,900 | 10,0  | *   |
| 2,950 | 10,0  | *   |
| 3,000 | 10,0  | *   |

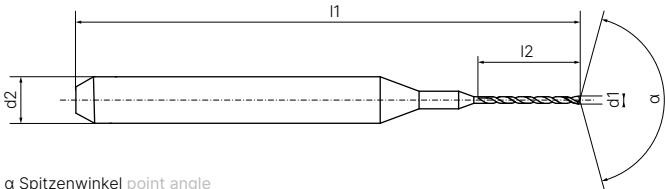
\* Artikel auf Anfrage article on request

### Anwendungen & Vorteile

Applications & advantages

- › **Bohren von anspruchsvollen Multilayern**  
Drilling of high-quality multilayer boards
- › **Sehr gute Lochqualität bei geringem Bohrer-  
verlauf durch optimierte Geometrie** Excel-  
lent hole quality by less drill deflection due to  
optimised geometry

\* Artikel auf Anfrage article on request



$\alpha$  Spitzenwinkel point angle

|                   |                    |                                        |  |
|-------------------|--------------------|----------------------------------------|--|
| <b>l1</b><br>38,1 | <b>d2</b><br>3,175 | <b><math>\alpha</math></b><br>120/130° |  |
|-------------------|--------------------|----------------------------------------|--|

|              |                |                            |              |
|--------------|----------------|----------------------------|--------------|
| ● DS-ML 4    | ● ML $\geq 6$  | ● ML $\geq 70 \mu\text{m}$ | ● Filled/HTg |
| ● Backpanels | ○ (Rigid) Flex | — IC-Substr.               | ● PI         |
| ● PTFE       | ○ Mc ML        | ○ Cu/CuZn                  | ○ PMMA       |

| d <sub>1</sub> | l <sub>2</sub> | 242          |
|----------------|----------------|--------------|
| 0,200          | 3,5            | 82420200035X |
| 0,200          | 4,0            | 82420200040X |
| 0,250          | 4,0            | 82420250040X |
| 0,250          | 4,5            | 82420250045X |
| 0,300          | 5,5            | 82420300055X |
| 0,300          | 6,5            | *            |
| 0,350          | 5,5            | 82420350055X |
| 0,350          | 6,5            | 82420350065X |
| 0,350          | 7,0            | 82420350070X |

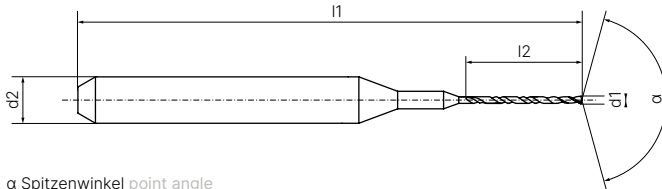
| d <sub>1</sub> | l <sub>2</sub> | 242          |
|----------------|----------------|--------------|
| 0,400          | 7,0            | 82420400070X |
| 0,450          | 7,0            | 82420450070X |
| 0,450          | 8,5            | *            |
| 0,500          | 7,0            | 82420500070X |
| 0,500          | 8,5            | *            |
| 0,550          | 7,0            | 82420550070X |
| 0,550          | 8,5            | *            |
| 0,600          | 8,5            | 82420600085X |
| 0,650          | 8,5            | 82420650085X |

\* Artikel auf Anfrage article on request

### Anwendungen & Vorteile

Applications & advantages

- › **Maximale Stabilität** Maximum stability
- › **Verbesserter Bohrerlauf** Improved drill deviation
- › **Geringere Bohrkosten durch mehrere Nachschleifzyklen** Lower drilling costs due to multiple regrinding cycles



α Spitzenwinkel point angle

l1  
38,1d2  
3,175α  
120/130°

|              |                |              |              |
|--------------|----------------|--------------|--------------|
| ● DS-ML 4    | ● ML ≥ 6       | ● ML ≥ 70 μm | ● Filled/HTg |
| ● Backpanels | ○ (Rigid) Flex | ● IC-Substr. | ● PI         |
| ● PTFE       | ○ Mc ML        | ○ Cu/CuZn    | ○ PMMA       |

| d <sub>1</sub> | l <sub>2</sub> | 271          |
|----------------|----------------|--------------|
| 0,075          | 1,2            | *            |
| 0,100          | 1,5            | 82710100015X |
| 0,105          | 1,8            | 82710105018X |
| 0,110          | 1,8            | *            |
| 0,120          | 2,0            | 82710120020X |
| 0,120          | 2,2            | *            |
| 0,150          | 2,5            | 82710150025X |
| 0,175          | 3,0            | 82710175030X |
| 0,200          | 3,5            | 82710200035X |
| 0,200          | 4,0            | 82710200040X |
| 0,200          | 4,5            | *            |
| 0,250          | 4,5            | 82710250045X |
| 0,250          | 5,0            | 82710250050X |
| 0,300          | 5,5            | 82710300055X |

| d <sub>1</sub> | l <sub>2</sub> | 271          |
|----------------|----------------|--------------|
| 0,300          | 6,5            | *            |
| 0,350          | 5,5            | 82710350055X |
| 0,350          | 6,5            | 82710350065X |
| 0,350          | 7,2            | 82710350072X |
| 0,400          | 5,5            | 82710400055X |
| 0,400          | 7,0            | 82710400070X |
| 0,450          | 7,0            | 82710450070X |
| 0,450          | 8,5            | *            |
| 0,500          | 7,0            | 82710500070X |
| 0,500          | 8,5            | 82710500085X |
| 0,550          | 7,0            | 82710550070X |
| 0,550          | 8,5            | 82710550085X |
| 0,600          | 8,5            | 82710600085X |
| 0,650          | 8,5            | 82710650085X |

\* Artikel auf Anfrage article on request

**Anwendungen & Vorteile**

Applications &amp; advantages

- › **2 in 1 Schneider** 2 in 1 flute
- › **Reduzierter Bohrerbruch** Reduced drill breakage
- › **Verbesserter Bohrerlauf** Improved drill deviation
- › **Höchste Bohrlochqualität** Highest drill hole quality
- › **Geringere Bohrkosten durch mehrere Nachschleifzyklen** Lower drilling costs due to multiple regrinding cycles

**Weitere Varianten**

Other variants

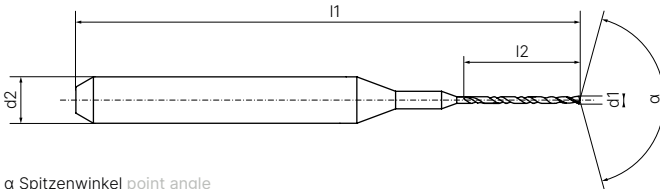
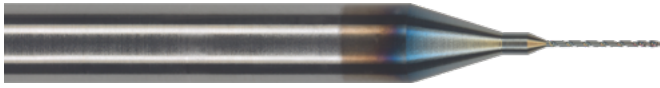
| 272                                                                                 |                                                | Page |
|-------------------------------------------------------------------------------------|------------------------------------------------|------|
|  | <b>Beschichtete Variante</b><br>Coated version | 12   |



# 272

## Multilayerbohrer, beschichtet

Multilayer drill, beschichtet



$\alpha$  Spitzenwinkel point angle

l1 38,1  
d2 3,175

$\alpha$   
120/130°



|              |                |                            |              |
|--------------|----------------|----------------------------|--------------|
| ● DS-ML 4    | ● ML $\geq 6$  | ● ML $\geq 70 \mu\text{m}$ | ● Filled/HTg |
| ● Backpanels | ○ (Rigid) Flex | ● IC-Substr.               | ● PI         |
| ● PTFE       | ○ Mc ML        | ○ Cu/CuZn                  | ○ PMMA       |

| d <sub>1</sub> | l <sub>2</sub> | 272          |
|----------------|----------------|--------------|
| 0,050          | 0,9            | *            |
| 0,075          | 1,2            | 82720075012X |
| 0,105          | 1,8            | *            |
| 0,120          | 1,8            | *            |
| 0,120          | 2,0            | *            |
| 0,150          | 2,5            | *            |

| d <sub>1</sub> | l <sub>2</sub> | 272 |
|----------------|----------------|-----|
| 0,200          | 4,0            | *   |
| 0,250          | 4,5            | *   |
| 0,300          | 5,5            | *   |
| 0,350          | 5,5            | *   |
| 0,400          | 7,0            | *   |
| 0,450          | 7,0            | *   |

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### Anwendungen & Vorteile

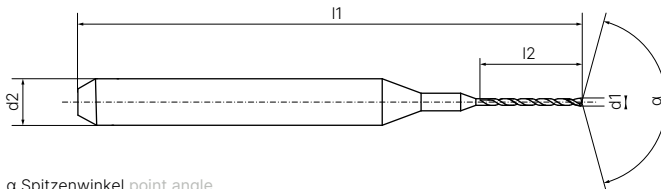
Applications & advantages

- › **2 in 1 Schneider** 2 in 1 flute
- › **Reduzierter Bohrerbruch** Reduced drill breakage
- › **Verbesserter Bohrerlauf** Improved drill deviation
- › **Höchste Bohrlochqualität** Highest drill hole quality
- › **Geringere Bohrkosten durch mehrere Nachschleifzyklen** Lower drilling costs due to multiple regrinding cycles

### Weitere Varianten

Other variants

| 271                                                                                 |                                                    | Page |
|-------------------------------------------------------------------------------------|----------------------------------------------------|------|
|  | <b>Unbeschichtete Variante</b><br>Uncoated version | 11   |



$\alpha$  Spitzenwinkel point angle

**l1**  
38,1

**d2**  
3,175

**$\alpha$**   
120/130°

|              |                |                            |              |
|--------------|----------------|----------------------------|--------------|
| ● DS-ML 4    | ● ML $\geq 6$  | ● ML $\geq 70 \mu\text{m}$ | ○ Filled/HTg |
| ● Backpanels | ● (Rigid) Flex | — IC-Substr.               | ● PI         |
| ● PTFE       | ● Mc ML        | ● Cu/CuZn                  | ● PMMA       |

| <b>d<sub>1</sub></b> | <b>l<sub>2</sub></b> | <b>540</b>    |
|----------------------|----------------------|---------------|
| 0,200                | 3,2                  | 854000200032X |
| 0,200                | 4,0                  | *             |
| 0,250                | 3,2                  | *             |
| 0,250                | 4,0                  | *             |
| 0,300                | 5,5                  | *             |
| 0,350                | 5,5                  | *             |
| 0,350                | 7,0                  | *             |
| 0,400                | 5,5                  | *             |
| 0,400                | 7,0                  | *             |
| 0,450                | 7,0                  | *             |
| 0,500                | 7,0                  | *             |
| 0,550                | 7,0                  | *             |
| 0,550                | 8,5                  | *             |
| 0,600                | 7,0                  | *             |
| 0,600                | 8,5                  | *             |
| 0,650                | 7,0                  | *             |
| 0,650                | 8,5                  | *             |

| <b>d<sub>1</sub></b> | <b>l<sub>2</sub></b> | <b>540</b> |
|----------------------|----------------------|------------|
| 0,700                | 8,5                  | *          |
| 0,700                | 8,5                  | *          |
| 0,750                | 8,5                  | *          |
| 0,750                | 10,5                 | *          |
| 0,800                | 8,5                  | *          |
| 0,800                | 10,5                 | *          |
| 0,850                | 8,5                  | *          |
| 0,850                | 10,5                 | *          |
| 0,900                | 8,5                  | *          |
| 0,900                | 10,5                 | *          |
| 0,950                | 8,5                  | *          |
| 0,950                | 10,5                 | *          |
| 1,000                | 10,5                 | *          |
| 1,050                | 10,5                 | *          |
| 1,100                | 10,5                 | *          |
| 1,150                | 10,5                 | *          |

\* Artikel auf Anfrage article on request

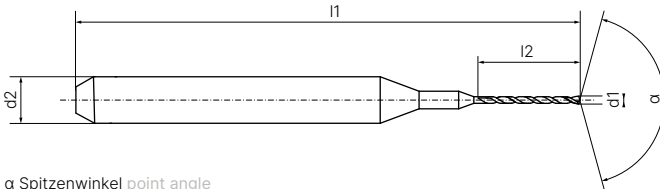
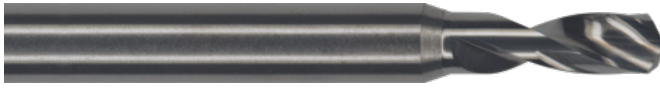
### Anwendungen & Vorteile

Applications & advantages

- › **Bohren von hochlagigen / dicken Multilayern**  
Drilling of high layer / thick multilayers
- › **Bohren von Dickkupfer** Drilling of thick copper
- › **Verbesserung der Lochqualität** Improvement of the hole quality

# 250

Langlochbohrer  
Slot drill



$\alpha$  Spitzenwinkel point angle

l1  
38,1

d2  
3,175

$\alpha$   
150°

|              |                |              |              |
|--------------|----------------|--------------|--------------|
| ● DS-ML 4    | ● ML ≥ 6       | ○ ML ≥ 70 µm | ● Filled/HTg |
| ○ Backpanels | ○ (Rigid) Flex | — IC-Substr. | ○ PI         |
| ○ PTFE       | ○ Mc ML        | ○ Cu/CuZn    | ○ PMMA       |

| d <sub>1</sub> | l <sub>2</sub> | 250          |
|----------------|----------------|--------------|
| 0,300          | 1,8            | *            |
| 0,350          | 4,0            | *            |
| 0,400          | 5,5            | *            |
| 0,450          | 5,0            | *            |
| 0,500          | 5,5            | 82500500055X |
| 0,500          | 7,0            | 82500500070X |
| 0,550          | 5,5            | 82500550055X |
| 0,550          | 7,0            | 82500550070X |
| 0,600          | 5,5            | 82500600055X |
| 0,600          | 7,0            | 82500600070X |
| 0,650          | 5,5            | 82500650055X |
| 0,650          | 7,0            | 82500650070X |
| 0,700          | 5,5            | *            |
| 0,700          | 7,0            | 82500700070X |
| 0,700          | 8,5            | 82500700085X |
| 0,750          | 5,5            | *            |
| 0,750          | 7,0            | 82500750070X |
| 0,750          | 8,5            | 82500750085X |

| d <sub>1</sub> | l <sub>2</sub> | 250          |
|----------------|----------------|--------------|
| 0,800          | 5,5            | *            |
| 0,800          | 7,0            | 82500800070X |
| 0,800          | 8,5            | 82500800085X |
| 0,850          | 5,5            | *            |
| 0,850          | 7,0            | 82500850070X |
| 0,850          | 8,5            | 82500850085X |
| 0,900          | 5,5            | *            |
| 0,900          | 7,0            | 82500900070X |
| 0,900          | 8,5            | 82500900085X |
| 0,950          | 5,5            | *            |
| 0,950          | 7,0            | 82500950070X |
| 0,950          | 8,5            | 82500950085X |
| 1,000          | 8,5            | 82501000085X |
| 1,050          | 8,5            | 82501050085X |
| 1,100          | 8,5            | 82501100085X |
| 1,150          | 8,5            | 82501150085X |
| 1,200          | 8,5            | 82501200085X |
| 1,250          | 8,5            | 82501250085X |

\* Artikel auf Anfrage article on request

Weitere Durchmesser und Spirallängen auf Anfrage other diameters and flute length on request

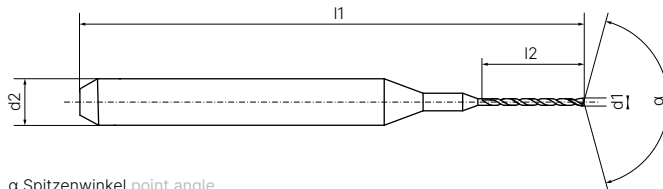
## Anwendungen & Vorteile

Applications & advantages

- › **Bohren (Nippeln) von Langlöchern und Schlitzn** Drilling of slotted holes and slots
- › **Reduzierung Verlauf** Reduction of deviation

# 250

**Langlochbohrer**  
Slot drill



$\alpha$  Spitzenwinkel point angle

**l1**  
38,1

**d2**  
3,175

**$\alpha$**   
150°

|              |                |                            |              |
|--------------|----------------|----------------------------|--------------|
| ● DS-ML 4    | ● ML $\geq 6$  | ○ ML $\geq 70 \mu\text{m}$ | ● Filled/HTg |
| ○ Backpanels | ○ (Rigid) Flex | — IC-Substr.               | ○ PI         |
| ○ PTFE       | ○ Mc ML        | ○ Cu/CuZn                  | ○ PMMA       |

| d <sub>1</sub> | l <sub>2</sub> | 250          |
|----------------|----------------|--------------|
| 1,300          | 8,5            | 82501300085X |
| 1,350          | 8,5            | 82501350085X |
| 1,400          | 8,5            | 82501400085X |
| 1,450          | 8,5            | 82501450085X |
| 1,500          | 8,5            | 82501500085X |
| 1,550          | 8,5            | 82501550085X |
| 1,600          | 8,5            | 82501600085X |
| 1,650          | 8,5            | 82501650085X |
| 1,700          | 8,5            | 82501700085X |
| 1,750          | 8,5            | 82501750085X |
| 1,800          | 8,5            | 82501800085X |
| 1,850          | 8,5            | 82501850085X |
| 1,900          | 8,5            | 82501900085X |
| 1,950          | 8,5            | 82501950085X |
| 2,000          | 8,5            | 82502000085X |
| 2,050          | 8,5            | 82502050085X |
| 2,100          | 8,5            | 82502100085X |
| 2,150          | 8,5            | 82502150085X |

| d <sub>1</sub> | l <sub>2</sub> | 250          |
|----------------|----------------|--------------|
| 2,200          | 8,5            | 82502200085X |
| 2,250          | 8,5            | 82502250085X |
| 2,300          | 8,5            | 82502300085X |
| 2,350          | 8,5            | 82502350085X |
| 2,400          | 8,5            | 82502400085X |
| 2,450          | 8,5            | 82502450085X |
| 2,500          | 8,5            | 82502500085X |
| 2,550          | 8,5            | *            |
| 2,600          | 8,5            | *            |
| 2,650          | 8,5            | *            |
| 2,700          | 8,5            | *            |
| 2,750          | 8,5            | *            |
| 2,800          | 8,5            | *            |
| 2,850          | 8,5            | *            |
| 2,900          | 8,5            | *            |
| 2,950          | 8,5            | *            |
| 3,000          | 8,5            | *            |

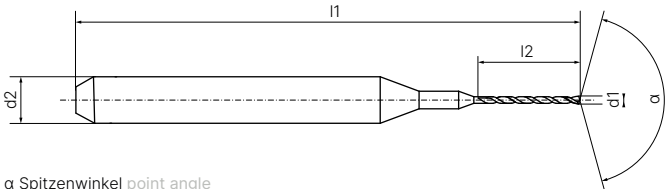
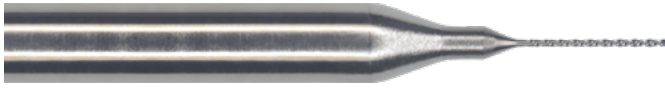
\* Artikel auf Anfrage [article on request](#)

Weitere Durchmesser und Spirallängen auf Anfrage [other diameters and flute length on request](#)

## Anwendungen & Vorteile

Applications & advantages

- › **Bohren (Nippeln) von Langlöchern und Schlitten** Drilling of slotted holes and slots
- › **Reduzierung Verlauf** Reduction of deviation


 $\alpha$  Spitzenwinkel point angle

**l1**  
38,1

**d2**  
3,175

 **$\alpha$**   
120/130°

|              |                |                            |              |
|--------------|----------------|----------------------------|--------------|
| – DS-ML 4    | – ML $\geq 6$  | – ML $\geq 70 \mu\text{m}$ | – Filled/HTg |
| – Backpanels | ● (Rigid) Flex | – IC-Substr.               | ● PI         |
| ○ PTFE       | – Mc ML        | – Cu/CuZn                  | – PMMA       |

| <b>d<sub>1</sub></b> | <b>l<sub>2</sub></b> | <b>512</b>   |
|----------------------|----------------------|--------------|
| 0,150                | 2,5                  | *            |
| 0,200                | 3,5                  | 85120200035X |
| 0,250                | 3,5                  | 85120250035X |
| 0,300                | 5,5                  | 85120300055X |

| <b>d<sub>1</sub></b> | <b>l<sub>2</sub></b> | <b>512</b> |
|----------------------|----------------------|------------|
| 0,350                | 5,5                  | *          |
| 0,400                | 5,5                  | *          |
| 0,450                | 7,0                  | *          |
| 0,500                | 7,0                  | *          |

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Weitere Durchmesser und Spirallängen auf Anfrage [other diameters and flute length on request](#)

## Anwendungen & Vorteile

Applications & advantages

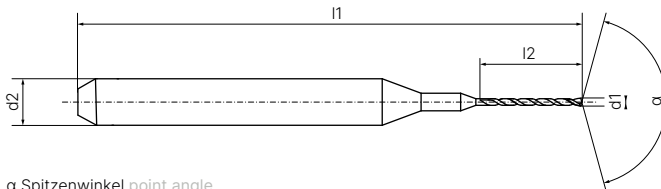
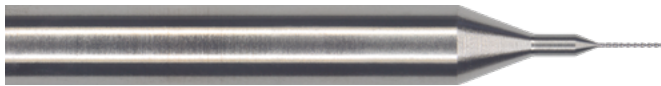
- › **Hoch produktive Bearbeitung von flexiblen und starr-flexiblen Multilayern** Highly productive processing of flexible and rigid-flexible multilayers
- › **Optimale Bohrlochqualität** Optimum hole quality
- › **Reduzierung von Nagelkopfbildung und Grat** Reduction of nail head formation and burrs

## Auslaufartikel nur noch 2026 erhältlich

Discontinued article only available in 2026

- › **Alternative Typ 540 / 530**  
Alternative type 540 / 530





$\alpha$  Spitzenwinkel point angle

**l1**  
**38,1**

**d2**  
**3,175**

**$\alpha$**   
**130°**

|              |                |                            |              |
|--------------|----------------|----------------------------|--------------|
| ● DS-ML 4    | ● ML $\geq 6$  | ● ML $\geq 70 \mu\text{m}$ | ● Filled/HTg |
| ● Backpanels | ● (Rigid) Flex | — IC-Substr.               | ● PI         |
| ● PTFE       | ● Mc ML        | ● Cu/CuZn                  | ● PMMA       |

| d <sub>1</sub> | l <sub>2</sub> | 519          |
|----------------|----------------|--------------|
| 0,050          | 0,6            | 85190050006X |
| 0,075          | 1,0            | 85190075010X |
| 0,100          | 1,5            | 85190100015X |
| 0,105          | 1,8            | *            |

| d <sub>1</sub> | l <sub>2</sub> | 519          |
|----------------|----------------|--------------|
| 0,110          | 1,8            | *            |
| 0,120          | 2,0            | *            |
| 0,150          | 2,5            | 85190150025X |

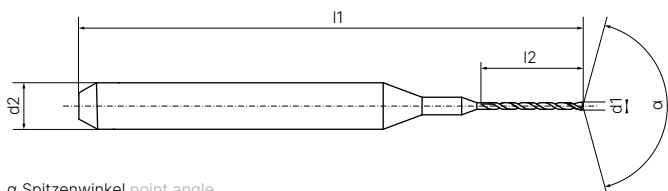
\* Artikel auf Anfrage article on request

Weitere Durchmesser und Spirallängen auf Anfrage other diameters and flute length on request

## Anwendungen & Vorteile

Applications & advantages

- › **Optimal für hochdrehende Spindeln**  
Optimal for high-speed spindles
- › **BGA / HDI** BGA / HDI
- › **Höchste Stabilität und Bohrgenauigkeit**  
Maximum stability and drilling accuracy
- › **Stabilerer Werkzeugkern, optimierte Hartmetallspezifikation und verbesserter Schleifprozess ermöglichen höhere Bruchstabilität** More stable tool core, optimized carbide specification and improved grinding process enable higher breaking stability



$\alpha$  Spitzwinkel point angle

**l1**  
38,1

**d2**  
3,175

**$\alpha$**   
130/165°

|              |                |                            |              |
|--------------|----------------|----------------------------|--------------|
| ● DS-ML 4    | ● ML $\geq 6$  | ○ ML $\geq 70 \mu\text{m}$ | ○ Filled/HTg |
| ● Backpanels | ● (Rigid) Flex | ● IC-Substr.               | ● PI         |
| ● PTFE       | ○ Mc ML        | — Cu/CuZn                  | — PMMA       |

| d <sub>1</sub> | l <sub>2</sub> | 530          |
|----------------|----------------|--------------|
| 0,200          | 2,5            | *            |
| 0,250          | 2,5            | *            |
| 0,300          | 3,5            | 85300300035X |
| 0,300          | 5,5            | 85300300055X |
| 0,350          | 3,5            | 85300350035X |
| 0,350          | 5,5            | 85300350055X |
| 0,350          | 7,0            | 85300350070X |
| 0,400          | 3,5            | 85300400035X |
| 0,400          | 5,5            | 85300400055X |
| 0,400          | 7,0            | 85300400070X |
| 0,450          | 3,5            | 85300450035X |
| 0,450          | 7,0            | 85300450070X |
| 0,500          | 3,5            | 85300500035X |
| 0,500          | 7,0            | 85300500070X |
| 0,500          | 8,5            | 85300500085X |
| 0,550          | 7,0            | 85300550070X |
| 0,550          | 8,5            | 85300550085X |
| 0,600          | 7,0            | 85300600070X |
| 0,600          | 8,5            | 85300600085X |
| 0,650          | 7,0            | *            |
| 0,650          | 8,5            | 85300650085X |
| 0,700          | 10,5           | 85300700105X |
| 0,750          | 10,5           | 85300750105X |
| 0,800          | 10,5           | 85300800105X |
| 0,850          | 10,5           | 85300850105X |
| 0,900          | 10,5           | 85300900105X |
| 0,950          | 10,5           | 85300950105X |
| 1,000          | 10,5           | 85301000105X |

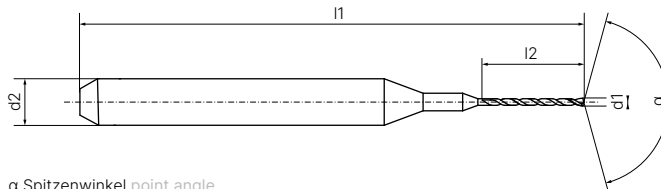
| d <sub>1</sub> | l <sub>2</sub> | 530          |
|----------------|----------------|--------------|
| 1,050          | 10,5           | 85301050105X |
| 1,100          | 10,5           | 85301100105X |
| 1,150          | 10,5           | 85301150105X |
| 1,200          | 10,5           | 85301200105X |
| 1,250          | 10,5           | 85301250105X |
| 1,300          | 10,5           | 85301300105X |
| 1,350          | 10,5           | 85301350105X |
| 1,400          | 10,5           | 85301400105X |
| 1,450          | 10,5           | 85301450105X |
| 1,500          | 10,5           | 85301500105X |
| 1,550          | 10,5           | 85301550105X |
| 1,600          | 10,5           | 85301600105X |
| 1,650          | 10,5           | 85301650105X |
| 1,700          | 10,5           | 85301700105X |
| 1,750          | 10,5           | 85301750105X |
| 1,800          | 10,5           | 85301800105X |
| 1,850          | 10,5           | 85301850105X |
| 1,900          | 10,5           | 85301900105X |
| 1,950          | 10,5           | 85301950105X |
| 2,000          | 10,5           | 85302000105X |
| 2,050          | 10,5           | 85302050105X |
| 2,100          | 10,5           | 85302100105X |

\* Artikel auf Anfrage article on request

### Anwendungen & Vorteile

Applications & advantages

- **Für alle Standardprodukte** For all standard products
- **Für Sacklochbohrungen (mit kurzer Spirallänge)** For blind holes (with short flute length)



$\alpha$  Spitzenwinkel point angle

**l1**  
38,1

**d2**  
3,175

**$\alpha$**   
130/165°

|              |                |                            |              |
|--------------|----------------|----------------------------|--------------|
| ● DS-ML 4    | ● ML $\geq 6$  | ○ ML $\geq 70 \mu\text{m}$ | ○ Filled/HTg |
| ● Backpanels | ● (Rigid) Flex | ● IC-Substr.               | ● PI         |
| ● PTFE       | ○ Mc ML        | — Cu/CuZn                  | — PMMA       |

| d <sub>1</sub> | l <sub>2</sub> | 530          |
|----------------|----------------|--------------|
| 2,150          | 10,5           | 85302150105X |
| 2,200          | 10,5           | 85302200105X |
| 2,250          | 10,5           | 85302250105X |
| 2,300          | 10,5           | 85302300105X |
| 2,350          | 10,5           | 85302350105X |
| 2,400          | 10,5           | 85302400105X |
| 2,450          | 10,5           | 85302450105X |
| 2,500          | 10,5           | 85302500105X |
| 2,550          | 10,5           | 85302550105X |
| 2,600          | 10,5           | 85302600105X |
| 2,650          | 10,5           | 85302650105X |
| 2,700          | 10,5           | 85302700105X |
| 2,750          | 10,5           | 85302750105X |
| 2,800          | 10,5           | 85302800105X |
| 2,850          | 10,5           | 85302850105X |
| 2,900          | 10,5           | 85302900105X |
| 2,950          | 10,5           | 85302950105X |
| 3,000          | 10,5           | 85303000105X |
| 3,050          | 10,5           | 85303050105X |
| 3,100          | 10,5           | 85303100105X |
| 3,150          | 10,5           | 85303150105X |
| 3,175          | 10,5           | 85303175105X |
| 3,200          | 12,0           | 85303200120X |
| 3,250          | 12,0           | 85303250120X |
| 3,300          | 12,0           | 85303300120X |
| 3,350          | 12,0           | 85303350120X |
| 3,400          | 12,0           | 85303400120X |
| 3,450          | 12,0           | 85303450120X |

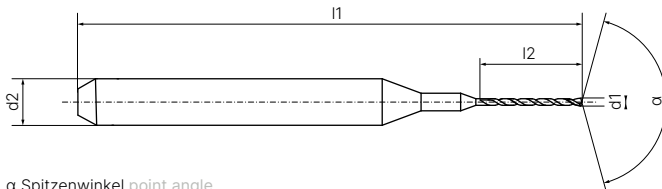
| d <sub>1</sub> | l <sub>2</sub> | 530          |
|----------------|----------------|--------------|
| 3,500          | 12,0           | 85303500120X |
| 3,550          | 12,0           | 85303550120X |
| 3,600          | 12,0           | 85303600120X |
| 3,650          | 12,0           | 85303650120X |
| 3,700          | 12,0           | 85303700120X |
| 3,750          | 12,0           | 85303750120X |
| 3,800          | 12,0           | 85303800120X |
| 3,850          | 12,0           | 85303850120X |
| 3,900          | 12,0           | 85303900120X |
| 3,950          | 12,0           | 85303950120X |
| 4,000          | 12,0           | 85304000120X |
| 4,050          | 12,0           | 85304050120X |
| 4,100          | 12,0           | 85304100120X |
| 4,150          | 12,0           | 85304150120X |
| 4,200          | 12,0           | 85304200120X |
| 4,250          | 12,0           | 85304250120X |
| 4,300          | 12,0           | 85304300120X |
| 4,350          | 12,0           | 85304350120X |
| 4,400          | 12,0           | 85304400120X |
| 4,450          | 12,0           | 85304450120X |
| 4,500          | 12,0           | 85304500120X |
| 4,550          | 12,0           | 85304550120X |

### Anwendungen & Vorteile

Applications & advantages

► **Für alle Standardprodukte** For all standard products

► **Für Sacklochbohrungen (mit kurzer Spirallänge)** For blind holes (with short flute length)



$\alpha$  Spitzwinkel point angle

|                   |                    |                                        |  |
|-------------------|--------------------|----------------------------------------|--|
| <b>l1</b><br>38,1 | <b>d2</b><br>3,175 | <b><math>\alpha</math></b><br>130/165° |  |
|-------------------|--------------------|----------------------------------------|--|

|              |                |                            |              |
|--------------|----------------|----------------------------|--------------|
| ● DS-ML 4    | ● ML $\geq 6$  | ○ ML $\geq 70 \mu\text{m}$ | ○ Filled/HTg |
| ● Backpanels | ● (Rigid) Flex | ● IC-Substr.               | ● PI         |
| ● PTFE       | ○ Mc ML        | — Cu/CuZn                  | — PMMA       |

| d <sub>1</sub> | l <sub>2</sub> | 530          |
|----------------|----------------|--------------|
| 4,600          | 12,0           | 85304600120X |
| 4,650          | 12,0           | 85304650120X |
| 4,700          | 12,0           | 85304700120X |
| 4,750          | 12,0           | 85304750120X |
| 4,800          | 12,0           | 85304800120X |
| 4,850          | 12,0           | 85304850120X |
| 4,900          | 12,0           | 85304900120X |
| 4,950          | 12,0           | 85304950120X |
| 5,000          | 12,0           | 85305000120X |
| 5,050          | 12,0           | 85305050120X |
| 5,100          | 12,0           | 85305100120X |
| 5,150          | 12,0           | 85305150120X |
| 5,200          | 12,0           | 85305200120X |
| 5,250          | 12,0           | 85305250120X |
| 5,300          | 12,0           | 85305300120X |
| 5,350          | 12,0           | 85305350120X |
| 5,400          | 12,0           | 85305400120X |
| 5,450          | 12,0           | 85305450120X |

| d <sub>1</sub> | l <sub>2</sub> | 530          |
|----------------|----------------|--------------|
| 5,500          | 12,0           | 85305500120X |
| 5,550          | 12,0           | 85305550120X |
| 5,600          | 12,0           | 85305600120X |
| 5,650          | 12,0           | 85305650120X |
| 5,700          | 12,0           | 85305700120X |
| 5,750          | 12,0           | 85305750120X |
| 5,800          | 12,0           | 85305800120X |
| 5,850          | 12,0           | 85305850120X |
| 5,900          | 12,0           | 85305900120X |
| 5,950          | 12,0           | 85305950120X |
| 6,000          | 12,0           | 85301000120X |
| 6,050          | 12,0           | 85301050120X |
| 6,100          | 12,0           | 85301100120X |
| 6,150          | 12,0           | 85301150120X |
| 6,200          | 12,0           | 85301200120X |
| 6,250          | 12,0           | 85301250120X |
| 6,300          | 12,0           | 85301300120X |
| 6,350          | 12,0           | 85306350120X |

### Anwendungen & Vorteile

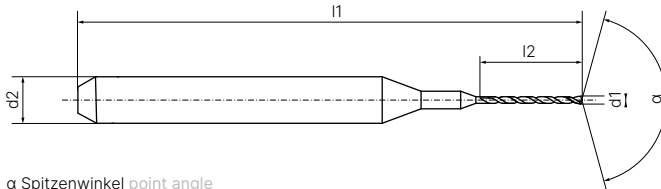
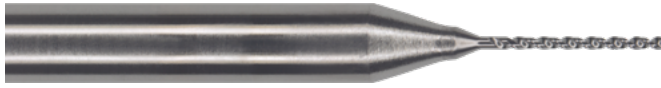
Applications & advantages

- › **Für alle Standardprodukte** For all standard products
- › **Für Sacklochbohrungen (mit kurzer Spirallänge)** For blind holes (with short flute length)

# 543



**Standardbohrer**  
Standard drill



$\alpha$  Spitzenwinkel point angle

**l1**  
38,1

**d2**  
3,175

**$\alpha$**   
120/130°

|                                             |                                               |                                                           |                                             |
|---------------------------------------------|-----------------------------------------------|-----------------------------------------------------------|---------------------------------------------|
| <input type="radio"/> DS-ML 4               | <input checked="" type="radio"/> ML $\geq 6$  | <input checked="" type="radio"/> ML $\geq 70 \mu\text{m}$ | <input checked="" type="radio"/> Filled/HTg |
| <input checked="" type="radio"/> Backpanels | <input checked="" type="radio"/> (Rigid) Flex | <input type="radio"/> IC-Substr.                          | <input checked="" type="radio"/> PI         |
| <input checked="" type="radio"/> PTFE       | <input type="radio"/> Mc ML                   | <input type="radio"/> Cu/CuZn                             | <input checked="" type="radio"/> PMMA       |

| $d_1$ | $l_2$ | 543          |
|-------|-------|--------------|
| 0,200 | 3,5   | *            |
| 0,250 | 4,5   | *            |
| 0,300 | 5,5   | *            |
| 0,350 | 6,5   | 85430350065X |

| $d_1$ | $l_2$ | 543 |
|-------|-------|-----|
| 0,400 | 7,0   | *   |
| 0,450 | 7,0   | *   |
| 0,500 | 7,0   | *   |

\* Artikel auf Anfrage article on request

## Anwendungen & Vorteile

Applications & advantages

- › **Geeignet für Hochfrequenzanwendungen**  
Suitable for high-frequency applications
- › **Verbesserung der Lochqualität** Improvement of the hole quality
- › **Reduzierung von Nagelkopfbildung und Grat**  
Reduction of nail head formation and burrs
- › **Geringere Bohrkosten durch mehrere Nachschleifzyklen** Lower drilling costs due to multiple regrinding cycles

**Auslaufartikel nur noch 2026 erhältlich**

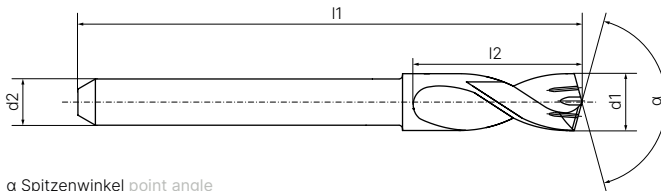
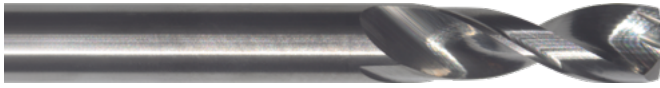
Discontinued article only available in 2026

- › **Alternative Typ 540 / 530**  
Alternative type 540 / 530

# 532

## Standardbohrer mit Spanbrecher

Standard drill with chip breaker



$\alpha$  Spitzenwinkel point angle

**l1**  
38,1

**d2**  
3,175

**$\alpha$**   
165°

|              |                |                            |              |
|--------------|----------------|----------------------------|--------------|
| ● DS-ML 4    | ● ML $\geq 6$  | ● ML $\geq 70 \mu\text{m}$ | ● Filled/HTg |
| ● Backpanels | ● (Rigid) Flex | — IC-Substr.               | ○ PI         |
| ○ PTFE       | ○ Mc ML        | ● Cu/CuZn                  | ○ PMMA       |

| d <sub>1</sub> | l <sub>2</sub> | 532          |
|----------------|----------------|--------------|
| 3,200          | 12,0           | 85323200120X |
| 3,250          | 12,0           | 85323250120X |
| 3,300          | 12,0           | 85323300120X |
| 3,350          | 12,0           | 85323350120X |
| 3,400          | 12,0           | 85323400120X |
| 3,450          | 12,0           | 85323450120X |
| 3,500          | 12,0           | 85323500120X |
| 3,550          | 12,0           | 85323550120X |
| 3,600          | 12,0           | 85323600120X |
| 3,650          | 12,0           | 85323650120X |
| 3,700          | 12,0           | 85323700120X |
| 3,750          | 12,0           | 85323750120X |
| 3,800          | 12,0           | 85323800120X |
| 3,850          | 12,0           | 85323850120X |
| 3,900          | 12,0           | 85323900120X |
| 3,950          | 12,0           | 85323950120X |

| d <sub>1</sub> | l <sub>2</sub> | 532          |
|----------------|----------------|--------------|
| 4,000          | 12,0           | 85324000120X |
| 4,050          | 12,0           | 85324050120X |
| 4,100          | 12,0           | 85324100120X |
| 4,150          | 12,0           | 85324150120X |
| 4,200          | 12,0           | 85324200120X |
| 4,250          | 12,0           | 85324250120X |
| 4,300          | 12,0           | 85324300120X |
| 4,350          | 12,0           | 85324350120X |
| 4,400          | 12,0           | 85324400120X |
| 4,450          | 12,0           | 85324450120X |
| 4,500          | 12,0           | 85324500120X |
| 4,550          | 12,0           | 85324550120X |
| 4,600          | 12,0           | 85324600120X |
| 4,650          | 12,0           | 85324650120X |
| 4,700          | 12,0           | 85324700120X |
| 4,750          | 12,0           | 85324750120X |

Weitere Durchmesser und Spirallängen auf Anfrage other diameters and flute length on request

### Anwendungen & Vorteile

Applications & advantages

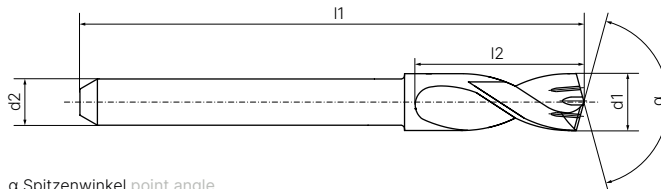
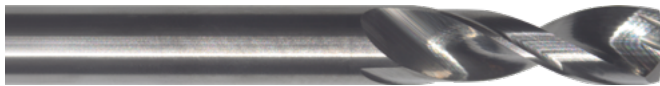
- › **Standardbohrer mit ausgespitztem Kern, Spanbrecher und Durchmesserverjüngung**  
Standard drill with thinned web, chip breaker and back-tapered diameter
- › **Geeignet für Dick-Kupferanwendungen**  
Suitable for thick copper applications
- › **Für langspanende Werkstoffe** For long-chipping materials
- › **Erhebliche Reduzierung der Spindelkräfte**  
Significant reduction of spindle forces



# 532

## Standardbohrer mit Spanbrecher

Standard drill with chip breaker



$\alpha$  Spitzenwinkel point angle

**l1**  
38,1

**d2**  
3,175

**$\alpha$**   
165°

|              |                |                            |              |
|--------------|----------------|----------------------------|--------------|
| ● DS-ML 4    | ● ML $\geq 6$  | ● ML $\geq 70 \mu\text{m}$ | ● Filled/HTg |
| ● Backpanels | ● (Rigid) Flex | — IC-Substr.               | ○ PI         |
| ○ PTFE       | ○ Mc ML        | ● Cu/CuZn                  | ○ PMMA       |

| d <sub>1</sub> | l <sub>2</sub> | 532          |
|----------------|----------------|--------------|
| 4,800          | 12,0           | 85324800120X |
| 4,850          | 12,0           | 85324850120X |
| 4,900          | 12,0           | 85324900120X |
| 4,950          | 12,0           | 85324950120X |
| 5,000          | 12,0           | 85325000120X |
| 5,050          | 12,0           | 85325050120X |
| 5,100          | 12,0           | 85325100120X |
| 5,150          | 12,0           | 85325150120X |
| 5,200          | 12,0           | 85325200120X |
| 5,250          | 12,0           | 85325250120X |
| 5,300          | 12,0           | 85325300120X |
| 5,350          | 12,0           | 85325350120X |
| 5,400          | 12,0           | 85325400120X |
| 5,450          | 12,0           | 85325450120X |
| 5,500          | 12,0           | 85325500120X |
| 5,550          | 12,0           | 85325550120X |

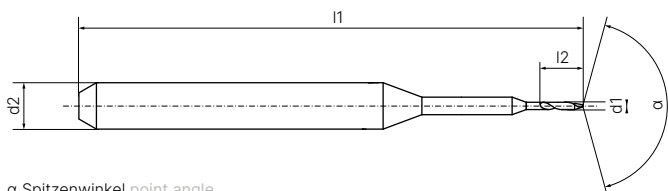
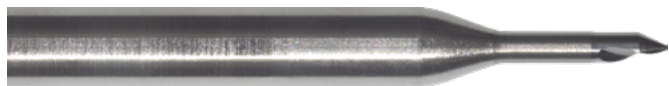
| d <sub>1</sub> | l <sub>2</sub> | 532          |
|----------------|----------------|--------------|
| 5,600          | 12,0           | 85325600120X |
| 5,650          | 12,0           | 85325650120X |
| 5,700          | 12,0           | 85325700120X |
| 5,750          | 12,0           | 85325750120X |
| 5,800          | 12,0           | 85325800120X |
| 5,850          | 12,0           | 85325850120X |
| 5,900          | 12,0           | 85325900120X |
| 5,950          | 12,0           | 85325950120X |
| 6,000          | 12,0           | 85326000120X |
| 6,050          | 12,0           | 85326050120X |
| 6,100          | 12,0           | 85326100120X |
| 6,150          | 12,0           | 85326150120X |
| 6,200          | 12,0           | 85326200120X |
| 6,250          | 12,0           | 85326250120X |
| 6,300          | 12,0           | 85326300120X |
| 6,350          | 12,0           | 85326350120X |

Weitere Durchmesser und Spirallängen auf Anfrage other diameters and flute length on request

### Anwendungen & Vorteile

Applications & advantages

- › **Standardbohrer mit ausgespitztem Kern, Spanbrecher und Durchmesserverjüngung**  
Standard drill with thinned web, chip breaker and back-tapered diameter
- › **Geeignet für Dick-Kupferanwendungen**  
Suitable for thick copper applications
- › **Für langspanende Werkstoffe** For long-chipping materials
- › **Erhebliche Reduzierung der Spindelkräfte**  
Significant reduction of spindle forces



α Spitzenwinkel point angle

l1  
38,1d2  
3,175α  
150°

|              |                |              |              |
|--------------|----------------|--------------|--------------|
| ● DS-ML 4    | ● ML ≥ 6       | ● ML ≥ 70 μm | ● Filled/HTg |
| ● Backpanels | ● (Rigid) Flex | ● IC-Substr. | ○ PI         |
| ○ PTFE       | ○ Mc ML        | ○ Cu/CuZn    | ○ PMMA       |

| d <sub>1</sub> | l <sub>2</sub> | 596          |
|----------------|----------------|--------------|
| 0,120          | 0,5            | 85960120005X |
| 0,150          | 0,5            | *            |
| 0,200          | 1,0            | 85960200010X |
| 0,250          | 1,0            | 85960250010X |
| 0,300          | 2,5            | 85960250025X |

| d <sub>1</sub> | l <sub>2</sub> | 596          |
|----------------|----------------|--------------|
| 0,350          | 2,5            | *            |
| 0,400          | 2,5            | 85960400025X |
| 0,450          | 2,5            | *            |
| 0,500          | 2,5            | *            |
| 0,600          | 2,5            | *            |

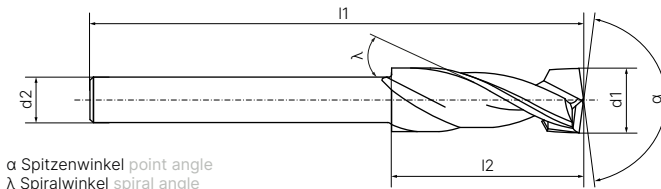
\* Artikel auf Anfrage article on request

Weitere Durchmesser auf Anfrage other diameters on request

**Anwendungen & Vorteile**

Applications &amp; advantages

- › **Konischer Außendurchmesser** Tapered outer diameter
- › **Bohren von Microvias (Sacklöchern)** Drilling of microvias (blind holes)
- › **Höchste Lochqualität und Positionsgenauigkeit** Highest hole quality and high position accuracy
- › **Wirtschaftliches Bohren im Vergleich zum Laser auf Mehrspindelmaschinen** Economical drilling compared to laser on multispindle machines
- › **Maximale Bohrtiefe** Maximum drilling depth:  
d<sub>1</sub> 0,12: 120 μm  
d<sub>1</sub> 0,40: 400 μm

l1  
38,1d2  
3,175 $\alpha$   
165° $\lambda$   
30°

|              |                |                            |              |
|--------------|----------------|----------------------------|--------------|
| ● DS-ML 4    | ● ML $\geq 6$  | ● ML $\geq 70 \mu\text{m}$ | ● Filled/HTg |
| ● Backpanels | ○ (Rigid) Flex | ○ IC-Substr.               | ○ PI         |
| ○ PTFE       | ● Mc ML        | ● Cu/CuZn                  | ○ PMMA       |

| d <sub>1</sub> | l <sub>2</sub> | 298 |
|----------------|----------------|-----|
| 3,500          | 13,0           | *   |
| 4,000          | 13,0           | *   |
| 4,500          | 13,0           | *   |
| 5,000          | 13,0           | *   |
| 5,500          | 13,0           | *   |
| 6,000          | 13,0           | *   |
| 6,500          | 13,0           | *   |
| 7,000          | 10,0           | *   |
| 7,500          | 10,0           | *   |
| 8,000          | 10,0           | *   |

| d <sub>1</sub> | l <sub>2</sub> | 298 |
|----------------|----------------|-----|
| 8,500          | 10,0           | *   |
| 9,000          | 10,0           | *   |
| 9,500          | 10,0           | *   |
| 10,000         | 10,0           | *   |
| 10,500         | 10,0           | *   |
| 11,000         | 10,0           | *   |
| 11,500         | 10,0           | *   |
| 12,000         | 10,0           | *   |
| 12,250         | 10,0           | *   |
| 12,500         | 10,0           | *   |

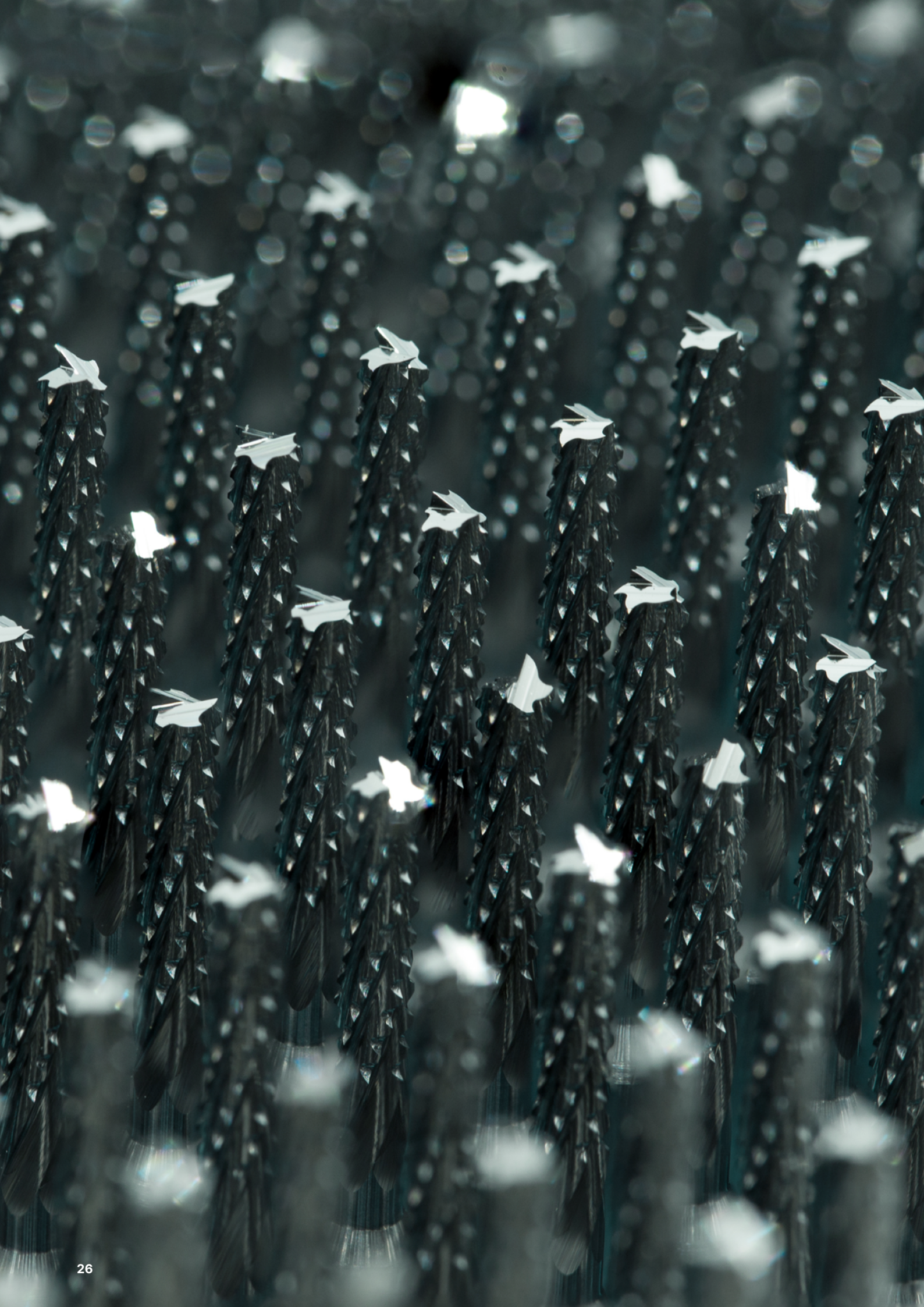
\* Artikel auf Anfrage article on request

**Anwendungen & Vorteile**

Applications &amp; advantages

- › **Steigerung von Effizienz, Präzision und Wirtschaftlichkeit** Increased efficiency, precision, and cost-effectiveness
- › **Bessere Oberflächenqualität und Maßgenauigkeit** Better surface quality and dimensional accuracy
- › **Längere Standzeiten durch extreme Verschleißfestigkeit** Longer service life thanks to extreme wear resistance
- › **Steigerung der Produktivität durch höhere Schnittgeschwindigkeiten** Increased productivity through higher cutting speeds







# ÜBERSICHT FRÄSEN

## OVERVIEW ROUTING

|                            |
|----------------------------|
| Ø<br>[mm]                  |
| FR-2 / FR-4 (oc)           |
| FR-2 / FR-4 (ic)           |
| CEM1 / CEM3                |
| Filled / HTg               |
| Polyethylene (PE)          |
| Teflon (PTFE)              |
| Plexiglas (PMMA)           |
| Polyimides (PI)            |
| (Rigid) Flex               |
| Aluminum (Al)              |
| Copper / Brass (Cu / CuZn) |
| Metal composite laminates  |
| Seite<br>Page              |

## Diamantverzahneter Fräser Diamond-patterned router

| <b>620</b>                                                                                   |  | 1,00-3,175 | ● | ● | ● | ○ | - | - | - | - | - | - | ○ | 30 |
|----------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------|---|---|---|---|---|---|---|---|---|---|---|----|
| <b>624</b>  |  | 1,00-3,175 | ● | ● | ● | ○ | - | - | - | - | - | - | ○ | 31 |
| <b>626</b>                                                                                   |  | 1,00-3,175 | ● | ● | ● | ○ | - | - | - | - | - | - | ○ | 32 |

Spiralverzahnter Fräser Spiral-patterned router

[illegible]

Ritzstichel V-groove cutter

|     |                                                                                     |            |   |   |   |   |   |   |   |   |   |   |   |    |
|-----|-------------------------------------------------------------------------------------|------------|---|---|---|---|---|---|---|---|---|---|---|----|
| 80X |  | 2,00-3,175 | ● | ● | ● | ● | ● | ● | ● | ○ | ● | ● | ○ | 39 |
|-----|-------------------------------------------------------------------------------------|------------|---|---|---|---|---|---|---|---|---|---|---|----|

1-Schneider 1-flute

|            |                                                                                     |            |   |   |   |   |   |   |   |   |   |   |   |    |    |
|------------|-------------------------------------------------------------------------------------|------------|---|---|---|---|---|---|---|---|---|---|---|----|----|
| <b>817</b> |  | 0,50-3,175 | — | ● | ○ | — | ● | ● | ● | ● | ○ | — | ○ | 40 |    |
| <b>818</b> |  | 0,40-3,175 | — | ● | ○ | — | ● | ● | ● | ● | ○ | ○ | ● | ○  | 41 |
| <b>892</b> |  | 1,60-3,175 | — | — | — | — | — | — | — | — | ○ | ● | ○ | 42 |    |

● optimal optimum ○ geeignet suitable – nicht empfehlenswert not recommendable 🔔 Letzte Chance last chance

| Ø<br>[mm] | FR-2 / FR-4 (oc) | FR-2 / FR-4 (ic) | CEM1 / CEM3 | Filled / HTg | Polyethylene (PE) | Teflon (PTFE) | Plexiglas (PMMA) | Polyimides (PI) | (Rigid) Flex | Aluminum (Al) | Copper / Brass (Cu / CuZn) | Metal composite laminates | Seite<br>Page |
|-----------|------------------|------------------|-------------|--------------|-------------------|---------------|------------------|-----------------|--------------|---------------|----------------------------|---------------------------|---------------|
|-----------|------------------|------------------|-------------|--------------|-------------------|---------------|------------------|-----------------|--------------|---------------|----------------------------|---------------------------|---------------|

#### 2-Schneider 2-flute

|                                                                                                                                                                                   |              |   |   |   |   |   |   |   |   |   |   |   |   |    |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|---|---|---|---|---|---|---|---|---|---|---|---|----|
| <b>821</b><br>                                                                                   | 0,40 - 2,40  | — | — | — | — | ● | ● | ● | ● | ○ | ● | ● | ○ | 43 |
| <b>825</b> <br> | 0,60 - 3,175 | — | ● | ○ | ○ | ● | ● | ● | ● | ● | — | ○ | ○ | 44 |
| <b>826</b><br>                                                                                   | 0,20 - 3,175 | — | ● | ○ | ○ | ● | ● | ● | ● | ● | — | ● | ○ | 45 |
| <b>827</b><br>                                                                                  | 0,50 - 3,175 | — | ● | ○ | ○ | ● | ● | ● | ● | ● | — | ○ | ○ | 46 |
| <b>828</b><br>                                                                                 | 0,20 - 3,175 | — | ● | ○ | ○ | ● | ● | ● | ● | ● | ○ | ● | ○ | 47 |
| <b>891</b><br>                                                                                 | 1,00 - 3,175 | ○ | ○ | ○ | — | ○ | ○ | ○ | ○ | — | ● | ○ | ○ | 48 |

#### 3-Schneider 3-flute

|                                                                                                   |              |   |   |   |   |   |   |   |   |   |   |   |   |    |
|---------------------------------------------------------------------------------------------------|--------------|---|---|---|---|---|---|---|---|---|---|---|---|----|
| <b>836</b><br> | 1,00 - 3,175 | — | ● | ○ | ○ | ○ | ○ | ○ | ● | ○ | — | ○ | ○ | 49 |
|---------------------------------------------------------------------------------------------------|--------------|---|---|---|---|---|---|---|---|---|---|---|---|----|

#### Kegelsenker Countersink

|                                                                                                   |      |   |   |   |   |   |   |   |   |   |   |   |   |    |
|---------------------------------------------------------------------------------------------------|------|---|---|---|---|---|---|---|---|---|---|---|---|----|
| <b>850</b><br> | 6,00 | ● | ● | ● | ● | ● | ● | ● | ● | — | ● | ● | ○ | 50 |
|---------------------------------------------------------------------------------------------------|------|---|---|---|---|---|---|---|---|---|---|---|---|----|

#### Schlichtfräser Contour finishing router

|                                                                                                   |             |   |   |   |   |   |   |   |   |   |   |   |   |    |
|---------------------------------------------------------------------------------------------------|-------------|---|---|---|---|---|---|---|---|---|---|---|---|----|
| <b>870</b><br> | 1,60 - 2,40 | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ● | 51 |
| <b>876</b><br> | 1,60 - 2,40 | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ● | 52 |

#### PKD-Fräser PKD router

|                                                                                                   |              |   |   |   |   |   |   |   |   |   |   |   |   |    |
|---------------------------------------------------------------------------------------------------|--------------|---|---|---|---|---|---|---|---|---|---|---|---|----|
| <b>848</b><br> | 3,175 - 6,00 | ● | ● | ● | ● | ● | ● | ● | ● | — | ● | ● | ● | 53 |
|---------------------------------------------------------------------------------------------------|--------------|---|---|---|---|---|---|---|---|---|---|---|---|----|

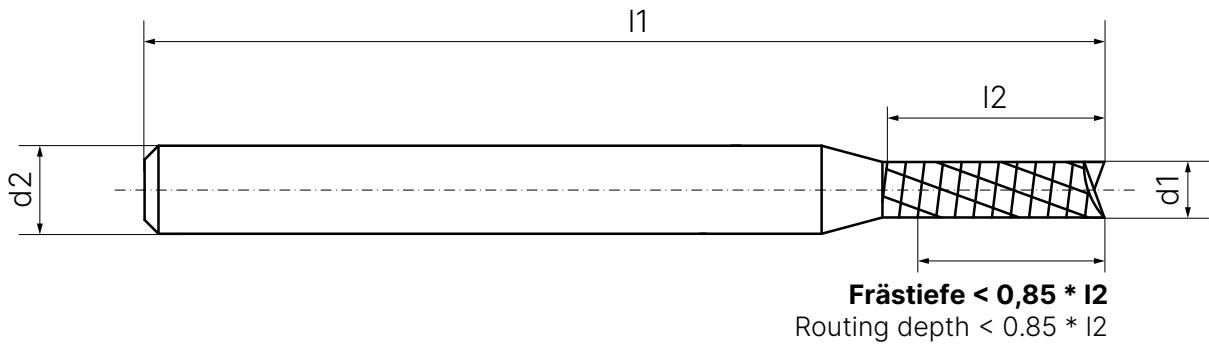
#### PKD-Senker PKD countersink

|                                                                                                   |       |   |   |   |   |   |   |   |   |   |   |   |   |    |
|---------------------------------------------------------------------------------------------------|-------|---|---|---|---|---|---|---|---|---|---|---|---|----|
| <b>858</b><br> | 3,175 | ● | ● | ● | ● | ● | ● | ● | ● | — | ● | ● | ● | 54 |
|---------------------------------------------------------------------------------------------------|-------|---|---|---|---|---|---|---|---|---|---|---|---|----|

● optimal optimum ○ geeignet suitable — nicht empfehlenswert not recommendable  Letzte Chance last chance

# SPEZIFIKATIONEN FRÄSER

## SPECIFICATIONS ROUTER



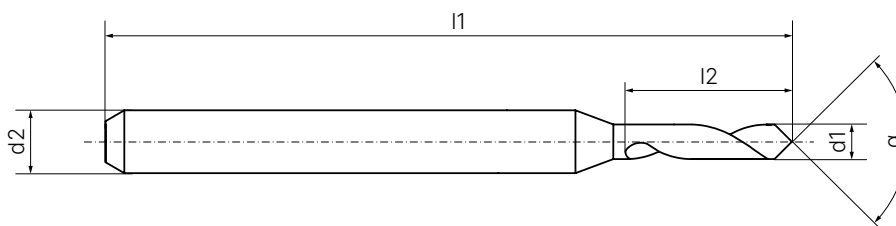
|                                                                         |                 |
|-------------------------------------------------------------------------|-----------------|
| <b>Gesamtlänge l<sub>1</sub></b> Total length l <sub>1</sub>            | 38,2 - 0,4      |
| <b>Spirallänge l<sub>2</sub></b> Flute length l <sub>2</sub>            | +0,6 / -0,1     |
| <b>Schaftdurchmesser d<sub>2</sub></b> Shank diameter d <sub>2</sub>    | -0,001 / -0,007 |
| <b>Nenn Durchmesser d<sub>1</sub></b> Nominal diameter d <sub>1</sub>   | +0,01 / -0,02   |
| wenn d <sub>1</sub> = d <sub>2</sub> if d <sub>1</sub> = d <sub>2</sub> | 0 / -0,04       |
| <b>Typ 836</b>                                                          | +0,01 / -0,03   |
| <b>Schneidenrauhtiefe R<sub>t</sub></b> Roughness R <sub>t</sub>        | ≤ 0,006         |
| <b>Ausbrüche</b> Chips                                                  | ≤ 0,030         |

**max. 10 % der Einzelschneiden eines Fräasers**  
max. 10 % of the single cutting teeth of a router

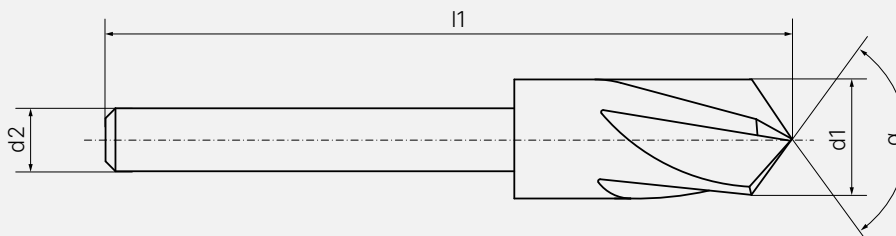
**Spitzenwinkel α** Point angle α  
Typ 80X

±3°

**Typ 80X**



**Typ 850**

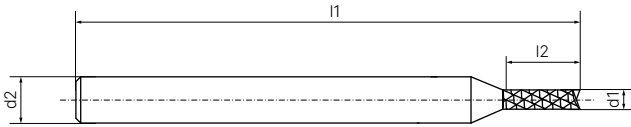


Angaben in [mm] data in [mm]



# 620

## Diamantverzahnter Fräser Diamond-patterned router



|                   |                    |  |  |
|-------------------|--------------------|--|--|
| <b>l1</b><br>38,1 | <b>d2</b><br>3,175 |  |  |
|-------------------|--------------------|--|--|

|                |              |           |              |
|----------------|--------------|-----------|--------------|
| ● FR-2/4(oc)   | ● FR-2/4(ic) | ● CEM1/3  | ○ Filled/HTg |
| – PE           | – PTFE       | – PMMA    | – PI         |
| – (Rigid) Flex | – Al         | – Cu/CuZn | ○ MCL        |

| d <sub>1</sub> | l <sub>2</sub> | 620 |
|----------------|----------------|-----|
| 1,000          | 7,0            | *   |
| 1,100          | 7,0            | *   |
| 1,200          | 7,0            | *   |
| 1,300          | 7,0            | *   |
| 1,400          | 7,0            | *   |
| 1,500          | 8,0            | *   |
| 1,600          | 8,0            | *   |
| 1,700          | 8,0            | *   |
| 1,800          | 8,0            | *   |
| 1,900          | 8,0            | *   |

| d <sub>1</sub> | l <sub>2</sub> | 620 |
|----------------|----------------|-----|
| 2,000          | 8,0            | *   |
| 2,000          | 10,0           | *   |
| 2,100          | 8,0            | *   |
| 2,200          | 8,0            | *   |
| 2,300          | 8,0            | *   |
| 2,400          | 8,0            | *   |
| 2,400          | 8,0            | *   |
| 2,500          | 8,0            | *   |
| 3,000          | 10,0           | *   |
| 3,175          | 10,0           | *   |

\* Artikel auf Anfrage article on request

### Anwendungen & Vorteile

Applications & advantages

- › **Standardfräser für Innen- und Außenkonturen** Standard router for inner and outer contours
- › **Alle Basismaterialien aus Glasgewebe** All kind of glass-epoxy materials
- › **Linksspiralig (Schnittdruck nach unten)** Left twisted (downward cutting pressure)

### Weitere Varianten

Other variants

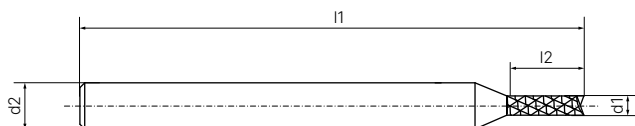
| 624* |                                                             | Page      |
|------|-------------------------------------------------------------|-----------|
|      | <b>Bohrspitzenanschliff rechts</b><br>Drill point cut right | <b>31</b> |

| 626 |                                                                | Page      |
|-----|----------------------------------------------------------------|-----------|
|     | <b>Fischschwanzanschliff rechts</b><br>Fishtail grinding right | <b>32</b> |

# 624



## Diamantverzahnter Fräser Diamond-patterned router



l1  
38,1

d2  
3,175

$\alpha$   
120/130°



|                |              |           |              |
|----------------|--------------|-----------|--------------|
| ● FR-2/4(oc)   | ● FR-2/4(ic) | ● CEM1/3  | ○ Filled/HTg |
| – PE           | – PTFE       | – PMMA    | – PI         |
| – (Rigid) Flex | – Al         | – Cu/CuZn | ○ MCL        |

| d <sub>1</sub> | l <sub>2</sub> | 624 |
|----------------|----------------|-----|
| 1,000          | 7,0            | *   |
| 1,100          | 7,0            | *   |
| 1,200          | 7,0            | *   |
| 1,300          | 7,0            | *   |
| 1,400          | 7,0            | *   |
| 1,500          | 8,0            | *   |
| 1,600          | 8,0            | *   |
| 1,700          | 8,0            | *   |
| 1,800          | 8,0            | *   |
| 1,900          | 8,0            | *   |

| d <sub>1</sub> | l <sub>2</sub> | 624 |
|----------------|----------------|-----|
| 2,000          | 8,0            | *   |
| 2,000          | 10,0           | *   |
| 2,100          | 8,0            | *   |
| 2,200          | 8,0            | *   |
| 2,300          | 8,0            | *   |
| 2,400          | 8,0            | *   |
| 2,400          | 8,0            | *   |
| 2,500          | 8,0            | *   |
| 3,000          | 9,0            | *   |
| 3,175          | 10,0           | *   |

\* Artikel auf Anfrage article on request

### Anwendungen & Vorteile

Applications & advantages

- › **Standardfräser für Innen- und Außenkonturen** Standard router for inner and outer contours
- › **Alle Basismaterialien aus Glasgewebe** Glass-epoxy based materials

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Discontinued article only available in 2026

- › **Alternative Typ 620 / 626**  
Alternative type 620 / 626

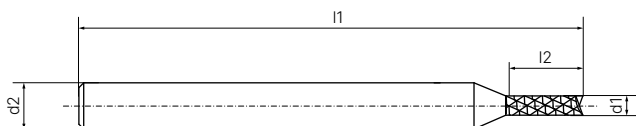
### Weitere Varianten

Other variants

| 620* |                                                                         | Page      |
|------|-------------------------------------------------------------------------|-----------|
|      | <b>Fischschwanzanschliff links</b><br>Fishtail grinding left (down cut) | <b>30</b> |
| 626  |                                                                         | Page      |
|      | <b>Fischschwanzanschliff rechts</b><br>Fishtail grinding right          | <b>32</b> |

# 626

## Diamantverzahnter Fräser Diamond-patterned router



|                   |                    |  |  |
|-------------------|--------------------|--|--|
| <b>l1</b><br>38,1 | <b>d2</b><br>3,175 |  |  |
|-------------------|--------------------|--|--|

|                |              |           |              |
|----------------|--------------|-----------|--------------|
| ● FR-2/4(oc)   | ● FR-2/4(ic) | ● CEM1/3  | ○ Filled/HTg |
| – PE           | – PTFE       | – PMMA    | – PI         |
| – (Rigid) Flex | – Al         | – Cu/CuZn | ○ MCL        |

| d <sub>1</sub> | l <sub>2</sub> | 626          |
|----------------|----------------|--------------|
| 1,000          | 7,0            | 86261000070X |
| 1,100          | 7,0            | *            |
| 1,200          | 7,0            | *            |
| 1,300          | 7,0            | *            |
| 1,400          | 7,0            | *            |
| 1,500          | 8,0            | 36261500080X |
| 1,600          | 8,0            | 36261600080X |
| 1,700          | 8,0            | 36261700080X |
| 1,800          | 8,0            | 36261800080X |
| 1,900          | 8,0            | 36261900080X |

| d <sub>1</sub> | l <sub>2</sub> | 626          |
|----------------|----------------|--------------|
| 2,000          | 8,0            | 36262000080X |
| 2,000          | 10,0           | 36262000100X |
| 2,100          | 8,0            | 36262100080X |
| 2,200          | 8,0            | 36262200080X |
| 2,300          | 8,0            | 36262300080X |
| 2,400          | 8,0            | 36262400080X |
| 2,400          | 10,0           | 36262400100X |
| 2,500          | 8,0            | 36262500080X |
| 3,000          | 10,0           | 36263000100X |
| 3,175          | 10,0           | *            |

\* Artikel auf Anfrage article on request

### Anwendungen & Vorteile

Applications & advantages

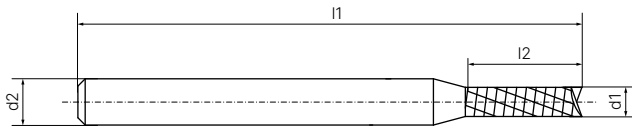
- › **Standardfräser für Innen- und Außenkonturen** Standard router for inner and outer contours
- › **Alle Basismaterialien aus Glasgewebe** Glass-epoxy based materials

### Weitere Varianten

Other variants

| 620* |                                                                         | Page      |
|------|-------------------------------------------------------------------------|-----------|
|      | <b>Fischschwanzanschliff links</b><br>Fishtail grinding left (down cut) | <b>30</b> |

| 624* |                                                             | Page      |
|------|-------------------------------------------------------------|-----------|
|      | <b>Bohrspitzenanschliff rechts</b><br>Drill point cut right | <b>31</b> |



l1  
38,1

d2  
3,175



|                |              |           |              |
|----------------|--------------|-----------|--------------|
| ● FR-2/4(oc)   | ● FR-2/4(ic) | ● CEM1/3  | ○ Filled/HTg |
| – PE           | – PTFE       | – PMMA    | – PI         |
| ○ (Rigid) Flex | – Al         | – Cu/CuZn | ○ MCL        |

| d <sub>1</sub> | l <sub>2</sub> | 720          |
|----------------|----------------|--------------|
| 0,500          | 3,0            | *            |
| 0,600          | 3,0            | *            |
| 0,700          | 3,5            | *            |
| 0,800          | 5,0            | *            |
| 0,900          | 5,0            | *            |
| 1,000          | 7,0            | *            |
| 1,000          | 8,5            | *            |
| 1,100          | 7,0            | *            |
| 1,100          | 8,5            | *            |
| 1,200          | 5,0            | *            |
| 1,200          | 7,0            | *            |
| 1,200          | 8,5            | *            |
| 1,300          | 7,0            | *            |
| 1,300          | 8,5            | *            |
| 1,400          | 7,0            | 87201400070X |

| d <sub>1</sub> | l <sub>2</sub> | 720 |
|----------------|----------------|-----|
| 1,400          | 8,5            | *   |
| 1,500          | 8,5            | *   |
| 1,600          | 8,5            | *   |
| 1,700          | 8,5            | *   |
| 1,800          | 8,5            | *   |
| 1,900          | 8,5            | *   |
| 2,000          | 9,0            | *   |
| 2,100          | 9,0            | *   |
| 2,200          | 9,0            | *   |
| 2,300          | 9,0            | *   |
| 2,400          | 9,0            | *   |
| 2,500          | 9,0            | *   |
| 3,000          | 9,0            | *   |
| 3,175          | 9,0            | *   |

\* Artikel auf Anfrage article on request

### Anwendungen & Vorteile

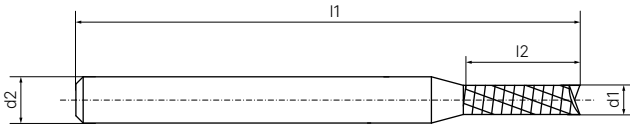
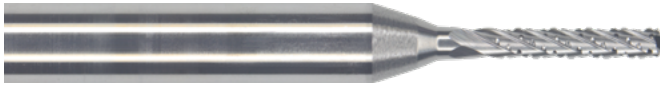
Applications & advantages

- › **Standardfräser für Innen- und Außenkonturen** Standard router for inner and outer contours
- › **Alle Basismaterialien aus Glasgewebe** All kind of glass-epoxy materials
- › **Sehr guter Spantransport und Oberflächenqualität** Excellent chip transport and surface finish
- › **Linksspiralig (Schnittdruck nach unten)** Left twisted (downward cutting pressure)

### Weitere Varianten

Other variants

| 724* |                                                                 | Page      |
|------|-----------------------------------------------------------------|-----------|
|      | <b>Bohrspitzenanschliff rechts</b><br>Drill point cut right     | <b>34</b> |
| 726  |                                                                 | Page      |
|      | <b>Fischeschwanzanschliff rechts</b><br>Fishtail grinding right | <b>35</b> |


**l1**  
 38,1

**d2**  
 3,175


|                |              |           |              |
|----------------|--------------|-----------|--------------|
| ● FR-2/4(oc)   | ● FR-2/4(ic) | ● CEM1/3  | ○ Filled/HTg |
| – PE           | – PTFE       | – PMMA    | – PI         |
| ○ (Rigid) Flex | – Al         | – Cu/CuZn | ○ MCL        |

| d <sub>1</sub> | l <sub>2</sub> | 724          |
|----------------|----------------|--------------|
| 0,500          | 3,0            | *            |
| 0,600          | 3,0            | *            |
| 0,700          | 3,5            | *            |
| 0,800          | 5,0            | *            |
| 0,900          | 5,0            | *            |
| 1,000          | 7,0            | *            |
| 1,000          | 8,5            | *            |
| 1,100          | 7,0            | *            |
| 1,100          | 8,5            | *            |
| 1,200          | 5,0            | *            |
| 1,200          | 7,0            | 87241200070X |
| 1,200          | 8,5            | *            |
| 1,300          | 7,0            | *            |
| 1,300          | 8,5            | *            |
| 1,400          | 7,0            | *            |

| d <sub>1</sub> | l <sub>2</sub> | 724 |
|----------------|----------------|-----|
| 1,400          | 8,5            | *   |
| 1,500          | 8,5            | *   |
| 1,600          | 8,5            | *   |
| 1,700          | 8,5            | *   |
| 1,800          | 8,5            | *   |
| 1,900          | 8,5            | *   |
| 2,000          | 9,0            | *   |
| 2,100          | 9,0            | *   |
| 2,200          | 9,0            | *   |
| 2,300          | 9,0            | *   |
| 2,400          | 9,0            | *   |
| 2,500          | 9,0            | *   |
| 3,000          | 9,0            | *   |
| 3,175          | 9,0            | *   |

\* Artikel auf Anfrage article on request

### Anwendungen & Vorteile

Applications &amp; advantages

- › **Standardfräser für Innen- und Außenkonturen** Standard router for inner and outer contours
- › **Alle Basismaterialien aus Glasgewebe** All kind of glass-epoxy materials
- › **Sehr guter Spantransport und Oberflächenqualität** Excellent chip transport and surface finish

**Auslaufartikel nur noch 2026 erhältlich**

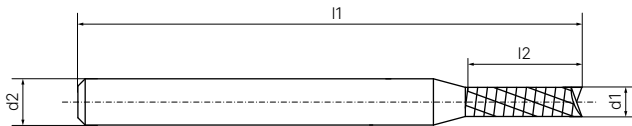
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- › **Alternative Typ 720 / 726**  
Alternative type 720 / 726

### Weitere Varianten

Other variants

| 720*                                                                                |                                                                         | Page      |
|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------|-----------|
|  | <b>Fischschwanzanschliff links</b><br>Fishtail grinding left (down cut) | <b>33</b> |
| 726                                                                                 |                                                                         | Page      |
|  | <b>Fischschwanzanschliff rechts</b><br>Fishtail grinding right          | <b>35</b> |



l1  
38,1

d2  
3,175



|                |              |           |              |
|----------------|--------------|-----------|--------------|
| ● FR-2/4(oc)   | ● FR-2/4(ic) | ● CEM1/3  | ○ Filled/HTg |
| – PE           | – PTFE       | – PMMA    | – PI         |
| ○ (Rigid) Flex | – Al         | – Cu/CuZn | ○ MCL        |

| d <sub>1</sub> | l <sub>2</sub> | 726          |
|----------------|----------------|--------------|
| 0,500          | 3,0            | 87260500030X |
| 0,600          | 3,0            | 87260600030X |
| 0,700          | 3,5            | 87260700035X |
| 0,800          | 5,0            | 87260800050X |
| 0,900          | 5,0            | 87260900050X |
| 1,000          | 7,0            | 87261000070X |
| 1,000          | 8,5            | 87261000085X |
| 1,100          | 7,0            | 87261100070X |
| 1,100          | 8,5            | 87261100085X |
| 1,200          | 5,0            | 87261200050X |
| 1,200          | 7,0            | 87261200070X |
| 1,200          | 8,5            | 87261200085X |
| 1,300          | 7,0            | 87261300070X |
| 1,300          | 8,5            | 87261300070X |
| 1,400          | 7,0            | 87261400070X |

| d <sub>1</sub> | l <sub>2</sub> | 726          |
|----------------|----------------|--------------|
| 1,400          | 8,5            | 87261400085X |
| 1,500          | 8,5            | 37261500085X |
| 1,600          | 8,5            | 37261600085X |
| 1,700          | 8,5            | 37261700085X |
| 1,800          | 8,5            | 37261800085X |
| 1,900          | 8,5            | 37261900085X |
| 2,000          | 9,0            | 37262000090X |
| 2,100          | 9,0            | 37262100090X |
| 2,200          | 9,0            | 37262200090X |
| 2,300          | 9,0            | 37262300090X |
| 2,400          | 9,0            | 37262400090X |
| 2,500          | 9,0            | 37262500090X |
| 3,000          | 9,0            | 37263000090X |
| 3,175          | 9,0            | 37263175090X |

### Anwendungen & Vorteile

Applications & advantages

- › **Standardfräser für Innen- und Außenkonturen** Standard router for inner and outer contours
- › **Alle Basismaterialien aus Glasgewebe** All kind of glass-epoxy materials
- › **Sehr guter Spantransport und Oberflächenqualität** Excellent chip transport and surface finish

### Weitere Varianten

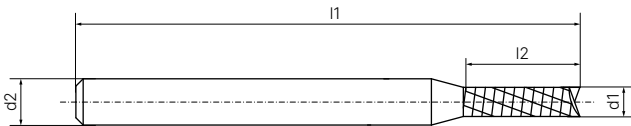
Other variants

| 720* |                                                                         | Page      |
|------|-------------------------------------------------------------------------|-----------|
|      | <b>Fischschwanzanschliff links</b><br>Fishtail grinding left (down cut) | <b>33</b> |
| 724* |                                                                         | Page      |
|      | <b>Bohrspitzenanschliff rechts</b><br>Drill point cut right             | <b>34</b> |



# 756

## Spiralverzahnter Fräser Spiral-patterned router



|                   |                    |  |  |
|-------------------|--------------------|--|--|
| <b>l1</b><br>38,1 | <b>d2</b><br>3,175 |  |  |
|-------------------|--------------------|--|--|

|                |              |           |              |
|----------------|--------------|-----------|--------------|
| ● FR-2/4(oc)   | ● FR-2/4(ic) | ● CEM1/3  | ● Filled/HTg |
| – PE           | – PTFE       | – PMMA    | – PI         |
| – (Rigid) Flex | – Al         | – Cu/CuZn | ○ MCL        |

| d <sub>1</sub> | l <sub>2</sub> | 756          |
|----------------|----------------|--------------|
| 0,500          | 3,0            | *            |
| 0,600          | 3,0            | *            |
| 0,700          | 3,5            | *            |
| 0,800          | 5,0            | *            |
| 0,900          | 5,0            | *            |
| 1,000          | 7,0            | 87561000070X |
| 1,000          | 8,5            | *            |
| 1,100          | 7,0            | *            |
| 1,100          | 8,5            | *            |
| 1,200          | 5,0            | *            |
| 1,200          | 7,0            | *            |
| 1,200          | 8,5            | *            |
| 1,300          | 7,0            | *            |
| 1,300          | 8,5            | *            |
| 1,400          | 7,0            | *            |

| d <sub>1</sub> | l <sub>2</sub> | 756          |
|----------------|----------------|--------------|
| 1,400          | 8,5            | *            |
| 1,500          | 8,5            | 37561500085X |
| 1,600          | 8,5            | 37561600085X |
| 1,700          | 8,5            | *            |
| 1,800          | 8,5            | *            |
| 1,900          | 8,5            | *            |
| 2,000          | 9,0            | 37562000090X |
| 2,100          | 9,0            | *            |
| 2,200          | 9,0            | *            |
| 2,300          | 9,0            | *            |
| 2,400          | 9,0            | 37562400090X |
| 2,500          | 9,0            | *            |
| 3,000          | 9,0            | *            |
| 3,175          | 9,0            | *            |

\* Artikel auf Anfrage [article on request](#)

Weitere Durchmesser und Spitzenwinkel auf Anfrage [other diameters and point angles on request](#)

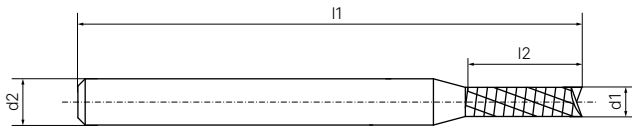
### Anwendungen & Vorteile

Applications & advantages

- › **Hochleistungsfräser für Innen- und Außenkonturen** High performance router for inner and outer contours
- › **Sehr guter Spantransport und Oberflächenqualität** Excellent chip transport and surface quality

# 788

## Spiralverzahnter Fräser Spiral-patterned router



l1  
38,1

d2  
3,175



|                |              |           |              |
|----------------|--------------|-----------|--------------|
| ● FR-2/4(oc)   | ● FR-2/4(ic) | ● CEM1/3  | ○ Filled/HTg |
| – PE           | – PTFE       | – PMMA    | – PI         |
| ○ (Rigid) Flex | – Al         | – Cu/CuZn | ○ MCL        |

| d <sub>1</sub> | l <sub>2</sub> | 788          |
|----------------|----------------|--------------|
| 0,800          | 5,0            | 87880800050X |
| 0,900          | 6,0            | 87880900060X |
| 1,000          | 7,0            | 87881000070X |
| 1,100          | 7,0            | 87881100070X |
| 1,200          | 7,0            | 87881200070X |
| 1,300          | 8,5            | 87881300085X |
| 1,400          | 8,5            | 87881400085X |
| 1,500          | 8,5            | 37881500085X |
| 1,600          | 8,5            | 37881600085X |

| d <sub>1</sub> | l <sub>2</sub> | 788          |
|----------------|----------------|--------------|
| 1,700          | 8,5            | 37881700085X |
| 1,800          | 8,5            | 37881800085X |
| 1,900          | 8,5            | 37881900085X |
| 2,000          | 10,5           | 37882000105X |
| 2,100          | 10,5           | 37882100105X |
| 2,200          | 10,5           | 37882200105X |
| 2,300          | 10,5           | 37882300105X |
| 2,400          | 10,5           | 37882400105X |
| 2,500          | 10,5           | 37882500105X |

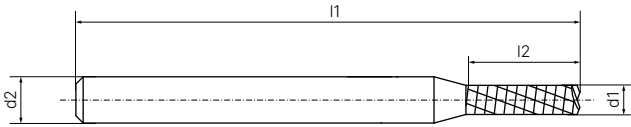
### Anwendungen & Vorteile

Applications & advantages

- › **Standardfräser für Innen- und Außenkonturen** Standard router for inner and outer contours
- › **Alle Basismaterialien aus Glasgewebe** All kind of glass-epoxy materials
- › **Sehr guter Spantransport und Oberflächenqualität** Excellent chip transport and surface finish

# 790

## Spiralverzahnter Fräser, diamantbeschichtet Spiral-patterned router, diamond-coated



|                   |                    |  |  |
|-------------------|--------------------|--|--|
| <b>l1</b><br>38,1 | <b>d2</b><br>3,175 |  |  |
|-------------------|--------------------|--|--|

|                |              |           |              |
|----------------|--------------|-----------|--------------|
| ● FR-2/4(oc)   | ● FR-2/4(ic) | ● CEM1/3  | ● Filled/HTg |
| – PE           | – PTFE       | – PMMA    | – PI         |
| – (Rigid) Flex | – Al         | – Cu/CuZn | ○ MCL        |

| d <sub>1</sub> | l <sub>2</sub> | 790          |
|----------------|----------------|--------------|
| 0,800          | 3,5            | *            |
| 0,900          | 4,0            | *            |
| 1,000          | 4,0            | *            |
| 1,000          | 5,0            | *            |
| 1,000          | 6,5            | *            |
| 1,100          | 6,5            | *            |
| 1,200          | 4,0            | *            |
| 1,200          | 7,0            | 37901200070X |
| 1,300          | 7,0            | *            |
| 1,400          | 4,0            | *            |
| 1,400          | 7,0            | 37901400070X |
| 1,500          | 4,0            | *            |
| 1,500          | 8,5            | *            |
| 1,600          | 8,5            | 37901600085X |

| d <sub>1</sub> | l <sub>2</sub> | 790          |
|----------------|----------------|--------------|
| 1,700          | 8,5            | *            |
| 1,800          | 4,0            | *            |
| 1,800          | 8,5            | *            |
| 1,900          | 8,5            | *            |
| 2,000          | 4,0            | *            |
| 2,000          | 9,0            | 37902000090X |
| 2,100          | 9,0            | *            |
| 2,200          | 9,0            | *            |
| 2,300          | 9,0            | *            |
| 2,400          | 9,0            | 37902400090X |
| 2,500          | 9,0            | *            |
| 3,000          | 9,0            | 37903000090X |
| 3,175          | 9,0            | 37903175090X |

\* Artikel auf Anfrage article on request

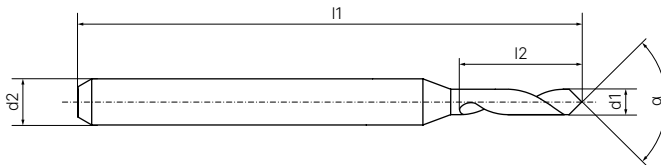
### Anwendungen & Vorteile

Applications & advantages

- › **Standardfräser für Innen- und Außenkonturen** Standard router for inner and outer contours
- › **Abrasive Basismaterialien** Abrasive base materials
- › **Guter Spantransport und sehr gute Oberflächenqualität** Good chip transport and excellent surface quality
- › **Engste Frästoleranzen** Tightest routing tolerances

# 80X

**Ritzstichel**  
V-groove cutter



|                   |                    |                    |  |
|-------------------|--------------------|--------------------|--|
| <b>l1</b><br>38,1 | <b>d2</b><br>3,175 | <b>α</b><br>30-90° |  |
|-------------------|--------------------|--------------------|--|

|                |              |           |              |
|----------------|--------------|-----------|--------------|
| ● FR-2/4(oc)   | ● FR-2/4(ic) | ● CEM1/3  | ● Filled/HTg |
| ● PE           | ● PTFE       | ● PMMA    | ● PI         |
| ○ (Rigid) Flex | ● Al         | ● Cu/CuZn | ○ MCL        |

| d <sub>1</sub> | α   | 80X          |
|----------------|-----|--------------|
| 2,000          | 30° | 88022000000X |
| 2,000          | 30° | 88032000000X |
| 2,000          | 45° | 88042000000X |

| d <sub>1</sub> | α   | 80X          |
|----------------|-----|--------------|
| 2,400          | 60° | 88062400000X |
| 3,175          | 22° | 88013175000X |
| 3,175          | 90° | 88093175000X |

Weitere Durchmesser und Spitzenwinkel auf Anfrage other diameters and point angles on request

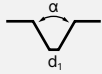
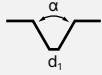
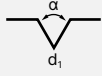
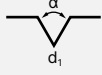
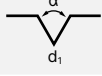
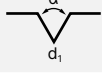
## Anwendungen & Vorteile

Applications & advantages

- › **Ritzen und Anfasen von Leiterplatten**  
Chamfering of circuit boards
- › **Fräsen von Isolationsabständen** Routing  
of dielectric spacing
- › **Ritzen von Bruchkanten** Scribing of  
break-out edges

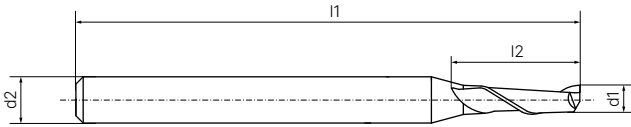
## Varianten

Variants

|            |                                                                                     |                                                     |
|------------|-------------------------------------------------------------------------------------|-----------------------------------------------------|
| <b>801</b> |  | <b>22° flache Ausführung</b><br>22° flat version    |
| <b>802</b> |  | <b>30° flache Ausführung</b><br>30° flat version    |
| <b>803</b> |  | <b>30° spitze Ausführung</b><br>30° pointed version |
| <b>804</b> |  | <b>45° spitze Ausführung</b><br>45° pointed version |
| <b>806</b> |  | <b>60° spitze Ausführung</b><br>60° pointed version |
| <b>809</b> |  | <b>90° spitze Ausführung</b><br>90° pointed version |

# 817

**1-Schneider**  
1-flute



|                   |                    |  |  |
|-------------------|--------------------|--|--|
| <b>l1</b><br>38,1 | <b>d2</b><br>3,175 |  |  |
|-------------------|--------------------|--|--|

|                |              |           |              |
|----------------|--------------|-----------|--------------|
| — FR-2/4(oc)   | ● FR-2/4(ic) | ○ CEM1/3  | — Filled/HTg |
| ● PE           | ● PTFE       | ● PMMA    | ● PI         |
| ● (Rigid) Flex | ○ Al         | — Cu/CuZn | ○ MCL        |

| d <sub>1</sub> | l <sub>2</sub> | 817 |
|----------------|----------------|-----|
| 0,500          | 3,0            | *   |
| 0,600          | 3,0            | *   |
| 0,800          | 3,0            | *   |
| 0,900          | 3,0            | *   |
| 1,000          | 3,0            | *   |
| 1,100          | 3,0            | *   |
| 1,200          | 4,0            | *   |
| 1,300          | 4,0            | *   |
| 1,400          | 4,0            | *   |

| d <sub>1</sub> | l <sub>2</sub> | 817          |
|----------------|----------------|--------------|
| 1,500          | 4,0            | *            |
| 1,600          | 5,0            | 38171600050X |
| 1,700          | 5,0            | *            |
| 1,800          | 5,0            | *            |
| 1,900          | 5,0            | *            |
| 2,000          | 8,0            | 38172000080X |
| 2,400          | 8,0            | *            |
| 3,000          | 9,0            | 38173000090X |
| 3,175          | 9,0            | *            |

\* Artikel auf Anfrage article on request

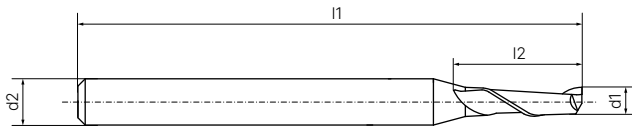
## Anwendungen & Vorteile

Applications & advantages

- › **Für Tiefenfräsen, Innenkonturen, Schlitz**  
For depth routing, inner contours, slots
- › **Beste Oberflächen- und Kantenqualität**  
Best surface and edge quality
- › **Extrascharfe Schneide** Extra sharp cutting edge

# 818

**1-Schneider**  
1-flute



**l1**  
**38,1**

**d2**  
**3,175**



|                |              |           |              |
|----------------|--------------|-----------|--------------|
| — FR-2/4(oc)   | ● FR-2/4(ic) | ○ CEM1/3  | — Filled/HTg |
| ● PE           | ● PTFE       | ● PMMA    | ● PI         |
| ○ (Rigid) Flex | ○ Al         | ● Cu/CuZn | ○ MCL        |

| d <sub>1</sub> | l <sub>2</sub> | 818          |
|----------------|----------------|--------------|
| 0,400          | 1,5            | 88180400015X |
| 0,500          | 3,0            | 88180500030X |
| 0,600          | 3,0            | 88180600030X |
| 0,700          | 3,0            | 88180700030X |
| 0,800          | 3,0            | 88180800030X |
| 0,900          | 3,0            | 88180900030X |
| 1,000          | 3,0            | 88181000030X |
| 1,100          | 3,0            | *            |
| 1,200          | 4,0            | 88181200040X |
| 1,300          | 4,0            | *            |

| d <sub>1</sub> | l <sub>2</sub> | 818          |
|----------------|----------------|--------------|
| 1,400          | 4,0            | 88181400040X |
| 1,500          | 4,0            | 38181500040X |
| 1,600          | 5,0            | 38181600050X |
| 1,700          | 5,0            | *            |
| 1,800          | 5,0            | *            |
| 1,900          | 5,0            | *            |
| 2,000          | 8,0            | 38182000080X |
| 2,400          | 8,0            | 38182400080X |
| 3,000          | 9,0            | 38183000090X |
| 3,175          | 9,0            | *            |

\* Artikel auf Anfrage [article on request](#)

Weitere Durchmesser und Spitzenwinkel auf Anfrage [other diameters and point angles on request](#)

## Anwendungen & Vorteile

Applications & advantages

### › Für Tiefenfräsen, Innenkonturen, Schlitz

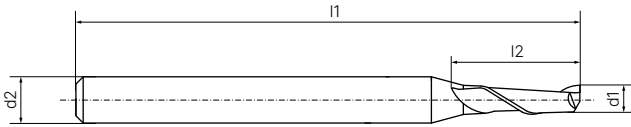
For depth routing, inner contours, slots

### › Beste Oberflächen- und Kantenqualität

Best surface and edge quality

# 892

**1-Schneider, diamantbeschichtet**  
1-flute, diamond-coated



|                   |                    |                                                                                     |                                                                                     |
|-------------------|--------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| <b>l1</b><br>38,1 | <b>d2</b><br>3,175 |  |  |
|-------------------|--------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|

|                |              |           |              |
|----------------|--------------|-----------|--------------|
| – FR-2/4(oc)   | – FR-2/4(ic) | – CEM1/3  | – Filled/HTg |
| – PE           | – PTFE       | – PMMA    | – PI         |
| – (Rigid) Flex | ○ Al         | ● Cu/CuZn | ○ MCL        |

| d <sub>1</sub> | l <sub>2</sub> | 892          |
|----------------|----------------|--------------|
| 1,600          | 4,0            | 38921600040X |
| 2,000          | 4,0            | 38922000040X |
| 2,400          | 6,0            | 38922400060X |
| 3,175          | 6,0            | 38923175060X |

Weitere Durchmesser und Spitzenwinkel auf Anfrage other diameters and point angles on request

## Anwendungen & Vorteile

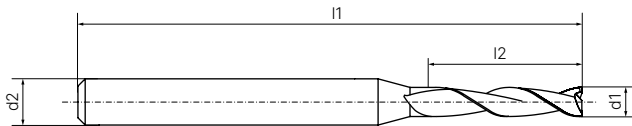
Applications & advantages

- › **Innenkonturen / Außenkonturen mit sehr hohen Qualitätsanforderungen** Inner / outer contours with very high quality demands
- › **Sehr guter Spantransport** Excellent chip transport
- › **Tiefenfräsungen möglich** Depth routing possible



# 821

**2-Schneider, beschichtet**  
2-flute, coated



**l1**  
38,1

**d2**  
3,175



|                |              |           |              |
|----------------|--------------|-----------|--------------|
| – FR-2/4(oc)   | – FR-2/4(ic) | – CEM1/3  | – Filled/HTg |
| ● PE           | ● PTFE       | ● PMMA    | ● PI         |
| ○ (Rigid) Flex | ● Al         | ● Cu/CuZn | ○ MCL        |

| d <sub>1</sub> | l <sub>2</sub> | 821          |
|----------------|----------------|--------------|
| 0,400          | 1,5            | *            |
| 0,500          | 3,0            | *            |
| 0,600          | 3,0            | *            |
| 0,700          | 3,0            | *            |
| 0,800          | 3,0            | 88210800030X |

| d <sub>1</sub> | l <sub>2</sub> | 821          |
|----------------|----------------|--------------|
| 1,000          | 3,0            | 88211000060X |
| 1,600          | 6,0            | 38211600060X |
| 2,000          | 6,0            | 38212000060X |
| 2,400          | 6,0            | 38212400060X |

\* Artikel auf Anfrage [article on request](#)  
Weitere Durchmesser auf Anfrage [other diameters on request](#)

## Anwendungen & Vorteile

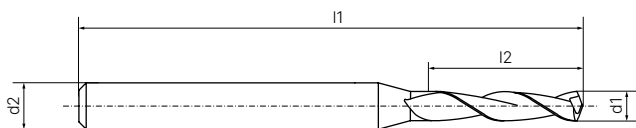
Applications & advantages

- › **Innenkonturen / Schlitz mit sehr hohen Qualitätsanforderungen** Inner contours / slots with very high quality demands
- › **Tiefenfräsungen möglich** Depth routing possible
- › **Reduzierte Zerspanungskräfte** Reduced cutting forces
- › **Reduzierte Temperaturen beim Zerspanen** Reduced temperature during routing process

# 825



**2-Schneider**  
2-flute



|                   |                    |  |  |
|-------------------|--------------------|--|--|
| <b>l1</b><br>38,1 | <b>d2</b><br>3,175 |  |  |
|-------------------|--------------------|--|--|

|                |              |           |              |
|----------------|--------------|-----------|--------------|
| – FR-2/4(oc)   | ● FR-2/4(ic) | ○ CEM1/3  | ○ Filled/HTg |
| ● PE           | ● PTFE       | ● PMMA    | ● PI         |
| ● (Rigid) Flex | – Al         | ○ Cu/CuZn | ○ MCL        |

| d <sub>1</sub> | l <sub>2</sub> | 825 |
|----------------|----------------|-----|
| 0,600          | 3,0            | *   |
| 0,700          | 3,0            | *   |
| 0,800          | 5,0            | *   |
| 0,900          | 5,0            | *   |
| 1,000          | 5,0            | *   |
| 1,100          | 5,0            | *   |
| 1,200          | 5,0            | *   |
| 1,300          | 5,0            | *   |
| 1,400          | 5,0            | *   |
| 1,500          | 6,0            | *   |
| 1,600          | 6,0            | *   |

| d <sub>1</sub> | l <sub>2</sub> | 825 |
|----------------|----------------|-----|
| 1,700          | 6,0            | *   |
| 1,800          | 6,0            | *   |
| 1,900          | 6,0            | *   |
| 2,000          | 8,0            | *   |
| 2,100          | 8,0            | *   |
| 2,200          | 8,0            | *   |
| 2,300          | 8,0            | *   |
| 2,400          | 8,0            | *   |
| 2,500          | 8,0            | *   |
| 3,000          | 10,0           | *   |
| 3,175          | 10,0           | *   |

\* Artikel auf Anfrage [article on request](#)

Weitere Artikel und Beschichtungen auf Anfrage [other articles and coatings on request](#)

## Anwendungen & Vorteile

Applications & advantages

- › **Für Tiefenfräsungen Typ 827** For depth routing type 827
- › **Innenkonturen / Schlitz mit sehr hohen Qualitätsanforderungen** Inner contours / slots with high quality demands
- › **Sehr guter Spantransport** Excellent chip transport

**Auslaufartikel nur noch 2026 erhältlich**

Discontinued article only available in 2026

› **Alternative Typ 827**

Alternative type 827

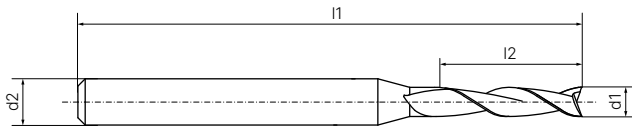
## Weitere Varianten

Other variants

| 827 |                                                            | Page      |
|-----|------------------------------------------------------------|-----------|
|     | <b>Flacher Stirnanschliff rechts</b><br>Flat end cut right | <b>46</b> |

# 826

**2-Schneider**  
2-flute



**l1**  
38,1

**d2**  
3,175



|                |              |           |              |
|----------------|--------------|-----------|--------------|
| – FR-2/4(oc)   | ● FR-2/4(ic) | ○ CEM1/3  | ○ Filled/HTg |
| ● PE           | ● PTFE       | ● PMMA    | ● PI         |
| ● (Rigid) Flex | – Al         | ● Cu/CuZn | ○ MCL        |

| d <sub>1</sub> | l <sub>2</sub> | 826          |
|----------------|----------------|--------------|
| 0,200          | 0,7            | *            |
| 0,250          | 1,0            | *            |
| 0,300          | 1,0            | *            |
| 0,400          | 1,5            | *            |
| 0,500          | 3,0            | 88260500030X |
| 0,600          | 3,0            | 88260600030X |
| 0,700          | 3,0            | 88260700030X |
| 0,800          | 5,0            | 88260800050X |
| 0,900          | 5,0            | 88260900050X |
| 1,000          | 5,0            | 88261000050X |
| 1,100          | 5,0            | 88261100050X |
| 1,200          | 5,0            | 88261200050X |
| 1,300          | 5,0            | 88261300050X |
| 1,400          | 5,0            | 88261400050X |

| d <sub>1</sub> | l <sub>2</sub> | 826          |
|----------------|----------------|--------------|
| 1,500          | 6,0            | 38261500060X |
| 1,600          | 6,0            | 38261600060X |
| 1,700          | 6,0            | 38261700060X |
| 1,800          | 6,0            | 38261800060X |
| 1,900          | 6,0            | 38261900060X |
| 2,000          | 8,0            | 38262000080X |
| 2,100          | 8,0            | 38262100080X |
| 2,200          | 8,0            | 38262200080X |
| 2,300          | 8,0            | 38262300080X |
| 2,400          | 8,0            | 38262400080X |
| 2,500          | 8,0            | 38262500080X |
| 3,000          | 10,0           | 38263000100X |
| 3,175          | 10,0           | 38263175100X |

\* Artikel auf Anfrage article on request

## Anwendungen & Vorteile

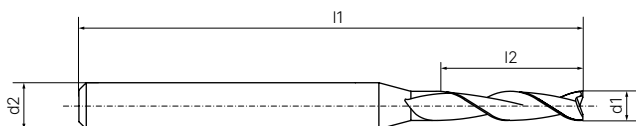
Applications & advantages

- › **Innenkonturen / Schlitz mit sehr hoher Qualitätsanforderungen** Inner contours / slots with high quality demands
- › **Beste Oberflächen- und Kantenqualität** Best surface and edge quality
- › **Sehr guter Spantransport** Excellent chip transport

## Weitere Varianten

Other variants

| 828* |                                                                  | Page      |
|------|------------------------------------------------------------------|-----------|
|      | <b>Flacher Stirnanschliff rechts</b><br>Flat face grinding right | <b>47</b> |



|                   |                    |  |  |
|-------------------|--------------------|--|--|
| <b>l1</b><br>38,1 | <b>d2</b><br>3,175 |  |  |
|-------------------|--------------------|--|--|

|                |              |           |              |
|----------------|--------------|-----------|--------------|
| – FR-2/4(oc)   | ● FR-2/4(ic) | ○ CEM1/3  | ○ Filled/HTg |
| ● PE           | ● PTFE       | ● PMMA    | ● PI         |
| ● (Rigid) Flex | – Al         | ○ Cu/CuZn | ○ MCL        |

| d <sub>1</sub> | l <sub>2</sub> | 827          |
|----------------|----------------|--------------|
| 0,500          | 4,0            | 88270500040X |
| 0,600          | 3,0            | 88270600040X |
| 0,700          | 3,0            | 88270700030X |
| 0,700          | 4,0            | 88270700040X |
| 0,800          | 5,0            | 88270800050X |
| 0,900          | 5,0            | 88270900050X |
| 1,000          | 5,0            | 38271000050X |
| 1,100          | 5,0            | 38271100050X |
| 1,200          | 5,0            | 38271200050X |
| 1,300          | 5,0            | 38271300050X |
| 1,400          | 5,0            | 38271400050X |
| 1,500          | 6,0            | 38271500060X |

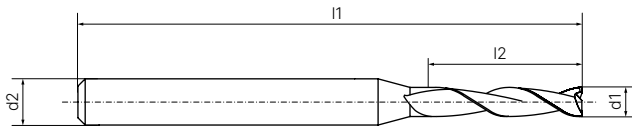
| d <sub>1</sub> | l <sub>2</sub> | 827          |
|----------------|----------------|--------------|
| 1,600          | 6,0            | 38271600060X |
| 1,700          | 6,0            | 38271700060X |
| 1,800          | 6,0            | 38271800060X |
| 1,900          | 6,0            | 38271900060X |
| 2,000          | 8,0            | 38272000080X |
| 2,100          | 8,0            | 38272100080X |
| 2,200          | 8,0            | 38272200080X |
| 2,300          | 8,0            | 38272300080X |
| 2,400          | 8,0            | 38272400080X |
| 2,500          | 8,0            | *            |
| 3,000          | 10,0           | 38273000100X |
| 3,175          | 10,0           | *            |

\* Artikel auf Anfrage article on request

### Anwendungen & Vorteile

Applications & advantages

- › **Für Tiefenfräsungen** For depth routing
- › **Innenkonturen / Schlitze mit sehr hohen Qualitätsanforderungen** Inner contours / slots with high quality demands
- › **Sehr guter Spantransport** Excellent chip transport
- › **Zentrumsschneidend** Center cutting
- › **Extrascharfe Schneide** Extra sharp cutting edge

l1  
38,1d2  
3,175

|                |              |           |              |
|----------------|--------------|-----------|--------------|
| – FR-2/4(oc)   | ● FR-2/4(ic) | ○ CEM1/3  | ○ Filled/HTg |
| ● PE           | ● PTFE       | ● PMMA    | ● PI         |
| ● (Rigid) Flex | ○ Al         | ● Cu/CuZn | ○ MCL        |

| d <sub>1</sub> | l <sub>2</sub> | 828          |
|----------------|----------------|--------------|
| 0,200          | 0,7            | *            |
| 0,250          | 1,0            | *            |
| 0,300          | 1,0            | *            |
| 0,400          | 1,5            | 88280400015X |
| 0,500          | 3,0            | 88280500030X |
| 0,600          | 3,0            | 88280600030X |
| 0,700          | 3,0            | 88280700030X |
| 0,800          | 5,0            | 88280800050X |
| 0,900          | 5,0            | 88280900050X |
| 1,000          | 5,0            | 88281000050X |
| 1,100          | 5,0            | 88281100050X |
| 1,200          | 5,0            | 88281200050X |
| 1,300          | 5,0            | 88281300050X |
| 1,400          | 5,0            | 88281400050X |

| d <sub>1</sub> | l <sub>2</sub> | 828          |
|----------------|----------------|--------------|
| 1,500          | 6,0            | 38281500060X |
| 1,600          | 6,0            | 38281600060X |
| 1,700          | 6,0            | 38281700060X |
| 1,800          | 6,0            | 38281800060X |
| 1,900          | 6,0            | 38281900060X |
| 2,000          | 8,0            | 38282000080X |
| 2,100          | 8,0            | 38282100080X |
| 2,200          | 8,0            | 38282200080X |
| 2,300          | 8,0            | 38282300080X |
| 2,400          | 8,0            | 38282400080X |
| 2,500          | 8,0            | 38282500080X |
| 3,000          | 10,0           | 38283000100X |
| 3,175          | 10,0           | 38283175100X |

\* Artikel auf Anfrage article on request

**Anwendungen & Vorteile**

Applications &amp; advantages

- **Für Tiefenfräsungen** For depth routing  
**Innenkonturen / Schlitze mit sehr hoher Qualitätsanforderungen** Inner contours / slots with high quality demands
- **Beste Oberflächen- und Kantenqualität**  
Best surface and edge quality
- **Sehr guter Spantransport** Excellent chip transport

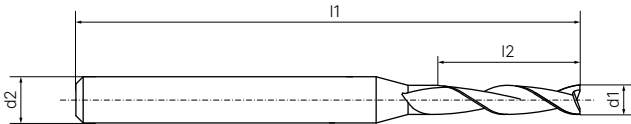
**Weitere Varianten**

Other variants

| 826                                                                                 |                                                                | Page      |
|-------------------------------------------------------------------------------------|----------------------------------------------------------------|-----------|
|  | <b>Fischschwanzanschliff rechts</b><br>Fishtail grinding right | <b>45</b> |

# 891

**2-Schneider, diamantbeschichtet**  
2-flute, diamond-coated



|                   |                    |  |  |
|-------------------|--------------------|--|--|
| <b>l1</b><br>38,1 | <b>d2</b><br>3,175 |  |  |
|-------------------|--------------------|--|--|

|                                               |                                     |                               |                                  |
|-----------------------------------------------|-------------------------------------|-------------------------------|----------------------------------|
| <input type="radio"/> FR-2/4(oc)              | <input type="radio"/> FR-2/4(ic)    | <input type="radio"/> CEM1/3  | <input type="radio"/> Filled/HTg |
| <input type="radio"/> PE                      | <input type="radio"/> PTFE          | <input type="radio"/> PMMA    | <input type="radio"/> PI         |
| <input checked="" type="radio"/> (Rigid) Flex | <input checked="" type="radio"/> Al | <input type="radio"/> Cu/CuZn | <input type="radio"/> MCL        |

| d <sub>1</sub> | l <sub>2</sub> | 891          |
|----------------|----------------|--------------|
| 1,000          | 3,0            | 38911000030X |
| 1,000          | 4,0            | *            |
| 1,100          | 3,0            | *            |
| 1,200          | 3,0            | *            |
| 1,200          | 4,0            | *            |
| 1,300          | 3,0            | *            |
| 1,400          | 3,0            | *            |
| 1,400          | 4,0            | *            |
| 1,500          | 4,0            | *            |
| 1,500          | 6,0            | 38911500060X |
| 1,600          | 4,0            | *            |
| 1,600          | 6,0            | 38911600060X |
| 1,700          | 6,0            | *            |
| 1,800          | 5,0            | *            |

| d <sub>1</sub> | l <sub>2</sub> | 891          |
|----------------|----------------|--------------|
| 1,800          | 6,0            | *            |
| 1,900          | 6,0            | *            |
| 2,000          | 4,0            | 38912000040X |
| 2,000          | 6,0            | 38912000060X |
| 2,100          | 6,0            | *            |
| 2,200          | 6,0            | *            |
| 2,300          | 6,0            | *            |
| 2,400          | 4,0            | *            |
| 2,400          | 6,0            | 38912400060X |
| 2,500          | 6,0            | *            |
| 3,000          | 4,0            | *            |
| 3,000          | 6,0            | 38913000060X |
| 3,175          | 6,0            | *            |

\* Artikel auf Anfrage article on request

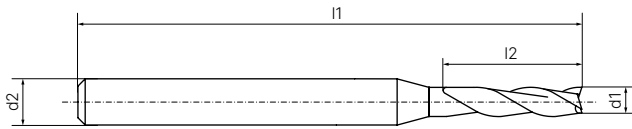
## Anwendungen & Vorteile

Applications & advantages

- › **Innenkonturen / Schlitz mit hohen Qualitätsanforderungen** Inner contours / slots with high quality demands
- › **Sehr guter Spantransport** Excellent chip transport
- › **Tiefenfräsungen möglich** Depth routing possible

# 836

**3-Schneider**  
3-flute



**l1**  
38,1

**d2**  
3,175



|                |              |           |              |
|----------------|--------------|-----------|--------------|
| — FR-2/4(oc)   | ● FR-2/4(ic) | ○ CEM1/3  | ○ Filled/HTg |
| ○ PE           | ○ PTFE       | ○ PMMA    | ● PI         |
| ○ (Rigid) Flex | — Al         | ○ Cu/CuZn | ○ MCL        |

| d <sub>1</sub> | l <sub>2</sub> | 836 |
|----------------|----------------|-----|
| 1,000          | 5,0            | *   |
| 1,100          | 5,0            | *   |
| 1,200          | 5,0            | *   |
| 1,300          | 5,0            | *   |
| 1,400          | 5,0            | *   |
| 1,500          | 7,0            | *   |
| 1,600          | 7,0            | *   |
| 1,700          | 7,0            | *   |
| 1,800          | 7,0            | *   |

| d <sub>1</sub> | l <sub>2</sub> | 836 |
|----------------|----------------|-----|
| 1,900          | 7,0            | *   |
| 2,000          | 9,0            | *   |
| 2,100          | 9,0            | *   |
| 2,200          | 9,0            | *   |
| 2,300          | 9,0            | *   |
| 2,400          | 9,0            | *   |
| 2,500          | 9,0            | *   |
| 3,000          | 9,0            | *   |
| 3,175          | 9,0            | *   |

\* Artikel auf Anfrage article on request

## Anwendungen & Vorteile

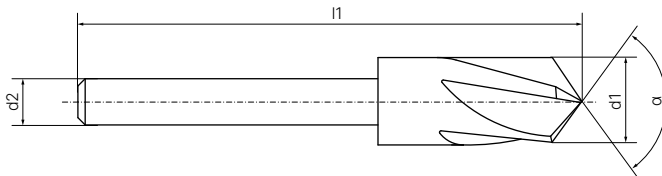
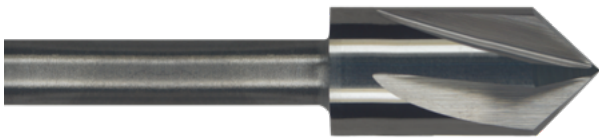
Applications & advantages

- › **Für Innenkonturen und metallisierte Schlitz**  
For inner contours and metallized slots
- › **Fräsen von Metalloberflächen** Routing metal surfaces
- › **Beste Oberflächen- und Kantenqualität**  
Best surface and edge quality
- › **Guter Spantransport** Good chip transport



# 850

**Kegelsenker**  
Countersink



$\alpha$  Spitzenwinkel point angle

|                   |                    |                                         |  |
|-------------------|--------------------|-----------------------------------------|--|
| <b>l1</b><br>38,1 | <b>d2</b><br>3,175 | <b><math>\alpha</math></b><br>90 - 140° |  |
|-------------------|--------------------|-----------------------------------------|--|

|                |              |           |              |
|----------------|--------------|-----------|--------------|
| ● FR-2/4(oc)   | ● FR-2/4(ic) | ● CEM1/3  | ● Filled/HTg |
| ● PE           | ● PTFE       | ● PMMA    | ● PI         |
| — (Rigid) Flex | ● Al         | ● Cu/CuZn | ○ MCL        |

| d <sub>1</sub> | $\alpha$ | 850          |
|----------------|----------|--------------|
| 6,000          | 90°      | 38506000090X |
| 6,000          | 120°     | 38506000120X |
| 6,000          | 140°     | 38506000140X |

Weitere Durchmesser und Spitzenwinkel auf Anfrage other diameters and point angles on request

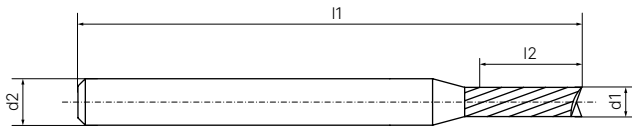
## Anwendungen & Vorteile

Applications & advantages

- › **Senken von Bohrungen** Countersinking of drill holes
- › **Anfasen von Leiterplatten** Chamfering of circuit boards

# 870

**Schlichtfräser**  
Contour finishing router



**l1**  
38,1

**d2**  
3,175



|                                    |                                  |                               |                                      |
|------------------------------------|----------------------------------|-------------------------------|--------------------------------------|
| <input type="radio"/> FR-2/4(oc)   | <input type="radio"/> FR-2/4(ic) | <input type="radio"/> CEM1/3  | <input type="radio"/> Filled/HTg     |
| <input type="radio"/> PE           | <input type="radio"/> PTFE       | <input type="radio"/> PMMA    | <input type="radio"/> PI             |
| <input type="radio"/> (Rigid) Flex | <input type="radio"/> Al         | <input type="radio"/> Cu/CuZn | <input checked="" type="radio"/> MCL |

| d <sub>1</sub> | l <sub>2</sub> | 870 |
|----------------|----------------|-----|
| 1,600          | 7,0            | *   |
| 2,000          | 7,0            | *   |
| 2,400          | 7,0            | *   |

\* Artikel auf Anfrage [article on request](#)

Weitere Artikel und Beschichtungen auf Anfrage [other articles and coatings on request](#)

## Anwendungen & Vorteile

Applications & advantages

- › **Gratfreies Fräsen von Galvanoanbindungen (Goldfingers) und Metalloberflächen**  
Burr-free routing of metal surfaces (goldfingers) and metal composite laminates
- › **Linksspiralig (Schnittdruck nach unten)**  
Left twisted (downward cutting pressure)

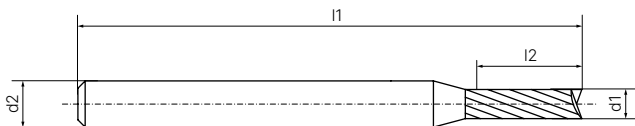
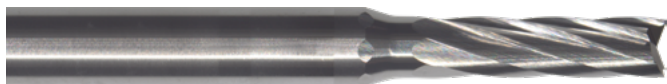
## Weitere Varianten

Other variants

| 876* |                                                                | Page |
|------|----------------------------------------------------------------|------|
|      | <b>Fischschwanzanschliff rechts</b><br>Fishtail grinding right | 52   |

# 876

## Schlichtfräser Contour finishing router



|                   |                    |  |  |
|-------------------|--------------------|--|--|
| <b>l1</b><br>38,1 | <b>d2</b><br>3,175 |  |  |
|-------------------|--------------------|--|--|

|                                    |                                  |                               |                                      |
|------------------------------------|----------------------------------|-------------------------------|--------------------------------------|
| <input type="radio"/> FR-2/4(oc)   | <input type="radio"/> FR-2/4(ic) | <input type="radio"/> CEM1/3  | <input type="radio"/> Filled/HTg     |
| <input type="radio"/> PE           | <input type="radio"/> PTFE       | <input type="radio"/> PMMA    | <input type="radio"/> PI             |
| <input type="radio"/> (Rigid) Flex | <input type="radio"/> Al         | <input type="radio"/> Cu/CuZn | <input checked="" type="radio"/> MCL |

| d <sub>1</sub> | l <sub>2</sub> | 876 |
|----------------|----------------|-----|
| 1,600          | 7,0            | *   |
| 2,000          | 7,0            | *   |
| 2,400          | 7,0            | *   |

\* Artikel auf Anfrage [article on request](#)  
Weitere Durchmesser auf Anfrage [other diameters on request](#)

### Anwendungen & Vorteile

Applications & advantages

- › **Gratfreies Fräsen von Galvanoanbindungen (Goldfingers) und Metalloberflächen**  
Burr-free routing of metal surfaces (goldfingers) and metal composite laminates

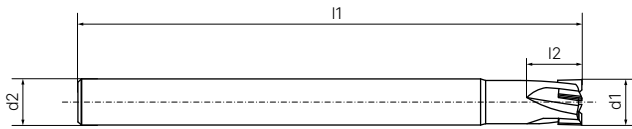
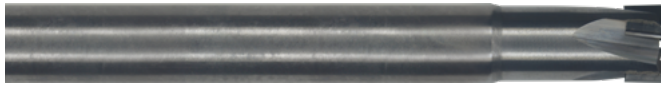
### Weitere Varianten

Other variants

| 870* |                                                                         | Page      |
|------|-------------------------------------------------------------------------|-----------|
|      | <b>Fischschwanzanschliff links</b><br>Fishtail grinding left (down cut) | <b>51</b> |

# 848

**PKD-Fräser**  
PCD router



**l1**  
38,1

**d2**  
3,175



0,05  
-0,10  
**45°**

|                |              |           |              |
|----------------|--------------|-----------|--------------|
| ● FR-2/4(oc)   | ● FR-2/4(ic) | ● CEM1/3  | ● Filled/HTg |
| ● PE           | ● PTFE       | ● PMMA    | ● PI         |
| — (Rigid) Flex | ● Al         | ● Cu/CuZn | ● MCL        |

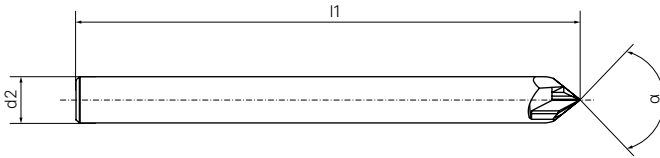
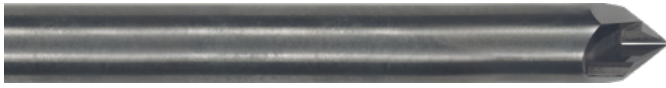
| d <sub>1</sub> | l <sub>2</sub> | Z | 848 |
|----------------|----------------|---|-----|
| 3,175          | 5,0            | 3 | *   |
| 4,000          | 5,0            | 3 | *   |
| 6,000          | 5,0            | 4 | *   |

\* Artikel auf Anfrage article on request

## Anwendungen & Vorteile

Applications & advantages

- › **Steigerung von Effizienz, Präzision und Wirtschaftlichkeit** Increased efficiency, precision, and cost-effectiveness
- › **Bessere Oberflächenqualität und Maßgenauigkeit** Better surface quality and dimensional accuracy
- › **Längere Standzeiten durch extreme Verschleißfestigkeit** Longer service life thanks to extreme wear resistance
- › **Steigerung der Produktivität durch höhere Schnittgeschwindigkeiten** Increased productivity through higher cutting speeds
- › **Für Tiefenfräsen geeignet** Suitable for depth routing



α Spitzenwinkel point angle

|            |             |                |  |
|------------|-------------|----------------|--|
| l1<br>38,1 | d2<br>3,175 | α<br>90 - 140° |  |
|------------|-------------|----------------|--|

|                |              |           |              |
|----------------|--------------|-----------|--------------|
| ● FR-2/4(oc)   | ● FR-2/4(ic) | ● CEM1/3  | ● Filled/HTg |
| ● PE           | ● PTFE       | ● PMMA    | ● PI         |
| — (Rigid) Flex | ● Al         | ● Cu/CuZn | ● MCL        |

| α    | 858 |
|------|-----|
| 90°  | *   |
| 120° | *   |
| 140° | *   |

\* Artikel auf Anfrage article on request

**Anwendungen & Vorteile**

Applications &amp; advantages

- › **Steigerung von Effizienz, Präzision und Wirtschaftlichkeit** Increased efficiency, precision, and cost-effectiveness
- › **Bessere Oberflächenqualität und Maßgenauigkeit** Better surface quality and dimensional accuracy
- › **Längere Standzeiten durch extreme Verschleißfestigkeit** Longer service life thanks to extreme wear resistance
- › **Steigerung der Produktivität durch höhere Schnittgeschwindigkeiten** Increased productivity through higher cutting speeds
- › **Senken von Bohrungen** Countersinking of drill holes
- › **Anfasen von Leiterplatten** Chamfering of circuit boards
- › **Gratfreies Fräsen von Galvanoanbindungen (Goldfingers) und Metalloberflächen** Burr-free routing of metal surfaces (goldfingers) and metal composite laminates





# PARAMETEREMPFEHLUNG BOHRER

## PARAMETER RECOMMENDATION DRILLS

**Kunde** Customer: **HPTEC Standard**

**Material<sup>1</sup>** material<sup>1</sup>: **FR 4 ≤ 6 layers**

**Spindeltyp** Spindle type: **Luftgelagert** Air Bearing

**Schnittgeschwindigkeit** Cutting speed:  **$v_c = 150$  m/min**

**Spindeldrehzahl<sup>1</sup>** Spindle speed<sup>1</sup>:  **$n_{max} = 125000$  rpm**

**D Durchmesser [mm]** Diameter [mm]

**f Vorschub/Umdrehung [mm/rev.]** Chip load [mm/rev.]

**F Vorschubgeschwindigkeit [m/min]** Feed rate [m/min]

**n Spindeldrehzahl<sup>1</sup> [rpm]** Spindle speed<sup>1</sup> [rpm]

**R Rückhubvorschub [m/min]** Retract feed [m/min]

| D    | f  | F   | n      | R    |
|------|----|-----|--------|------|
| 0,10 | 6  | 0,7 | 125000 | 2,0  |
| 0,15 | 10 | 1,2 | 125000 | 3,0  |
| 0,20 | 13 | 1,7 | 125000 | 4,0  |
| 0,25 | 18 | 2,3 | 125000 | 5,0  |
| 0,30 | 22 | 2,7 | 125000 | 6,0  |
| 0,35 | 25 | 3,1 | 125000 | 7,0  |
| 0,40 | 28 | 3,3 | 119000 | 8,0  |
| 0,45 | 31 | 3,3 | 106000 | 9,0  |
| 0,50 | 35 | 3,3 | 95000  | 10,0 |
| 0,55 | 40 | 3,5 | 87000  | 15,0 |
| 0,60 | 44 | 3,5 | 80000  | 20,0 |
| 0,65 | 48 | 3,5 | 73000  | 25,0 |
| 0,70 | 52 | 3,6 | 68000  | 25,0 |
| 0,75 | 57 | 3,6 | 64000  | 25,0 |
| 0,80 | 62 | 3,7 | 60000  | 25,0 |
| 0,85 | 67 | 3,7 | 56000  | 25,0 |
| 0,90 | 71 | 3,8 | 53000  | 25,0 |
| 0,95 | 76 | 3,8 | 50000  | 25,0 |
| 1,00 | 81 | 3,9 | 48000  | 25,0 |
| 1,05 | 86 | 3,8 | 45000  | 25,0 |
| 1,10 | 86 | 3,7 | 43000  | 25,0 |
| 1,15 | 86 | 3,6 | 42000  | 25,0 |
| 1,20 | 86 | 3,4 | 40000  | 25,0 |
| 1,25 | 86 | 3,2 | 38000  | 25,0 |
| 1,30 | 86 | 3,2 | 37000  | 25,0 |
| 1,35 | 86 | 3,0 | 35000  | 25,0 |
| 1,40 | 86 | 2,9 | 34000  | 25,0 |
| 1,45 | 86 | 2,8 | 33000  | 25,0 |
| 1,50 | 86 | 2,7 | 32000  | 25,0 |
| 1,55 | 86 | 2,7 | 31000  | 25,0 |
| 1,60 | 86 | 2,6 | 30000  | 25,0 |
| 1,65 | 86 | 2,5 | 29000  | 25,0 |
| 1,70 | 86 | 2,4 | 28000  | 25,0 |
| 1,75 | 86 | 2,3 | 27000  | 25,0 |
| 1,80 | 86 | 2,3 | 27000  | 25,0 |
| 1,85 | 86 | 2,2 | 26000  | 25,0 |
| 1,90 | 86 | 2,1 | 25000  | 25,0 |
| 1,95 | 86 | 2,1 | 24000  | 25,0 |
| 2,00 | 86 | 2,1 | 24000  | 25,0 |
| 2,05 | 86 | 2,0 | 23000  | 25,0 |
| 2,10 | 86 | 2,0 | 23000  | 25,0 |
| 2,15 | 86 | 1,9 | 22000  | 25,0 |
| 2,20 | 86 | 1,9 | 22000  | 25,0 |
| 2,25 | 86 | 1,8 | 21000  | 25,0 |

| D     | f  | F   | n     | R    |
|-------|----|-----|-------|------|
| 2,30  | 86 | 1,8 | 21000 | 25,0 |
| 2,35  | 86 | 1,7 | 20000 | 25,0 |
| 2,40  | 86 | 1,7 | 20000 | 25,0 |
| 2,45  | 86 | 1,7 | 20000 | 25,0 |
| 2,50  | 86 | 1,7 | 20000 | 25,0 |
| 2,55  | 86 | 1,7 | 20000 | 25,0 |
| 2,60  | 86 | 1,7 | 20000 | 25,0 |
| 2,65  | 86 | 1,7 | 20000 | 25,0 |
| 2,70  | 86 | 1,7 | 20000 | 25,0 |
| 2,75  | 86 | 1,7 | 20000 | 25,0 |
| 2,80  | 86 | 1,7 | 20000 | 25,0 |
| 2,85  | 86 | 1,7 | 20000 | 25,0 |
| 2,90  | 86 | 1,7 | 20000 | 25,0 |
| 2,95  | 86 | 1,7 | 20000 | 25,0 |
| 3,00  | 86 | 1,7 | 20000 | 25,0 |
| 3,05  | 86 | 1,7 | 20000 | 25,0 |
| 3,10  | 86 | 1,7 | 20000 | 25,0 |
| 3,15  | 86 | 1,7 | 20000 | 25,0 |
| 3,175 | 86 | 1,7 | 20000 | 25,0 |
| 3,20  | 43 | 0,9 | 20000 | 25,0 |
| 3,30  | 43 | 0,9 | 20000 | 25,0 |
| 3,40  | 43 | 0,9 | 20000 | 25,0 |
| 3,50  | 43 | 0,9 | 20000 | 25,0 |
| 3,60  | 43 | 0,9 | 20000 | 25,0 |
| 3,70  | 43 | 0,9 | 20000 | 25,0 |
| 3,80  | 43 | 0,9 | 20000 | 25,0 |
| 3,90  | 43 | 0,9 | 20000 | 25,0 |
| 4,00  | 40 | 0,8 | 20000 | 25,0 |
| 4,10  | 40 | 0,8 | 20000 | 25,0 |
| 4,20  | 40 | 0,8 | 20000 | 25,0 |
| 4,30  | 40 | 0,8 | 20000 | 25,0 |
| 4,40  | 40 | 0,8 | 20000 | 25,0 |
| 4,50  | 40 | 0,8 | 20000 | 25,0 |
| 4,60  | 40 | 0,8 | 20000 | 25,0 |
| 4,70  | 40 | 0,8 | 20000 | 25,0 |
| 4,80  | 40 | 0,8 | 20000 | 25,0 |
| 4,90  | 33 | 0,7 | 20000 | 25,0 |
| 5,00  | 33 | 0,7 | 20000 | 25,0 |
| 5,20  | 33 | 0,7 | 20000 | 25,0 |
| 5,40  | 33 | 0,7 | 20000 | 25,0 |
| 5,60  | 33 | 0,7 | 20000 | 25,0 |
| 5,80  | 33 | 0,7 | 20000 | 25,0 |
| 6,00  | 33 | 0,7 | 20000 | 25,0 |
| 6,50  | 33 | 0,7 | 20000 | 25,0 |

<sup>1</sup> Andere Materialien und Spindeldrehzahlen auf Anfrage other materials and spindle speeds on request



# PARAMETEREMPFEHLUNG LANGLOCHBOHRER

## PARAMETER RECOMMENDATION SLOT DRILLS

**Kunde** Customer: **HPTec Standard**

**Material<sup>1</sup>** material<sup>1</sup>: **FR 4**

**Spindeltyp** Spindle type: **Luftgelagert** Air Bearing

**Schnittgeschwindigkeit** Cutting speed:  **$v_c = 150$  m/min**

**Spindeldrehzahl<sup>1</sup>** Spindle speed<sup>1</sup>:  **$n_{max} = 125000$  rpm**

**D Durchmesser [mm]** Diameter [mm]

**f Vorschub/Umdrehung [mm/rev.]** Chip load [mm/rev.]

**F Vorschubgeschwindigkeit [m/min]** Feed rate [m/min]

**n Spindeldrehzahl<sup>1</sup> [rpm]** Spindle speed<sup>1</sup> [rpm]

**R Rückhubvorschub [m/min]** Retract feed [m/min]

| D    | f  | F   | n      | R    |
|------|----|-----|--------|------|
| 0,50 | 10 | 1,1 | 108000 | 10,0 |
| 0,55 | 17 | 1,7 | 98000  | 15,0 |
| 0,60 | 20 | 1,8 | 90000  | 20,0 |
| 0,65 | 27 | 2,2 | 83000  | 25,0 |
| 0,70 | 33 | 2,5 | 77000  | 25,0 |
| 0,75 | 35 | 2,5 | 72000  | 25,0 |
| 0,80 | 38 | 2,6 | 68000  | 25,0 |
| 0,85 | 40 | 2,6 | 64000  | 25,0 |
| 0,90 | 43 | 2,6 | 60000  | 25,0 |
| 0,95 | 47 | 2,7 | 57000  | 25,0 |
| 1,00 | 50 | 2,7 | 54000  | 25,0 |
| 1,05 | 52 | 2,3 | 45000  | 25,0 |
| 1,10 | 53 | 2,3 | 43000  | 25,0 |
| 1,15 | 55 | 2,3 | 42000  | 25,0 |
| 1,20 | 56 | 2,2 | 40000  | 25,0 |
| 1,25 | 58 | 2,2 | 38000  | 25,0 |
| 1,30 | 59 | 2,2 | 37000  | 25,0 |
| 1,35 | 61 | 2,1 | 35000  | 25,0 |
| 1,40 | 62 | 2,1 | 34000  | 25,0 |
| 1,45 | 63 | 2,1 | 33000  | 25,0 |
| 1,50 | 64 | 2,0 | 32000  | 25,0 |
| 1,55 | 66 | 2,0 | 31000  | 25,0 |
| 1,60 | 67 | 2,0 | 30000  | 25,0 |
| 1,65 | 68 | 2,0 | 29000  | 25,0 |
| 1,70 | 69 | 1,9 | 28000  | 25,0 |
| 1,75 | 70 | 1,9 | 27000  | 25,0 |
| 1,80 | 72 | 1,9 | 27000  | 25,0 |
| 1,85 | 74 | 1,9 | 26000  | 25,0 |

| D     | f  | F   | n     | R    |
|-------|----|-----|-------|------|
| 1,90  | 76 | 1,9 | 25000 | 25,0 |
| 1,95  | 78 | 1,9 | 24000 | 25,0 |
| 2,00  | 80 | 1,9 | 24000 | 25,0 |
| 2,05  | 80 | 1,8 | 23000 | 25,0 |
| 2,10  | 80 | 1,8 | 23000 | 25,0 |
| 2,15  | 80 | 1,8 | 22000 | 25,0 |
| 2,20  | 80 | 1,8 | 22000 | 25,0 |
| 2,25  | 80 | 1,7 | 21000 | 25,0 |
| 2,30  | 80 | 1,7 | 21000 | 25,0 |
| 2,35  | 80 | 1,6 | 20000 | 25,0 |
| 2,40  | 80 | 1,6 | 20000 | 25,0 |
| 2,45  | 80 | 1,6 | 20000 | 25,0 |
| 2,50  | 80 | 1,6 | 20000 | 25,0 |
| 2,55  | 70 | 1,4 | 20000 | 25,0 |
| 2,60  | 70 | 1,4 | 20000 | 25,0 |
| 2,65  | 70 | 1,4 | 20000 | 25,0 |
| 2,70  | 70 | 1,4 | 20000 | 25,0 |
| 2,75  | 70 | 1,4 | 20000 | 25,0 |
| 2,80  | 70 | 1,4 | 20000 | 25,0 |
| 2,85  | 70 | 1,4 | 20000 | 25,0 |
| 2,90  | 70 | 1,4 | 20000 | 25,0 |
| 2,95  | 70 | 1,4 | 20000 | 25,0 |
| 3,00  | 60 | 1,2 | 20000 | 25,0 |
| 3,05  | 60 | 1,2 | 20000 | 25,0 |
| 3,10  | 60 | 1,2 | 20000 | 25,0 |
| 3,15  | 60 | 1,2 | 20000 | 25,0 |
| 3,175 | 60 | 1,2 | 20000 | 25,0 |

<sup>1</sup> Andere Materialien und Spindeldrehzahlen auf Anfrage other materials and spindle speeds on request



# PARAMETEREMPFEHLUNG FRÄSER

## PARAMETER RECOMMENDATION ROUTER

**Kunde** Customer: **HPTec Standard**

**Material**<sup>1</sup> material<sup>1</sup>: **FR 4**

**Spindeltyp** Spindle type: **Luftgelagert** Air Bearing

**Werkzeugtyp** Tool type: **726 / 756**

**Schnittgeschwindigkeit** Cutting speed:  **$v_c = 220$  m/min**

**Spindeldrehzahl**<sup>1</sup> Spindle speed<sup>1</sup>:  **$n_{max} = 60000$  rpm**

**D** **Durchmesser [mm]** Diameter [mm]

**f** **Vorschub/Umdrehung [mm/rev.]** Chip load [mm/rev.]

**F (xy)** **Vorschub (xy) [m/min]** Table feed [m/min]

**n** **Spindeldrehzahl<sup>1</sup> [rpm]** Spindle speed<sup>1</sup> [rpm]

**F (z)** **Zustellung mit/ohne Vorbohren [m/min]**  
Infeed with/without pre-drilling [m/min]

**H** **Max. Stapelhöhe [mm]** Max. stack height [mm]

| D<br>[mm] | f<br>[μm/1] | F (xy)<br>[m/min] | n<br>Type 726<br>[rpm] | F (z)<br>w/o pre-drilling<br>[m/min] | F (z)<br>w/ pre-drilling<br>[m/min] | H<br>[mm] |
|-----------|-------------|-------------------|------------------------|--------------------------------------|-------------------------------------|-----------|
| 0,20      | 1           | 0,1               | 60000                  | 0,1                                  | 0,2                                 | 0,5       |
| 0,30      | 2           | 0,1               | 60000                  | 0,1                                  | 0,2                                 | 0,5       |
| 0,40      | 2           | 0,1               | 60000                  | 0,1                                  | 0,5                                 | 1,0       |
| 0,50      | 3           | 0,2               | 60000                  | 0,1                                  | 0,5                                 | 1,0       |
| 0,60      | 3           | 0,2               | 60000                  | 0,1                                  | 0,5                                 | 1,6       |
| 0,70      | 4           | 0,2               | 60000                  | 0,1                                  | 0,5                                 | 1,6       |
| 0,80      | 5           | 0,3               | 60000                  | 0,2                                  | 0,5                                 | 3,5       |
| 0,90      | 6           | 0,4               | 60000                  | 0,2                                  | 0,5                                 | 3,5       |
| 1,00      | 8           | 0,5               | 60000                  | 0,4                                  | 2,0                                 | 5,0       |
| 1,10      | 9           | 0,5               | 60000                  | 0,4                                  | 2,0                                 | 5,0       |
| 1,20      | 10          | 0,6               | 58000                  | 0,4                                  | 2,0                                 | 5,0       |
| 1,30      | 12          | 0,6               | 54000                  | 0,6                                  | 2,0                                 | 5,0       |
| 1,40      | 14          | 0,7               | 50000                  | 0,6                                  | 2,0                                 | 5,0       |
| 1,50      | 16          | 0,8               | 47000                  | 0,6                                  | 2,0                                 | 6,0       |
| 1,60      | 18          | 0,8               | 44000                  | 0,8                                  | 5,0                                 | 6,0       |
| 1,70      | 22          | 0,9               | 41000                  | 0,8                                  | 5,0                                 | 6,0       |
| 1,80      | 26          | 1,0               | 39000                  | 0,8                                  | 5,0                                 | 6,0       |
| 1,90      | 30          | 1,1               | 37000                  | 0,8                                  | 5,0                                 | 6,0       |
| 2,00      | 34          | 1,2               | 35000                  | 1,3                                  | 5,0                                 | 6,5       |
| 2,10      | 38          | 1,3               | 33000                  | 1,3                                  | 5,0                                 | 6,5       |
| 2,20      | 40          | 1,3               | 32000                  | 1,3                                  | 5,0                                 | 6,5       |
| 2,30      | 42          | 1,3               | 30000                  | 1,3                                  | 5,0                                 | 6,5       |
| 2,40      | 44          | 1,3               | 29000                  | 1,3                                  | 5,0                                 | 6,5       |
| 2,50      | 46          | 1,3               | 28000                  | 1,3                                  | 5,0                                 | 6,5       |
| 3,00      | 53          | 1,2               | 23000                  | 1,3                                  | 5,0                                 | 6,5       |
| 3,175     | 55          | 1,2               | 22000                  | 1,3                                  | 5,0                                 | 6,5       |

<sup>1</sup> Andere Materialien und Spindeldrehzahlen auf Anfrage other materials and spindle speeds on request

# BERECHNUNG SCHNITTPARAMETER

## CALCULATION OF CUTTING PARAMETERS

**Schnittgeschwindigkeit  $v_c$**   
Cutting speed  $v_c$

$$v_c = \frac{n \times D \times \pi}{1000}$$

**Spindeldrehzahl  $n$**   
Spindle speed  $n$

$$n = \frac{v_c}{D \times \pi} \times 1000$$

**$v_c$  Schnittgeschwindigkeit [m/min]**  
Cutting speed [m/min]

**$n$  Spindeldrehzahl [rpm]**  
Spindle speed [rpm]

**$D$  Nenndurchmesser [mm]**  
Nominal diameter [mm]

**$\pi$  3,14**

**Vorschub/Umdrehung  $f$**   
Chip load  $f$  (feed/revolution)

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

**Vorschubgeschwindigkeit  $F$**   
Feed rate  $F$

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

**$f$  Vorschub/Umdrehung [mm/rev.]**  
Chip load [mm/rev.]

**$F$  Vorschubgeschwindigkeit [m/min]**  
Feed rate [m/min]

**$n$  Spindeldrehzahl [1/min]**  
Spindle speed [1/min]

## BERECHNUNGSBEISPIEL

### CALCULATION EXAMPLE

**Schnittgeschwindigkeit  $v_c$**  150 m/min  
Cutting speed  $v_c$

**Vorschub/Umdrehung  $f$**  0,055 mm/rev  
Chip load  $f$

**Durchmesser  $D$**  0,7 mm  
Diameter  $D$

$$\text{Spindeldrehzahl } n = \frac{150 \text{ m/min}}{(0,7 \text{ mm} \times 3,14)} \times 1000 = 68243 \text{ rpm}$$

Spindle speed  $n$

**Gewählte Spindeldrehzahl:  $n = 68000$  rpm**  
Chosen spindle speed  $n$

$$\text{Vorschubgeschwindigkeit } F = \frac{(0,055 \text{ mm/rev} \times 68000 \text{ rpm})}{1000} = 3,74 \text{ m/min}$$

Feed rate  $F$

**Gewählte Vorschubgeschwindigkeit:  $F = 3,7$  m/min**  
Chosen feed rate  $F$

# FEHLERBEHEBUNG

## TROUBLESHOOTING

| Problem<br>Problem                                                                                              | Mögliche Ursachen<br>Possible causes                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Abhilfe<br>Remedy                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-----------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Bohrerbruch</b><br>Drill breakage                                                                            | <ul style="list-style-type: none"> <li>› <b>Spänestau im Schneidenbereich</b><br/>Chip jam in flute space</li> <li>› <b>Schneiddruck zu hoch</b><br/>Cutting pressure too high</li> <li>› <b>Rundlauffehler der Spindel</b><br/>Runout error of the spindle</li> <li>› <b>Verschmutzte/defekte Spannzange</b><br/>Dirty/defective collet</li> <li>› <b>Bohrerabweichung</b><br/>Drill deviation</li> <li>› <b>Ausbrüche an den Schneidkanten</b><br/>Chipping on the cutting edges</li> </ul> | <ul style="list-style-type: none"> <li>› <b>Passende Bohrer für spezifische Schnittbedingungen (Geometrie) verwenden, Absauganlage/Parameter prüfen</b> Use suitable drills for specific cutting conditions (geometry), check extraction system/parameters</li> <li>› <b>Vorschubgeschwindigkeit anpassen</b><br/>Adjusting feed rate</li> <li>› <b>Spindelrundlauf prüfen</b><br/>Check spindle run-out</li> <li>› <b>Spannzange reinigen/ersetzen</b><br/>Clean/replace collet</li> <li>› <b>Minimierung der Bohrerabweichung</b><br/>Minimization of drill deviation</li> <li>› <b>Richtige Werkzeughandhabung sicherstellen</b><br/>Ensure correct tool handling</li> </ul>                                                                                                                                                                                                   |
| <b>Ungenau Bohrlochpositionierung (Bohrerabweichung)</b><br>Inaccurate drill hole positioning (drill deviation) | <ul style="list-style-type: none"> <li>› <b>Schneidenlänge zu lang</b><br/>Flute length too long</li> <li>› <b>Rundlauffehler der Spindel</b><br/>Runout error of the spindle</li> <li>› <b>Verschmutzte/defekte Spannzange</b><br/>Dirty/defective collet</li> <li>› <b>Ungenauigkeit Auslenkung</b><br/>Pin hole inaccurate</li> <li>› <b>Zu hoher Bohrerverschleiß/Ausbrüche an den Schneidkanten</b> Excessive drill wear/chipping on the cutting edges</li> </ul>                        | <ul style="list-style-type: none"> <li>› <b>Schneidenlänge anpassen</b><br/>Adjust flute length</li> <li>› <b>Spindelrundlauf prüfen</b><br/>Check spindle run-out</li> <li>› <b>Spannzange reinigen/ersetzen</b><br/>Clean/replace collet</li> <li>› <b>Aufnahmebohrung prüfen</b><br/>Check pin hole</li> <li>› <b>Verringerung der Schlagzahl/Anzahl der Nachschleifvorgänge, Überprüfung der Schnittbedingungen, Werkzeughandhabung prüfen</b> Reduce the number of strokes/number of regrinding operations, check cutting conditions, check tool handling</li> </ul>                                                                                                                                                                                                                                                                                                         |
| <b>Schlechte Oberflächen- &amp; Lochqualität</b><br>Poor surface & hole quality                                 | <ul style="list-style-type: none"> <li>› <b>Abstrich durch ineffiziente Spanabfuhr</b><br/>Smear due to inefficient chip removal</li> <li>› <b>Zu hoher Bohrerverschleiß/Ausbrüche an den Schneidkanten</b> Excessive drill wear/chipping on the cutting edges</li> <li>› <b>Plattenmaterial unzureichend gehärtet</b><br/>Board material insufficiently hardened</li> </ul>                                                                                                                  | <ul style="list-style-type: none"> <li>› <b>Verbesserung der Spanabfuhr durch</b><br/>Improved chip removal through <ul style="list-style-type: none"> <li><b>1. Verbessertes Absaugsystem</b><br/>Improved extraction system</li> <li><b>2. Verwendung Werkzeuge mit geeigneter Geometrie (Kopfbohrer)</b> Use of tools with suitable geometry (spade type drills)</li> <li><b>3. Anpassung der Parameter</b><br/>Adjusting the parameters</li> </ul> </li> <li>› <b>Verringerung der Schlagzahl/Anzahl der Nachschleifvorgänge, Überprüfung der Schnittbedingungen, Werkzeughandhabung prüfen</b> Reduce the number of strokes/number of regrinding operations, check cutting conditions, check tool handling</li> <li>› <b>Kontrolle der Qualität des Laminats (mehrschichtige Pressbedingungen)</b> Check quality of the laminate (multilayer pressing conditions)</li> </ul> |
| <b>Nagelkopf</b><br>Nail heading                                                                                | <ul style="list-style-type: none"> <li>› <b>Vorschub-/Rückzugsgeschwindigkeit zu hoch/niedrig</b> Feed/retraction speed too high/low</li> <li>› <b>Falsche Schnittparameter</b><br/>Wrong cutting parameters</li> <li>› <b>Zu hoher Bohrerverschleiß/Ausbrüche an den Schneidkanten</b> Excessive drill wear/chipping on the cutting edges</li> </ul>                                                                                                                                         | <ul style="list-style-type: none"> <li>› <b>Vorschub-/Rückzugsgeschwindigkeit anpassen</b><br/>Adjusting the feed/retraction speed</li> <li>› <b>Empfohlene Parameter verwenden</b><br/>Use recommended parameters</li> <li>› <b>Anpassung der Schnittbedingungen an das verwendeten Laminat</b> Adaptation of the cutting conditions to the laminate used</li> <li>› <b>Verringerung der Schlagzahl/Anzahl der Nachschleifvorgänge, Überprüfung der Schnittbedingungen, Werkzeughandhabung prüfen</b> Reduce the number of strokes/number of regrinding operations, check cutting conditions, check tool handling</li> </ul>                                                                                                                                                                                                                                                     |

# FEHLERBEHEBUNG

## TROUBLESHOOTING

| Problem<br>Problem                                                                                 | Mögliche Ursachen<br>Possible causes                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Abhilfe<br>Remedy                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|----------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Nagelkopf</b><br>Nail heading                                                                   | <ul style="list-style-type: none"> <li>› <b>Verweilzeit des Bohrers am Scheitelpunkt zu lang</b> Dwell time of drill at cusp too long</li> </ul>                                                                                                                                                                                                                                                                                                                                          | <ul style="list-style-type: none"> <li>› <b>Verweilzeit reduzieren</b><br/>Reduce dwell time</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Verglasung</b><br>Smear of resin                                                                | <ul style="list-style-type: none"> <li>› <b>Überhöhte Bohrtemperaturen</b><br/>Excessive drilling temperatures</li> <li>› <b>Laminat unzureichend gehärtet</b><br/>Laminate insufficiently hardened</li> <li>› <b>Zu hoher Bohrerverschleiß/Ausbrüche an den Schneidkanten</b> Excessive drill wear/chipping on the cutting edges</li> <li>› <b>Unzureichender Abschmiervorgang</b><br/>Insufficient de-smear process</li> </ul>                                                          | <ul style="list-style-type: none"> <li>› <b>Spänestau im Schneidenbereich</b><br/>Chip jam in flute space</li> <li>› <b>Laminat prüfen</b><br/>Check laminate</li> <li>› <b>Verringerung der Schlagzahl/Anzahl der Nachschleifvorgänge, Überprüfung der Schnittbedingungen, Werkzeughandhabung prüfen</b> Reduce the number of strokes/number of regrinding operations, check cutting conditions, check tool handling</li> <li>› <b>Abschmiervorgang prüfen</b><br/>Check de-smear process</li> </ul>                                                                                                                                                                              |
| <b>Grat an der Eintrittsseite und/oder Austrittsseite</b><br>Burr on entry and/or exit side        | <ul style="list-style-type: none"> <li>› <b>Zu hoher Bohrerverschleiß/Ausbrüche an den Schneidkanten</b> Excessive drill wear/chipping on the cutting edges</li> <li>› <b>Vorschub-/Rückzugsgeschwindigkeit zu hoch/niedrig</b> Feed/retraction speed too high/low</li> <li>› <b>Einstiegs-/Stützmaterial zu weich</b><br/>Entry/backup material too soft</li> <li>› <b>Druckfußkraft unzureichend</b><br/>Pressure foot power insufficient</li> </ul>                                    | <ul style="list-style-type: none"> <li>› <b>Verringerung der Schlagzahl/Anzahl der Nachschleifvorgänge, Überprüfung der Schnittbedingungen, Werkzeughandhabung prüfen</b> Reduce the number of strokes/number of regrinding operations, check cutting conditions, check tool handling</li> <li>› <b>Vorschub-/Rückzugsgeschwindigkeit anpassen</b><br/>Adjusting the feed/retraction speed</li> <li>› <b>Verwendung von härterem Eingangs-/Backup-Material</b> Use harder entry/backup material</li> <li>› <b>Druck/korrekte Funktion des Druckfußes prüfen</b><br/>Check pressure/correct operation of pressure foot</li> </ul>                                                   |
| <b>Verunreinigungen Eingangs- und/oder Ausgangsseite</b><br>Contamination input and/or output side | <ul style="list-style-type: none"> <li>› <b>Falsche Schnittparameter</b><br/>Wrong cutting parameters</li> <li>› <b>Zu hoher Bohrerverschleiß/Ausbrüche an den Schneidkanten</b> Excessive drill wear/chipping on the cutting edges</li> <li>› <b>Druckfußkraft unzureichend</b><br/>Pressure foot power insufficient</li> <li>› <b>Einstiegs-/Stützmaterial zu weich</b><br/>Entry/backup material too soft</li> <li>› <b>Schlechte Laminatbindung</b><br/>Poor laminate bond</li> </ul> | <ul style="list-style-type: none"> <li>› <b>Empfohlene Parameter verwenden</b><br/>Use recommended parameters</li> <li>› <b>Verringerung der Schlagzahl/Anzahl der Nachschleifvorgänge, Überprüfung der Schnittbedingungen, Werkzeughandhabung prüfen</b> Reduce the number of strokes/number of regrinding operations, check cutting conditions, check tool handling</li> <li>› <b>Druck/korrekte Funktion des Druckfußes prüfen</b><br/>Check pressure/correct operation of pressure foot</li> <li>› <b>Verwendung von härterem Eingangs-/Backup-Material</b> Use harder entry/backup material</li> <li>› <b>Pressvorgang überprüfen</b><br/>Check pressing procedure</li> </ul> |
| <b>Deformation der inneren Schichten</b><br>Deformation of inner layers                            | <ul style="list-style-type: none"> <li>› <b>Spänestau im Schneidenbereich</b><br/>Chip jam in flute space</li> <li>› <b>Zu hoher Bohrerverschleiß/Ausbrüche an den Schneidkanten</b> Excessive drill wear/chipping on the cutting edges</li> <li>› <b>Schlechte Laminatbindung</b><br/>Poor laminate bond</li> </ul>                                                                                                                                                                      | <ul style="list-style-type: none"> <li>› <b>Passende Bohrer für spezifische Schnittbedingungen (Geometrie) verwenden, Absauganlage/Parameter prüfen</b> Use suitable drills for specific cutting conditions (geometry), check extraction system/parameters</li> <li>› <b>Verringerung der Schlagzahl/Anzahl der Nachschleifvorgänge, Überprüfung der Schnittbedingungen, Werkzeughandhabung prüfen</b> Reduce the number of strokes/number of regrinding operations, check cutting conditions, check tool handling</li> <li>› <b>Pressvorgang überprüfen</b><br/>Check pressing procedure</li> </ul>                                                                               |
| <b>Aufwickeln von Spänen am Bohrer</b><br>Winding of chips on the drill                            | <ul style="list-style-type: none"> <li>› <b>Unzureichende Späneabsaugung</b><br/>Insufficient chip extraction</li> <li>› <b>Vorschubgeschwindigkeit zu niedrig (Späne werden zu lang)</b> Feed speed too low (Chips become too long)</li> </ul>                                                                                                                                                                                                                                           | <ul style="list-style-type: none"> <li>› <b>Absauganlage reinigen/prüfen, ggf. leistungsfähigeres Absaugsystem verwenden</b> Clean/check extraction system, use a more powerful extraction system if necessary</li> <li>› <b>Vorschubgeschwindigkeit erhöhen</b><br/>Increase the feed speed</li> </ul>                                                                                                                                                                                                                                                                                                                                                                            |

# TECHNISCHE SYMBOLE

## TECHNICAL SYMBOLS



**Fischschwanzanschliff rechts / links**  
Fishtail grinding right / left



**M-Anchliff rechts / links**  
M-grinding right / left



**Flacher Stirnanschliff rechts / links**  
Flat face grinding right / left



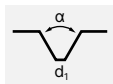
**Bohrspitzenanschliff rechts / links**  
Drill point cut right / left



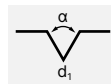
**Kopfbohrer rechts / links**  
Spade type right / left



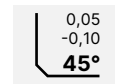
**Bearbeitungsrichtung axial, diagonal, radial**  
Machining direction axial, diagonal, radial



**Flache Ausführung**  
Flat version



**Spitze Ausführung**  
Pointed version



**Ecke 45°**  
Corner 45°



**Beschichtet**  
Coated

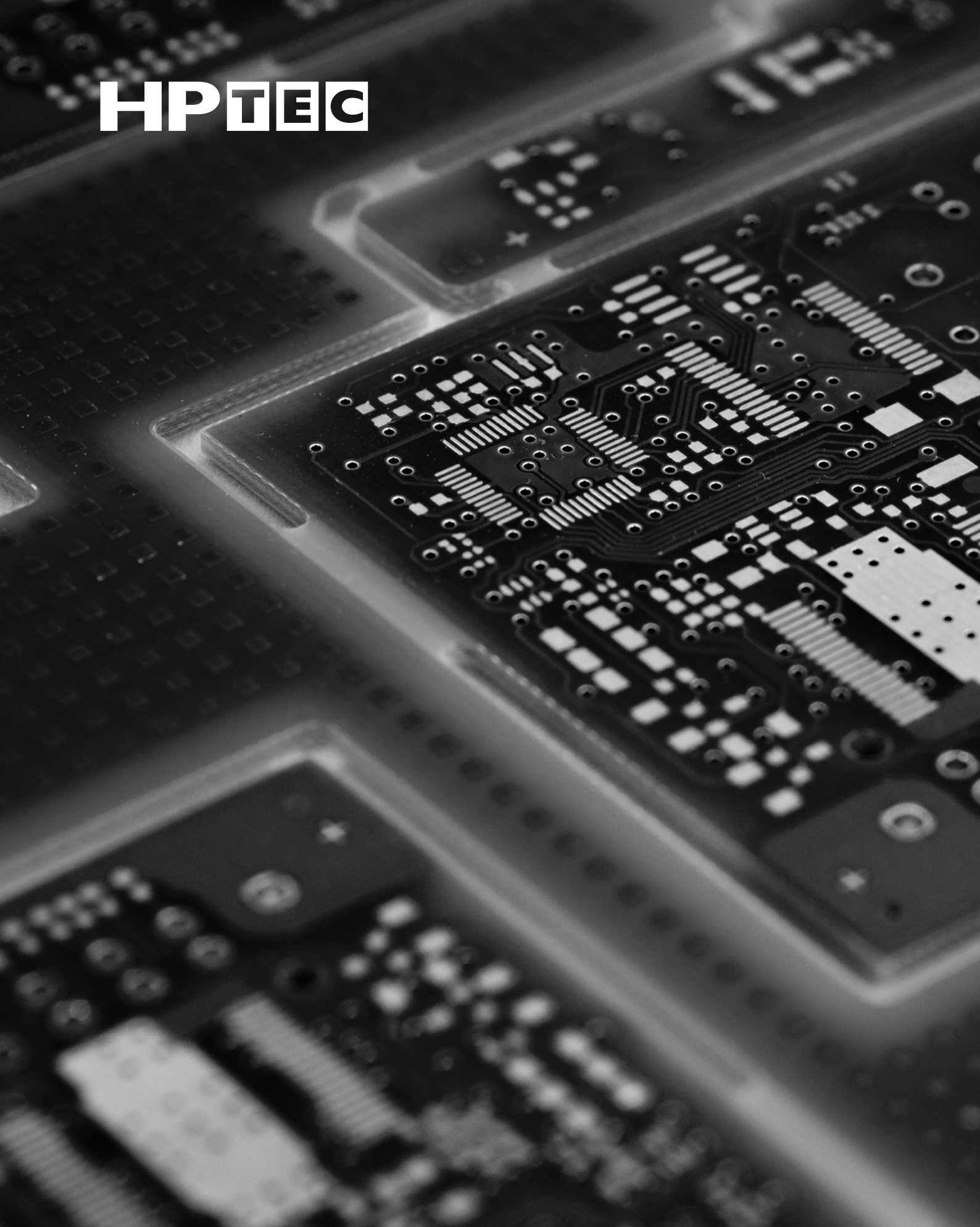


**Unbeschichtet**  
Uncoated

NOTIZEN  
NOTES

Grid of dots for notes.





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