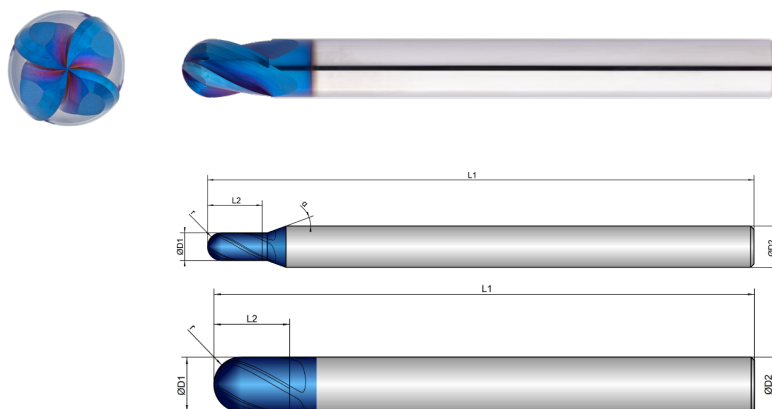


|           |                |
|-----------|----------------|
| Cooling   |                |
| Tolerance | f8             |
| Coating   | AlphaDura Navy |

|             |                               |
|-------------|-------------------------------|
| Strategy    | <b>HSC</b>                    |
| Application |                               |
| Features    | <b>HA</b> <b>1xD</b> <b>R</b> |



- Ultrafine carbide grade specially developed for machining hardened steels
  - Adapted rake angle for safe milling up to 70 HRC
  - Defined cutting edge preparation for homogeneous wear
- 
- Long version for deeper cavities
- 
- 4 cutting edges to the center
  - Radius tolerance  $r \leq 2 \text{ mm}$ :  $\pm 0.003 \text{ mm}$
  - Radius tolerance  $r > 2 \text{ mm}$ :  $\pm 0.005 \text{ mm}$













**Roughing**





**Finishing**









|         | D1               | L2   | L1    | D2               | z | r     |    | $\alpha$ |
|---------|------------------|------|-------|------------------|---|-------|----|----------|
| K203343 | mm $\varnothing$ | mm   | mm    | mm $\varnothing$ | # | mm    | °  | °        |
| 2/3     | 2.0              | 4.0  | 75.0  | 3.0              | 4 | 1.00  | 30 | 8        |
| 2/6     | 2.0              | 4.0  | 80.0  | 6.0              | 4 | 1.00  | 30 | 12       |
| 2,5/6   | 2.5              | 5.0  | 80.0  | 6.0              | 4 | 1.25  | 30 | 12       |
| 3/3     | 3.0              | 5.0  | 75.0  | 3.0              | 4 | 1.50  | 30 |          |
| 3/6     | 3.0              | 5.0  | 80.0  | 6.0              | 4 | 1.50  | 30 | 12       |
| 4/4     | 4.0              | 8.0  | 75.0  | 4.0              | 4 | 2.00  | 30 |          |
| 4/6     | 4.0              | 8.0  | 80.0  | 6.0              | 4 | 2.00  | 30 | 12       |
| 5/5     | 5.0              | 9.0  | 75.0  | 5.0              | 4 | 2.50  | 30 |          |
| 5/6     | 5.0              | 9.0  | 100.0 | 6.0              | 4 | 2.50  | 30 | 12       |
| 6/6     | 6.0              | 10.0 | 100.0 | 6.0              | 4 | 3.00  | 30 |          |
| 8/8     | 8.0              | 12.0 | 100.0 | 8.0              | 4 | 4.00  | 30 |          |
| 10/10   | 10.0             | 14.0 | 100.0 | 10.0             | 4 | 5.00  | 30 |          |
| 12/12   | 12.0             | 16.0 | 100.0 | 12.0             | 4 | 6.00  | 30 |          |
| 14/14   | 14.0             | 18.0 | 100.0 | 14.0             | 4 | 7.00  | 30 |          |
| 16/16   | 16.0             | 22.0 | 150.0 | 16.0             | 4 | 8.00  | 30 |          |
| 20/20   | 20.0             | 26.0 | 150.0 | 20.0             | 4 | 10.00 | 30 |          |

|          |                 | Dimension    | Ø2  | Ø2,5  | Ø3  | Ø4  | Ø5   | Ø6  | Ø8  | Ø10   | Ø12   | Ø14   |
|----------|-----------------|--------------|---|---|---|---|--|---|---|---|---|---|
|          |                 | Infeed in mm | ae=0,05xD<br>ap=0,05xD  | ae=0,05xD<br>ap=0,05xD  | ae=0,05xD<br>ap=0,05xD  | ae=0,05xD<br>ap=0,05xD  | ae=0,05xD<br>ap=0,05xD   | ae=0,05xD<br>ap=0,05xD  | ae=0,05xD<br>ap=0,05xD  | ae=0,05xD<br>ap=0,05xD  | ae=0,05xD<br>ap=0,05xD  | ae=0,05xD<br>ap=0,05xD  |
|          |                 | Application  |  |  |  |  |  |  |  |  |  |  |
| Material | Hardness in HRC | Feed (mm/Z)  | fz  | fz  | fz  | fz  | fz   | fz  | fz  | fz  | fz  | fz  |
| H        | HARDENED STEEL  | Vc (m/min)   |   |   |   |   |  |   |   |   |   |   |
| 1.1      | 46-55           | 145          | 0,03  | 0,031   | 0,034   | 0,045   | 0,06   | 0,07  | 0,09  | 0,1   | 0,12  | 0,12  |
| 1.2      | 56-60           | 115          | 0,029   | 0,03  | 0,033   | 0,042   | 0,058  | 0,068   | 0,085   | 0,095   | 0,11  | 0,11  |
| 1.3      | 60-65           | 100          | 0,028   | 0,029   | 0,032   | 0,04  | 0,055  | 0,065   | 0,08  | 0,09  | 0,1   | 0,1   |
| 1.4      | 66-70           | 75           | 0,024   | 0,025   | 0,028   | 0,035   | 0,05   | 0,06  | 0,07  | 0,08  | 0,09  | 0,09  |

|          |                 | Dimension    | Ø16   | Ø20   |
|----------|-----------------|--------------|---|---|
|          |                 | Infeed in mm | ae=0,05xD<br>ap=0,05xD  | ae=0,05xD<br>ap=0,05xD  |
|          |                 | Application  |  |  |
| Material | Hardness in HRC | Feed (mm/Z)  | fz  | fz  |
| H        | HARDENED STEEL  | Vc (m/min)   |   |   |
| 1.1      | 46-55           | 145          | 0,125   | 0,15  |
| 1.2      | 56-60           | 115          | 0,115   | 0,14  |
| 1.3      | 60-65           | 100          | 0,105   | 0,12  |
| 1.4      | 66-70           | 75           | 0,095   | 0,11  |

# EXPLANATION


























## APPLICATIONS

|   |   |  |   |
|---|---|--|---|
|  Multipass milling |  Trimming          |  Deburring                      |  Engraving |
|  Corner rounding   |  Full slot milling |  Forward and backward deburring |   |






## COOLINGS

|  |   |   |   |
|--|---|---|---|
|  Air-cooling                  |  Dry machining |  Oil cooling |  Cooling Lubricant |
|  Minimum quantity lubrication |   |   |   |

## FEATURES

















|   |   |   |   |
|---|---|---|---|
|  0,5xD                   |  1xD                       |  1,5xD                 |  2xD                 |
|  2,5xD                   |  3xD                       |  3,5xD                 |  4xD                 |
|  5xD                     |  Center cutting            |  Non-center cutting    |  Without Weldon      |
|  With Weldon             |  Internal cooling          |  Dynamic helical pitch |  Chip breaker        |
|  Unequal tooth pitch     |  Roughing teeth            |  Helical immersion     |  Feed directions x,y |
|  Feed directions x, y, z |  Feed directions x, y, (z) |  Corner radius         |  Corner bevel        |
|  Sharp edged             |   |   |   |

## STRATEGY

|   |  |  |  |
|---|--|--|--|
|  Extended Trochoidal Cutting |  High Performance Cutting |  High Speed Cutting |  Multi Task Cutting |
|  Universal Machining         |  |  |  |



## PROPERTIES

|  |  |  |   |
|--|--|--|---|
|  Cutting diameter   |  Small cutting diameter |  Large cutting diameter |  Undercut diameter |
|  Cutting length     |  Total bevel length     |  Undercut length        |  Total length      |
|  Shank diameter     |  Number of teeth        |  Corner radius          |  Corner bevel      |
|  Programming radius |  Maximum cutting depth  |  Helical angle          |  Alpha angle       |

## APPLICATION TABLE

The values given in the application table are only guidelines. These values are largely dependent on the machining situation and application.

## FIGURES

All technical drawings and photographs are given as an example. The product may deviate from the original in terms of colour and dimensions.

**H 1.1-1.4 HARDENED STEEL | 46-70 HRC**

| Materialnummer | Germany   DIN   | Europe   EN     | France   AFNOR       | Great Britain   BS | Italy   UNI         | Sweden   SIS | Spain   UNE    | Japan   JIS | USA   AISI |
|----------------|-----------------|-----------------|----------------------|--------------------|---------------------|--------------|----------------|-------------|------------|
| 1.2311         | 40CrMnMo7       |                 |                      | BP 20              | 35 CrMo 8 KU        |              |                |             | P 20       |
| 1.2312         | 40CrMnMoS86     |                 | 40 CMD 8             |                    |                     |              |                |             |            |
| 1.2316         | X36CrMo17       | X 36 CrMo 17    | X38CrMo 16 1         |                    | X 38 CrMo 16 1 KU   |              | X 38 CrMo 16   |             | D-4        |
| 1.2365         | X32CrMoV33      | X 32CrMoV 12 28 | 32 DCV 28            | BH 10              | 30 CrMoV 12 27 KU   |              | F.5313         | SKD 7       | H 10       |
| 1.2567         | X30WCrV53       | X 30 WCrV 5 3   | Z 32 WCV 5           |                    | X 30 WCrV 5 3 KU    |              |                | SKD 4       |            |
| 1.2581         | X30WCrV93       | X 30 WCrV 9 3   | Z 30 WCV 9           | BH 21              | X 30 WCrV 9 3 KU    |              | X 30 WCrV 9    | SKD 5       | H 21       |
| 1.2738         | 40CrMnNiMo864   |                 | 40 CMND 8            |                    |                     |              | F.5303         |             |            |
| 1.2885         | X32CrMoCoV333   |                 | 30 DCKV 28           |                    |                     |              |                |             |            |
| 1.4028         | X30Cr13         | X 30 Cr 13      | Z 30 Cr 13           | 420 S 45           | X 30 Cr 13          | 2304         | X 30 Cr 13     | SUS 420 J2  | 420        |
| 1.4031         | X40Cr13         | X 40 Cr 13      | Z 40 C 14            |                    | X 40 Cr 14          | 2304         | X 40 Cr 13     | SUS 420     | 420        |
| 1.4034         | X45Cr13         | X 45 Cr 13      | Z 40 C 14            | 420 S 45           | X 40 Cr 14          |              | X 46 Cr 13     |             | 420        |
| 1.4112         | X90CrMoV18      | X 90 CrMoV 18   | Z 3 CT 1 2           | 409 S 1 9          | X 6 Cr Ti 1 2       |              |                | SUS 440 B   | 440 B      |
| 1.5122         | 37 MnSi 4       |                 | 38 MS 5              |                    |                     |              |                |             |            |
| 1.6358         | X2NiCoMoTi 1895 |                 |                      |                    |                     |              |                |             |            |
| 1.6582         | 34CrNiMo6       |                 | 35 NCD 6             | 817 M 40           | 35 NiCrMo 6 (KW)    | 2541         | F.1270         | SNCM 447    | 4340       |
| 1.7003         | 38 Cr 2         |                 | 38 C 2               | 120 M 36           | 38 Cr 2             |              | F.1200         |             |            |
| 1.7006         | 46 Cr 2         |                 | 45 C 2               |                    | 4 5Cr 2             |              |                |             | 5045       |
| 1.7030         | 28 Cr 4         |                 |                      | 530 A 30           |                     |              |                |             | 5130       |
| 1.7176         | 55 Cr 3         |                 | 55 C 3               | 525 A 58           | 55 Cr 3             | 2253         | F.1431         | SUP 9       | 5155       |
| 1.0961         | 60SiCr7         | 60 SiCr 8       | 60 SC 7              | 250 A 61           | 60 SiCr 8           |              | 60 SiCr 8      | SUP 7       | 9262       |
| 1.1248         | Ck 75           |                 | XC 75                | 060 A 78           |                     | 1774         |                |             | 1078       |
| 1.1273         | 90Mn4           |                 |                      | 060 A 96           |                     |              |                | SUP 4       | 1090       |
| 1.2083         | X42Cr13         | X 42 Cr 13      | Z 40 C 14            |                    | X 41 Cr 13 KU       | 2314         |                | SUS 420 J2  | 420        |
| 1.2323         | 48CrMoV67       |                 | 45 CDV 6             |                    |                     |              |                |             |            |
| 1.2343         | X38CrMoVH1      | X 38 CrMoV 5 1  | Z 38 CDV 5           | BH 11              | X 37 CrMoV 5 1 KU   |              | X 37 CrMoV 5   | SKD 6       | H 11       |
| 1.2367         | X38CrMoV53      |                 | Z 38 CDV 5 3         |                    |                     |              |                |             |            |
| 1.2510         | 100 MnCrW 4     |                 | 90 MWCV 5            | B0 1               | 95 MnWCr 5 KU       | 2140         | F.5220         | SKS 3       | 0 1        |
| 1.2542         | 45WCrV7         | 45 WCrV 8       |                      | BS 1               | 45 WCrV 8 KU        | 2710         | 45 WCrSi 8     |             | S1         |
| 1.2550         | 60 WCrV 7       |                 | 55 WC 20             |                    | 55 WCrV 8 KU        |              |                |             |            |
| 1.2606         | X37CrMoW51      |                 | Z 35 CWDV 5          | BH 12              | X 35 CrMoW 05 KU    |              | F.537          | SKD 62      | H 12       |
| 1.2711         | 54 NiCrMoV      |                 | 55 NCDV 6            |                    |                     |              |                |             |            |
| 1.2713         | 55 NiCrMoV 6    |                 | 55 NCDV 7            |                    |                     |              | F.520.S        | SKT 4       | L 6        |
| 1.2764         | X19NiCrMo4      |                 |                      |                    |                     |              |                |             |            |
| 1.2767         | X45NiCrMo4      | 40 NiCrMo 4     | Y 35 NCD 16          |                    | 42 NiCrMo 15 7 KU   |              |                |             | A 9        |
| 1.4109         | X65CrMo14       | X 70 CrMo 15    | Z 70 CD 14           |                    |                     |              |                | SUS 440 A   | 440 A      |
| 1.1157         | 40Mn4           |                 | 35 M 5               | 150 M 36           |                     |              |                |             | 1039       |
| 1.1231         | Ck 67           |                 | XC 68                | 060 A 67           | C 70                | 1770         |                |             | 1070       |
| 1.1274         | Ck 101          |                 | XC 100               | 060 A 96           |                     | 1870         |                | SUP 4       | 1095       |
| 1.2080         | X210Cr12        |                 | Z 200 C 12           |                    | X 210 Cr 13 KU      |              |                | SKD 1       | D 3        |
| 1.2101         | 62SiMnCr4       |                 |                      |                    |                     |              |                |             |            |
| 1.2162         | 21MnCr5         | 21 MnCr 5       | 20 NC 5              |                    |                     |              |                | SCR 420 H   |            |
| 1.2201         | X165CrV12       |                 |                      |                    |                     |              |                |             |            |
| 1.2210         | 115CrV3         | 107 CrV 3 KU    | 100 C 3              |                    | 107 CrV 3 KU        |              | F.520.L        |             | L2         |
| 1.2341         | X6CrMo4         |                 |                      |                    |                     |              |                |             |            |
| 1.2379         | X155CrVMo121    | X 153 CrMoV 12  | Z 160 CDV 12         | BD 2               | X 155 CrVMo 12 1 KU | 2310         |                | SKD 11      | D 2        |
| 1.2419         | 105WCr6         | 105 WCr 5       | 105 WC 13            |                    | 107 WCr 5 KU        | 2140         | 105 WCr 5      | SKS 31      |            |
| 1.2601         | X165CrMoV12     | X 165 CrMoV 12  |                      |                    | X 165 CrMoW 12 KU   | 2310         | X 160 CrMoV 12 |             |            |
| 1.2721         | 50NiCr13        |                 |                      |                    |                     |              |                |             |            |
| 1.2735         | 15NiCr14        |                 | 10 NC 12             |                    |                     |              |                | SNC 22      |            |
| 1.2833         | 100V1           |                 | Y1 105 V             | BW 2               | 102 V 2 KU          |              |                | SKS 43      | W 210      |
| 1.2842         | 90MnCrV8        | 90 MnV 8        | 90 MV 8              | BO 2               | 90 MnVCr 8 KU       |              |                |             | 0 2        |
| 1.3505         | 100Cr6          |                 | 100 C 6              | 534 A 99           | 100 Cr 6            | 2258         | F.1310         | SUJ 2       | 52100      |
| 1.4125         | X105CrMo17      |                 | Z 100 CD 17          |                    | X 105 CrMo 17       |              |                | SUS 440 C   | 440 C      |
| 1.8161         | 58CrV4          |                 |                      |                    |                     |              |                |             |            |
| 1.1520         | C70W1           |                 |                      |                    |                     |              |                |             |            |
| 1.2363         | X100CrMoV51     | X 100 CrMoV 5 1 | Z 100 CDV 5          | BA 2               | X 100 CrMoV 5 1 KU  | 2260         | X 100 CrMoV 5  | SKD 12      | A 2        |
| 1.2436         | X210CrW12       | X 210 CrW 12    | Z 210 CW1 2          |                    | X 215 CrW 12 1 KU   | 2312         | X 210 CrW 12   | SKD 2       |            |
| 1.2880         | X165CrCoMo12    |                 |                      |                    |                     |              |                |             |            |
| 1.3202         | S12145          | HS12-1-5-5      |                      | BT 15              | HS 12-1-5-5         |              | 12-1-5-5       |             | T 15       |
| 1.3207         | S104310         | HS10-4-3-10     | Z130WKCDV10-10-04-04 | BT 42              | HS 10-4-3-10        |              | 10-4-3-10      | SKH 57      | M 44       |
| 1.3243         | S6525           | HS6-5-2-5       | KCV 06-05-05-04-02   |                    | HS 6-5-2-5          | 2723         | 6-5-2-5        | SKH 55      | M 35       |
| 1.3246         | S7425           | HS1-8-1         | Z110 WKCDV 07-05-04  | T 11341            | HS 7-4-2-5          |              | 7-4-2-5        |             | M 41       |
| 1.3247         | S21018          | HS2-9-1-8       | Z110 DKCWV 09-08-04  | BM 42              | HS 2-9-1-8          |              | 2-10-1-8       |             | M 42       |
| 1.3249         | S2928           |                 |                      | BM 34              |                     |              | 2-9-2-8        |             |            |

| Materialnumber | Germany   DIN | Europe   EN | France   AFNOR        | Great Britain   BS | Italy   UNI | Sweden   SIS | Spain   UNE | Japan   JIS | USA   AISI |
|----------------|---------------|-------------|-----------------------|--------------------|-------------|--------------|-------------|-------------|------------|
| 1.3257         | S181215       |             |                       |                    |             |              |             |             |            |
| 1.3333         | S332          | HS 3-3-2    |                       |                    | HS 3-3-2    |              |             |             |            |
| 1.3343         | S652          | HS6-5-3     | Z85 WDCV 06-05-04-02  | BM 2               | HS 6-5-2    | 2722         | 6-5-2       | SKH 51      | M2         |
| 1.3344         | S653          |             | Z120 WDCV 06-05-04-03 |                    |             |              | 6-5-3       | SKH 52      | M 3 Cl.2   |
| 1.3346         | S291          | HS1-8-1     | Z85 DCWV 08-04-02-01  | BM 1               | HS 1-8-1    |              |             |             | M1         |
| 1.3348         | S292          | HS2-9-2     | Z100 DCWV 09-04-02-02 |                    | HS 2-9-2    | 2782         | 2-9-2       |             | M 7        |
| 1.3355         | S1801         | HS18-0-1    | Z80 WCV 18-04-01      | BT 1               | HS 18-0-1   |              | 18-0-1      | SKH 2       | T 1        |
| 1.1654         | C 110 W       |             |                       |                    |             |              |             |             |            |

## Technical formulas

Calculate cutting speed (m/min)

$$V_c = \frac{D \cdot \pi \cdot n}{1000}$$

Calculate rotational speed (rpm)

$$n = \frac{V_c \cdot 1000}{D \cdot \pi}$$

Calculate feed rate (mm/min)

$$V_f = n \cdot z \cdot f_z$$

Calculate feed per tooth (mm/number of teeth)

$$f_z = \frac{V_f}{n \cdot z}$$

Calculate chip removal rate (cm<sup>3</sup>/min)

$$Q = \frac{a_p \cdot a_e \cdot V_f}{1000}$$

Calculate average chip thickness (mm)

$$h_m = f_z \cdot \sqrt{\frac{a_e}{D}}$$

### Explanation of terms

|                      |                           |                         |
|----------------------|---------------------------|-------------------------|
| <b>V<sub>c</sub></b> | Cutting speed             | in m/min                |
| <b>n</b>             | Rotational speed          | in rpm                  |
| <b>V<sub>f</sub></b> | Feed rate                 | in mm/min               |
| <b>F<sub>z</sub></b> | Feed per tooth            | in mm/number of teeth   |
| <b>z</b>             | Number of teeth (cutting) |                         |
| <b>a<sub>p</sub></b> | Depth of cut              | in mm                   |
| <b>a<sub>e</sub></b> | Width of cut              | in mm                   |
| <b>h<sub>m</sub></b> | Average chip thickness    | in mm                   |
| <b>Q</b>             | Chip removal rate         | in cm <sup>3</sup> /min |
| <b>D</b>             | Diameter of tool          | in mm                   |