




Cooling 

Tolerance h6

Coating AlphaSlide Rainbow

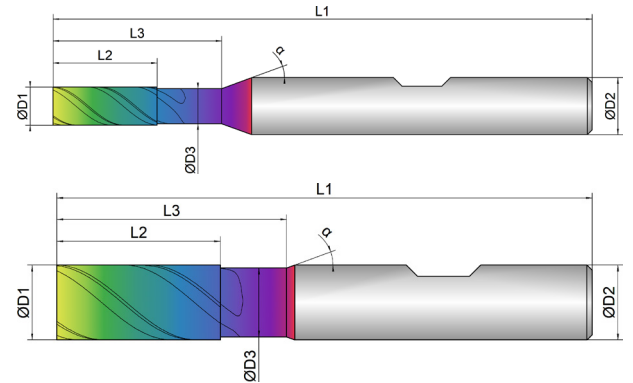
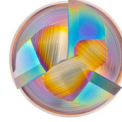
Strategy **ETC** **HPC**

Application 

Features **HB** **≠** **2xD** 



- Defined clearance angle for ideal stabilization with high cutting depths
  - Special helical pitch for smooth running and soft cut
  - Extra large chip chambers for an extreme chip volume
- 
- For process reliable, helical diving and immersion
  - For roughing and finishing, up to 2xD full slot
- 
- Sharp-edged version without edge protection




**Roughing**



**Finishing**



| EXN1-M01-0094 | D1<br>mm<br>∅ | D3<br>mm<br>∅ | L2<br>mm | L3<br>mm | L1<br>mm | D2<br>mm<br>∅ | z<br># |  | $\alpha$<br>° |
|---------------|---------------|---------------|----------|----------|----------|---------------|--------|---|---------------|
| 2             | 2.0           | 1.8           | 6.0      | 12.0     | 57.0     | 6.0           | 3      | 45  | 20            |
| 3             | 3.0           | 2.7           | 8.0      | 14.0     | 57.0     | 6.0           | 3      | 45  | 20            |
| 4             | 4.0           | 3.7           | 11.0     | 16.0     | 57.0     | 6.0           | 3      | 45  | 20            |
| 5             | 5.0           | 4.7           | 13.0     | 18.0     | 57.0     | 6.0           | 3      | 45  | 20            |
| 6             | 6.0           | 5.7           | 13.0     | 20.0     | 57.0     | 6.0           | 3      | 45  | 20            |
| 8             | 8.0           | 7.4           | 21.0     | 26.0     | 63.0     | 8.0           | 3      | 45  | 20            |
| 10            | 10.0          | 9.2           | 22.0     | 31.0     | 72.0     | 10.0          | 3      | 45  | 20            |
| 12            | 12.0          | 11.0          | 26.0     | 37.0     | 83.0     | 12.0          | 3      | 45  | 20            |
| 16            | 16.0          | 15.0          | 36.0     | 43.0     | 92.0     | 16.0          | 3      | 45  | 20            |
| 20            | 20.0          | 19.0          | 41.0     | 53.0     | 104.0    | 20.0          | 3      | 45  | 20            |



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| N       | Material                 | Strength (N/mm <sup>2</sup> ) | Full Slot  | Side Milling | Finishing  | ETC        | Materialgroup Factor fz / a | Materialgroup Factor ae ETC |
|---------|--------------------------|-------------------------------|------------|--------------|------------|------------|-----------------------------|-----------------------------|
|         |                          |                               | Vc = m/min | Vc = m/min   | Vc = m/min | Vc = m/min |                             |                             |
| 1.1     | ALUMINIUM   alloyed      | <500                          | 500        | 500          | 500        | 560        | 1                           | 1                           |
| 1.2     | ALUMINIUM   alloyed      | <600                          | 480        | 480          | 480        | 540        | 1                           | 1                           |
| 2.1-2.3 | ALUMINIUM   cast         | <600                          | 450        | 450          | 450        | 510        | 0.9                         | 0.8                         |
| 3.1-3.3 | COPPER   alloyed         | <650                          | 200        | 200          | 200        | 260        | 0.8                         | 0.7                         |
| 4.1     | MAGNESIUM   alloyed      | <250                          | 500        | 500          | 500        | 560        | 1                           | 1                           |
| 5.1     | PLASTICS   Thermoplastic | <100                          | 400        | 400          | 400        | 460        | 0.7                         | 0.8                         |
| 5.2     | PLASTICS   Duroplastic   | <150                          | 350        | 350          | 350        | 410        | 0.6                         | 0.7                         |








**ADVICE |** All fz/a values in the table for material group 1.1, consider factors for the other groups! Depending on the material, it may be necessary to change the Vc or Fz value. When helical and ramping reduce fz by 50 %. The specified values represent starting values for a solid clamping situation. To determine the hmax values, please use the provided calculator. The use of cooling lubricant is recommended for high process reliability.

**Material N 1.1**

| D1 | L2 | Immersion Angle | Full Slot |               |               | Side Milling |                 |         | Finishing |         |         | ETC       |                  |         |           |
|----|----|-----------------|-----------|---------------|---------------|--------------|-----------------|---------|-----------|---------|---------|-----------|------------------|---------|-----------|
|    |    |                 | fz (mm/Z) | ae = 1xD (mm) | ap = 1xD (mm) | fz (mm/Z)    | ae = 0.3xD (mm) | ap (mm) | fz (mm/Z) | ae (mm) | ap (mm) | fz (mm/Z) | ae = 0.25xD (mm) | ap (mm) | hmax (mm) |
| 2  | 6  | 1°              | 0.025     | 2             | 2             | 0.04         | 0.6             | L2max   | 0.018     | 0.2     | L2max   | 0.06      | 0.5              | L2max   | 0.052     |
| 3  | 8  | 1°              | 0.04      | 3             | 3             | 0.05         | 0.9             | L2max   | 0.02      | 0.2     | L2max   | 0.07      | 0.75             | L2max   | 0.0606    |
| 4  | 11 | 1.2°            | 0.05      | 4             | 4             | 0.06         | 1.2             | L2max   | 0.021     | 0.2     | L2max   | 0.08      | 1                | L2max   | 0.0693    |
| 5  | 13 | 1.2°            | 0.055     | 5             | 5             | 0.07         | 1.5             | L2max   | 0.023     | 0.2     | L2max   | 0.09      | 1.25             | L2max   | 0.0779    |
| 6  | 13 | 1.5°            | 0.06      | 6             | 6             | 0.08         | 1.8             | L2max   | 0.025     | 0.2     | L2max   | 0.11      | 1.5              | L2max   | 0.0953    |
| 8  | 21 | 2°              | 0.08      | 8             | 8             | 0.09         | 2.4             | L2max   | 0.03      | 0.2     | L2max   | 0.12      | 2                | L2max   | 0.1039    |
| 10 | 22 | 2.5°            | 0.09      | 10            | 10            | 0.11         | 3               | L2max   | 0.035     | 0.2     | L2max   | 0.14      | 2.5              | L2max   | 0.1212    |
| 12 | 26 | 3°              | 0.1       | 12            | 12            | 0.13         | 3.6             | L2max   | 0.04      | 0.2     | L2max   | 0.16      | 3                | L2max   | 0.1386    |
| 16 | 36 | 4°              | 0.14      | 16            | 16            | 0.16         | 4.8             | L2max   | 0.045     | 0.2     | L2max   | 0.19      | 4                | L2max   | 0.1645    |
| 20 | 41 | 5°              | 0.18      | 20            | 20            | 0.2          | 6               | L2max   | 0.05      | 0.2     | L2max   | 0.23      | 5                | L2max   | 0.1992    |

# EXPLANATION


























## APPLICATIONS

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






## COOLINGS

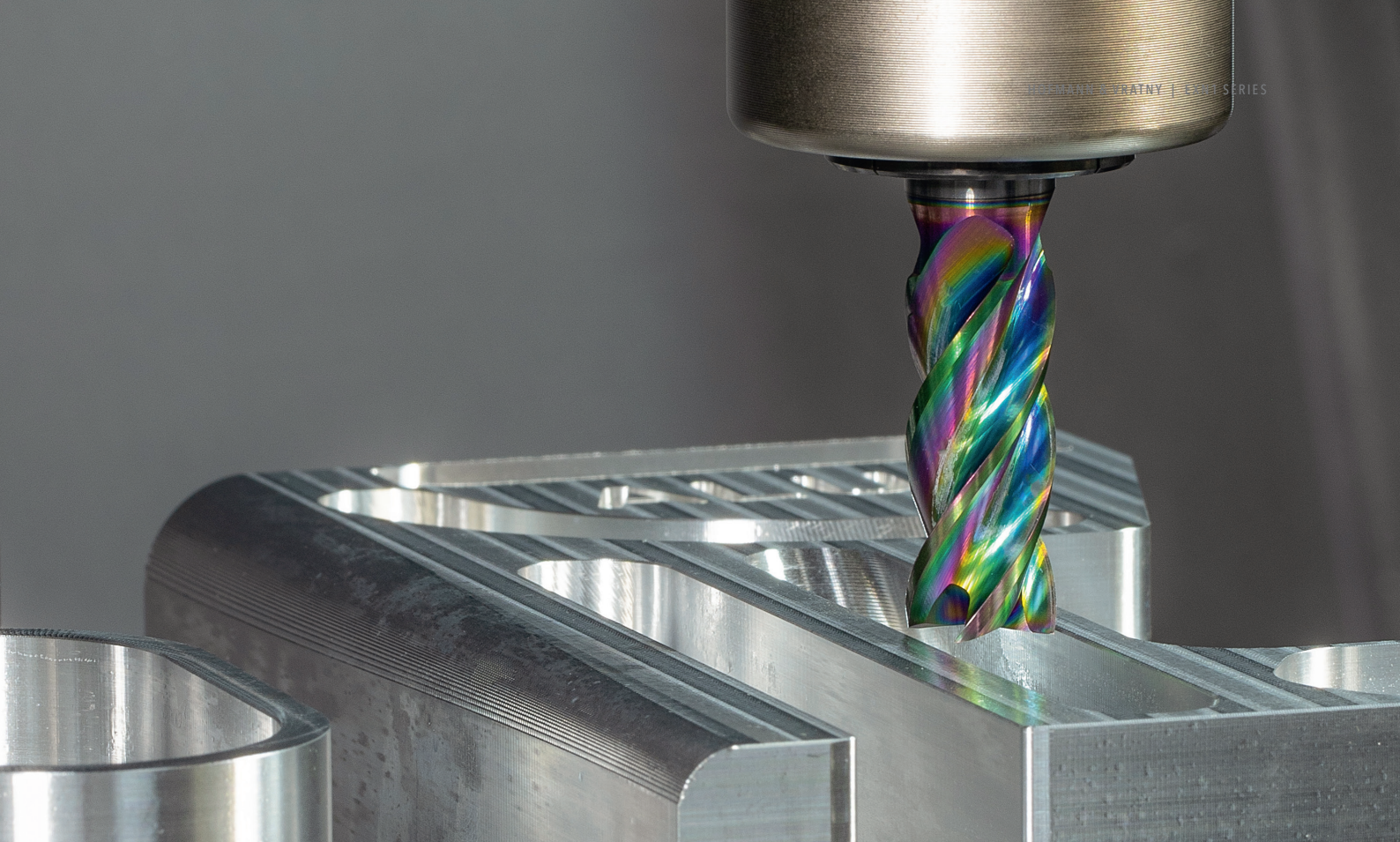
|  |   |   |   |
|--|---|---|---|
|  Air-cooling                  |  Dry machining |  Oil cooling |  Cooling Lubricant |
|  Minimum quantity lubrication |   |   |   |

## FEATURES

















|   |   |   |   |
|---|---|---|---|
|  0,5xD                   |  1xD                       |  1,5xD                 |  2xD                 |
|  2,5xD                   |  3xD                       |  3,5xD                 |  4xD                 |
|  5xD                     |  Center cutting            |  Non-center cutting    |  HA Without Weldon   |
|  HB 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         |  45° Corner bevel    |
|  90° Sharp edged         |   |   |   |

## STRATEGY

|   |  |  |  |
|---|--|--|--|
|  ETC Extended Trochoidal Cutting |  HPC High Performance Cutting |  HSC High Speed Cutting |  MTC Multi Task Cutting |
|  UNI 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.

**N 1.1 ALUMINIUM | alloyed <500 N/mm<sup>2</sup>**

| Materialnumber | Germany   DIN      | Europe   EN | France   AFNOR | Great Britain   BS | Italy   UNI       | Sweden   SIS | Spain   UNE | Japan   JIS | USA   AISI |
|----------------|--------------------|-------------|----------------|--------------------|-------------------|--------------|-------------|-------------|------------|
| 3.0205         | Al99               | AW-1200     | A 4            | 1 C                | P-Al99,0          | 4010         | L-3001      | A1200       | AA1200     |
| 3.0250         | Al99.5H            |             | A 59050 C      | L 31               |                   |              |             |             | AA1000     |
| 3.0255         | Al99.5             | AW-1050 A   | A 5            | L 31               | P-AIP99.5         | 4007         | L-3051      | A1050       | AA1050 A   |
| 3.0275         | Al99.7             | AW-1070 A   | A 7            | 2L 48              | P-AIP99.7         | 4005         | L-3071      | A1070       | AA1070 A   |
| 3.0280         | Al99.8             |             |                |                    |                   |              |             |             |            |
| 3.0285         | Al99.8             | AW-1080 A   | A 8            | 1A                 | P-Al99.8          | 4004         | L-3081      | A1080       | AA1080 A   |
| 3.0305         | Al99.9             | AW-1090     |                |                    |                   |              |             |             |            |
| 3.0505         | AlMn 0.5 Mg 0.5    | AW-3105     |                | N 31               |                   |              |             | A3105       | AA3105     |
| 3.0506         | AlMn 0.6           | AW-3207     |                |                    |                   |              |             |             |            |
| 3.0515         | AlMn 1             | AW-3103     |                | N 3                | P-AlMn 1.2        | 4067         | L-3811      | A3103       | AA3103     |
| 3.0517         | AlMn 1 Cu          | AW-3003     | A-M1           |                    | P-AlMn 1.2 Cu     |              | L-3810      | A3003       | AA3003     |
| 3.0525         | AlMn 1 Mg 0.5      | AW-3005     | A-MG0,5        |                    |                   |              |             | A3005       | AA3005     |
| 3.0526         | AlMn 1 Mg 1        | AW-3004     | A-M1G          |                    | P-AlMn 1.2 Mg     | GA/6511      | L-3820      | A3004       | AA3004     |
| 3.0915         | AlFeSi             | AW-8011A    |                |                    |                   |              |             |             |            |
| 3.1255         | AlCu 4 SiMg        | AW-2014     | A-U45G         | H 15               | P-AlCu 4.4 SiMnMg |              | L-3130      | A2014       | AA2014     |
| 3.1305         | AlCu 2.5 Mg        | AW-2117     | A-U2G          | L 86               | P-AlCu 2.5 MgSi   |              | L-3180      | A2117       | AA2117     |
| 3.1324         | AlCu 4 MgSi        | AW-2017 A   |                |                    |                   |              |             |             |            |
| 3.1325         | AlCuMg1            | AW-2017 A   | A-U4G          | H 14               | P-AlCu 4.5 MgMn   | GA631        | L-3120      | A2017       | AA2017 A   |
| 3.1355         | AlCuMg2            | AW-2024     | A-U4G1         | L 97 / L 98        | P-AlCu 4.5 MgMn   | 5            | L-3140      | A2024       | AA2024     |
| 3.1371         | G-AlCu 4 TiMg      | AC-21000    |                |                    |                   |              |             |             |            |
| 3.1841         | G-AlCu 4 Ti        | AC-21100    |                |                    |                   |              |             |             |            |
| 3.2134         | G-AlSi 5 Cu 1,3 Mg | AC-45300    |                |                    |                   |              |             |             |            |
| 3.2307         | Al99.85 MgSi       |             |                |                    |                   |              |             |             |            |
| 3.2315         | AlMgSi 1           | AW-6082     | A-SGM0,7       | H 30               | P-AlMgSi          | 4212         | L-3453      |             | AA6082     |
| 3.3206         | AlMgSi 0.5         | AW-6060     | A-GS           | H 9                | P-AlMgSi          | 4140         | L-3442      |             | AA6060     |
| 3.3208         | Al99.9 MgSi        | AW-6401     |                |                    |                   |              |             |             |            |
| 3.3210         | AlMgSi 0.7         | AW-6005 A   |                |                    |                   |              |             |             |            |
| 3.3211         | AlMg 1 SiCu        | AW-6061     | A-GSUC         | H 20               | P-AlMg 1 SiCu     |              | L-3420      | A6061       | AA6061     |
| 3.3241         | G-AlMg 3 Si        |             |                |                    |                   |              |             |             |            |
| 3.3261         | G-AlMg 5 Si        | AC-51400    |                |                    |                   |              |             |             |            |
| 3.3292         | GD-AlMg 9          | AC-51200    |                |                    |                   |              |             |             |            |
| 3.3307         | Al99.85 Mg 0.5     | AW-5110     |                |                    |                   |              |             |             |            |
| 3.3308         | Al99.9 Mg 0.5      | AW-5210     |                |                    |                   |              |             |             |            |
| 3.3315         | AlMg1              | AW-5005 A   | A-G0,6         | N 41               | P-AlMg 0.9        | 4106         | L-3350      | A5005       | AA5005 A   |
| 3.3316         | AlMg 1.5           | AW-5050     | A-G1,5         | 3L 44              | P-AlMg 1.5        |              | L-3380      |             | AA5050 B   |
| 3.3317         | Al99.85 Mg 1       | AW-5305     |                |                    |                   |              |             |             |            |
| 3.3318         | Al99.9 Mg 1        | AW-5505     |                |                    |                   |              |             |             |            |
| 3.3326         | AlMg 1.8           | AW-5051 A   |                |                    |                   |              |             |             |            |
| 3.3345         | AlMg 4.5           | AW-5082     | A-G4,5         |                    | P-AlMg 4.4        |              |             | A5082       | AA5082     |
| 3.3523         | AlMg 2.5           | AW-5052     | A-G2,5C        | L 80 / L 81        | P-AlMg 2.5        | 4120         | L-3360      | A5052       | AA5052     |
| 3.3525         | AlMg 2 Mn 0.3      | AW-5251     | A-G2M          | N4                 | P-AlMg 2 Mn       |              | L-3361      |             | AA5251     |
| 3.3527         | AlMg 2 Mn 0.8      | AW-5049     | A-G2,5MC       |                    |                   |              |             | A5049       | AA5049     |
| 3.3535         | AlMg 3             | AW-5754     | A-G3M          |                    | P-AlMg 3.5        | 4130         | L-3390      |             | AA5754     |
| 3.3537         | AlMg 2.7 Mn        | AW-5454     | A-G2,5MC       |                    | P-AlMg 2.7 Mn     | 4130         | L-3391      |             | AA5454     |
| 3.3541         | G-AlMg 3           | AC-51100    |                |                    |                   |              |             |             |            |
| 3.3545         | AlMg 4 Mn          | AW-5086     | A-G4MC         |                    | P-AlMg 4.4        |              | L-3382      |             | AA5086     |
| 3.3547         | AlMg 4.5 Mn        | AW-5083     | A-G4,5MC       | N 8                | P-AlMg 4.5        | 4140         | L-3321      | A5083       | AA5083     |
| 3.3549         | AlMg 5 Mn          | AW-5182     |                |                    |                   |              |             |             |            |
| 3.3555         | AlMg 5             | AW-5019     |                |                    |                   |              |             |             |            |
| 3.3561         | G-AlMg 5           | AC-51300    |                |                    |                   |              |             |             |            |

**N 1.2 ALUMINIUM | alloyed <600 N/mm<sup>2</sup>**

| Materialnumber | Germany   DIN | Europe   EN | France   AFNOR | Great Britain   BS | Italy   UNI     | Sweden   SIS | Spain   UNE | Japan   JIS | USA   AISI |
|----------------|---------------|-------------|----------------|--------------------|-----------------|--------------|-------------|-------------|------------|
| 3.0615         | AlMgSiPb      | AW-6012     | A-SGPb         |                    | P-AlSiMgMn      |              | L-3452      |             | AA6012     |
| 3.1645         | AlCu 4 PbMgMn | AW-2007     |                |                    |                 | 4355         | L-3121      | A2007       | AA2007     |
| 3.1655         | AlCu 6 BiPb   | AW-2011     | A-U5PbBi       | FC 1               | P-AlCu 5.5 PbBi | 4338         | L-3192      | A2011       | AA2011     |
| 3.4335         | AlZn 4.5 Mg 1 | AW-7020     | A-Z5G          | H 17               |                 | 4425         | L-3741      |             | AA7020     |
| 3.4345         | AlZnMgCu 0.5  | AW-7022     | A-Z4GU         |                    |                 |              |             |             | AA7022     |
| 3.4365         | AlZnMgCu 1.5  | AW-7075     | A-Z5GU         | 2L 95              | P-AlZn 5.8 MgCu |              | L-3710      | A7075       | AA7075     |

**N 2.1 - N 2.3 ALUMINIUM | cast <600 N/mm<sup>2</sup>**

| Materialnumber | Germany   DIN    | Europe   EN | France   AFNOR | Great Britain   BS | Italy   UNI | Sweden   SIS | Spain   UNE | Japan   JIS | USA   AISI |
|----------------|------------------|-------------|----------------|--------------------|-------------|--------------|-------------|-------------|------------|
| 3.1841         | G-AlCu 4 Ti      |             |                |                    |             |              |             | AC1A        | A 295.0    |
| 3.1871         | G-AlCu 4 TiMg    |             |                |                    |             |              |             |             |            |
| 3.2131         | G-AlSiCu1        |             |                |                    |             |              |             |             |            |
| 3.2151         | G-AlSi 6 Cu 4    | AC-45000    | A-S5UZ         | LM 4               |             |              |             | AC4B        | A 319.0    |
| 3.2161         | G-AlSi 8 Cu 3    | AC-46200    | A-S9U3A-Y4     | LM 24              | 5075        |              |             | AC4D        | A 328.0    |
| 3.2163         | GD-AlSi 9 Cu 3   |             |                |                    |             |              |             |             |            |
| 3.2211         | G-AlSi 11        |             |                |                    |             |              |             |             |            |
| 3.2341         | G-AlSi 5 Mg      |             |                |                    |             |              |             |             |            |
| 3.2371         | G-AlSi 7 Mg 0,3  | AC-42100    |                |                    |             |              |             | AC4CH       | A 356.0    |
| 3.2373         | G-AlSi 9 Mg      | AC-43300    |                |                    |             |              |             |             |            |
| 3.2381         | G-AlSi 10 Mg     | AC-43100    |                |                    |             |              |             |             |            |
| 3.2382         | GD-AlSi 10 Mg    |             |                |                    |             |              |             |             |            |
| 3.2383         | G-AlSi 10 Mg(Cu) | AC-43400    | A-S10G         | LM 9               | 3049        | 4253         |             | ADC3        | A 360.2    |
| 3.2581         | G-AlSi 12        | AC-47100    | A-S13          | LM 6               | 4514        | 4261         |             | AC3A        | A 413.2    |
| 3.2582         | GD-AlSi 12       |             |                |                    |             | 4247         |             | ADC1        | A 413.0    |
| 3.2583         | G-AlSi 12 Cu     | AC-44300    | A-S12-Y4       | LM 20              | 5079        | 4260         |             | ADC1        | A 413.1    |
| 3.2585         | SG-AlSi12        |             |                |                    |             |              |             |             |            |
| 3.2982         | GD-AlSi 12 Cu    |             |                |                    |             |              |             |             |            |
| 3.3241         | G-ALMg 3 Si      |             |                |                    |             |              |             |             |            |
| 3.3261         | G-ALMg 5 Si      |             |                |                    |             |              |             |             |            |
| 3.3561         | G-ALMg 5         |             |                |                    |             |              |             | AC7A        | A 514.0    |

**N 3.1 COPPER | alloyed <600 N/mm<sup>2</sup>**

| Materialnumber | Germany   DIN     | Europe   EN | France   AFNOR | Great Britain   BS | Italy   UNI | Sweden   SIS | Spain   UNE | Japan   JIS | USA   AISI |
|----------------|-------------------|-------------|----------------|--------------------|-------------|--------------|-------------|-------------|------------|
| 2.0060         | E-Cu 57           | CW-004A     |                |                    |             |              |             |             | B-120      |
| 2.0065         | E-Cu 58           | CW-004A     | Sn-a2          | C 101              |             |              |             |             | C 11000    |
| 2.0070         | SE-Cu             | CW-020A     | Cu-c1          | C 101              |             |              |             |             | C 10300    |
| 2.0082         | G-Cu L 45         |             |                | HCC 1              |             |              |             |             | C 81100    |
| 2.0085         | G-Cu L 50         | CC-040A     |                | HCC 1              |             |              |             |             | C 81100    |
| 2.0240         | CuZn 15           | CW-502L     | CuZn 15        | CZ 102             |             |              |             | C 2300      | C 23000    |
| 2.0265         | CuZn 30           | CW-505L     | CuZn 30        | CZ 102             |             |              |             | C 2600      | C 26000    |
| 2.0321         | CuZn 37           | CW-508L     | CuZn 37        | CZ 180             | C 2720      |              |             |             | C 27200    |
| 2.0340         | G-CuZn 37 Pb      | CC-754S-GM  |                |                    |             |              |             |             |            |
| 2.0492         | G-CuZn 15 Si 4    | CC-761S-GS  |                |                    |             |              |             |             | B-198      |
| 2.0592         | G-CuZn 35 Al 1    | CC-765S     | U-Z 36 N 3     | HTB 1              |             |              |             |             | C 86500    |
| 2.0595         | G-KCuZn 37 Al 1   | CC-766S     |                |                    |             |              |             |             |            |
| 2.0596         | G-CuZn 34 Al 2    | CC-764S     | U-Z 36 N 3     |                    |             |              |             |             |            |
| 2.0857         | CuNi 3 Si         | CW-112C     |                |                    |             |              |             |             |            |
| 2.0916         | CuAl 5            |             |                |                    |             |              |             |             |            |
| 2.0927         | SG-CuAl 9 Ni 5 Fe |             |                |                    |             |              |             |             |            |
| 2.0936         | CuAl 10 Fe 3 Mn 2 | CW-306G     | U-A 10 Fe      | CA 103             |             |              |             |             |            |
| 2.0966         | CuAl 10 Ni 5 Fe 4 | CW-307G     | U-A 10 N       | CA 104             |             |              |             |             | C 63000    |
| 2.1006         | SG-CuSn           |             |                |                    |             |              |             |             |            |
| 2.1050         | G-CuSn 10         | CC-480K-GS  |                | CT 1               |             |              |             |             | C 90700    |
| 2.1052         | G-CuSn 12         | CC-483K-GS  | UE 12 P        | Pb 2               |             |              |             |             | C 91700    |
| 2.1060         | G-CuSn 12 Ni 2    | CC-484K-GS  |                |                    |             |              |             |             | C 91700    |
| 2.1090         | G-CuSn 7 ZnPb     |             | UE 7 Z5 Pb 4   |                    |             |              |             |             | C 93200    |
| 2.1093         | G-CuSn 6 ZnNi     |             |                | LG 4               |             |              |             |             |            |
| 2.1096         | G-CuSn 5 ZnPb     |             | UE 5 Pb 5 Z 5  | LG 2               |             |              |             |             | C 83600    |
| 2.1176         | G-CuPb 10 Sn      | CC-495K-GS  | UE 10 Pb 10    | LB 2               |             |              |             |             | C 93700    |
| 2.1182         | G-CuPb 15 Sn      | CC-496K-GS  | U-Pb 15 E 8    | LB 1               |             |              |             |             | C 93800    |
| 2.1188         | G-CuPb 20 Sn      | CC-497K-GS  | U-Pb 20        | LB 5               |             |              |             |             | C 94100    |
| 2.1266         | CuCd 1            |             |                |                    |             |              |             |             |            |
| 2.1292         | G-CuCrF 35        | CC-140C     |                | CC1-FF             |             |              |             |             | C 81500    |
| 2.1293         | CuCrZr            | CW-106C     | U-Cr 0.8 Zr    | CC 102             |             |              |             |             | C 81500    |
| 2.1322         | CuMg 0.4          |             |                |                    |             |              |             |             |            |
| 2.1355         | CuMn 2            |             |                |                    |             |              |             |             |            |
| 2.1461         | SG-CuSi 3         | CW-116C     |                |                    |             |              |             |             |            |

**N 4.1** **MAGNESIUM** | alloyed <200 N/mm<sup>2</sup>

| Materialnumber | Germany   DIN     | Europe   EN | France   AFNOR | Great Britain   BS | Italy   UNI | Sweden   SIS | Spain   UNE | Japan   JIS | USA   AISI |
|----------------|-------------------|-------------|----------------|--------------------|-------------|--------------|-------------|-------------|------------|
| 3.5101         | G-MgZn 4 SE1 Zr 1 | MC-35110    | G-Z 4 Tr       | MAG-5              |             |              |             |             | ZE 41      |
| 3.5102         | G-MgZn 5 Th2 Zr1  |             |                |                    |             |              |             |             |            |
| 3.5103         | MgSE 3 Zn2 Zr1    | MC-65120    | G-Tr 3 Z 2     | MAG-6              |             |              |             |             | EZ 33      |
| 3.5105         | G-MgTh 3 Zn2 Zr1  |             |                |                    |             |              |             |             | QE 22      |
| 3.5106         | G-MgAg 3 SE2 Zr1  | MC-65210    | G-Ag 22.5      | MAG-12             |             |              |             |             |            |
| 3.5200         | G-MgAl 8 Zn 1     | MA-40020    |                |                    |             |              |             |             |            |
| 3.5312         | MgAl 3 Zn         | MA-21130    |                |                    |             |              |             |             |            |
| 3.5314         | MgAl 3 Zn         |             | G-A3 Z1        | MAG-E-111          |             |              |             |             | AZ 31 B    |
| 3.5470         | GD-MgAl 4 Si 1    | MC-21320    |                |                    |             |              |             |             |            |
| 3.5612         | GD-MgAl 6 Zn 3    | MC-21140    |                |                    |             |              |             |             |            |
| 3.5614         | MgAl 6 Zn         |             | G-A6 Z1        | MAG-E-121          |             |              |             |             | AZ 61 A    |
| 3.5662         | GD-MgAl 6         |             |                |                    |             |              |             |             |            |
| 3.5812         | G-MgAl 8 Zn 1     | MC-21110    | G-A9           |                    |             |              |             |             | AZ 81      |
| 3.5912         | G-MgAl 9 Zn 1     | MC-21120    | G-A 9 Z 1      |                    |             |              |             |             | AZ 91      |

**N 5.1** **PLASTICS** | thermoplastics <100 N/mm<sup>2</sup>

| Materialnumber | Germany   DIN               | Europe   EN | France   AFNOR | Great Britain   BS | Italy   UNI | Sweden   SIS | Spain   UNE | Japan   JIS | USA   AISI    |
|----------------|-----------------------------|-------------|----------------|--------------------|-------------|--------------|-------------|-------------|---------------|
| PC             | Makralon                    |             | Orgalan        | Sirvet             |             |              |             |             | Lexan         |
| PC             | Nuclon                      |             |                |                    |             |              |             |             | Merlon        |
| PC             | Plastocarbon                |             |                |                    |             |              |             |             |               |
| PE             | Baylon                      |             |                | Fertene            | Carlona     |              |             |             | Althon        |
| PE             | Dekalen                     |             |                | Eraclene           | Escorene    |              |             |             | Bakelite      |
| PE             | Lupolen                     |             |                |                    |             |              |             |             | Chemplex      |
| PE             | Hostalen                    |             |                |                    |             |              |             |             | Dylan         |
| PF             | Alberit                     |             |                | Fenachem           |             |              |             |             | Biralit       |
| PF             | Bakelit                     |             |                | Moldesile          |             |              |             |             | Biratex       |
| PF             | Bulitol                     |             |                |                    |             |              |             |             | Birax         |
| PF             | Durax                       |             |                |                    |             |              |             |             |               |
| PF             | Harex                       |             |                |                    |             |              |             |             |               |
| PF             | Resinol                     |             |                |                    |             |              |             |             |               |
| PFTE           | Hostaflon                   |             | Soreflon       |                    |             |              |             |             | Halon; Teflon |
| PP             | Vestolen PP                 |             | Eitex P        | Moplen             | Carola P    |              |             |             | Profax        |
| PP             | Synalen PP                  |             | Napryl         | Kastilen           | Procom      |              |             |             | Rexene        |
| PP             | Novolen                     |             |                |                    |             |              |             |             | Tenite        |
| PP             | Hostalen PP                 |             |                |                    |             |              |             |             |               |
| PS             | Hostylon                    |             |                | Sdistir            | Lustrex     |              |             |             | Carinex       |
| PS             | Lorkalen                    |             |                | Lastinol           |             |              |             |             | Dylene        |
| PS             | Polystyrol                  |             |                |                    |             |              |             |             | Toporex       |
| PS             | Styropor                    |             |                |                    |             |              |             |             |               |
| PVC            | Coroplast                   |             |                |                    |             |              |             |             |               |
| PVC            | Hostalit                    |             |                |                    |             |              |             |             |               |
| PVC            | Mipolam                     |             |                |                    |             |              |             |             |               |
| PVC            | Opalon                      |             |                |                    |             |              |             |             |               |
| PVC            | Solvec                      |             |                |                    |             |              |             |             |               |
| PVC            | Vinoflex                    |             |                |                    |             |              |             |             |               |
| PP-H           | Homopolymer                 |             |                |                    |             |              |             |             |               |
| PP-C           | Copolymer                   |             |                |                    |             |              |             |             |               |
| ABS            | Acrylnitrid Butadien Styrol |             |                |                    |             |              |             |             |               |
| PMMA           | Polymethyl metha Crylat     |             |                |                    |             |              |             |             |               |
| PMMA           | Plexiglas; Resarit; Degluan |             |                |                    |             |              |             |             |               |
| POMC           | Polyoxymethylen             |             |                |                    |             |              |             |             |               |
| POMC           | Hostaform; ultraform        |             |                |                    |             |              |             |             |               |
| PI             | Polymid                     |             |                |                    |             |              |             |             |               |
| PEI            | Polytherimid                |             |                |                    |             |              |             |             |               |
| PVC-H          | Polyvinylchlorid (hard)     |             |                |                    |             |              |             |             |               |
| PA             | Polyamide                   |             |                |                    |             |              |             |             |               |

## N 5.2 PLASTICS | duroplastics <150 N/mm<sup>2</sup>

| Materialnumber | Germany   DIN | Europe   EN | France   AFNOR | Great Britain   BS | Italy   UNI | Sweden   SIS | Spain   UNE | Japan   JIS | USA   AISI |
|----------------|---------------|-------------|----------------|--------------------|-------------|--------------|-------------|-------------|------------|
| PUR 5220       |               |             |                |                    |             |              |             |             |            |
| PF 31          |               |             |                |                    |             |              |             |             |            |
| MP 183         |               |             |                |                    |             |              |             |             |            |

### 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)

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

#### 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                   |



# EXPLANATION OF CUTTING DATA

## EXAMPLE FOR SIDE MILLING OF 3.2151 WITH Ø10:

N 2.1 - N 2.3 ALUMINIUM | cast <600 N/mm<sup>2</sup>

| Materialnumber | Germany   DIN | Europe   EN | France   AFNOR | Great Britain   BS | Italy   UNI | Sweden   SIS | Spain   UNE | Japan   JIS | USA   AISI |
|----------------|---------------|-------------|----------------|--------------------|-------------|--------------|-------------|-------------|------------|
| 3.1841         | G-AlCu 4 Ti   |             |                |                    |             |              |             | AC1A        | A 295.0    |
| 3.1871         | G-AlCu 4 TiMg |             |                |                    |             |              |             |             |            |
| 3.2131         | G-AlSiCu1     |             |                |                    |             |              |             |             |            |
| 3.2151         | G-AlSi 6 Cu 4 | AC-45000    | A-SSUZ         | LM 4               |             |              |             | AC4B        | A 319.0    |
| 3.2161         | G-AlSi 8 Cu 3 | AC-46200    | A-S9U3A-Y4     | LM 24              | 5075        |              |             | AC4D        | A 328.0    |

THE MATERIAL KEY WITH DETAILED BREAKDOWN OF MATERIALS BY MATERIAL GROUP CAN BE FOUND AT THE END OF THE CATALOGUE.

| Material                     | Strength (N/mm <sup>2</sup> ) | Full Slot  | Side Milling | Finishing  | ETC        | Materialgroup Factor fz / a | Materialgroup Factor ae ETC |
|------------------------------|-------------------------------|------------|--------------|------------|------------|-----------------------------|-----------------------------|
|                              |                               | Vc = m/min | Vc = m/min   | Vc = m/min | Vc = m/min |                             |                             |
| N NON-FERROUS                |                               |            |              |            |            |                             |                             |
| 1.1 ALUMINIUM   alloyed      | <500                          | 500        | 500          | 500        | 560        | 1                           | 1                           |
| 1.2 ALUMINIUM   alloyed      | <600                          | 480        | 480          | 480        | 540        | 1                           | 1                           |
| 2.1-2.3 ALUMINIUM   cast     | <600                          | 450        | 450          | 450        | 510        | 0.9                         | 0.8                         |
| 3.1-3.3 COPPER   alloyed     | <650                          | 200        | 200          | 200        | 260        | 0.8                         | 0.7                         |
| 4.1 MAGNESIUM   alloyed      | <250                          | 500        | 500          | 500        | 560        | 1                           | 1                           |
| 5.1 PLASTICS   Thermoplastic | <100                          | 400        | 400          | 400        | 460        | 0.7                         | 0.8                         |
| 5.2 PLASTICS   Duroplastic   | <150                          | 350        | 350          | 350        | 410        | 0.6                         | 0.7                         |

OVERVIEW OF THE DIFFERENT MATERIAL GROUPS FOR THIS TOOL INCLUDING FACTORS

### Material N 1.1

| D1 | L2 | Immersion Angle α° | Full Slot |               |               | Side Milling |                 |         | Finishing |         |         | ETC       |                  |         |           |
|----|----|--------------------|-----------|---------------|---------------|--------------|-----------------|---------|-----------|---------|---------|-----------|------------------|---------|-----------|
|    |    |                    | fz (mm/Z) | ae = 1xD (mm) | ap = 1xD (mm) | fz (mm/Z)    | ae = 0.3xD (mm) | ap (mm) | fz (mm/Z) | ae (mm) | ap (mm) | fz (mm/Z) | ae = 0.25xD (mm) | ap (mm) | hmax (mm) |
| 2  | 6  | 1°                 | 0.02      | 2             | 2             | 0.03         | 0.6             | L2max   | 0.018     | 0.2     | L2max   | 0.045     | 0.5              | L2max   | 0.039     |
| 3  | 10 | 1°                 | 0.03      | 3             | 3             | 0.04         | 0.9             | L2max   | 0.02      | 0.2     | L2max   | 0.055     | 0.75             | L2max   | 0.0476    |
| 4  | 13 | 1.2°               | 0.04      | 4             | 4             | 0.05         | 1.2             | L2max   | 0.021     | 0.2     | L2max   | 0.07      | 1                | L2max   | 0.0606    |
| 5  | 14 | 1.2°               | 0.045     | 5             | 5             | 0.065        | 1.5             | L2max   | 0.023     | 0.2     | L2max   | 0.08      | 1.25             | L2max   | 0.0693    |
| 6  | 16 | 1.5°               | 0.05      | 6             | 6             | 0.07         | 1.8             | L2max   | 0.025     | 0.2     | L2max   | 0.1       | 1.5              | L2max   | 0.0866    |
| 8  | 22 | 2°                 | 0.07      | 8             | 8             | 0.09         | 2.4             | L2max   | 0.03      | 0.2     | L2max   | 0.12      | 2                | L2max   | 0.1039    |
| 10 | 25 | 2.5°               | 0.09      | 10            | 10            | 0.1          | 3               | L2max   | 0.035     | 0.2     | L2max   | 0.14      | 2.5              | L2max   | 0.1212    |
| 12 | 28 | 3°                 | 0.1       | 12            | 12            | 0.13         | 3.6             | L2max   | 0.04      | 0.2     | L2max   | 0.16      | 3                | L2max   | 0.1386    |
| 16 | 36 | 4°                 | 0.12      | 16            | 16            | 0.15         | 4.8             | L2max   | 0.045     | 0.2     | L2max   | 0.18      | 4                | L2max   | 0.1559    |
| 20 | 41 | 5°                 | 0.15      | 20            | 20            | 0.18         | 6               | L2max   | 0.05      | 0.2     | L2max   | 0.22      | 5                | L2max   | 0.1905    |

ALL DATA GIVEN HERE IS FOR THE FIRST GROUP N1.1 IN THE MATERIAL GROUP OVERVIEW

### DETERMINATION OF CUTTING DATA:

From the material key results: material group N2.1-2.3

Vc= 450 m/min (as indicated in the table)

fz= 0.1 mm/Z (as indicated in the table) x Factor fz 0.9 = fz 0.09 mm/Z



VIDEO EXPLANATION

## EXAMPLE FOR ETC MILLING OF PE WITH Ø10:

### N 5.1 PLASTICS | thermoplastics <100 N/mm<sup>2</sup>

| Materialnumber | Germany   DIN | Europe   EN | France   AFNOR | Great Britain   BS | Italy   UNI | Sweden   SIS | Spain   UNE | Japan   JIS | USA   AISI |
|----------------|---------------|-------------|----------------|--------------------|-------------|--------------|-------------|-------------|------------|
| PC             | Makralon      |             | Orgalan        | Sinvet             |             |              |             |             | Lexan      |
| PC             | Nuclon        |             |                |                    |             |              |             |             | Merlon     |
| PC             | Plastocarbon  |             |                |                    |             |              |             |             |            |
| PE             | Baylon        |             |                | Fertene            | Carlona     |              |             |             | Althlon    |
| PE             | Dekalen       |             |                | Eraclene           | Escorene    |              |             |             | Bakelite   |

THE MATERIAL KEY WITH DETAILED BREAKDOWN OF MATERIALS BY MATERIAL GROUP CAN BE FOUND AT THE END OF THE CATALOGUE.

| Material           | Strength (N/mm <sup>2</sup> ) | Full Slot  | Side Milling | Finishing  | ETC        | Materialgroup Factor fz / a | Materialgroup Factor ae ETC |
|--------------------|-------------------------------|------------|--------------|------------|------------|-----------------------------|-----------------------------|
|                    |                               | Vc = m/min | Vc = m/min   | Vc = m/min | Vc = m/min |                             |                             |
| <b>NON-FERROUS</b> |                               |            |              |            |            |                             |                             |
| 1.1                | ALUMINIUM   alloyed           | <500       | 500          | 500        | 500        | 1                           | 1                           |
| 1.2                | ALUMINIUM   alloyed           | <600       | 480          | 480        | 480        | 1                           | 1                           |
| 2.1-2.3            | ALUMINIUM   cast              | <600       | 450          | 450        | 450        | 0.9                         | 0.8                         |
| 3.1-3.3            | COPPER   alloyed              | <650       | 200          | 200        | 200        | 0.8                         | 0.7                         |
| 4.1                | MAGNESIUM   alloyed           | <250       | 500          | 500        | 500        | 1                           | 1                           |
| 5.1                | PLASTICS   Thermoplastic      | <100       | 400          | 400        | 400        | 0.7                         | 0.8                         |
| 5.2                | PLASTICS   Duroplastic        | <150       | 350          | 350        | 350        | 0.6                         | 0.7                         |

OVERVIEW OF THE DIFFERENT MATERIAL GROUPS FOR THIS TOOL INCLUDING FACTORS

#### Material N 1.1

| D1 | L2 | Immersion Angle | Full Slot |               |               | Side Milling |                 |         | Finishing |         |         | ETC       |                  |         |           |
|----|----|-----------------|-----------|---------------|---------------|--------------|-----------------|---------|-----------|---------|---------|-----------|------------------|---------|-----------|
|    |    |                 | fz (mm/Z) | ae = 1xD (mm) | ap = 1xD (mm) | fz (mm/Z)    | ae = 0.3xD (mm) | ap (mm) | fz (mm/Z) | ae (mm) | ap (mm) | fz (mm/Z) | ae = 0.25xD (mm) | ap (mm) | hmax (mm) |
| 2  | 6  | 1°              | 0.02      | 2             | 2             | 0.03         | 0.6             | L2max   | 0.018     | 0.2     | L2max   | 0.045     | 0.5              | L2max   | 0.039     |
| 3  | 10 | 1°              | 0.03      | 3             | 3             | 0.04         | 0.9             | L2max   | 0.02      | 0.2     | L2max   | 0.055     | 0.75             | L2max   | 0.0476    |
| 4  | 13 | 1.2°            | 0.04      | 4             | 4             | 0.05         | 1.2             | L2max   | 0.021     | 0.2     | L2max   | 0.07      | 1                | L2max   | 0.0606    |
| 5  | 14 | 1.2°            | 0.045     | 5             | 5             | 0.065        | 1.5             | L2max   | 0.023     | 0.2     | L2max   | 0.08      | 1.25             | L2max   | 0.0693    |
| 6  | 16 | 1.5°            | 0.05      | 6             | 6             | 0.07         | 1.8             | L2max   | 0.025     | 0.2     | L2max   | 0.1       | 1.5              | L2max   | 0.0866    |
| 8  | 22 | 2°              | 0.07      | 8             | 8             | 0.09         | 2.4             | L2max   | 0.03      | 0.2     | L2max   | 0.12      | 2                | L2max   | 0.1039    |
| 10 | 25 | 2.5°            | 0.09      | 10            | 10            | 0.1          | 3               | L2max   | 0.035     | 0.2     | L2max   | 0.14      | 2.5              | L2max   | 0.1212    |
| 12 | 28 | 3°              | 0.1       | 12            | 12            | 0.13         | 3.6             | L2max   | 0.04      | 0.2     | L2max   | 0.16      | 3                | L2max   | 0.1386    |
| 16 | 36 | 4°              | 0.12      | 16            | 16            | 0.15         | 4.8             | L2max   | 0.045     | 0.2     | L2max   | 0.18      | 4                | L2max   | 0.1559    |
| 20 | 41 | 5°              | 0.15      | 20            | 20            | 0.18         | 6               | L2max   | 0.05      | 0.2     | L2max   | 0.22      | 5                | L2max   | 0.1905    |

ALL DATA GIVEN HERE IS FOR THE FIRST GROUP N1.1 IN THE MATERIAL GROUP OVERVIEW

#### DETERMINATION OF CUTTING DATA:

From the material key results: **material group N5.1**

Vc= 460 m/min (as indicated in the table)

fz= 0.14 mm/Z (as indicated in the table) x Factor fz 0.7 = **fz 0.098 mm/Z**

ae= 2.5 mm (as indicated in the table) x Factor ae 0.8 = **2.0 mm ae**