

Cooling

Tolerance

Coating



V1

BetaUni Iron

Strategy

Application

Features

UNI



HA

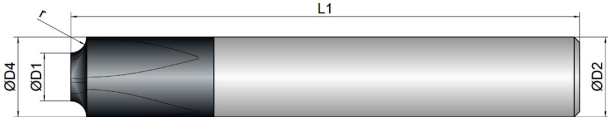


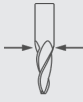
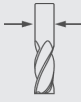
Basic



■ For the universal manufacturing of radii to components





| Roughing                                                                                           |                                                                                                                      |                                                                                                                      |                                                                                                                | Finishing                                                                                                             |                                                                                                                |                                                                                                                  |
|----------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|
| <div><div></div><div></div><div></div><div></div><div></div></div> <div>inappropriateoptimal</div> |                                                                                                                      |                                                                                                                      |                                                                                                                | <div><div></div><div></div><div></div><div></div><div></div></div> <div>inappropriateoptimal</div>                    |                                                                                                                |                                                                                                                  |
| BCU1-M11-0023                                                                                      | <div>D1</div>  <div>mm<br/>Ø</div> | <div>D4</div>  <div>mm<br/>Ø</div> | <div>L1</div>  <div>mm</div> | <div>D2</div>  <div>mm<br/>Ø</div> | <div>z</div>  <div>#</div> | <div>r</div>  <div>mm</div> |
| 3/0,5                                                                                              | 3.0                                                                                                                  | 4                                                                                                                    | 50.0                                                                                                           | 4.0                                                                                                                   | 4                                                                                                              | 0.50                                                                                                             |
| 3,2/0,4                                                                                            | 3.2                                                                                                                  | 4                                                                                                                    | 50.0                                                                                                           | 4.0                                                                                                                   | 4                                                                                                              | 0.40                                                                                                             |
| 3,4/0,3                                                                                            | 3.4                                                                                                                  | 4                                                                                                                    | 50.0                                                                                                           | 4.0                                                                                                                   | 4                                                                                                              | 0.30                                                                                                             |
| 3,6/0,2                                                                                            | 3.6                                                                                                                  | 4                                                                                                                    | 50.0                                                                                                           | 4.0                                                                                                                   | 4                                                                                                              | 0.20                                                                                                             |
| 4/1                                                                                                | 4.0                                                                                                                  | 6                                                                                                                    | 50.0                                                                                                           | 6.0                                                                                                                   | 4                                                                                                              | 1.00                                                                                                             |
| 4,4/0,8                                                                                            | 4.4                                                                                                                  | 6                                                                                                                    | 50.0                                                                                                           | 6.0                                                                                                                   | 4                                                                                                              | 0.80                                                                                                             |
| 4,8/0,6                                                                                            | 4.8                                                                                                                  | 6                                                                                                                    | 50.0                                                                                                           | 6.0                                                                                                                   | 4                                                                                                              | 0.60                                                                                                             |
| 5/10                                                                                               | 5.0                                                                                                                  | 25                                                                                                                   | 100.0                                                                                                          | 25.0                                                                                                                  | 4                                                                                                              | 10.00                                                                                                            |
| 6/2                                                                                                | 6.0                                                                                                                  | 10                                                                                                                   | 66.0                                                                                                           | 10.0                                                                                                                  | 4                                                                                                              | 2.00                                                                                                             |
| 6/3                                                                                                | 6.0                                                                                                                  | 12                                                                                                                   | 73.0                                                                                                           | 12.0                                                                                                                  | 4                                                                                                              | 3.00                                                                                                             |
| 7/1,5                                                                                              | 7.0                                                                                                                  | 10                                                                                                                   | 66.0                                                                                                           | 10.0                                                                                                                  | 4                                                                                                              | 1.50                                                                                                             |
| 7/2,5                                                                                              | 7.0                                                                                                                  | 12                                                                                                                   | 73.0                                                                                                           | 12.0                                                                                                                  | 4                                                                                                              | 2.50                                                                                                             |
| 7/4,5                                                                                              | 7.0                                                                                                                  | 16                                                                                                                   | 82.0                                                                                                           | 16.0                                                                                                                  | 4                                                                                                              | 4.50                                                                                                             |
| 8/4                                                                                                | 8.0                                                                                                                  | 16                                                                                                                   | 82.0                                                                                                           | 16.0                                                                                                                  | 4                                                                                                              | 4.00                                                                                                             |
| 8/6                                                                                                | 8.0                                                                                                                  | 20                                                                                                                   | 80.0                                                                                                           | 20.0                                                                                                                  | 4                                                                                                              | 6.00                                                                                                             |
| 9/3,5                                                                                              | 9.0                                                                                                                  | 16                                                                                                                   | 82.0                                                                                                           | 16.0                                                                                                                  | 4                                                                                                              | 3.50                                                                                                             |
| 9/8                                                                                                | 9.0                                                                                                                  | 25                                                                                                                   | 100.0                                                                                                          | 25.0                                                                                                                  | 4                                                                                                              | 8.00                                                                                                             |
| 10/5                                                                                               | 10.0                                                                                                                 | 20                                                                                                                   | 80.0                                                                                                           | 20.0                                                                                                                  | 4                                                                                                              | 5.00                                                                                                             |

|                                                                                                                                      |                            |             |              |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
|--------------------------------------------------------------------------------------------------------------------------------------|----------------------------|-------------|--------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| <div></div> <div>Download Catalog Pages (PDF)</div> |                            |             | Dimension    | Ø3.6 R0.2                                                                         | Ø3.4 R0.3                                                                         | Ø3.2 R0.4                                                                         | Ø3 R0.5                                                                           | Ø4.8 R0.6                                                                          | Ø4.4 R0.8                                                                           | Ø4 R1                                                                               | Ø7 R1.5                                                                             | Ø6 R2                                                                               | Ø7 R2.5                                                                             |
|                                                                                                                                      |                            |             | Infeed in mm | ae= rmax<br>ap= rmax                                                              | ae= rmax<br>ap= rmax                                                              | ae= rmax<br>ap= rmax                                                              | ae= rmax<br>ap= rmax                                                              | ae= rmax<br>ap= rmax                                                               | ae= rmax<br>ap= rmax                                                                | ae= rmax<br>ap= rmax                                                                | ae= rmax<br>ap= rmax                                                                | ae= rmax<br>ap= rmax                                                                | ae= rmax<br>ap= rmax                                                                |
|                                                                                                                                      |                            |             | Application  |  |  |  |  |  |  |  |  |  |  |
| Material                                                                                                                             | Strength (N/mm²)           | Feed (mm/Z) | fz           | fz                                                                                | fz                                                                                | fz                                                                                | fz                                                                                | fz                                                                                 | fz                                                                                  | fz                                                                                  | fz                                                                                  | fz                                                                                  | fz                                                                                  |
| P                                                                                                                                    | STEEL                      | Vc (m/min)  |              |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| 1.1-1.3                                                                                                                              | unalloyed                  | <850        | 170          | 0.024                                                                             | 0.024                                                                             | 0.024                                                                             | 0.024                                                                             | 0.028                                                                              | 0.028                                                                               | 0.028                                                                               | 0.03                                                                                | 0.034                                                                               | 0.038                                                                               |
| 2.1-2.2                                                                                                                              | low-alloyed                | <950        | 150          | 0.02                                                                              | 0.02                                                                              | 0.02                                                                              | 0.02                                                                              | 0.024                                                                              | 0.024                                                                               | 0.024                                                                               | 0.026                                                                               | 0.03                                                                                | 0.034                                                                               |
| 3.1-3.2                                                                                                                              | high-alloyed               | <1100       | 100          | 0.016                                                                             | 0.016                                                                             | 0.016                                                                             | 0.016                                                                             | 0.02                                                                               | 0.02                                                                                | 0.02                                                                                | 0.022                                                                               | 0.026                                                                               | 0.03                                                                                |
| K                                                                                                                                    | CASTINGS                   | Vc (m/min)  |              |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| 1.1-1.2                                                                                                                              | grey cast iron             | <1000       | 125          | 0.016                                                                             | 0.016                                                                             | 0.016                                                                             | 0.016                                                                             | 0.02                                                                               | 0.02                                                                                | 0.02                                                                                | 0.022                                                                               | 0.026                                                                               | 0.03                                                                                |
| M                                                                                                                                    | STAINLESS STEEL            | Vc (m/min)  |              |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| 1.1                                                                                                                                  | ferritic/martensitic       | <850        | 85           | 0.012                                                                             | 0.012                                                                             | 0.012                                                                             | 0.012                                                                             | 0.016                                                                              | 0.016                                                                               | 0.016                                                                               | 0.018                                                                               | 0.022                                                                               | 0.026                                                                               |
| 2.1                                                                                                                                  | austenitic                 | <650        | 75           | 0.01                                                                              | 0.01                                                                              | 0.01                                                                              | 0.01                                                                              | 0.014                                                                              | 0.014                                                                               | 0.014                                                                               | 0.016                                                                               | 0.02                                                                                | 0.024                                                                               |
| N                                                                                                                                    | NON-FERROUS                | Vc (m/min)  |              |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| 1.1-2.3                                                                                                                              | ALUMINIUM   alloyed/casted | <600        | 500          | 0.029                                                                             | 0.029                                                                             | 0.029                                                                             | 0.029                                                                             | 0.033                                                                              | 0.033                                                                               | 0.033                                                                               | 0.035                                                                               | 0.039                                                                               | 0.043                                                                               |
| 3.1-3.3                                                                                                                              | COPPER   alloyed           | <600        | 180          | 0.02                                                                              | 0.02                                                                              | 0.02                                                                              | 0.02                                                                              | 0.024                                                                              | 0.024                                                                               | 0.024                                                                               | 0.026                                                                               | 0.03                                                                                | 0.034                                                                               |
| T                                                                                                                                    | TITANIUM                   | Vc (m/min)  |              |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| 2.1-2.2                                                                                                                              | pure/alloyed               | <1000       | 40           | 0.012                                                                             | 0.012                                                                             | 0.012                                                                             | 0.012                                                                             | 0.016                                                                              | 0.016                                                                               | 0.016                                                                               | 0.018                                                                               | 0.022                                                                               | 0.026                                                                               |
| S                                                                                                                                    | SUPER ALLOYS               | Vc (m/min)  |              |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| 1.1-1.3                                                                                                                              | HRSA                       | <1450       | 25           | 0.01                                                                              | 0.01                                                                              | 0.01                                                                              | 0.01                                                                              | 0.014                                                                              | 0.014                                                                               | 0.014                                                                               | 0.016                                                                               | 0.02                                                                                | 0.024                                                                               |

|          |                            |             |              |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                      |                                                                                       |                                                                                       |                                                                                       |
|----------|----------------------------|-------------|--------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
|          |                            |             | Dimension    | Ø6 R3                                                                               | Ø9 R3.5                                                                             | Ø8 R4                                                                               | Ø7 R4.5                                                                             | Ø10 R5                                                                               | Ø8 R6                                                                                 | Ø9 R8                                                                                 | Ø5 R10                                                                                |
|          |                            |             | Infeed in mm | ae= rmax<br>ap= rmax                                                                | ae= rmax<br>ap= rmax                                                                | ae= rmax<br>ap= rmax                                                                | ae= rmax<br>ap= rmax                                                                | ae= rmax<br>ap= rmax                                                                 | ae= rmax<br>ap= rmax                                                                  | ae= rmax<br>ap= rmax                                                                  | ae= rmax<br>ap= rmax                                                                  |
|          |                            |             | Application  |  |  |  |  |  |  |  |  |
| Material | Strength (N/mm²)           | Feed (mm/Z) | fz           | fz                                                                                  | fz                                                                                  | fz                                                                                  | fz                                                                                  | fz                                                                                   | fz                                                                                    | fz                                                                                    | fz                                                                                    |
| P        | STEEL                      | Vc (m/min)  |              |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                      |                                                                                       |                                                                                       |                                                                                       |
| 1.1-1.3  | unalloyed                  | <850        | 170          | 0.038                                                                               | 0.04                                                                                | 0.04                                                                                | 0.04                                                                                | 0.041                                                                                | 0.041                                                                                 | 0.045                                                                                 | 0.045                                                                                 |
| 2.1-2.2  | low-alloyed                | <950        | 150          | 0.034                                                                               | 0.036                                                                               | 0.036                                                                               | 0.036                                                                               | 0.037                                                                                | 0.037                                                                                 | 0.04                                                                                  | 0.04                                                                                  |
| 3.1-3.2  | high-alloyed               | <1100       | 100          | 0.03                                                                                | 0.032                                                                               | 0.032                                                                               | 0.032                                                                               | 0.033                                                                                | 0.033                                                                                 | 0.035                                                                                 | 0.035                                                                                 |
| K        | CASTINGS                   | Vc (m/min)  |              |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                      |                                                                                       |                                                                                       |                                                                                       |
| 1.1-1.2  | grey cast iron             | <1000       | 125          | 0.03                                                                                | 0.032                                                                               | 0.032                                                                               | 0.032                                                                               | 0.033                                                                                | 0.033                                                                                 | 0.035                                                                                 | 0.035                                                                                 |
| M        | STAINLESS STEEL            | Vc (m/min)  |              |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                      |                                                                                       |                                                                                       |                                                                                       |
| 1.1      | ferritic/martensitic       | <850        | 85           | 0.026                                                                               | 0.028                                                                               | 0.028                                                                               | 0.028                                                                               | 0.029                                                                                | 0.029                                                                                 | 0.03                                                                                  | 0.03                                                                                  |
| 2.1      | austenitic                 | <650        | 75           | 0.024                                                                               | 0.026                                                                               | 0.026                                                                               | 0.026                                                                               | 0.027                                                                                | 0.027                                                                                 | 0.028                                                                                 | 0.028                                                                                 |
| N        | NON-FERROUS                | Vc (m/min)  |              |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                      |                                                                                       |                                                                                       |                                                                                       |
| 1.1-2.3  | ALUMINIUM   alloyed/casted | <600        | 500          | 0.043                                                                               | 0.045                                                                               | 0.045                                                                               | 0.045                                                                               | 0.046                                                                                | 0.046                                                                                 | 0.05                                                                                  | 0.05                                                                                  |
| 3.1-3.3  | COPPER   alloyed           | <600        | 180          | 0.034                                                                               | 0.036                                                                               | 0.036                                                                               | 0.036                                                                               | 0.037                                                                                | 0.037                                                                                 | 0.04                                                                                  | 0.04                                                                                  |
| T        | TITANIUM                   | Vc (m/min)  |              |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                      |                                                                                       |                                                                                       |                                                                                       |
| 2.1-2.2  | pure/alloyed               | <1000       | 40           | 0.026                                                                               | 0.028                                                                               | 0.028                                                                               | 0.028                                                                               | 0.029                                                                                | 0.029                                                                                 | 0.03                                                                                  | 0.03                                                                                  |
| S        | SUPER ALLOYS               | Vc (m/min)  |              |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                      |                                                                                       |                                                                                       |                                                                                       |
| 1.1-1.3  | HRSA                       | <1450       | 25           | 0.024                                                                               | 0.026                                                                               | 0.026                                                                               | 0.026                                                                               | 0.027                                                                                | 0.027                                                                                 | 0.028                                                                                 | 0.028                                                                                 |

ADVICE | The values marked in turquoise are side applications!

Please use the arithmetic average from D2 and D1 to calculate cutting datas.  
For example tool Ø5 R10, D1=Ø5; R=10 calculated diameter = Ø15    Formula: D1+R= Result    Example: 5mm+10mm=15mm

# EXPLANATION

## APPLICATIONS

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

## COOLINGS

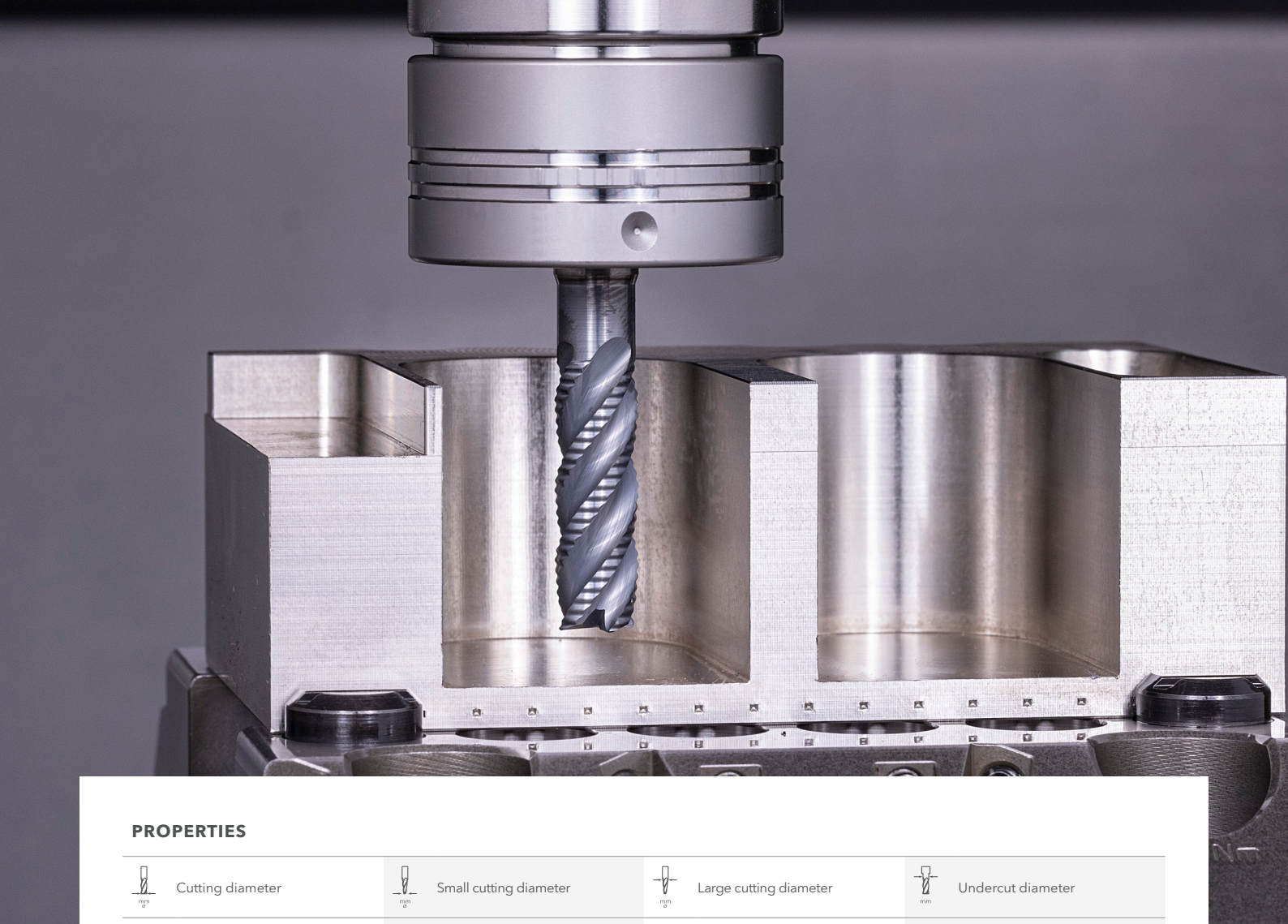
|                                                                                                                  |                                                                                                   |                                                                                                 |                                                                                                         |
|------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|
|  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.

**P 1.1** **STEEL** | unalloyed <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 |
|----------------|---------------|-------------|----------------|--------------------|--------------|--------------|-------------|-------------|------------|
| <b>1.0254</b>  | St37.0        | P235T1      |                |                    |              |              |             | STPG 38     |            |
| <b>1.1120</b>  | GS20Mn5       |             |                |                    |              |              |             | SMnC 420    |            |
| <b>1.1121</b>  | Ck10          | 2 C 10      | XC 10          | 040 A 10           | C 10         | 1265         | C 10 k      | S 10 C      | 1010       |
| <b>1.1131</b>  | GS15Mn5       |             |                |                    |              |              |             |             |            |
| <b>1.8961</b>  | WTS1373       |             |                |                    | Fe 360 D FF  |              |             | SMA 50 A    |            |
| <b>1.0715</b>  | 9SMn28        | 11 SMn 28   | S 250          | 230 M 07           | CF 9 SMn 28  | 1912         | 11 SMn 28   | SUM 22      | 1213       |
| <b>1.0718</b>  | 9SMnPb28      | 11 SMnPb28  | S 250 Pb       |                    | CF 9SMnPb 28 | 1914         | 11 SMnPb 28 | SUM 22 L    | 12 L 13    |
| <b>1.0736</b>  | 9SMn36        |             | S300           | 240 M 07           | CF 9 SMn 36  |              | 12 SMn 35   | SUM 25      | 1215       |

**P 1.2** **STEEL** | unalloyed <700 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   |
|----------------|---------------|-------------|----------------|--------------------|-------------|--------------|-------------|-------------|--------------|
| <b>1.0116</b>  | ST373         |             | E 24-3         | 4360-40 C          | Fe 37-3     | 1312         | A 360 C     |             | A 570 Gr. 36 |
| <b>1.0144</b>  | ST443         |             | E 28-3         | 4360-43 C          | Fe 430 D FF | 1414         | AE 275-D    | SM 41 B     | A 573 Gr. 70 |
| <b>1.0401</b>  | C15           |             | CC12           | 080 M 15           | C 15        | 1350         | F.111       | S 15 C      | 1015         |
| <b>1.0402</b>  | C22           | 1 C 22      | CC 22          | 070 M 20           | C 22        |              | C 22 k      | SFVC 1      |              |
| <b>1.0406</b>  | C25           | 1 C 25      | CC 25          | 070 M 26           | C 25        |              | C 25 k      | S 22 C      | 1025         |
| <b>1.0482</b>  | 19Mn5         |             | A 52 CP        | 224-460            |             |              |             | SG 37       |              |
| <b>1.0486</b>  | STE285        |             |                |                    | FE E 285 KG |              | AE 285 KG   | SM 41 A     |              |
| <b>1.0501</b>  | C35           | 1 C 35      | CC 35          | 060 A 35           | C 35        | 1550         | F.113       | S 35 C      | 1035         |
| <b>1.0503</b>  | C45           | 1 C 45      | CC 45          | 080 M 46           | C 45        | 1650         | C 45 k      | S 45 C      | 1045         |
| <b>1.0528</b>  | C30           | 1 C 30      | CC 32          | 080 M 30           | C30         |              |             | SUP 7       | 1030         |
| <b>1.0562</b>  | STE355        |             | E 355 R/FP     |                    | Fe E 355 KG | 2132         | AE 355 KG   | SM 50 YB    | A 633 Gr. C  |
| <b>1.0711</b>  | 9S20          |             |                | 220 M 07           | CF 9 S 22   |              |             | G 11120     | 1212         |
| <b>1.1127</b>  | 36Mn6         |             |                | 212 M 36           |             |              |             | SMn 443     | 1141         |
| <b>1.1133</b>  | 20Mn5         |             |                | 120 M 19           | G 22 Mn3    |              | 20 Mn 6     | SMn 420     | 1022         |
| <b>1.5637</b>  | 10Ni14        |             |                | 503                | 18 Ni 14 KT |              |             |             | A 350-LF 5   |
| <b>1.8962</b>  | 9CrNiCuP324   |             |                | WR 50 A            |             |              |             | SPA-H       |              |
| <b>1.0726</b>  | 35S20         | 35 S 20     | 35 MF 4        | 212 M 36           |             | 1957         | F.210G      |             | 1140         |
| <b>1.0760</b>  | 38SMn28       | 38SMn28     | 38SMn28        | 38SMn28            |             |              | 38SMn28     |             |              |
| <b>1.5423</b>  | 16Mo5         |             |                | 1503-245-420       | 16 Mo 5     |              | 16 Mo 5     | SBC 690     | 4520         |

**P 1.3** **STEEL** | unalloyed <850 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 |
|----------------|---------------|---------------|----------------|--------------------|--------------|--------------|-------------|-------------|------------|
| <b>1.1525</b>  | C80W1         | C 80 U        | Y1 90          |                    | C 80 KU      | 1880         | F.513       |             | W 108      |
| <b>1.1545</b>  | C105W1        | C 105 U       | Y1 105         | BW 1A              | C 100 KU     | 1880         | F.515       |             | W 110      |
| <b>1.1620</b>  | C70W2         | C 70 U        |                |                    |              |              |             |             |            |
| <b>1.1625</b>  | C80W2         |               | Y1 80          | BW 1B              | C 80 KU      |              | C 80        | SKC 3       | W 1        |
| <b>1.1645</b>  | C105W2        |               |                |                    |              |              | C 102       | SK 3        |            |
| <b>1.1663</b>  | C125W         | C 120 U       | Y2 120         |                    | C 120 KU     |              | C 120       | SK 2        | W 112      |
| <b>1.1673</b>  | C135W         |               | Y2 140         |                    | C 140 KU     |              |             | SK 1        |            |
| <b>1.1740</b>  | C60W          |               | Y3 55          |                    |              |              |             | SK 7        |            |
| <b>1.1830</b>  | C85W          | C 90 U        | Y3 90          |                    |              |              |             | SK 5        | 1084       |
| <b>1.1744</b>  | C67W          |               | Y1 70          |                    |              |              | F.512       |             | A-6        |
| <b>1.5406</b>  | 17MoV84       |               |                |                    |              |              |             |             |            |
| <b>1.5633</b>  | 24Ni8         | G 9 Ni 10     | 22 N 8         |                    | G 9 Ni 10    |              |             | SCPL 21     |            |
| <b>1.6311</b>  | 20MnMoNi45    | 20 MnMoNi 4 5 |                |                    |              |              |             | SQV 2 B     |            |
| <b>1.7242</b>  | 16CrMo4       | 18 CrMo 4     | 15 CD 3.5      |                    | 18 CrMo 4    |              | 18 CrMo 4   | SCM 418 H   |            |
| <b>1.7350</b>  | 22CrMo44      |               |                |                    |              |              |             |             |            |
| <b>1.7362</b>  | 12CrMo195     | X 12 CrMo 5   | Z 10 CD 5.05   | 3606-625           | 16 CrMo 20 5 |              |             | SCMV 6      |            |
| <b>1.7709</b>  | 21CrMoV57     | 21 CrMoV 5 7  | 20 CDV 5.07    |                    |              |              |             |             |            |

P 2.1 **STEEL** | low alloyed <750 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 |
|----------------|---------------|--------------|----------------|--------------------|---------------|--------------|-------------|-------------|------------|
| 1.0961         | 60SiCr7       | 60 SiCr 8    | 60 SC 7        | 250 A 61           | 60 SiCr 8     |              | 60 SiCr 8   | SUP 7       | 9262       |
| 1.2162         | 21MnCr5       | 21 MnCr 5    | 20 NC 5        |                    |               |              |             | SCR 420 H   |            |
| 1.2210         | 115CrV3       | 107 CrV 3 KU | 100 C 3        |                    | 107 CrV 3 KU  |              | F.520.L     |             | L2         |
| 1.2235         | 80CrV2        |              |                |                    |               |              | F.520.J     |             |            |
| 1.2241         | 51CrV4        | 51 CRMnV 4   |                |                    | 51 CrMnV 4 KU |              |             |             | S6         |
| 1.2382         | GX155CrVMo121 |              |                |                    |               |              |             |             |            |
| 1.2542         | 45WCrV7       | 45 WCrV 8    |                | BS 1               | 45 WCrV 8 KU  | 2710         | 45 WCrSi 8  |             | S1         |
| 1.2552         | 80WCrV8       |              |                |                    |               |              | 60 WCrSi 8  |             |            |
| 1.2842         | 90MnCrV8      | 90 MnV 8     | 90 MV 8        | BO 2               | 90 MnVCr 8 KU |              |             |             | 0 2        |
| 1.7003         | 38Cr2         | 38 Cr 2 KD   | 38 C 2         | 120 M 36           | 38 Cr 3       |              | 38 Cr 3     | SMn 438     | 50 B40     |
| 1.7131         | 16MnCr5       | 16 MnCr 5 KD | 16 MC 5        | 527 M 17           | 16 MnCr 5     | 2173         | 16 MnCr 5   | SCR 415     | 5115       |
| 1.7715         | 14MoV63       | 14 MoV 6-3   |                | 1503-660-440       |               |              | 13 MoCrV 6  |             |            |

P 2.2 **STEEL** | low alloyed <950 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 |
|----------------|---------------|-------------|----------------|--------------------|---------------|--------------|-------------|-------------|------------|
| 1.0902         | 46Si7         |             | 45 S7          |                    |               |              | 46 Si 7     |             |            |
| 1.1157         | 40Mn4         |             | 35 M 5         | 150 M 36           |               |              |             |             | 1039       |
| 1.1167         | 36Mn5         |             | 40 M 5         | 150 M 36           |               | 2120         | 36 Mn 5     |             | 1335       |
| 1.1170         | 28Mn6         | 28 Mn 6     | 35 M 5         | 150 M 17           | C 28 Mn       |              | 36 Mn 6     | SCMn 1      | 1330       |
| 1.1199         | 49MnVS3       |             |                | 280 M 01           |               |              |             |             |            |
| 1.2002         | 125Cr1        |             | Y2 120 C       |                    |               |              |             |             |            |
| 1.2003         | 75Cr1         |             | 35 M 5         | 150 M 36           |               |              |             |             |            |
| 1.2004         | 85Cr1         |             | Y1 100 C 2     |                    |               |              |             |             |            |
| 1.2008         | 140Cr3        |             | Y2 140 C       |                    |               |              |             | SKS 8       |            |
| 1.2108         | 90CrSi5       | P 280 GH    |                |                    | C 100 KU      | 2092         |             | SFVC 2A     |            |
| 1.2127         | 105MnCr4      |             |                |                    | 100 CrMn 4 KU |              |             | SUJ 3       |            |
| 1.2303         | 100CrMo5      |             |                |                    |               |              | F.520.F     |             | L 7        |
| 1.2312         | 40CrMnMoS86   |             | 40 CMD 8       |                    |               |              |             |             |            |
| 1.2519         | 110WCrV5      |             |                |                    |               |              | 102 WCrV 5  |             |            |
| 1.3501         | 100Cr2        |             | 100 C 2        |                    |               |              |             |             | E 50100    |
| 1.3505         | 100Cr6        | 100 Cr 6    | 100 C 6        | 535 A 99           | 100 Cr 6      | 2258         | 100 Cr 6    | SUJ 2       | E52100     |
| 1.3520         | 100CrMn6      | 100 Cr Mn 6 | 100 CM 6       |                    |               |              | 100 CrMn 6  |             |            |

P 3.1 **STEEL** | high alloyed <800 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 |
|----------------|---------------|-----------------|----------------|--------------------|---------------------|--------------|---------------|-------------|------------|
| 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        |
| 1.2367         | X38CrMoV53    |                 | Z 38 CDV 5 3   |                    |                     |              |               |             |            |
| 1.2379         | X155CrVMo121  | X 153 CrMoV 12  | Z 160 CDV 12   | BD 2               | X 155 CrVMo 12 1 KU | 2310         |               | SKD 11      | D 2        |
| 1.2453         | X130W5        |                 |                |                    |                     |              |               |             |            |
| 1.2564         | X30WCrV41     | 30 WCrV 15 1    |                |                    |                     |              | F.527         |             |            |
| 1.2567         | X30WCrV53     | X 30 WCrV 5 3   | Z 32 WCV 5     |                    | X 30 WCrV 5 3 KU    |              |               | SKD 4       |            |
| 1.2606         | X37CrMoW51    |                 | Z 35 CWDV 5    | BH 12              | X 35 CrMoW 05 KU    |              | F.537         | SKD 62      | H 12       |

**P 3.2** **STEEL** | high alloyed <1100 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 |
|----------------|---------------|----------------|----------------|--------------------|--------------------------|--------------|----------------|-------------|------------|
| <b>1.2083</b>  | X42Cr13       | X 42 Cr 13     | Z 40 C 14      |                    | X 41 Cr 13 KU            | 2314         |                | SUS 420 J2  | 420        |
| <b>1.2316</b>  | X36CrMo17     | X 36 CrMo 17   | X38CrMo 16 1   |                    | X 38 CrMo 16 1 KU        |              | X 38 CrMo 16   |             | D-4        |
| <b>1.2343</b>  | 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       |
| <b>1.2344</b>  | X40CrMoV51    | X 40 CrMoV 5 1 | Z 40 CDV 5     | BH 13              | X 40 CrMoV 5 1 1 KU 2242 |              | X 40 CrMoV 5   | SKD 61      | H 13       |
| <b>1.2436</b>  | X210CrW12     | X 210 CrW 12   | Z 210 CW1 2    |                    | X 215 CrW 12 1 KU 2312   |              | X 210 CrW 12   | SKD 2       |            |
| <b>1.2581</b>  | 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       |
| <b>1.2601</b>  | X165CrMoV12   | X 165 CrMoV 12 |                |                    | X 165 CrMoW 12 KU 2310   |              | X 160 CrMoV 12 |             |            |
| <b>1.2767</b>  | X45NiCrMo4    | 40 NiCrMo 4    | Y 35 NCD 16    |                    | 42 NiCrMo 15 7 KU        |              |                |             | A 9        |
| <b>1.2779</b>  | X6NiCrTi2615  |                |                | S 66286            |                          |              |                |             | 660        |
| <b>1.3302</b>  | S1214         | HS 12 1 4      |                |                    | X 150 WV 1305 KU         |              |                |             | A 7        |
| <b>1.3318</b>  | S1212         | HS 02.01.12    |                |                    |                          |              |                |             |            |
| <b>1.3401</b>  | X120Mn12      | X 120 Mn 12    | Z 120 M 12     | BW 10              | X G 120 Mn 12            | 2183         | AM-X 120 Mn 12 | SCMnH 1     | A 128      |
| <b>1.3543</b>  | X102CrMo17    | X 102 CrMo 17  | X100CrMo17     |                    | X 105 CrMo 17            |              | X 100 CrMo 17  |             |            |
| <b>1.3549</b>  | X89CrMoV81    |                |                |                    |                          |              |                |             |            |
| <b>1.3551</b>  | 80MoCrV4216   |                | 80 DCV 40      | T 11350            | X 80 MoCrV 4 4           |              | 80 MoCrV 40-16 |             | M 50       |
| <b>1.7225</b>  | 42CrMo4.M4S   | 42 CrMo 4      | 42 CD 4        | 708 A 42           | 42 CrMo 4                | 2244         |                | SCM 440 H   | 4140       |

**K 1.1** **GREY CAST IRON** <600 N/mm<sup>2</sup> (180 HB)

| Materialnumber | Germany   DIN | Europe   EN | France   AFNOR | Great Britain   BS | Italy   UNI | Sweden   SIS | Spain   UNE | Japan   JIS | USA   AISI |
|----------------|---------------|-------------|----------------|--------------------|-------------|--------------|-------------|-------------|------------|
| <b>0.6010</b>  | GG10          | GJL-100     | FGL 100        | Grade 100          | G 10        | 0110-00      | FG 10       | FC 100      | A48-20 B   |
| <b>0.6012</b>  | GG150 HB      | GJL-HB 170  |                |                    |             |              |             |             |            |
| <b>0.6015</b>  | GG15          | GJL-150     | FGL 150        | Grade 150          | G 15        | 0115-00      | FG 15       | FC 150      | A48-25 B   |
| <b>0.6017</b>  | GG170 HB      | GJL-HB 205  |                |                    |             |              |             |             |            |

**K 1.2** **GREY CAST IRON** <1000 N/mm<sup>2</sup> (300 HB)

| Materialnumber | Germany   DIN | Europe   EN | France   AFNOR | Great Britain   BS | Italy   UNI | Sweden   SIS | Spain   UNE | Japan   JIS | USA   AISI |
|----------------|---------------|-------------|----------------|--------------------|-------------|--------------|-------------|-------------|------------|
| <b>0.6020</b>  | GG20          | GJL-200     | FGL 200        | Grade 220          | G 20        | 0120-00      | FG 20       | FC 200      | A48-30 B   |
| <b>0.6022</b>  | GG190 HB      | GJL-HB 230  |                |                    |             |              |             |             |            |
| <b>0.6025</b>  | GG25          | GJL-250     | FGL 250        | Grade 260          | G 25        | 0125-00      | FG 25       | FC 250      | A48-40 B   |
| <b>0.6027</b>  | GG220 HB      | GJL-HB 250  | FGL 250        |                    |             |              |             |             |            |
| <b>0.6030</b>  | GG30          | GJL-300     | FGL 300        | Grade 300          | G 30        | 0130-00      | FG 30       | FC 300      | A48-45 B   |
| <b>0.6032</b>  | GG240 HB      | GJL-HB 275  |                |                    |             |              |             |             |            |
| <b>0.6035</b>  | GG35          | GJL-350     | FGL 350        | Grade 350          | G 35        | 0135-00      | FG 35       | FC 350      | A48-50 B   |
| <b>0.6037</b>  | GG260 HB      | GJL-HB 275  |                |                    |             |              |             |             |            |
| <b>0.6040</b>  | GG40          | GJL-400     | FGL 400        | Grade 400          |             | 0140-00      |             |             | A48-60 B   |

**M 1.1** STAINLESS STEEL FERRITIC/MARTENSITIC <850 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 |
|----------------|---------------|--------------------|--------------------|--------------------|--------------------|--------------|------------------|-------------|------------|
| 1.4000         | X6Cr13        | X 6 Cr 13          | Z 6 C 13           | 403 S 17           | X 6 Cr 13          | 2301         | X 6 Cr 13        | SUS 403     | 403        |
| 1.4002         | X6CrAl13      | X 6 CrAl 13        | Z 6 CA 13          | 405 S 17           | X 6 CrAl 13        | 2302         | X 6 CrAl 13      | SUS 405     | 405        |
| 1.4005         | X12CrS13      | X 12 CrS 13        | Z 12 CF 13         | 416 S 21           | X 12 CrS 13        | 2380         | X12 CrS 13       | SUS 416     | 416        |
| 1.4006         | X10Cr13       | X 12 Cr 13 KD      | Z 12 C 13          | 410 S 21           | X 12 Cr 13         | 2302         | X 12 Cr 13       | SUS 410     | 410        |
| 1.4008         | GX8CrNi13     | GX 7 CrNiMo 12 1   | Z 12 CN 13 M       | 410 C 21           | GX 12 Cr 13        |              |                  | SCS 1       | 414        |
| 1.4016         | X6Cr17        | X 8 Cr 17          | Z 8 C 17           | 430 S 15           | X 8 Cr 17 KD       | 2320         | X 8 Cr 17        | SUS 430     | 430        |
| 1.4021         | X20Cr13       | X 20 Cr 13         | Z 20 C 13          | 420 S 37           | X 20 Cr 13         | 2303         | X 20 Cr 13       | SUS 420 J1  | 420        |
| 1.4024         | X15Cr13       | X 15 Cr 13         | Z 12 C 13 M        | 420 S 29           | X 12 Cr 13         |              |                  | SUS 410 J1  |            |
| 1.4027         | GX20Cr14      |                    | Z 20 C 13 M        | 420 C 29           |                    |              |                  | SCS 2       |            |
| 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        |
| 1.4034         | X45Cr13       | X 45 Cr 13         | Z 40 C 14          | 420 S 45           | X 40 Cr 14         |              | X 46 Cr 13       |             | 420        |
| 1.4057         | X19CrNi172    | X 19 CrNi 17 2     | Z 15 CN 16.02      | 431 S 29           | X 16 CrNi 16       | 2321         | X 15 CrNi 16     | SUS 431     | 431        |
| 1.4104         | X12CrMoS17    | X 14 CrMoS 17      | Z 10 CF 17         | 441 S 29           | X 10 CrS 17        | 2383         | X 10 CrS 17      | SUS 430 F   | 430 F      |
| 1.4105         | X4CrMoS18     | X 6 CrMoS 17       | Z 6 CDF 18-02      |                    |                    |              |                  | SUS 430 F   | 430        |
| 1.4107         | GX8CrNi12     | GX 8 CrNi 12       | GX 8 CrNi 12       |                    | GX 8 CrNi 12       |              |                  |             |            |
| 1.4109         | X65CrMo14     | X 70 CrMo 15       | Z 70 CD 14         |                    |                    |              |                  | SUS 440 A   | 440 A      |
| 1.4110         | X55CrMo14     |                    | Z 50 CD 13         |                    |                    |              |                  |             |            |
| 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      |
| 1.4113         | X6CrMo171     | X 8 CrMo 17        | Z 8 CD 17.02       | 434 S 17           | X 8 CrMo 17        | 2325         |                  | SUS 434     | 434        |
| 1.4116         | X45CrMoV15    | X 50 CrMoV 15      | Z 50 CD 15         |                    | X50 CrMoV 15       |              | X 46 CrMo 16     |             |            |
| 1.4122         | X35CrMo17     | X 39 CrMo 17 1     | X39CrMo17-1        |                    | X 35 CrMo 17       |              |                  |             |            |
| 1.4125         | X105CrMo17    | X 105 CrMo 17      | Z 100 CD 17        |                    | X 105 CrMo 17      |              |                  | SUS 440 C   | 440 C      |
| 1.4136         | GX70CrMo292   |                    | Z 60 CD 29.2 M     |                    |                    |              |                  |             |            |
| 1.4313         | X5CrNi134     | X 3 CrNiMo 13 4    | Z 4 CDN 13.4       | 425 C 11           | X 3 CrNiMo 13 4    | 2385         |                  | SCS 5       | CA 6-NM    |
| 1.4317         | GX4CrNi134    | GX 4 CrNi 13 4     | GX 4 CrNi 13 4     |                    | GX 4 CrNi 13 4     |              |                  |             |            |
| 1.4351         | X3CrNi134     | X 3 CrNi 14 04 KE  |                    |                    |                    |              |                  |             |            |
| 1.4405         | GX5CrNiMo165  | GX 4 CrNiMo 16 5 1 | GX 4 CrNiMo 16 5 1 |                    | GX 4 CrNiMo 16 5 1 |              |                  |             |            |
| 1.4510         | X6CrTi17      | X 8 CrTi 17        | Z 8 CT 17          |                    | X 6 CrTi 17        |              | X 8 CrTi 17      | SUS 430 LX  | 430 Ti     |
| 1.4511         | X6CrNb17      | X 3 CrNb 17        | Z 8 CNb 17         |                    | X 6 CrNb 17        |              |                  | SUS 430 LX  | 430 Nb     |
| 1.4512         | X6CrTi12      | X 5 CrTi 12        | Z 6 CT 12          | 409 S 19           | X 6 CrTi12         |              |                  | SUH 409     | 409        |
| 1.4523         | X8CrMoTi17    | X 2 CrMoTiS 18 2   | X 2 CrMoTiS 18 2   |                    |                    |              |                  |             |            |
| 1.4704         | X45SiCr4      | 45SiCr16-11        |                    |                    |                    |              |                  |             | HNV 2      |
| 1.4718         | X45CrSi93     | X 45 CrSi 8        | Z 45 CS 9          | 401 S 45           | X 45 CrSi 8        |              | F.3220           | SUH 1       | HNV 3      |
| 1.4722         | X10CrSi13     |                    |                    |                    |                    |              | X 10 CrSi 13     |             |            |
| 1.4724         | X10CrAl13     | X 10 CrAl 13       | Z 10 C 13          | BH 12              | X 10 CrAl 12       |              | X 10 CrAl 13     | SUS 405     | H-12       |
| 1.4725         | X8CrAl144     | CrAl 14 4          | K 91670            |                    |                    |              |                  |             |            |
| 1.4747         | X80CrNiSi20   | X 80 CrNiSi 20     | Z 80 CSN 20.02     | 433 S 65           | X 80 CrSiNi 20     |              | X 80 CrSiNi20-02 | SUH 4       | HNV 6      |
| 1.4762         | X10CrAl24     | X 10 CrAl 24       | Z 10 CAS 24        |                    | X 16 Cr 26         | 2322         | X 10 CrAl 24     | SUH 442     | 446        |
| 1.4767         | X8CrAl205     | CrAl 20 5          |                    |                    |                    |              |                  |             |            |

**M 2.1** STAINLESS STEEL | austenitic <650 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 |
|----------------|------------------|------------------------|---------------------|--------------------|---------------------|--------------|---------------------|-------------|------------|
| 1.4300         | X12CrNi188       |                        |                     | 302                |                     |              |                     |             |            |
| 1.4301         | X5CrNi1810       | X 6 CrNi 18 10 KD      | Z 6 CN 18.09        | 304 S 15           | X 5 CrNi 18 10      | 2332         | X 5 CrNi 18 11      | SUS 304     | 304 H      |
| 1.4302         | X5CrNi199        | X 6 CrNi 20 10 KE      |                     | 308 S 96           |                     |              |                     |             |            |
| 1.4303         | X5CrNi1812       | X 8 CrNi 18 12 KD      | Z 8 CN 17.07        | 305 S 19           | X 8 CrNi 19 10      |              | X 8 CrNi 18 12      | SUS 305     | 308        |
| 1.4305         | X10CrNiS189      | X 8 CrNiS 19 9         | Z 8 CNF 18.09       | 303 S 31           | X 8 CrNiS 18 9      | 2346         | F.310.C             | SUS 303     | 303        |
| 1.4307         | X2CrNi189        | X 2 CrNi 18 9          | CLC 18.9.L          | 304 S 11           | X 2 CrNi 18 9       |              |                     | SUS 304 L   | 304 L      |
| 1.4308         | GX6CrNi189       | X 2 CrNi 18 7          | Z 6 CN 18.10 M      | 304 C 15           | GX 5 CrNi 19 10     | 2333         |                     | SCS 13      | CF-8       |
| 1.4310         | X12CrNi177       | X 12 CrNi 17 7         | Z 12 CN 17.07       | 301 S 21           | X 12 CrNi 17 07     |              | X 12 CrNi 17 07     | SUS 301     | 301        |
| 1.4311         | X2CrNiN1810      | X 2 CrNiN 18 10        | Z 8 CN 18.12        | 304 S 62           | X 8 CrNi 19 10      | 2371         | X 8 CrNi 18 12      | SUS 304 LN  | 304 LN     |
| 1.4312         | GX10CrNi188      |                        | Z 10 CN 18.9 M      | 302 C 25           |                     |              |                     | SCS 12      |            |
| 1.4318         | X 2 CrNiN 18 7   | X 2 CrNiN 18 7         | 18-7L               |                    | 18-7L               |              |                     |             |            |
| 1.4319         | X3CrNi178        |                        |                     | 302 S 26           | X 10 CrNi 18 09     |              |                     | SUS 302     |            |
| 1.4350         | X5CrNi189        |                        | Z 6 CN 18.09        | 304 S 31           | X 5 CrNi 18 10      |              |                     |             | 304        |
| 1.4401         | X5CrNiMo17122    | X 6 CrNiMo 17 12 2 KD  | Z 6 CND 17.11       | 316 S 16           | X 5 CrNiMo 17 12    | 2347         | X 5 CrNiMo 17 12    | SUS 316     | 316        |
| 1.4404         | X2CrNiMo17132    | GX 3 CrNiMo 17 12 2 KD | Z 3 CND 19.10 M     | 316 S 12           | GX 2 CrNiMo 19 11   | 2348         | X 2 CrNiMo          | SUS 316 L   | 316 L      |
| 1.4406         | X2CrNiMoN17122   | X 3 CrNiMoN 17 12 2    | Z 2 CND 17.12 Az    | 316 S 61           | X 2 CrNiMoN 17 12   |              |                     | SUS 316 LN  | 316 LN     |
| 1.4407         | GX 5 CrNiMo 13 4 | GX 5 CrNiMo 13 4       | J 91550             |                    |                     |              |                     |             | A757       |
| 1.4408         | GX6CrNiMo1810    | GX 5 CrNiMo 19 11 2    | GX 5 CrNiMo 19 11 2 | 316 C 16           | GX 5 CrNiMo 19 11 2 | 2343         | X 7 CrNiMo 20 10    | SCS 14      | CF-8M      |
| 1.4435         | X2CrNiMo18143    | X 2 CrNiMo 18 16       | Z 2 CDN 17.13       | 316 S 11           | X 2 CrNiMo 17 13    | 2353         |                     | SVS 16      | 316 L      |
| 1.4436         | X5CrNiMo17133    | X 6 CrNiMo 18 13 3 KD  | Z 6 CND 17.12       | 316 S 16           | X 5 CrNiMo 17 13    | 2343         | X 6 CrNiMo 17 12 03 | SUS 316     | 316        |
| 1.4438         | X2CrNiMo18164    | X 3 CrNiMo 18 16 4     | Z 2 CND 19.15       | 317 S 12           | X 2 CrNiMo 18 15    | 2367         |                     | SUS 317 L   | 317 L      |
| 1.4440         | X2CrNiMo18165    |                        |                     |                    |                     |              |                     |             |            |
| 1.4442         | X2CrNiMo18154    |                        | X 3 CrNiMoN 18 14   |                    |                     |              |                     |             |            |

**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 |
|----------------|---------------|-------------|----------------|--------------------|-------------------|--------------|-------------|-------------|------------|
| 3.1255         | AlCu 4 SiMg   | AW-2014     | A-U4SG         | 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     |
| 3.2315         | 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     |
| 3.3315         | 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 Mn     | AW-5086     | A-G4MC         | N8                 | P-AlMg 4.5        | 4140         | L-3321      | A5083       | AA5083     |

**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 - 2.3 ALUMINIUM |** casted <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 |
|----------------|------------------|-------------|----------------|--------------------|-------------|--------------|-------------|-------------|------------|
| 3.2151         | 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    |
| 3.2371         | 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    |                |                    |             |              |             |             |            |
| 3.2383         | 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    |
| 3.2583         | G-AlSi 12 Cu     | AC-44300    | A-S12-Y4       | LM 20              | 5079        | 4260         |             | ADC1        | A 413.1    |

## N 3.1 – 3.3 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 |
|----------------|-------------------|-------------|----------------|--------------------|-------------|--------------|-------------|-------------|------------|
| <b>2.0240</b>  | CuZn 15           | CW-502L     | CuZn 15        | CZ 102             |             |              |             | C 2300      | C 23000    |
| <b>2.0265</b>  | CuZn 30           | CW-505L     | CuZn 30        | CZ 102             |             |              |             | C 2600      | C 26000    |
| <b>2.0321</b>  | CuZn 37           | CW-508L     | CuZn 37        | CZ 180             | C 2720      |              |             |             | C 27200    |
| <b>2.0492</b>  | G-CuZn 15 Si 4    | CC-761S-GS  |                |                    |             |              |             |             | B-198      |
| <b>2.0592</b>  | G-CuZn 35 Al 1    | CC-765S     | U-Z 36 N 3     | HTB 1              |             |              |             |             | C 86500    |
| <b>2.0966</b>  | CuAl 10 Ni 5 Fe 4 | CW-307G     | U-A 10 N       | CA 104             |             |              |             |             | C 63000    |
| <b>2.1006</b>  | SG-CuSn           |             |                |                    |             |              |             |             |            |
| <b>2.1050</b>  | G-CuSn 10         | CC-480K-GS  |                | CT 1               |             |              |             |             | C 90700    |
| <b>2.1052</b>  | G-CuSn 12         | CC-483K-GS  | UE 12 P        | Pb 2               |             |              |             |             | C 91700    |
| <b>2.1060</b>  | G-CuSn 12 Ni 2    | CC-484K-GS  |                |                    |             |              |             |             | C 91700    |
| <b>2.1176</b>  | G-CuPb 10 Sn      | CC-495K-GS  | UE 10 Pb 10    | LB 2               |             |              |             |             | C 93700    |
| <b>2.1182</b>  | G-CuPb 15 Sn      | CC-496K-GS  | U-Pb 15 E 8    | LB 1               |             |              |             |             | C 93800    |
| <b>2.1188</b>  | G-CuPb 20 Sn      | CC-497K-GS  | U-Pb 20        | LB 5               |             |              |             |             | C 94100    |
| <b>2.1266</b>  | CuCd 1            |             |                |                    |             |              |             |             |            |
| <b>2.1292</b>  | G-CuCrF 35        | CC-140C     |                | CC1-FF             |             |              |             |             | C 81500    |
| <b>2.1293</b>  | CuCrZr            | CW-106C     | U-Cr 0.8 Zr    | CC 102             |             |              |             |             | C 81500    |

## § 2.1 TITANIUM | commercially pure <600 N/mm<sup>2</sup>

| Material-number | Tradename | Germany   DIN | Europe   EN   | France   AFNOR | GB   BS  | Italy   UNI | Sweden   SIS | Spain   UNE | Japan   JIS | USA   AISI |
|-----------------|-----------|---------------|---------------|----------------|----------|-------------|--------------|-------------|-------------|------------|
| <b>3.7025</b>   |           | Ti 99,8       | Titan Grade 1 | AIR:9182T35    | 2 TA 1   |             |              |             |             | R 50250    |
| <b>3.7035</b>   |           | Ti 99,7       | Titan Grade 2 | AIR:9182T40    | 2 TA 2-1 |             |              |             |             | R 50400    |
| <b>3.7055</b>   |           | Ti-99,6       | Titan Grade 3 | AIR:9182T50    | TA 3     |             |              |             |             | R 50550    |
| <b>3.7065</b>   |           | Ti-99,5       | Titan Grade 4 | AIR:9182T60    | 2 TA 6-9 |             |              |             |             | R 50700    |

## § 2.2 TITANIUM | alloyed <1000 N/mm<sup>2</sup>

| Material-number | Tradename | Germany   DIN   | Europe   EN    | France   AFNOR | GB   BS  | Italy   UNI | Sweden   SIS | Spain   UNE | Japan   JIS | USA   AISI     |
|-----------------|-----------|-----------------|----------------|----------------|----------|-------------|--------------|-------------|-------------|----------------|
| <b>3.7105</b>   |           | TiNi 0,8 Mo 0,3 | Titan Grade 12 |                |          |             |              |             |             |                |
| <b>3.7115</b>   |           | TiAl 5 Sn 2,5   | Titan Grade 6  | T-A 5 E        |          |             |              |             |             | Ti 5 Al-2,5 Sn |
| <b>3.7195</b>   |           | TiAl 3 V 2,5    | Titan Grade 9  |                |          |             |              |             |             |                |
| <b>3.7225</b>   |           | Ti 1 Pd         | Titan Grade 11 |                | TP 1     |             |              |             |             | R 52250        |
| <b>3.7235</b>   |           | Ti 2 Pd         | Titan Grade 7  |                |          |             |              |             |             | T 52400        |
| <b>3.7164</b>   |           | TiAl 6 V 4-LN   | Titan Grade 5  |                |          |             |              |             |             | R 56400        |
| <b>3.7165</b>   |           | TiAl 6 V4       | Titan Grade 5  | T-A 6 V        | TA 10-13 |             |              |             |             |                |

## § 1.1 IRON-BASED ALLOY [HRSA] <1200 N/mm<sup>2</sup>

| Material-number | Tradename           | Germany   DIN      | Europe   EN            | France   AFNOR        | GB   BS  | Italy   UNI           | Sweden   SIS | Spain   UNE | Japan   JIS | USA   AISI |
|-----------------|---------------------|--------------------|------------------------|-----------------------|----------|-----------------------|--------------|-------------|-------------|------------|
| <b>1.3910</b>   | Magnifer® 36        | Ni36               | D 1                    |                       |          |                       |              |             |             |            |
| <b>1.3926</b>   | Magnifer® 50        | RNi12              |                        |                       |          |                       |              |             |             |            |
| <b>1.4361</b>   | X1CrNiSi1815        | X 1 CrNiSi 18-15-4 | X 1 CrNiSi 18 15 4     |                       |          |                       |              |             |             |            |
| <b>1.4562</b>   | Nicrofer® 3127      | X1NiCrMoCu32287    | X 1 NiCrMoCu 32 28 7   |                       |          |                       |              |             |             |            |
| <b>1.4562</b>   | Alloy 31            | X1NiCrMoCu32287    | X 1 NiCrMoCu 32 28 7   |                       |          |                       |              |             |             |            |
| <b>1.4563</b>   | Sanicro® 28         | X1NiCrMoCuN31274   | X 1 NiCrMoCuN 31-27-4  | X 1 NiCrMoCuN 31 27 4 |          | X 1 NiCrMoCuN 31 27 4 | 2584         |             |             |            |
| <b>1.4862</b>   | INCOLOY® Alloy DS   | X12NiCr3618        |                        | Z 12 NCS 37.18        | NA 17    |                       |              |             |             |            |
| <b>1.4980</b>   | INCOLOY® Alloy 286  | X6NiCrTiMoVB21152  | X 6 NiCrTiMoVB 21 15 2 | Z 6 NCTDV 25.15 B     | 286 S 31 |                       |              |             |             |            |
| <b>2.4478</b>   | Alloy 52 (Nilo® 52) | FeNi 52            | Titan Grade 4          | AIR:9182T60           | 2 TA 6-9 |                       |              |             |             | N 14052    |

S 1.2 NICKEL-BASED ALLOY [HRSA] <1450 N/mm<sup>2</sup>

| Material-number | Tradename        | Germany   DIN   | Europe   EN | France   AFNOR | GB   BS      | Italy   UNI    | Sweden   SIS | Spain   UNE | Japan   JIS | USA   AISI |
|-----------------|------------------|-----------------|-------------|----------------|--------------|----------------|--------------|-------------|-------------|------------|
| 2.4602          | INCONEL® 622     | NiCr21Mo14W     |             |                |              | INCONEL® 622   |              |             |             |            |
| 2.4632          | Nimonic® 90      | NiCr20Co80Ti    | HR 2        | NC 20 KTA      | NA 36        | Nimonic® 90    |              |             |             | N 07090    |
| 2.4642          | INCONEL® 690     | NiCr29Fe        |             | NC 30 Fe       |              | INCONEL® 690   |              |             | NCF 690     | N 06690    |
| 2.4650          | Nimonic® C-263   | NiCo20Cr20MoTi  | HR 10       | NCK 20 D       | NA 38        | Nimonic® C-263 |              |             | NCF 690     | N 07263    |
| 2.4654          | Waspaloy®        | NiCr19Co14Mo4Ti |             | NC 20 K14 Y    |              | Waspaloy®      |              |             |             | N 07001    |
| 2.4662          | INCOLOY® 901     | NiCr13Mo6Ti3    |             | Z 8 NCDT 42    |              |                |              |             |             | N 09901    |
| 2.4663          | INCONEL® 617     | NiCr23Co12Mo    |             | NC 22 K12 D9 A |              | INCONEL® 617   |              |             |             | N 06617    |
| 2.4665          | Hastelloy® X     | NiCr22Fe18Mo    | HR 6        | NC 22 FeD      | NA 40        | Hastelloy X    |              |             |             |            |
| 2.4666          | Nimonic® PK25    | NiCr18CoMo      |             | NKCD 20 ATU    |              |                |              |             |             |            |
| 2.4668          | INCONEL® 718     | NiCr19FeNbMo    | HR 8        | NC 19 Fe Nb    | INCONEL® 718 | INCONEL® 718   |              |             |             | N 07718    |
| 2.4669          | INCONEL® X-750   | NiCr15Fe7TiAl   |             | NC 15 Fe 7 TA  |              | INCONEL® X-750 |              |             |             | N 07750    |
| 2.4694          | INCONEL® 751     | NiCr16Fe7TiAl   |             |                |              |                |              |             |             | N 07751    |
| 2.4816          | INCONEL® 600     | NiCr15Fe        |             | NC 15 Fe       | NA 14        | INCONEL® 600   |              |             | NFC 600     | N 06600    |
| 2.4819          | Nimonic® C-276   | NiMo16Cr15W     |             | NC 17 D        |              | Nimonic® C-276 |              |             |             | N 10276    |
| 2.4851          | INCONEL® 601     | NiCr23Fe15      |             | NC 23 Fe 14 A  |              | INCONEL® 601   |              |             | NCF 601     | N 06601    |
| 2.4856          | INCONEL® 625     | NiCr22Mo9Nb     |             | NC 22 Fe DNb   | NA 21        | INCONEL® 625   |              |             | NCF 625     | N 06625    |
| 2.4858          | INCOLOY® 825     | NiCr21Mo        | 3072.76     | NC 21 Fe DU    | NA 16        | INCOLOY® 825   |              |             | NCF 825 TB  | N 08825    |
| 2.4869          | Alloy 80/20      | NiCr80-20       |             |                |              |                |              |             |             | N 06003    |
| 2.4879          | Centralloy® 4879 | G-NiCr38W       |             |                |              |                |              |             |             |            |
| 2.4883          | Hastelloy® C276  | G-NiMo16Cr      |             |                |              |                |              |             |             |            |
| 2.4889          | Nicrofer® 45 TM  | NiCr28FeSiCe    |             |                |              |                |              |             |             | N 06045    |
| 2.4951          | Nicrofer® 7520   | NiCr20Ti        |             | NC 20 T        | HR 5         |                |              |             |             | N 06075    |

S 1.3 COBALT-BASED ALLOY [HRSA] <1450 N/mm<sup>2</sup>

| Material-number | Tradename       | Germany   DIN | Europe   EN | France   AFNOR | GB   BS | Italy   UNI     | Sweden   SIS | Spain   UNE | Japan   JIS | USA   AISI |
|-----------------|-----------------|---------------|-------------|----------------|---------|-----------------|--------------|-------------|-------------|------------|
| 2.4681          | ULTIMET® alloy  | CoCr26Ni9Mo5W |             |                |         |                 |              |             |             |            |
| 2.4682          | Stellite® 31    | G-CoCr25NiW   |             | KC 25 WN       |         |                 |              |             |             | ASTM A567  |
| 2.4683          | Conicro® 4023 W | CoCr22NiW     |             |                |         |                 |              |             |             |            |
| 2.4691          | HS 21           | G-CoCr28Mo    |             | KC 27 D5 NFe   |         |                 |              |             |             | ASTM F-75  |
| 2.4964          | Stellite® 25    | CoCr20W15Ni   |             | KC 22 WN       | HR 240  | L605 Haynes® 25 |              |             |             | R 30605    |
| 2.4979          | S 816           | CoCr28Mo6     |             |                |         |                 |              |             |             |            |

## 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  
(cm³/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 cm³/min            |
| <b>D</b>             | Diameter of tool          | in mm                 |

# EXPLANATION OF CUTTING DATA

## EXAMPLE FOR SIDE MILLING OF 1.2343 WITH Ø10:

### P 3.2 STEEL | high alloyed <1100 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 |
|----------------|---------------|----------------|----------------|--------------------|--------------------------|--------------|--------------|-------------|------------|
| 1.2083         | X42Cr13       | X 42 Cr 13     | Z 40 C 14      |                    | X 41 Cr 13 KU            | 2314         |              | SUS 420 J2  | 420        |
| 1.2316         | X36CrMo17     | X 36 CrMo 17   | X38CrMo 16 1   |                    | X 38 CrMo 16 1 KU        |              | X 38 CrMo 16 |             | D-4        |
| 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       |
| 1.2344         | X40CrMoV51    | X 40 CrMoV 5 1 | Z 40 CDV 5     | BH 13              | X 40 CrMoV 5 1 1 KU 2242 |              | X 40 CrMoV 5 | SKD 61      | H 13       |
| 1.2436         | X210CrW12     | X 210 CrW 12   | Z 210 CW1 2    |                    | X 215 CrW 12 1 KU 2312   |              | X 210 CrW 12 | SKD 2       |            |

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

|         |                            | Strength<br>(N/mm <sup>2</sup> ) | Full Slot  | Side Milling | Finishing  | ETC        | Materialgroup<br>Factor<br>fz / a | Materialgroup<br>Factor<br>ae ETC |
|---------|----------------------------|----------------------------------|------------|--------------|------------|------------|-----------------------------------|-----------------------------------|
| P       | STEEL                      |                                  | Vc = m/min | Vc = m/min   | Vc = m/min | Vc = m/min |                                   |                                   |
| 1.1-1.3 | unalloyed                  | <850                             | 200        | 200          | 220        | 315        | 1                                 | 1                                 |
| 2.1-2.2 | low alloyed                | <950                             | 190        | 190          | 210        | 232        | 0.9                               | 0.8                               |
| 3.1-3.2 | high alloyed               | <1100                            | 170        | 170          | 190        | 198        | 0.8                               | 0.7                               |
| K       | CASTINGS                   |                                  | Vc = m/min | Vc = m/min   | Vc = m/min | Vc = m/min |                                   |                                   |
| 1.1-1.2 | grey cast iron             | <1000                            | 210        | 210          | 230        | 242        | 0.9                               | 0.8                               |
| M       | STAINLESS STEEL            |                                  | Vc = m/min | Vc = m/min   | Vc = m/min | Vc = m/min |                                   |                                   |
| 1.1     | ferritic/martensitic       | <850                             |            | 90           | 95         | 152        | 0.9                               | 0.7                               |
| 2.1     | austenitic                 | <650                             |            | 80           | 85         | 132        | 0.8                               | 0.5                               |
| N       | NON-FERROUS                |                                  | Vc = m/min | Vc = m/min   | Vc = m/min | Vc = m/min |                                   |                                   |
| 1.1-2.3 | ALUMINIUM   alloyed/casted | <600                             | 400        | 400          | 420        | 500        | 1.6                               | 2                                 |
| 3.1-3.3 | COPPER   alloyed           | <600                             | 200        | 200          | 220        | 262        | 1.5                               | 1.6                               |
| T       | TITANIUM                   |                                  | Vc = m/min | Vc = m/min   | Vc = m/min | Vc = m/min |                                   |                                   |
| 2.1-2.2 | pure/alloyed               | <1000                            |            | 50           | 53         | 75         | 0.8                               | 0.5                               |
| S       | SUPER ALLOYS               |                                  | Vc = m/min | Vc = m/min   | Vc = m/min | Vc = m/min |                                   |                                   |
| 1.1-1.3 | HRSA                       | <1450                            |            | 25           | 28         | 42         | 0.7                               | 0.3                               |

OVERVIEW OF THE DIFFERENT MATERIAL GROUPS FOR THIS TOOL INCLUDING FACTORS

#### Material P 1.1-1.3

|  |  |  |  |                  |                  |  |                    |            |  |            |            |  |            |            |              |
|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|------------------|------------------|-------------------------------------------------------------------------------------|--------------------|------------|-------------------------------------------------------------------------------------|------------|------------|-------------------------------------------------------------------------------------|------------|------------|--------------|
| Ø                                                                                   | mm                                                                                  | α°                                                                                  | fz<br>(mm/Z)                                                                        | ae = 1xD<br>(mm) | ap = 1xD<br>(mm) | fz<br>(mm/Z)                                                                        | ae = 0.3xD<br>(mm) | ap<br>(mm) | fz<br>(mm/Z)                                                                        | ae<br>(mm) | ap<br>(mm) | fz<br>(mm/Z)                                                                        | ae<br>(mm) | ap<br>(mm) | hmax<br>(mm) |
| 3                                                                                   | 6                                                                                   | 0.5°                                                                                | 0.015                                                                               | 3                | 3                | 0.02                                                                                | 0.9                | L2max      | 0.013                                                                               | 0.2        | L2max      | 0.045                                                                               | 0.8        | L2max      | 0.0398       |
| 4                                                                                   | 8                                                                                   | 0.5°                                                                                | 0.015                                                                               | 4                | 4                | 0.02                                                                                | 1.2                | L2max      | 0.013                                                                               | 0.2        | L2max      | 0.06                                                                                | 1.1        | L2max      | 0.0536       |
| 5                                                                                   | 9                                                                                   | 0.5°                                                                                | 0.025                                                                               | 5                | 5                | 0.03                                                                                | 1.5                | L2max      | 0.02                                                                                | 0.2        | L2max      | 0.07                                                                                | 1.3        | L2max      | 0.0614       |
| 6                                                                                   | 10                                                                                  | 0.8°                                                                                | 0.035                                                                               | 6                | 6                | 0.04                                                                                | 1.8                | L2max      | 0.025                                                                               | 0.2        | L2max      | 0.09                                                                                | 1.6        | L2max      | 0.0796       |
| 8                                                                                   | 12                                                                                  | 1°                                                                                  | 0.045                                                                               | 8                | 8                | 0.055                                                                               | 2.4                | L2max      | 0.03                                                                                | 0.2        | L2max      | 0.11                                                                                | 1.9        | L2max      | 0.0936       |
| 10                                                                                  | 14                                                                                  | 1.5°                                                                                | 0.05                                                                                | 10               | 10               | 0.065                                                                               | 3                  | L2max      | 0.033                                                                               | 0.2        | L2max      | 0.13                                                                                | 2.3        | L2max      | 0.1094       |
| 12                                                                                  | 16                                                                                  | 2°                                                                                  | 0.055                                                                               | 12               | 12               | 0.075                                                                               | 3.6                | L2max      | 0.035                                                                               | 0.2        | L2max      | 0.15                                                                                | 2.6        | L2max      | 0.1236       |
| 16                                                                                  | 22                                                                                  | 2.5°                                                                                | 0.065                                                                               | 16               | 16               | 0.085                                                                               | 4.8                | L2max      | 0.04                                                                                | 0.2        | L2max      | 0.17                                                                                | 3.3        | L2max      | 0.1376       |
| 20                                                                                  | 26                                                                                  | 3°                                                                                  | 0.08                                                                                | 20               | 20               | 0.1                                                                                 | 6                  | L2max      | 0.045                                                                               | 0.2        | L2max      | 0.2                                                                                 | 3.6        | L2max      | 0.1537       |

ALL DATA GIVEN HERE IS FOR THE FIRST GROUP P1.1-1.3 IN THE MATERIAL GROUP OVERVIEW

#### DETERMINATION OF CUTTING DATA:

From the material key results: **material group P3.2**

Vc= 170 m/min (as indicated in the table)

fz= 0.065 mm/Z (as indicated in the table) x Factor fz 0.8 = **fz 0.052 mm/Z**



VIDEO EXPLANATION

## EXAMPLE FOR ETC OF 1.4303 WITH Ø10:

**M 2.1** STAINLESS STEEL | austenitic <650 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 |
|----------------|---------------|-------------------|----------------|--------------------|----------------|--------------|----------------|-------------|------------|
| 1.4300         | X12CrNi188    |                   |                | 302                |                |              |                |             |            |
| 1.4301         | X5CrNi1810    | X 6 CrNi 18 10 KD | Z 6 CN 18.09   | 304 S 15           | X 5 CrNi 18 10 | 2332         | X 5 CrNi 18 11 | SUS 304     | 304 H      |
| 1.4302         | X5CrNi199     | X 6 CrNi 20 10 KE |                | 308 S 96           |                |              |                |             |            |
| 1.4303         | X5CrNi1812    | X 8 CrNi 18 12 KD | Z 8 CN 17.07   | 305 S 19           | X 8 CrNi 19 10 |              | X 8 CrNi 18 12 | SUS 305     | 308        |
| 1.4305         | X10CrNiS189   | X 8 CrNiS 19 9    | Z 8 CNF 18.09  | 303 S 31           | X 8 CrNiS 18 9 | 2346         | F.310.C        | SUS 303     | 303        |

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

|         |                            |                               | Full Slot                                                                         | Side Milling                                                                      | Finishing                                                                         | ETC                                                                               | Materialgroup Factor fz / a | Materialgroup Factor ae ETC |
|---------|----------------------------|-------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------|-----------------------------|
|         |                            |                               |  |  |  |  |                             |                             |
| P       | STEEL                      | Strength (N/mm <sup>2</sup> ) | Vc = m/min                                                                        | Vc = m/min                                                                        | Vc = m/min                                                                        | Vc = m/min                                                                        |                             |                             |
| 1.1-1.3 | unalloyed                  | <850                          | 200                                                                               | 200                                                                               | 220                                                                               | 315                                                                               | 1                           | 1                           |
| 2.1-2.2 | low alloyed                | <950                          | 190                                                                               | 190                                                                               | 210                                                                               | 232                                                                               | 0.9                         | 0.8                         |
| 3.1-3.2 | high alloyed               | <1100                         | 170                                                                               | 170                                                                               | 190                                                                               | 198                                                                               | 0.8                         | 0.7                         |
| K       | CASTINGS                   |                               | Vc = m/min                                                                        | Vc = m/min                                                                        | Vc = m/min                                                                        | Vc = m/min                                                                        |                             |                             |
| 1.1-1.2 | grey cast iron             | <1000                         | 210                                                                               | 210                                                                               | 230                                                                               | 242                                                                               | 0.9                         | 0.8                         |
| M       | STAINLESS STEEL            |                               | Vc = m/min                                                                        | Vc = m/min                                                                        | Vc = m/min                                                                        | Vc = m/min                                                                        |                             |                             |
| 1.1     | ferritic/martensitic       | <850                          |                                                                                   | 90                                                                                | 95                                                                                | 152                                                                               | 0.9                         | 0.7                         |
| 2.1     | austenitic                 | <650                          |                                                                                   | 80                                                                                | 85                                                                                | 132                                                                               | 0.8                         | 0.5                         |
| N       | NON-FERROUS                |                               | Vc = m/min                                                                        | Vc = m/min                                                                        | Vc = m/min                                                                        | Vc = m/min                                                                        |                             |                             |
| 1.1-2.3 | ALUMINIUM   alloyed/casted | <600                          | 400                                                                               | 400                                                                               | 420                                                                               | 500                                                                               | 1.6                         | 2                           |
| 3.1-3.3 | COPPER   alloyed           | <600                          | 200                                                                               | 200                                                                               | 220                                                                               | 262                                                                               | 1.5                         | 1.6                         |
| T       | TITANIUM                   |                               | Vc = m/min                                                                        | Vc = m/min                                                                        | Vc = m/min                                                                        | Vc = m/min                                                                        |                             |                             |
| 2.1-2.2 | pure/alloyed               | <1000                         |                                                                                   | 50                                                                                | 53                                                                                | 75                                                                                | 0.8                         | 0.5                         |
| S       | SUPER ALLOYS               |                               | Vc = m/min                                                                        | Vc = m/min                                                                        | Vc = m/min                                                                        | Vc = m/min                                                                        |                             |                             |
| 1.1-1.3 | HRSA                       | <1450                         |                                                                                   | 25                                                                                | 28                                                                                | 42                                                                                | 0.7                         | 0.3                         |

OVERVIEW OF THE DIFFERENT MATERIAL GROUPS FOR THIS TOOL INCLUDING FACTORS

### Material P 1.1-1.3

| 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 (mm) | ap (mm) | hmax (mm) |
| 3  | 6  | 0.5°            | 0.015     | 3             | 3             | 0.02         | 0.9             | L2max   | 0.013     | 0.2     | L2max   | 0.045     | 0.8     | L2max   | 0.0398    |
| 4  | 8  | 0.5°            | 0.015     | 4             | 4             | 0.02         | 1.2             | L2max   | 0.013     | 0.2     | L2max   | 0.06      | 1.1     | L2max   | 0.0536    |
| 5  | 9  | 0.5°            | 0.025     | 5             | 5             | 0.03         | 1.5             | L2max   | 0.02      | 0.2     | L2max   | 0.07      | 1.3     | L2max   | 0.0614    |
| 6  | 10 | 0.8°            | 0.035     | 6             | 6             | 0.04         | 1.8             | L2max   | 0.025     | 0.2     | L2max   | 0.09      | 1.6     | L2max   | 0.0796    |
| 8  | 12 | 1°              | 0.045     | 8             | 8             | 0.055        | 2.4             | L2max   | 0.03      | 0.2     | L2max   | 0.11      | 1.9     | L2max   | 0.0936    |
| 10 | 14 | 1.5°            | 0.05      | 10            | 10            | 0.065        | 3               | L2max   | 0.033     | 0.2     | L2max   | 0.13      | 2.3     | L2max   | 0.1094    |
| 12 | 16 | 2°              | 0.055     | 12            | 12            | 0.075        | 3.6             | L2max   | 0.035     | 0.2     | L2max   | 0.15      | 2.6     | L2max   | 0.1236    |
| 16 | 22 | 2.5°            | 0.065     | 16            | 16            | 0.085        | 4.8             | L2max   | 0.04      | 0.2     | L2max   | 0.17      | 3.3     | L2max   | 0.1376    |
| 20 | 26 | 3°              | 0.08      | 20            | 20            | 0.1          | 6               | L2max   | 0.045     | 0.2     | L2max   | 0.2       | 3.6     | L2max   | 0.1537    |

ALL DATA GIVEN HERE IS FOR THE FIRST GROUP P1.1-1.3 IN THE MATERIAL GROUP OVERVIEW

### DETERMINATION OF CUTTING DATA:

From the material key results: **material group M2.1**

Vc= 132 m/min (as indicated in the table)

fz= 0.13 mm/Z (as indicated in the table) x Factor fz 0.8 = **fz 0.104 mm/Z**

ae= 2.3 mm (as indicated in the table) x Factor ae 0.5 = **1.15 mm ae**