

# Material Group

## STEP 1 - Identify workpiece Material Group



| DIN ISO 513                | Material   | Condition                        | Tensile Strength (Kpsi)      | Hardness HB | Material Group # VDI 3323 | Trade Names  |   |    |
|----------------------------|--|----------------------------------|------------------------------|-------------|---------------------------|--|---|----|
| P                          | Non-alloy steel, cast steel, free cutting steel                    | <0.25%C<br>Annealed              | 61                           | 125         | 1                         | 1010, 1015, 1018, 1020, 1023, 1102, 1108, 1109, 1213, 12L13, 1215  |   |    |
|                            |  | >=0.25%C<br>Annealed             | 94                           | 190         | 2                         | 1025, 1030, 1035, 1040, 1045, 1050, 1140, 1141, 1330   |   |    |
|                            |  | <0.55%C<br>Quenched and tempered | 123                          | 250         | 3                         | 1025, 1030, 1035, 1040, 1045, 1050, 1140, 1141, 1330   |   |    |
|                            |  | >=0.55%C<br>Annealed             | 109                          | 220         | 4                         | 1055, 1060, 1070, 1080, 1151, W112   |   |    |
|                            | Low alloy steel and cast steel (Less than 5% of alloying elements) | Quenched and tempered            | 145                          | 300         | 5                         | 1055, 1060, 1151   |   |    |
|                            |  | Annealed                         | 87                           | 200         | 6                         | 3135, 3435, 3440, 4130, 4140, 4150, 4320, 4340, 5015, 5060, 5120, 5132, 5140, 5160, 6150, 8620, 8640, 9254, 9255, 9262, L1, L2, L3, O1, O2, S1, P2, P3, P5, P20, W1, W2, W5, 51100, 52100, |   |    |
|                            |  | Quenched and tempered            | 135                          | 275         | 7                         |  |   |    |
|                            |  |                                  | 145                          | 300         | 8                         |  |   |    |
|                            |  |                                  | 174                          | 350         | 9                         |  |   |    |
|                            | High alloy steel, cast steel and tool steel                        | Annealed                         | 99                           | 200         | 10                        | A2, A3, A4, A,6 A7, A10, D2, D3, D4, D5, D7, H11, H12, H13, H14, H17, H22, H23, S7, M1, M2, M3, M4, M6, M7, M10, M30, M42, T1, T2, T4, T5,   |   |    |
| Quenched and tempered      |  | 160                              | 325                          | 11          |                           |  |   |    |
| M                          | Stainless steel and cast steel                                     | Ferritic/martensitic             | 99                           | 200         | 12                        | 203, 303, 303Plus X, 303Pb, 409, 430, 430F, 440, 444   |   |    |
|                            |  | Martensitic                      | 119                          | 240         | 13                        | 410, 420, 431, 440A, 416   |   |    |
|                            |  | Austenitic                       | 87                           | 180         | 14                        | 304, 310, 316, 316L, 317, Nitronic 40, Carpenter 20, 13-8, 15-5, 17-4  |   |    |
| K                          | Gray cast iron (GG)  | Ferritic                         |                              | 180         | 15                        | ASTM A48 Classes 20, 25, SAEJ431c grades G1800, G2000, G2500   |   |    |
|                            |  | Pearlitic                        |                              | 260         | 16                        | ASTM A48 Classes 30, 35, 40, 45, 50, SAEJ431c grades G3000, G3500  |   |    |
|                            | Cast iron nodular (GGG)  | Ferritic                         |                              | 160         | 17                        | 60-40-18, 65-45-12   |   |    |
|                            |  | Pearlitic                        |                              | 250         | 18                        | 80-55-06, 100-70-03, 120-90-02   |   |    |
|                            | Malleable cast iron  | Ferritic                         |                              | 130         | 19                        | 22010, 325110  |   |    |
|                            |  | Pearlitic                        |                              | 230         | 20                        | 40010, 50005, 70003, 90001   |   |    |
| N                          | Aluminum - Wrought alloy   | Not cureable                     |                              | 60          | 21                        | 1000, 2011, 2014, 2124, 2024, 6061, 7075   |   |    |
|                            |  | Cured                            |                              | 100         | 22                        |  |   |    |
|                            | Aluminum - cast, alloyed   | <=12% Si<br>Not cureable         |                              | 75          | 23                        | 319, 383, 356, 413, 535, A280, A380, A413  |   |    |
|                            |  | Cured                            |                              | 90          | 24                        |  |   |    |
|                            |  | >12% Si<br>High temp             |                              | 130         | 25                        |  |   |    |
|                            | Copper alloys  | >1% Pb<br>Free cutting           |                              | 110         | 26                        | C23000, C36000, C83600, C93200, C93600   |   |    |
|                            |  | Brass                            |                              | 90          | 27                        | C18200, C27200, C27700, C86500, Red Brass  |   |    |
|                            |  | Electrolitic copper              |                              | 100         | 28                        | B-148-52, C63000, C81500, C90700, C90800   |   |    |
|                            |  | Non-metallic                     | Duroplastics, fiber plastics |             |                           | 29   |   |    |
|                            | S  | High temp. alloys                | Fe based<br>Annealed         |             | 200                       | 31   | A286, Incoloy 800, Incoloy 801, Incoloy 802, N-155, W-545 |    |
| Cured                      |  |                                  |                              |             | 280                       | 32   |   |    |
| Ni or Co based<br>Annealed |  |                                  |                              | 250         | 33                        | Astroloy, Hastelloy, C-272, IN-100, Inconel 625, Inconel 718, Inconel 750, Numonic, Rene, Udimet, Waspaoly, Haynes, Stellite, AR213, MP35N   |   |    |
|                            |  |                                  | Cured                        |             | 350                       |  |   | 34 |
|                            |  |                                  | Cast                         |             | 320                       |  |   | 35 |
| Titanium, Ti alloys        |  |                                  | Rm 58                        |             | 36                        | Grade 1, Grade 2, Grade 2H, Grade 3  |   |    |
|                            |  | Alpha+beta alloys cured          | Rm 152                       |             | 37                        | Grade 5, Ti6AL4V, Ti6-4  |   |    |
| H                          | Hardened steel   | Hardened                         |                              | 55 HRC      | 38                        | Hardox 400, Hardox 500, W1, W210   |   |    |
|                            |  | Hardened                         |                              | 60 HRC      | 39                        | HSS, 90 MnV8   |   |    |
|                            | Chilled cast iron  | Cast                             |                              | 400         | 40                        | Ni-Hard 1, Ni-Hard 2, Ni-Hard 4, A532, GX300   |   |    |
|                            | Cast iron nodular  | Hardened                         |                              | 55 HRC      | 41                        |  |   |    |

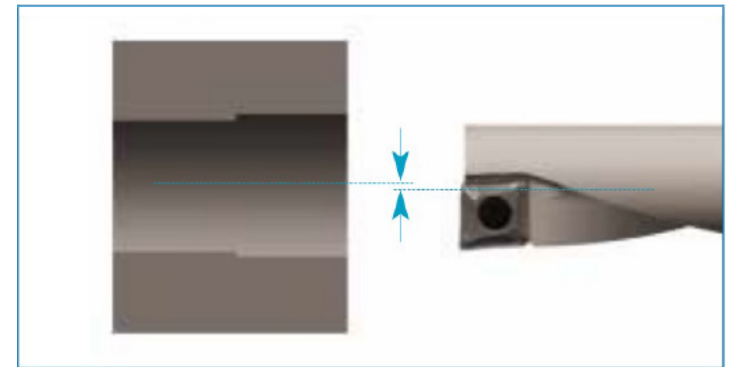
## T-Cap - Cutting Speeds & Feeds

### STEP 2 - Locate Cutting Speed & Feed by Operation & Material Group

| DIN<br>ISO<br>513 | Material<br>Group #<br>VDI 3323 | Drilling |             | Turning & Boring |             | Grooving |            |
|-------------------|---------------------------------|----------|-------------|------------------|-------------|----------|------------|
|                   |                                 | SFM      | IPR         | SFM              | IPR         | SFM      | IPR        |
| P                 | 1                               | 395-855  | .002-.006   | 460-920          | .0015-.0055 | 395-820  | .0015-.010 |
|                   | 2                               | 260-625  | .002-.006   | 295-655          | .0015-.005  | 260-590  | .0015-.010 |
|                   | 3                               | 330-920  | .0025-.007  | 330-655          | .0015-.006  | 260-590  | .0015-.010 |
|                   | 4                               | 330-920  | .0025-.007  | 330-655          | .0015-.006  | 260-590  | .0015-.010 |
|                   | 5                               | 330-920  | .0025-.007  | 330-655          | .0015-.006  | 260-590  | .0015-.010 |
|                   | 6                               | 330-920  | .0025-.007  | 330-655          | .0015-.006  | 260-590  | .0015-.010 |
|                   | 7                               | 195-260  | .0015-.006  | 260-590          | .003-.005   | 195-525  | .0015-.010 |
|                   | 8                               | 195-260  | .0015-.006  | 260-590          | .003-.005   | 195-525  | .0015-.010 |
|                   | 9                               | 195-260  | .0015-.006  | 260-590          | .003-.005   | 195-525  | .0015-.010 |
|                   | 10                              | 260-625  | .002-.006   | 260-655          | .0015-.005  | 260-525  | .0015-.010 |
| M                 | 12                              | 165-690  | .0015-.006  | 195-755          | .003-.005   | 165-655  | .0015-.010 |
|                   | 13                              | 165-690  | .0015-.006  | 195-755          | .003-.005   | 165-655  | .0015-.010 |
|                   | 14                              | 165-690  | .0015-.006  | 195-755          | .003-.005   | 165-655  | .0015-.010 |
| K                 | 15                              | 330-985  | .0025-.009  | 395-755          | .003-.008   | 330-655  | .0015-.010 |
|                   | 16                              | 330-985  | .0025-.009  | 395-755          | .003-.008   | 330-655  | .0015-.010 |
|                   | 17                              | 330-985  | .0025-.009  | 395-755          | .003-.008   | 330-655  | .0015-.010 |
|                   | 18                              | 330-985  | .0025-.009  | 395-755          | .003-.008   | 330-655  | .0015-.010 |
|                   | 19                              | 330-655  | .0025-.006  | 395-755          | .0015-.005  | 330-655  | .0015-.010 |
|                   | 20                              | 330-655  | .0025-.006  | 395-755          | .0015-.005  | 330-655  | .0015-.010 |
| N                 | 21                              | 395-1640 | .002-.012   | 395-2295         | .0015-.010  | 330-2295 | .0015-.010 |
|                   | 22                              | 395-1640 | .002-.012   | 395-2295         | .0015-.010  | 330-2295 | .0015-.010 |
|                   | 23                              | 395-1640 | .002-.012   | 395-2295         | .0015-.010  | 330-2295 | .0015-.010 |
|                   | 24                              | 395-1640 | .002-.012   | 395-2295         | .0015-.010  | 330-2295 | .0015-.010 |
|                   | 25                              | 395-1640 | .002-.012   | 395-2295         | .0015-.010  | 330-2295 | .0015-.010 |
|                   | 26                              | 260-1245 | .002-.009   | 260-1640         | .0015-.008  | 260-1150 | .0015-.010 |
|                   | 27                              | 260-1245 | .002-.009   | 260-1640         | .0015-.008  | 260-1150 | .0015-.010 |
|                   | 28                              | 260-1245 | .002-.009   | 260-1640         | .0015-.008  | 260-1150 | .0015-.010 |
|                   | 29                              | 165-460  | .0015-.0055 | 165-525          | .0015-.005  | 165-425  | .0015-.010 |
|                   | 30                              | 165-460  | .0015-.0055 | 165-525          | .0015-.005  | 165-425  | .0015-.010 |
| S                 | 31                              | 65-165   | .0015-.002  | 65-590           | .0015-.002  | 65-165   | .0015-.002 |
|                   | 32                              | 65-165   | .0015-.002  | 65-590           | .0015-.002  | 65-165   | .0015-.002 |
|                   | 33                              | 65-165   | .0015-.002  | 65-590           | .0015-.002  | 65-165   | .0015-.002 |
|                   | 34                              | 65-165   | .0015-.002  | 65-590           | .0015-.002  | 65-165   | .0015-.002 |
|                   | 35                              | 65-165   | .0015-.002  | 65-590           | .0015-.002  | 65-165   | .0015-.002 |
|                   | 36                              | 100-195  | .0015-.002  | 100-330          | .0015-.002  | 100-590  | .0015-.002 |
|                   | 37                              | 100-195  | .0015-.002  | 100-330          | .0015-.002  | 100-590  | .0015-.002 |
| H                 | 38                              | 65-130   | .0015-.002  | 65-230           | .0015-.002  | 65-165   | .0015-.002 |
|                   | 39                              | 65-130   | .0015-.002  | 65-230           | .0015-.002  | 65-165   | .0015-.002 |
|                   | 40                              | 65-130   | .0015-.002  | 65-230           | .0015-.002  | 65-165   | .0015-.002 |
|                   | 41                              | 65-130   | .0015-.002  | 65-230           | .0015-.002  | 65-165   | .0015-.002 |

## Radial Adjustment (Off-Center Drilling)

Radial Adjustment is Dependent on Drill Diameter



| Tool      | Drill Ø       | Dmin   | Dmax   |
|-----------|---------------|--------|--------|
| TCAP 08 - | .315" (8mm)   | .309"  | .329"  |
| TCAP 10 - | .394" (10mm)  | .387"  | .457"  |
| TCAP 12 - | .472" (12mm)  | .465"  | .496"  |
| TCAP 14 - | .551" (14mm)  | .543"  | .575"  |
| TCAP 16 - | .630" (16mm)  | .620"  | .650"  |
| TCAP 20 - | .787" (20mm)  | .780"  | .811"  |
| TCAP 25 - | .984" (25mm)  | .974"  | .992"  |
| TCAP 32 - | 1.260" (32mm) | 1.252" | 1.266" |