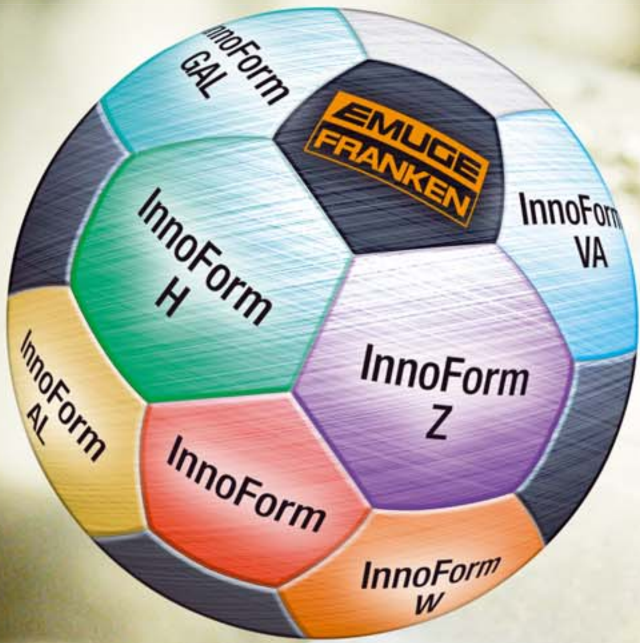
# EMUGE
## Threading Technology




EMUGE FRANKEN

# InnoForm Cold-forming Taps
## Chipless production of internal threads

# Contents

## Always in Top Form with EMUGE InnoForm

EMUGE is the first threading tool manufacturer worldwide to introduce a programme of cold-forming taps specially designed for the machining of specific materials or material groups. While this was possible only for cutting tools in the past, we have now succeeded in designing cold-forming taps especially for the special properties of single materials and material groups, sometimes increasing performance in a dramatic way.

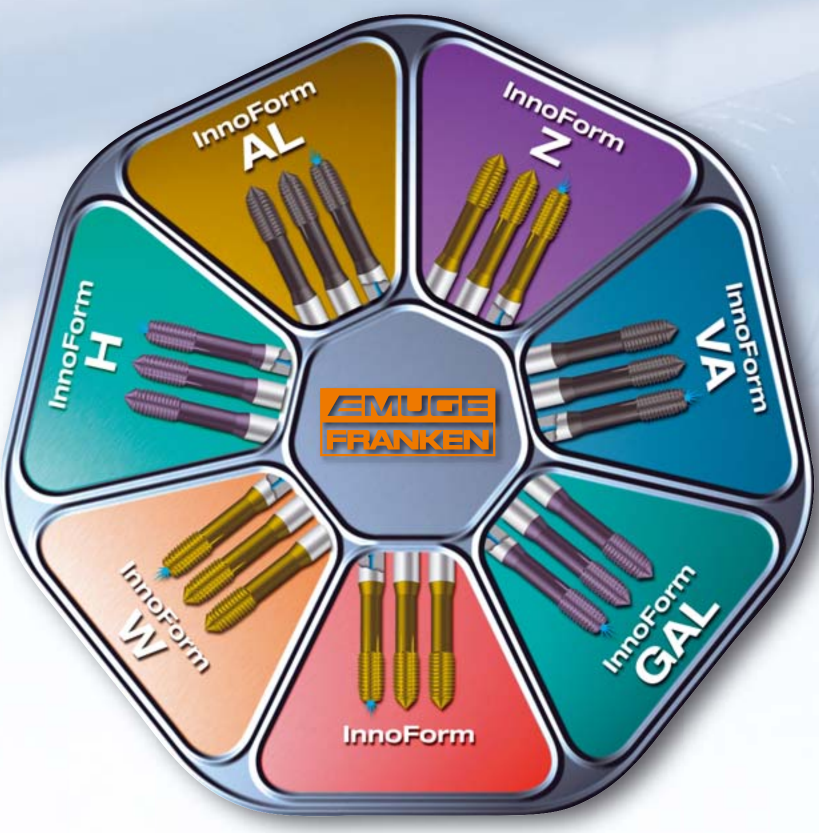
Conventional cold-forming taps were made for the use in all ductile materials: potential performance features in defined applications were simply wasted in the process. EMUGE has made extensive investigations into the mechanisms of cold forming for years, and developed an entirely new tool generation from the results.

In order to highlight the uniqueness of this highly innovative programme of cold-forming taps, we have thought of a new name:

***InnoForm***

The geometry abbreviations of the different designs fit in seamlessly with those already used by EMUGE, so that the single tools can be easily recognized. For instance, there is a new cold-forming tap type InnoForm 1-**Z**, the application possibilities of which correspond generally to those of our well-known cutting tap Rekord 1B-**Z**.

## The InnoForm programme at one view




Cold-forming taps with and without lubrication flutes (here called “SN” for German “Schmier-Nuten”) form part of the InnoForm programme as well as tools with and without internal coolant supply IKZ/IKZN. InnoForm cold-forming taps of the ÖKO design are available in the geometry types “Z” and “GAL.” For the machining of sheet metal components, we have developed the InnoForm-BL type. All InnoForm tools are provided with a hard surface coating and sometimes an additional anti-friction coating suited for their special application.

As a consequence, some materials which could not be economically machined with a conventional cold-forming tap can now be easily cold-formed with the new InnoForm tools.

InnoForm cold-forming taps are available ex stock in the thread standards

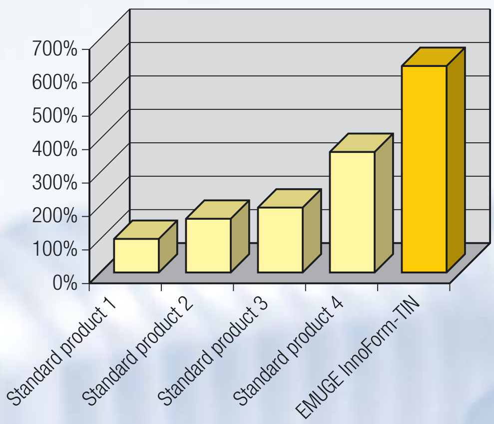
- ISO Metric coarse thread DIN 13
- ISO Metric fine thread DIN 13
- Unified coarse thread UNC ASME B1.1
- Unified fine thread UNF ASME B1.1
- Whitworth pipe thread DIN EN ISO 228

With this new tool generation, EMUGE is well prepared, and “in top form”, for the continuously rising demand for cold-forming taps.

## InnoForm

The standard design of the InnoForm cold-forming taps has been conceived for a general application in steel materials. The optimised geometry, combined with a titanium-nitride hard surface coating, makes the excellent performance of this cold-forming tap possible. In comparison with conventional standard products, this new tool will yield up to 500% more performance in C45k.

**Number of threads M10-6H, C45, emulsion lubrication, blind hole**




## InnoForm-AL

The application range of this tool includes wrought aluminium alloys and non-ferrous metals. Under the usual lubrication conditions, e.g. emulsion lubrication, these materials show a strong inclination to adhesion in the cold forming of threads. In order to obtain satisfactory work results in spite of these unfavourable material properties, this tap was provided with a coating that offers excellent friction characteristics and, as a result, a perfect degree of process safety.

## InnoForm-W

This cold-forming tap should be used for thread production in the softer steel types. The specially adjusted cold-forming geometry will provide an optimal formation of the thread profile. An additional titanium-nitride hard surface coating offers perfect wear protection in combination with very good friction characteristics.

## InnoForm-GAL

Cast aluminium materials, especially those with a high percentage of silicon, exert a very strong abrasive stress on the forming wedges of a cold-forming tap during work. In addition, the ductile properties of these rather brittle materials must be regarded as relatively poor: often, the quality of surfaces or of the whole thread comes out rather poor. In order to achieve easier thread production and better wear resistance even under these bad conditions, we have given this tool type a specially adjusted geometry and an additional hard surface coating.

## InnoForm-VA

This cold-forming tap was specially designed for the use in stainless steels. These materials tend to rather strong adhesion on one hand, resulting in cold-welding effects and sometimes, when increased forces come into play, in the forming wedges being actually welded into the workpiece material. On the other hand, these materials show an inclination to increase their strength during a cold-forming process, which leads to increased stress on the forming wedges. In order to counter these two main characteristics, we had to develop a geometry that can meet the extreme challenges regarding stability. In addition, a combination of a special hard surface coating with an anti-friction coating offers perfect protection against wear and reduces the inclination to adhere to the workpiece material at the same time.

## InnoForm-H

This tool was designed for the cold forming of materials with restricted ductile properties, e.g. GGV. The special tool geometry, combined with an appropriate hard surface coating, provides excellent quality of the finished threads and very good wear resistance.

## InnoForm-Z

This tool type is definitely made for the highest requirements. Its application range includes tough and high-strength steel materials and their alloys. In the specification of the tool geometry and in the choice of the hard surface coating, a top priority was set on controlling the extreme forming forces in these materials with a high degree of process safety, and reducing the resulting friction and heat development on the forming wedges as effectively as possible.

## InnoForm-GAL-ÖKO and InnoForm-Z-ÖKO

Cold-forming taps which are meant to meet even higher requirements regarding friction and thermal stress, as they occur for example with minimum-quantity lubrication, must be provided not only with a material-specific optimised geometry, but require other, additional measures. For this purpose, anti-friction coatings are applied to the tool and an internal coolant-lubricant supply is introduced for the safe cooling and lubrication of the forming area.
When introducing a new tool, the combination of these two construction features provides considerably improved run-in characteristics in spite of the unfavourable lubrication conditions, permitting safe thread production and with it a clear increase of efficiency.

## InnoForm-BL

The InnoForm-BL tools are based each on an appropriate basic InnoForm tool, depending on the choice of material. Their special features include an extra long lead taper for a safer centering of the tool, and increased thread length for safe reversal, even with less exact reversing cycles.

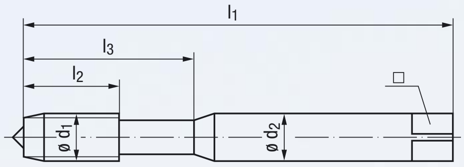
## InnoForm design variants

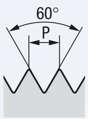
The basic types of the InnoForm tool series are complemented by a number of additional variants. In the construction of such variants, special features of the individual application case are observed. For instance, lubrication grooves may be introduced in order to guarantee safe transport of the lubrication medium to the forming area. Another possibility is to provide a tool with an internal coolant-lubricant bore for improving conditions in the machining of blind holes, or to specially adjust the length of the lead taper if extra short thread run-outs are necessary.

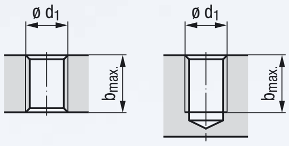
## InnoForm special tools

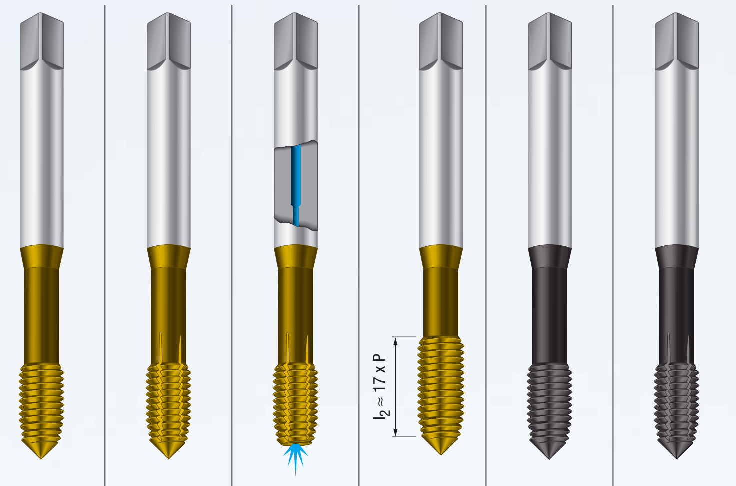
If our comprehensive InnoForm programme of cold-forming taps does not include a suitable tool design for a specific application, we will be happy to furnish a custom-made, special InnoForm tool designed for the work conditions and according to the workpiece drawing of the individual customer. Such special designs can be made in special thread sizes and tolerances, with special thread profiles and dimensional specifications, or for special processes involving combined thread cutting and cold forming.

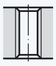
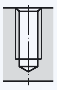
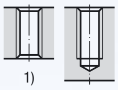
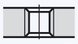
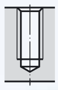
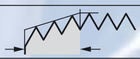
# Cold-forming taps DIN 2174



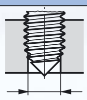



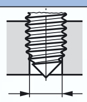




| | | | | | | |
|---|---|---|---|---|---|---|
| Hole type |  |  |  1) |  |  |  |
| Thread depth $b_{max}$ | 3 x $d_1$ | | | | | |
| Coolant-lubricant (page 24) | E / O / P | E / O / P | E / O | E / O / P | E / O / P | E / O / P |
| Range of application (page 14) | 1.2-4<br>2.2, 4<br>3.4<br>7.1-2 | 1.2-4<br>2.2, 4<br>3.4<br>7.1-2 | 1.2-4<br>2.2, 4<br>3.4<br>7.1-2 | 1.2-4<br>2.2, 4<br>3.4<br>7.1-2 | 3.1-2<br>5.1-2 | 3.1-2<br>5.1-2 |
| Tolerance | 6HX | 6HX | 6HX | 6HX | 6HX | 6HX |
| DIN form/threads $l_A$ =  | C/2-3 | C/2-3 | C/2-3 | D/4-5 | C/2-3 | C/2-3 |

## M ISO Metric coarse thread DIN 13

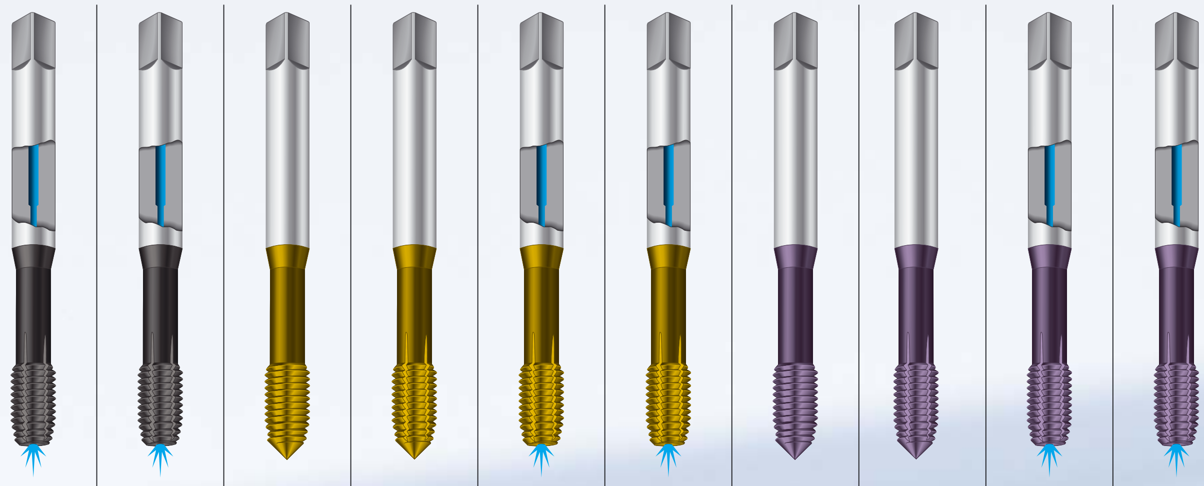
| Tool ident | | | | | | | | | B519P300 | B521P300 | B523P300 | B535P300 | B519S800 | B521S800 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cat. No. | | | | | | |  | Dimens.-Ident | B974 | B975 | B976 | B978 | B101 | B102 |
| ø $d_1$ mm | P mm | $l_1$ | $l_2$ | $l_3$ | ø $d_2$ | □ | | | InnoForm 1<br>TIN | InnoForm 1<br>SN<br>TIN | InnoForm 1<br>SN-IKZ<br>TIN | InnoForm 1<br>BL/D<br>TIN | InnoForm 1<br>AL<br>GLT-8 | InnoForm 1<br>AL-SN<br>GLT-8 |
| M 3 | 0.5 | 56 | 6 | 18 | 3.5 | 2.7 | 2.8 | 0030 | ● | ● | | ● | | |
| 4 | 0.7 | 63 | 7 | 21 | 4.5 | 3.4 | 3.7 | 0040 | ● | ● | | ● | | |
| 5 | 0.8 | 70 | 8 | 25 | 6 | 4.9 | 4.65 | 0050 | ● | ● | ● | ● | ● | ● |
| 6 | 1 | 80 | 10 | 30 | 6 | 4.9 | 5.6 | 0060 | ● | ● | ● | ● | ● | ● |
| 8 | 1.25 | 90 | 14 | 35 | 8 | 6.2 | 7.45 | 0080 | ● | ● | ● | ● | ● | ● |
| 10 | 1.5 | 100 | 16 | 39 | 10 | 8 | 9.35 | 0100 | ● | ● | ● | ● | ● | ● |

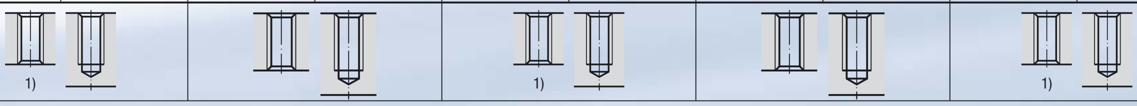
## MF ISO Metric fine thread DIN 13

| Tool ident | | | | | | | | | | B523P300 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cat. No. | | | | | | |  | Dimens.-Ident | | | B977 | | | |
| ø $d_1$ mm | P mm | $l_1$ | $l_2$ | $l_3$ | ø $d_2$ | □ | | | | | InnoForm 1<br>SN-IKZ<br>TIN | | | |
| M 8 x | 1 | 90 | 10 | 35 | 8 | 6.2 | 7.6 | 0251 | | | ● | | | |
| 10 x | 1 | 90 | 10 | 35 | 10 | 8 | 9.6 | 0276 | | | ● | | | |

1) Cold forming of threads in through holes is possible only with external cooling/lubrication

SN = lubrication grooves



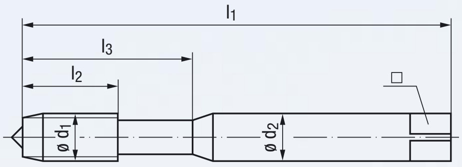


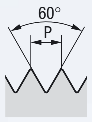
1) 1) 1)

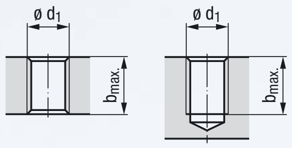
| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 3 x $d_1$ | | | | | | | | | |
| E / O | E / O | E / O / P | E / O / P | E / O | E / O | E / O / P | E / O / P | E / O | E / O |
| | | 1.1-2 | 1.1-2 | 1.1-2 | 1.1-2 | | | | |
| 3.1-2 | 3.1-2 | 3.1-2 | 3.1-2 | 3.1-2 | 3.1-2 | 3.3, 5 | 3.3, 5 | 3.3, 5 | 3.3, 5 |
| 5.1-2 | 5.1-2 | 5.1 | 5.1 | 5.1 | 5.1 | 5.2-4 | 5.2-4 | 5.2-4 | 5.2-4 |
| 6HX | 6HX | 6HX | 6HX | 6HX | 6HX | 6HX | 6HX | 6HX | 6HX |
| C/2-3 | E/1.5-2 | C/2-3 | C/2-3 | C/2-3 | E/1.5-2 | C/2-3 | C/2-3 | C/2-3 | E/1.5-2 |

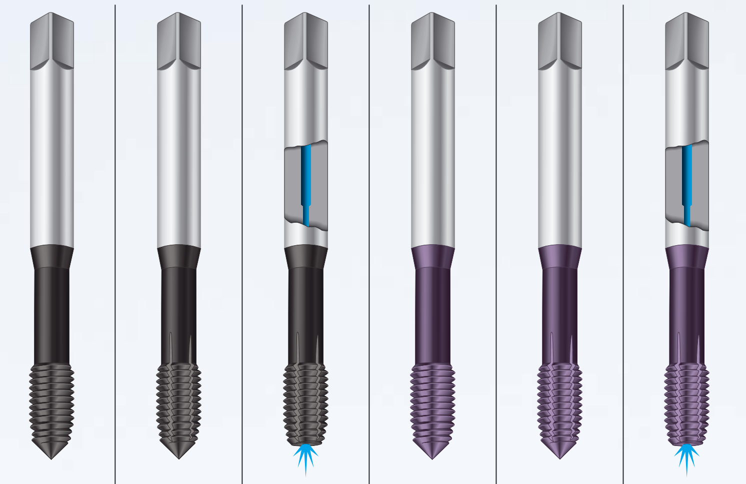
| B523S800 | B531S800 | B5198400 | B5218400 | B5238400 | B5318400 | B519Q200 | B521Q200 | B523Q200 | B531Q200 |
|---|---|---|---|---|---|---|---|---|---|
| **B103** | **B105** | **B979** | **B980** | **B981** | **B982** | **B107** | **B108** | **B109** | **B113** |
| InnoForm 1 AL-SN-IKZ GLT-8 | InnoForm 1 AL/E-SN-IKZ GLT-8 | InnoForm 1 W TIN | InnoForm 1 W-SN TIN | InnoForm 1 W-SN-IKZ TIN | InnoForm 1 W/E-SN-IKZ TIN | InnoForm 1 GAL TICN | InnoForm 1 GAL-SN TICN | InnoForm 1 GAL-SN-IKZ TICN | InnoForm 1 GAL/E-SN-IKZ TICN |
| | | | | | | | | | |
| | | | | | | | | | |
| • | • | • | • | • | • | • | • | • | • |
| • | • | • | • | • | • | • | • | • | • |
| • | • | • | • | • | • | • | • | • | • |
| • | • | • | • | • | • | • | • | • | • |
| | | | | | | | | | |

# Cold-forming taps DIN 2174



| | B519N000 | B521N000 | B523N000 | B519E600 | B521E600 | B523E600 |
|---|---|---|---|---|---|---|
| Hole type | | | 1) | | | 1) |
| Thread depth $b_{max}$ | 3 x $d_1$ | | | | | |
| Coolant-lubricant (page 24) | E / O / P | E / O / P | E / O | E / O / P | E / O / P | E / O |
| Range of application (page 14) | 1.10-11 | 1.10-11 | 1.10-11 | 1.2<br>2.2-4<br>5.3-4 | 1.2<br>2.2-4<br>5.3-4 | 1.2<br>2.2-4<br>5.3-4 |
| Tolerance | 6HX | 6HX | 6HX | 6HX | 6HX | 6HX |
| DIN form/threads $l_A$ = | C/2-3 | C/2-3 | C/2-3 | C/2-3 | C/2-3 | C/2-3 |

## M ISO Metric coarse thread DIN 13

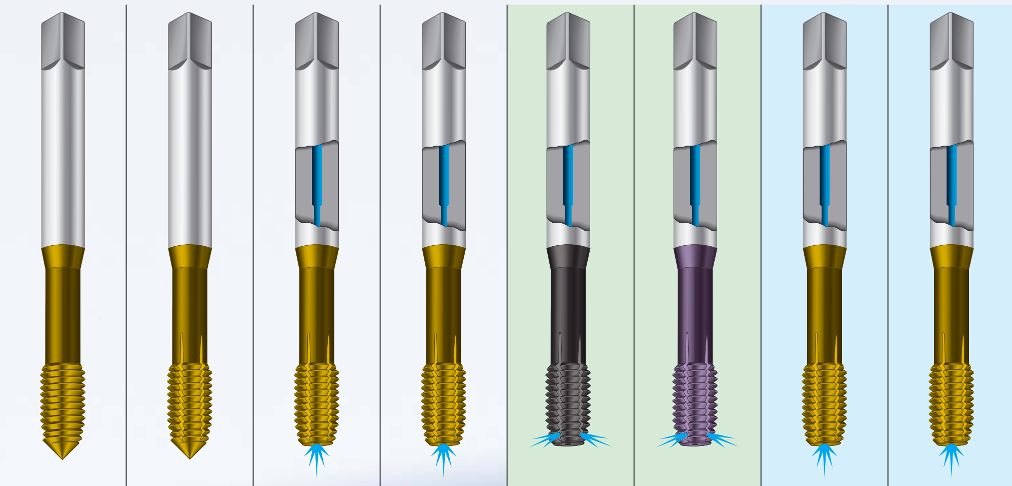
| Tool ident | | | | | | | | | B519N000 | B521N000 | B523N000 | B519E600 | B521E600 | B523E600 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cat. No. | | | | | | | | | B983 | B984 | B985 | B997 | B998 | B999 |
| ø $d_1$ mm | P mm | $l_1$ | $l_2$ | $l_3$ | ø $d_2$ | □ | | Dimens.-Ident | InnoForm 1 VA GLT-7 | InnoForm 1 VA-SN GLT-7 | InnoForm 1 VA-SN-IKZ GLT-7 | InnoForm 1 H TICN | InnoForm 1 H-SN TICN | InnoForm 1 H-SN-IKZ TICN |
| M 3 | 0.5 | 56 | 6 | 18 | 3.5 | 2.7 | 2.8 | 0030 | | | | | | |
| 4 | 0.7 | 63 | 7 | 21 | 4.5 | 3.4 | 3.7 | 0040 | | | | | | |
| 5 | 0.8 | 70 | 8 | 25 | 6 | 4.9 | 4.65 | 0050 | ● | ● | ● | ● | ● | ● |
| 6 | 1 | 80 | 10 | 30 | 6 | 4.9 | 5.6 | 0060 | ● | ● | ● | ● | ● | ● |
| 8 | 1.25 | 90 | 14 | 35 | 8 | 6.2 | 7.45 | 0080 | ● | ● | ● | ● | ● | ● |
| 10 | 1.5 | 100 | 16 | 39 | 10 | 8 | 9.35 | 0100 | ● | ● | ● | ● | ● | ● |

## MF ISO Metric fine thread DIN 13

| Tool ident | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cat. No. | | | | | | | | | | | | | | |
| ø $d_1$ mm | P mm | $l_1$ | $l_2$ | $l_3$ | ø $d_2$ | □ | | Dimens.-Ident | | | | | | |
| M 8 x | 1 | 90 | 10 | 35 | 8 | 6.2 | 7.6 | 0251 | | | | | | |
| 10 x | 1 | 90 | 10 | 35 | 10 | 8 | 9.6 | 0276 | | | | | | |

1) Cold forming of threads in through holes is possible only with external cooling/lubrication

SN = lubrication grooves

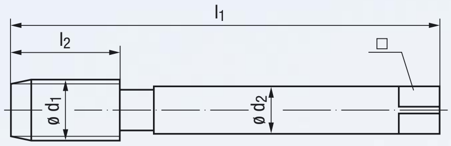


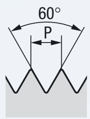
| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1) | | | | 1) | | | | |
| 3 x $d_1$ | | | | | | | | | | |
| E / O / P | E / O / P | E / O | E / O | E / M | E / M | E / O | E / O | | | |
| 1.3-5, 10-12 | 1.3-5, 10-12 | 1.3-5, 10-12 | 1.3-5, 10-12 | 1.3-5, 10-12 | | 1.3-5, 10-12 | 1.3-5, 10-12 | | | |
| 3.4 | 3.4 | 3.4 | 3.4 | 3.4 | 3.3, 5 | 3.4 | 3.4 | | | |
| 4.1-2 | 4.1-2 | 4.1-2 | 4.1-2 | 4.1-2 | | 4.1-2 | 4.1-2 | | | |
| | | | | | 5.2-4 | | | | | |
| 7.1-2 | 7.1-2 | 7.1-2 | 7.1-2 | 7.1-2 | | 7.1-2 | 7.1-2 | | | |
| 6HX | 6HX | 6HX | 6HX | 6HX | 6HX | 6HX | 6HX | | | |
| C/2-3 | C/2-3 | C/2-3 | E/1.5-2 | C/2-3 | C/2-3 | C/2-3 | E/1.5-2 | | | |

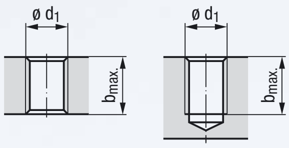
| B519A800 | B521A800 | B523A800 | B531A800 | B536N900 | B536Q200 | B523P900 | B531P900 | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| B987 | B988 | B989 | B993 | B991 | B111 | B995 | B996 | | | |
| InnoForm 1 Z TIN-T1 | InnoForm 1 Z-SN TIN-T1 | InnoForm 1 Z-SN-IKZ TIN-T1 | InnoForm 1 Z/E-SN-IKZ TIN-T1 | InnoForm 1 Z-ÖKO-SN IKZN-GLT-7 | InnoForm 1 GAL-ÖKO-SN IKZN-TICN | VHM InnoForm 1-Z SN-IKZ-TIN-T1 | VHM InnoForm 1-Z/E SN-IKZ-TIN-T1 | | | |
| ● | ● | | | | | | | | | |
| ● | ● | | | | | | | | | |
| ● | ● | ● | ● | ○ | ○ | ● | ● | | | |
| ● | ● | ● | ● | ○ | ○ | ● | ● | | | |
| ● | ● | ● | ● | ○ | ○ | ● | ● | | | |
| ● | ● | ● | ● | ○ | ○ | ● | ● | | | |
| | | | | | | | | | | |

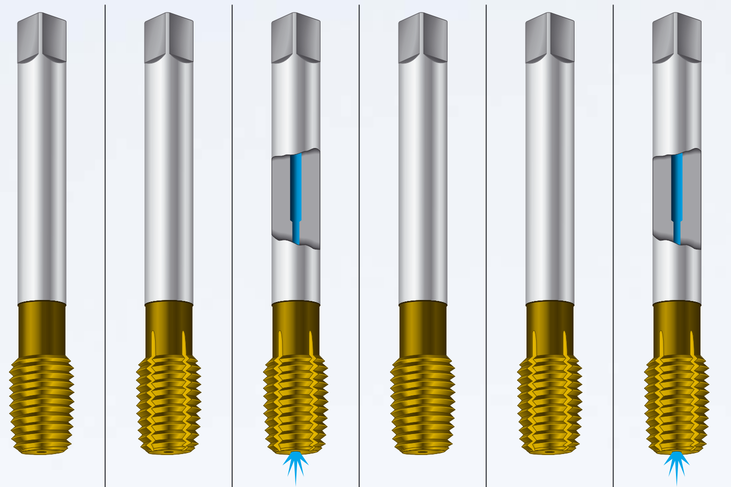
| | | B523A800 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | B990 | | | | | | | | |
| | | InnoForm 1 Z-SN-IKZ TIN-T1 | | | | | | | | |
| | | ● | | | | | | | | |
| | | ● | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |

## Cold-forming taps DIN 2174



| | | | | | | |
|---|---|---|---|---|---|---|
| Hole type | blind / through | blind / through | through 1) / blind | through / blind | through / blind | through 1) / blind |
| Thread depth $b_{max}$ | 3 x $d_1$ | | | | | |
| Coolant-lubricant (page 24) | E / O / P | E / O / P | E / O | E / O / P | E / O / P | E / O |
| Range of application (page 14) | **1**.2-4<br>**2**.2, 4<br>**3**.4<br>**7**.1-2 | **1**.2-4<br>**2**.2, 4<br>**3**.4<br>**7**.1-2 | **1**.2-4<br>**2**.2, 4<br>**3**.4<br>**7**.1-2 | **1**.3-5, 10-12<br>**3**.4<br>**4**.1-2<br>**7**.1-2 | **1**.3-5, 10-12<br>**3**.4<br>**4**.1-2<br>**7**.1-2 | **1**.3-5, 10-12<br>**3**.4<br>**4**.1-2<br>**7**.1-2 |
| Tolerance | 6HX | 6HX | 6HX | 6HX | 6HX | 6HX |
| DIN form/threads $l_A$ = | C/2-3 | C/2-3 | C/2-3 | C/2-3 | C/2-3 | C/2-3 |

# M ISO Metric coarse thread DIN 13

| Tool ident | | | | | | | Dimens.- Ident | C519P300 | C521P300 | C523P300 | C519A800 | C521A800 | C523A800 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cat. No. | | | | | | | | C695 | C696 | C697 | C952 | C953 | C954 |
| ø $d_1$ mm | P mm | $l_1$ | $l_2$ | ø $d_2$ | □ | | | InnoForm 2 TIN | InnoForm 2 SN TIN | InnoForm 2 SN-IKZ TIN | InnoForm 2 Z TIN-T1 | InnoForm 2 Z-SN TIN-T1 | InnoForm 2 Z-SN-IKZ TIN-T1 |
| **M** 12 | 1.75 | 110 | 18 | 9 | 7 | 11.25 | **0112** | ● | ● | ● | ● | ● | ● |
| 16 | 2 | 110 | 22 | 12 | 9 | 15.1 | **0116** | ● | ● | ● | ● | ● | ● |

# MF ISO Metric fine thread DIN 13

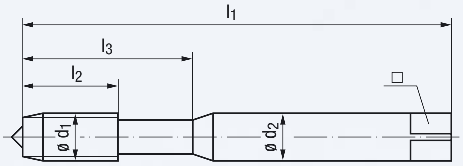
| Tool ident | | | | | | | | Dimens.- Ident | | | C523P300 | | | C523A800 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cat. No. | | | | | | | | | | | C698 | | | C955 |
| ø $d_1$ | | P mm | $l_1$ | $l_2$ | ø $d_2$ | □ | | | | | InnoForm 2 SN-IKZ TIN | | | InnoForm 2 Z-SN-IKZ TIN-T1 |
| **M** 12 | x | 1.5 | 100 | 15 | 9 | 7 | 11.35 | **0303** | | | ● | | | ● |
| 14 | x | 1.5 | 100 | 15 | 11 | 9 | 13.35 | **0331** | | | ● | | | ● |
| 16 | x | 1.5 | 100 | 15 | 12 | 9 | 15.35 | **0359** | | | ● | | | ● |

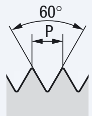
1) Cold forming of threads in through holes is possible only with external cooling/lubrication

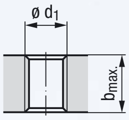
SN = lubrication grooves

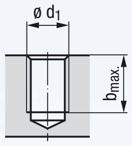
EMUGE Threading Technology

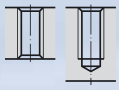
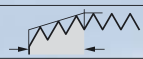
## Cold-forming taps ≈ DIN 2174



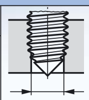



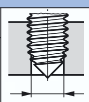




| | | | | |
|---|---|---|---|---|
| Hole type |  | | | |
| Thread depth $b_{max}$ | | | | |
| Coolant-lubricant (page 24) | E / O / P | | | |
| Range of application (page 14) | 1.3-5, 10-12<br>3.4<br>4.1-2<br>7.1-2 | | | |
| Tolerance | 2BX | | | |
| DIN form/threads $l_A$ =  | C/2-3 | | | |

# UNC Unified coarse thread UNC ASME B1.1

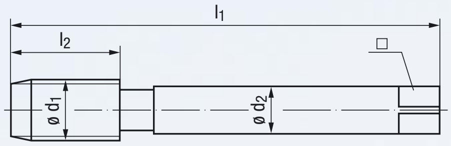
| Tool ident | | | | | | | | | | B521A800 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cat. No. | | | | | | | |  | Dimens.-Ident | B118 | | | |
| ø $d_1$ inch | inch | P Thr./1" | $l_1$ | $l_2$ | $l_3$ | ø $d_2$ | □ | | | InnoForm 1 Z-SN TIN-T1 | | | |
| No. 4 | 0.1120 | 40 | 56 | 6 | 18 | 3.5 | 2.7 | 2.55 | 5003 | ● | | | |
| No. 6 | 0.1380 | 32 | 56 | 7 | 20 | 4 | 3 | 3.15 | 5005 | ● | | | |
| No. 8 | 0.1640 | 32 | 63 | 8 | 21 | 4.5 | 3.4 | 3.8 | 5006 | ● | | | |
| No. 10 | 0.1900 | 24 | 70 | 10 | 25 | 6 | 4.9 | 4.35 | 5007 | ● | | | |
| 1/4 | 0.2500 | 20 | 80 | 13 | 30 | 7 | 5.5 | 5.75 | 5009 | ● | | | |
| 5/16 | 0.3125 | 18 | 90 | 14 | 35 | 8 | 6.2 | 7.3 | 5010 | ● | | | |
| 3/8 | 0.3750 | 16 | 100 | 16 | 39 | 10 | 8 | 8.8 | 5011 | ● | | | |

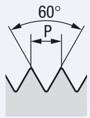
# UNF Unified fine thread UNF ASME B1.1

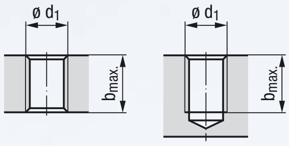
| Tool ident | | | | | | | | | | B521A800 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cat. No. | | | | | | | |  | Dimens.-Ident | B119 | | | |
| ø $d_1$ inch | inch | P Thr./1" | $l_1$ | $l_2$ | $l_3$ | ø $d_2$ | □ | | | InnoForm 1 Z-SN TIN-T1 | | | |
| No. 6 | 0.1380 | 40 | 56 | 7 | 20 | 4 | 3 | 3.2 | 5039 | ● | | | |
| No. 8 | 0.1640 | 36 | 63 | 8 | 21 | 4.5 | 3.4 | 3.85 | 5040 | ● | | | |
| No. 10 | 0.1900 | 32 | 70 | 10 | 25 | 6 | 4.9 | 4.45 | 5041 | ● | | | |
| 1/4 | 0.2500 | 28 | 80 | 10 | 30 | 7 | 5.5 | 5.95 | 5043 | ● | | | |
| 5/16 | 0.3125 | 24 | 90 | 10 | 35 | 8 | 6.2 | 7.45 | 5044 | ● | | | |
| 3/8 | 0.3750 | 24 | 90 | 10 | 35 | 10 | 8 | 9.05 | 5045 | ● | | | |

SN = lubrication grooves

## Cold-forming taps ≈ DIN 2174




| | | | | |
|---|---|---|---|---|
| Hole type | (through hole / blind hole) | | | |
| Thread depth $b_{max}$ | | | | |
| Coolant-lubricant (page 24) | E / O / P | | | |
| Range of application (page 14) | **1**.3-5, 10-12<br>**3**.4<br>**4**.1-2<br>**7**.1-2 | | | |
| Tolerance | 2BX | | | |
| DIN form/threads $l_A$ = | C/2-3 | | | |

# UNC Unified coarse thread UNC ASME B1.1

| Tool ident | | | | | | | | | C521A800 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cat. No. | | | | | | | | | C966 | | | |
| ø $d_1$ inch | inch | P Thr./1" | $l_1$ | $l_2$ | ø $d_2$ | □ | | Dimens.-Ident | InnoForm 2 Z-SN TIN-T1 | | | |
| 7/16 | 0.4375 | 14 | 100 | 18 | 8 | 6.2 | 10.25 | **5012** | ● | | | |
| 1/2 | 0.5000 | 13 | 110 | 20 | 9 | 7 | 11.8 | **5013** | ● | | | |

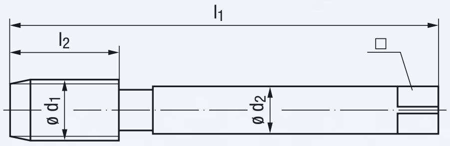
# UNF Unified fine thread UNF ASME B1.1

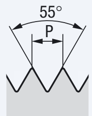
| Tool ident | | | | | | | | | C521A800 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cat. No. | | | | | | | | | C967 | | | |
| ø $d_1$ inch | inch | P Thr./1" | $l_1$ | $l_2$ | ø $d_2$ | □ | | Dimens.-Ident | InnoForm 2 Z-SN TIN-T1 | | | |
| 7/16 | 0.4375 | 20 | 100 | 13 | 8 | 6.2 | 10.55 | **5046** | ● | | | |
| 1/2 | 0.5000 | 20 | 100 | 13 | 9 | 7 | 12.15 | **5047** | ● | | | |

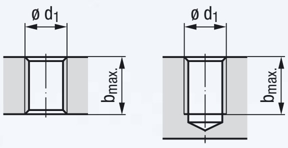
SN = lubrication grooves

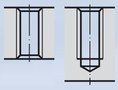
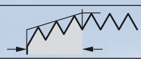
EMUGE Threading Technology

## Cold-forming taps DIN 2189

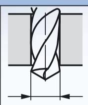



| | | | | |
|---|---|---|---|---|
| Hole type |  | | | |
| Thread depth $b_{max}$ | | | | |
| Coolant-lubricant (page 24) | E / O / P | | | |
| Range of application (page 14) | 1.3-5, 10-12<br>3.4<br>4.1-2<br>7.1-2 | | | |
| Tolerance | ISO 228 "X" | | | |
| DIN form/threads $l_A$ =  | C/2-3 | | | |

# G Whitworth pipe thread DIN EN ISO 228

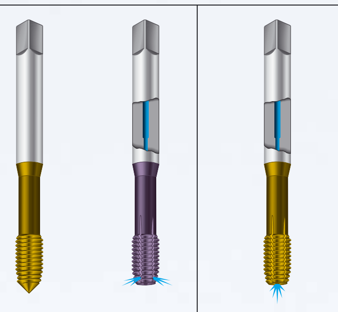
| Tool ident | | | | | | | | | C521A800 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cat. No. | | | | | | |  | Dimens.-Ident | C968 | | | |
| Nominal size ø $d_1$ | ø $d_1$ mm | P Thr./1" | $l_1$ | $l_2$ | ø $d_2$ | □ | | | InnoForm 2 Z-SN TIN-T1 | | | |
| G 1/8 | 9.73 | 28 | 90 | 18 | 7 | 5.5 | 9.25 | 4035 | ● | | | |
| 1/4 | 13.16 | 19 | 100 | 22 | 11 | 9 | 12.55 | 4036 | ● | | | |
| 3/8 | 16.66 | 19 | 100 | 22 | 12 | 9 | 16.05 | 4037 | ● | | | |
| 1/2 | 20.96 | 14 | 125 | 25 | 16 | 12 | 20.1 | 4038 | ● | | | |

SN = lubrication grooves

## Circumferential speed

The speeds which can be achieved in the cold forming of threads depend on the forming properties of the material, on lubrication, and on the size of the thread to be produced. In general, the circumferential speed will be higher than that which would be recommended in thread cutting.

**Standard values for circumferential speed $v_c$ in m/min**



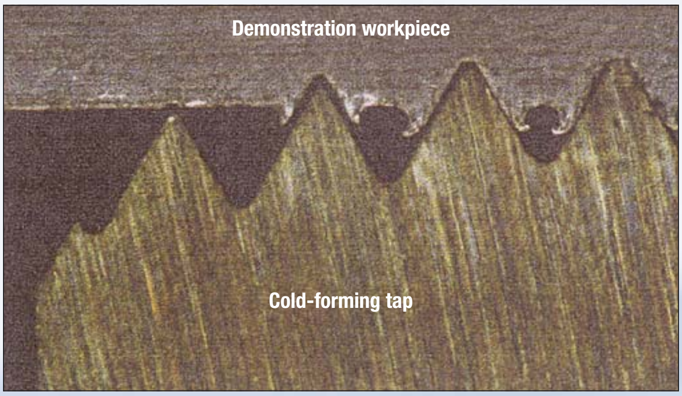
## Material groups

| | | | | | | HSSE coated | HSSE ÖKO | VHM Solid carbide |
|---|---|---|---|---|---|---|---|---|
| **1** | **Steel materials** | | | | | | | |
| 1.1 | Cold-extrusion steels, Magnetic soft iron | ≤ 400 N/mm² | Q-St37-3<br>R-Fe80 | 1.0123<br>1.1014 | | 10 - 50 | – | – |
| 1.2 | Free-cutting steels, General construction steels | ≤ 600 N/mm² | 9SMnPb28<br>St37-2 | 1.0718<br>1.0037 | 500-700 N/mm²<br>340-470 N/mm² | 10 - 50 | – | – |
| 1.3 | Free-cutting steels, Construction steels, Alloyed steels, Steel castings | ≤ 850 N/mm² | St70-2<br>GS-25CrMo4 | 1.0070<br>1.7218 | 700-900 N/mm²<br>650-950 N/mm² | 10 - 30 | 5 - 20 | 15 - 45 |
| 1.4 | Cementation steels, Heat-treatable steels, Nitriding steels, Cold work steels | ≤ 1100 N/mm² | 16MnCr5<br>Ck45<br>100Cr6 | 1.7131<br>1.1191<br>1.3505 | 500-700 N/mm²<br>600-800 N/mm²<br>700-900 N/mm² | 5 - 20 | 2 - 10 | 15 - 40 |
| 1.5 | Heat-treatable steels, Nitriding steels, Hot work steels, Hardened steels up to 44 HRC, Cold work steels | ≤ 1400 N/mm² | 42CrMo4V<br>X30WCrV5-3<br>X38CrMoV5-3<br>X155CrVMo12-1 | 1.7225<br>1.2567<br>1.2367<br>1.2379 | 1200-1400 N/mm²<br>1100 N/mm²<br>900-1100 N/mm²<br>900-1100 N/mm² | 2 - 10 | 1 - 5 | 10 - 25 |
| 1.6 | Hardened steels > 44 - 55 HRC | | 55NiCrMoV6 | 1.2713 | 47-52 HRC | – | – | – |
| 1.7 | Hardened steels > 55 - 60 HRC | | 45WCrV7 | 1.2542 | 56-57 HRC | – | – | – |
| 1.8 | Hardened steels > 60 - 63 HRC | | X155CrVMo12-1 | 1.2379 | 60-63 HRC | – | – | – |
| 1.9 | Hardened steels > 63 - 66 HRC | | X210CrW12 | 1.2436 | 63-64 HRC | – | – | – |
| 1.10 | Corrosion-proof steels, Acid-proof steels, Heat-resistant steels | ≤ 850 N/mm² | X10NiCrAlTi32-20 [INCOLOY800]<br>X12CrNiTi18-9<br>X6CrNiMoTi17-12-2 | 1.4876<br>1.4878<br>1.4571 | 610-850 N/mm²<br>500-700 N/mm²<br>500-730 N/mm² | 5 - 20 | 2 - 10 | 10 - 25 |
| 1.11 | Corrosion-/Acid-proof steels, Heat-resistant steels | ≤ 1100 N/mm² | X45SiCr4 | 1.4704 | 900-1100 N/mm² | 5 - 15 | 1 - 8 | 10 - 25 |
| 1.12 | Corrosion-/Acid-proof steels, Heat-resistant steels | ≤ 1400 N/mm² | X5NiCrTi26-15 | 1.4980 | 1200 N/mm² | 2 - 10 | 1 - 5 | 2 - 10 |
| 1.13 | Special steel materials | ≤ 1400 N/mm² | FerroTiC<br>Hardox500 | | 800-900 N/mm²<br>1300-1400 N/mm² | – | – | – |
| **2** | **Cast materials** | | | | | | | |
| 2.1 | Cast iron | | GG 20<br>GG 30 | 0.6020<br>0.6030 | 120-220 HB<br>220-270 HB | – | – | – |
| 2.2 | Cast iron with nodular graphite | | GGG 40<br>GGG 70 | 0.7040<br>0.7070 | 400 N/mm²<br>700-1050 N/mm² | 10 - 25 | – | – |
| 2.3 | Cast iron with vermicular graphite | | GGV (80% Perlit)<br>GGV (100% Perlit) | | 220 HB<br>230 HB | 10 - 25 | – | – |
| 2.4 | Malleable cast iron | | GTW 40<br>GTS 65 | 0.8040<br>0.8165 | 360-420 N/mm²<br>580-650 N/mm² | 10 - 30 | – | – |
| 2.5 | Hard castings up to 400 HB | | | | -400 HB | – | – | – |
| **3** | **Copper, Copper alloys, Bronze, Brass** | | | | | | | |
| 3.1 | Pure copper and low-alloyed copper | ≤ 500 N/mm² | E-Cu | 2.0060 | 250-350 N/mm² | 10 - 50 | – | – |
| 3.2 | Copper-zinc alloys (brass, long-chipping) | | CuZn40 [Ms60]<br>CuZn37 [Ms63] | 2.0360<br>2.0321 | 340-490 N/mm²<br>310-550 N/mm² | 10 - 50 | – | – |
| 3.3 | Copper-zinc alloys (brass, short-chipping) | | CuZn39Pb2 [Ms58] | 2.0380 | 380-500 N/mm² | 10 - 50 | 10 - 40 | – |
| 3.4 | Copper-aluminium alloys (alubronze, long-chipping) Copper-tin alloys (bronze, long-chipping) | | CuAl10Ni | 2.0966 | 500-800 N/mm² | 5 - 20 | 2 - 10 | 5 - 20 |
| 3.5 | Copper-tin alloys (bronze, short-chipping) | | GCuSn5ZnPb [Rg5]<br>GCuSn7ZnPb [Rg7] | 2.1096<br>2.1090 | 150-300 N/mm²<br>150-300 N/mm² | 10 - 30 | 5 - 20 | – |
| 3.6 | Special copper alloys, up to Q18 | | Ampco16 | | 630 N/mm² | – | – | – |
| 3.7 | Special copper alloys, over Q18 | | Ampco20 | | 600 N/mm² | – | – | – |
| **4** | **Nickel/Cobalt alloys** | | | | | | | |
| 4.1 | Nickel/Cobalt alloys heat-resistant | ≤ 850 N/mm² | NiCu30Fe [MONEL400] | 2.4360 | 420-610 N/mm² | 5 - 20 | 2 - 10 | 5 - 20 |
| 4.2 | Nickel/Cobalt alloys high-heat resistant | 850 - 1400 N/mm² | NiCr19NbMo [INCONEL718] | 2.4668 | 850-1190 N/mm² | 2 - 10 | 1 - 5 | – |
| 4.3 | Nickel/Cobalt alloys high-heat resistant | > 1400 N/mm² | Haynes 25 (L605) | | 1550-2000 N/mm² | – | – | – |
| **5** | **Aluminium alloys** | | | | | | | |
| 5.1 | Aluminium wrought alloys | | Al 99,5 [F13]<br>AlCuMg1 [F39] | 3.0255<br>3.1325 | 100-250 N/mm²<br>300-500 N/mm² | 10 - 50 | – | – |
| 5.2 | Aluminium cast alloys, Si ≤ 5% | | G-AlMg3 | 3.3541 | 130-190 N/mm² | 10 - 50 | 10 - 20 | 20 - 60 |
| 5.3 | Aluminium cast alloys, 5% < Si ≤ 12% | | GD-AlSi9Cu3<br>GD-AlSi12 | 3.2163<br>3.2582 | 240-310 N/mm²<br>220-300 N/mm² | 10 - 50 | 10 - 20 | 20 - 60 |
| 5.4 | Aluminium cast alloys, 12% < Si ≤ 17% | | G-AlSi17Cu4 | | 180-250 N/mm² | 10 - 30 | 10 - 20 | – |
| **6** | **Magnesium alloys** | | | | | | | |
| 6.1 | Magnesium wrought alloys | | MgAl6 | 3.5662 | 300-500 N/mm² | – | – | – |
| 6.2 | Magnesium cast alloys | | GMgAl9Zn1 | 3.5912 | 300-500 N/mm² | – | – | – |
| **7** | **Titanium, Titanium alloys** | | | | | | | |
| 7.1 | Pure titanium, Titanium alloys | ≤ 900 N/mm² | Ti3 [Ti99.4]<br>TiAl6V4 | 3.7055<br>3.7164 | 700 N/mm²<br>700-900 N/mm² | 5 - 15 | 1 - 8 | 2 - 10 |
| 7.2 | Titanium alloys | 900 - 1250 N/mm² | TiAl4Mo4Sn2 | 3.7185 | 900-1250 N/mm² | 2 - 10 | 1 - 5 | 2 - 10 |
| **8** | **Synthetics** | | | | | | | |
| 8.1 | Duroplastics (short-chipping) | | BAKELIT | | 110 N/mm² | – | – | – |
| 8.2 | Thermoplastics (long-chipping) | | HOSTALEN | | 80 N/mm² | – | – | – |
| 8.3 | Fibre-reinforced synthetics | | CFK / GFK / AFK | | 800-1500 N/mm² | – | – | – |
| **9** | **Materials for special applications** | | | | | | | |
| 9.1 | Graphite | | C-8000 | | 60 N/mm² | – | – | – |
| 9.2 | Tungsten-copper alloys | | W-Cu 80/20 | | 230-250 HV | – | – | – |

## The process

The cold forming of threads, according to DIN 8583-5, belongs to the pressure-forming processes. The internal thread is produced by the impression of a helical sequence of thread teeth into the formerly prepared thread hole, the desired profile is formed by pressure.

A cold-forming tap is provided with a lead taper and a cylindrical guiding part. The thread helix runs on through both parts. If you look at a cross-section of the tool, there is a polygon shape to be recognized at a right angle to the tool axis. This polygon shape provides forming wedges which carry the effective thread profile.




The lead portion of a cold-forming tap is made as a lead taper, in which the helical thread line is continuously increasing in diameter. In the cold-forming process, the lead taper produces the thread, the forming wedges penetrating the workpiece successively in a radial direction by forming the thread. During this process, the workpiece material "flows" from the thread crests along the thread flanks into the area of the minor thread diameter. This creates smooth flank surfaces and, in the minor diameter area, the typical "claw."

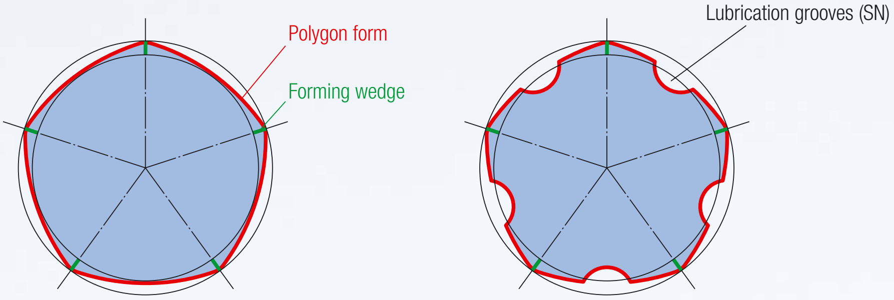
The cylindrical guiding part of the cold-forming tap makes the surface of the produced thread even smoother, and serves to firmly guide the tool axially.

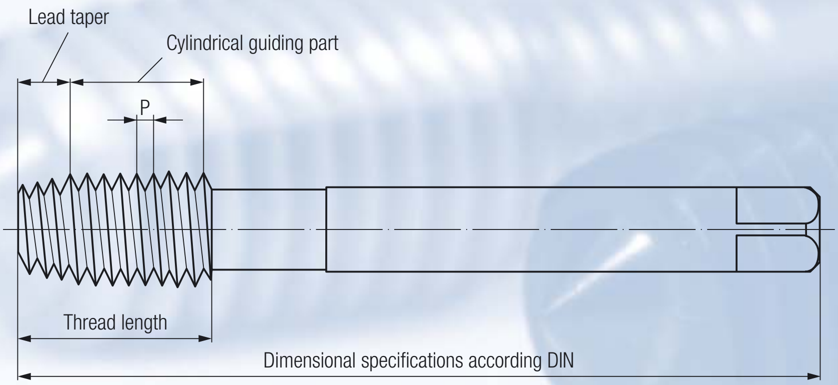
Depending on the workpiece material, the essential advantages of cold forming include excellent surface quality but also increased static and dynamic strength of the thread. The length of the thread to be produced is not limited by chips which need to be removed, so process safety is extremely good.

The excellent self-guiding characteristics of a cold-forming tap prevent axial "miscutting". The extraordinary stability of the tools is very helpful, especially with small diameters.

## Geometric construction of a cold-forming tap

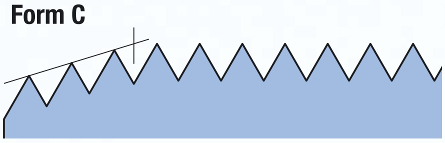
The polygon form of a cold-forming tap is decisive for the so-called contact or touch zone along the forming wedges. These have by far the greatest influence on the friction characteristics of the tool, and determine the flowing speed and the flowing behaviour of the workpiece material. With our InnoForm tools, the polygon form and the number of forming wedges are designed according to the special properties of the workpiece material.



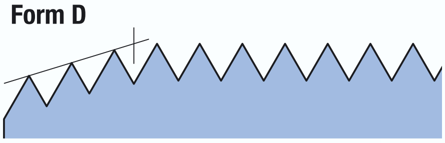

## Lead taper forms and lead taper lengths for cold-forming taps acc. DIN 2175

**Form C**



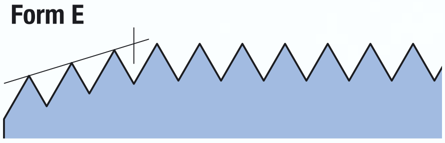
Lead taper length 2-3.5 threads

**Form D**



Lead taper length 3.5-5.5 threads

**Form E**

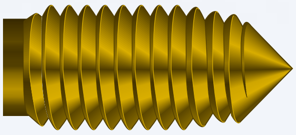


Lead taper length ≤ 2 threads

## Coatings

All InnoForm cold-forming taps are provided with hard surface and/or anti-friction coatings specially selected for their specific application. These coatings are:

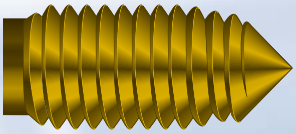
**TIN**



**Titanium nitride (gold colour)**

The hardness of approx. 2300 HV, the good sliding properties and the coating adhesion yield considerable tool life increase. This mono-layer coating will remain resistant up to approx. 600 °C.

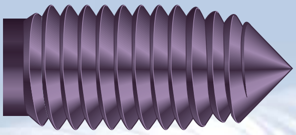
**TIN-T1**



**Titanium nitride (gold colour)**

The hardness of approx. 3000 HV is achieved by the multi-layer coating structure, among other factors.

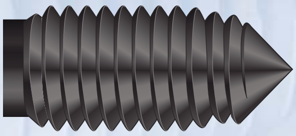
**TICN**



**Titanium carbonitride (blue-grey)**

The hardness is approx. 3000 HV. The TICN coating will resist up to approx. 400 °C.

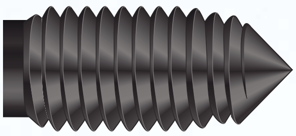
**GLT-7**



**Hard surface coating with anti-friction layer (black-grey)**

The hardness is approx. 3000 HV. The combination of a multi-layer-graded hard surface coating with a superimposed anti-friction layer provides excellent chip flow and wear resistance. This layer will remain resistant up to approx. 400 °C.

**GLT-8**



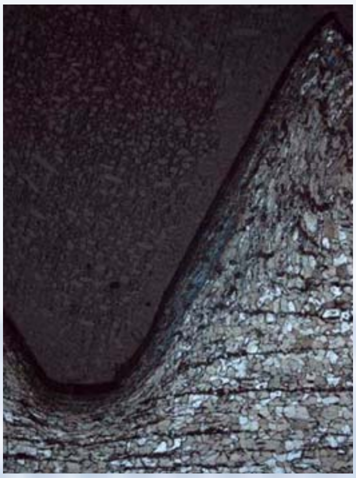
**Diamond-like, amorphous carbon coating (black-grey)**

The hardness is approx. 2500 HV. This mono-layer coating is an excellent choice for the machining of non-ferrous metals and aluminium with a low silicon content (< 9% Si). Thanks to the low friction, material adhesion is drastically reduced. This coating will remain resistant up to approx. 350 °C.

## Difference between a cut thread and a cold-formed thread

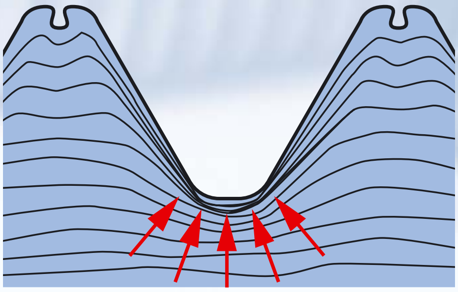
With a cut thread, the permissible stress values are limited due to the fact that the grain structure of the material is cut. Also, flank angle errors can occur easily; these will cause a very unfavourable distribution of stress on the thread and limit its holding strength. With a cold-formed thread, the grain of the material is not cut or interrupted, and the material itself shows increased strength, due to its having been compressed by cold-forming. Flank angle errors which are quite common in cut threads are prevented by the material being formed, without any play, along the thread flanks of the tap. The incomplete minor diameter, typical for cold-formed threads, has no influence on the stripping resistance of the thread.

Cold forming causes material strengthening on the thread flanks and especially in the root area of the thread. This strengthening of the material structure has a very positive influence on the vibration properties and the general resistance of the thread under dynamic stress.

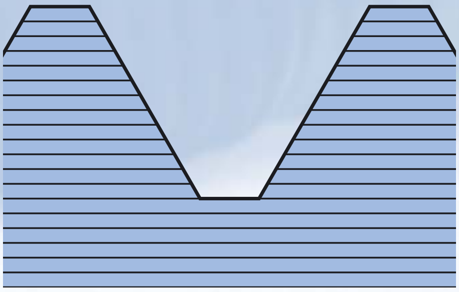


Cold-formed thread

Cut thread



Grain structure in a cold-formed thread, strengthening in the root area / on the major diameter which is especially exposed to the danger of crack formation increases resistance



Grain structure in a cut thread

## Maximum thread depth, maximum thread pitch

The maximum thread depth to be achieved and the fastest possible thread pitch to be produced by cold-forming are a topic about which a general statement is impossible. The possible thread depth is definitely larger than it could be with a cutting tap. In practical work, it depends primarily on the quality of cooling/lubrication, and is limited by the constructional length of the tool.

The maximum thread pitch in cold forming is limited by the workpiece material properties. A pitch of approx. 3.5 mm is normally the upper limit.

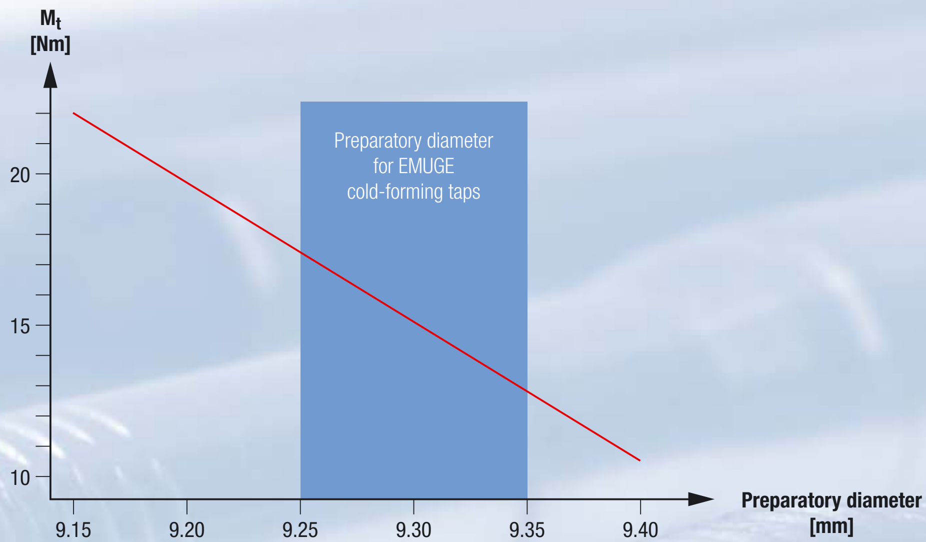
## Technical data of the workpiece material

Not all materials are suitable for cold forming. For that, they must show a minimum value of ductility and must not exceed a certain maximum strength. Suitable materials usually have a tensile strength of less than 1400 N/mm$^2$ and a minimum fracture strain of 5%. In addition, different materials and their alloys lead to very specific flow properties and strengthening characteristics. Obviously, wrought aluminium, high-strength steel or stainless materials will react in very different ways.

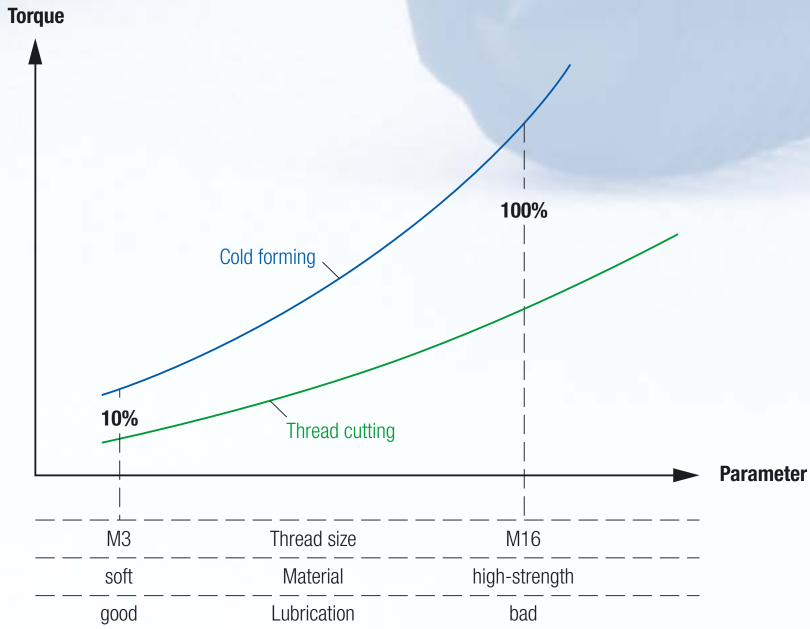
## Torque

Torque, in the cold forming of threads, depends mostly on the workpiece material, the thread size, lubrication and preparatory diameter, as well as on the geometry and the coating of the tool. The influence of the preparatory diameter on torque is shown in the following diagram.

**InnoForm, M10-6HX**
Material C45
n = 350 rpm



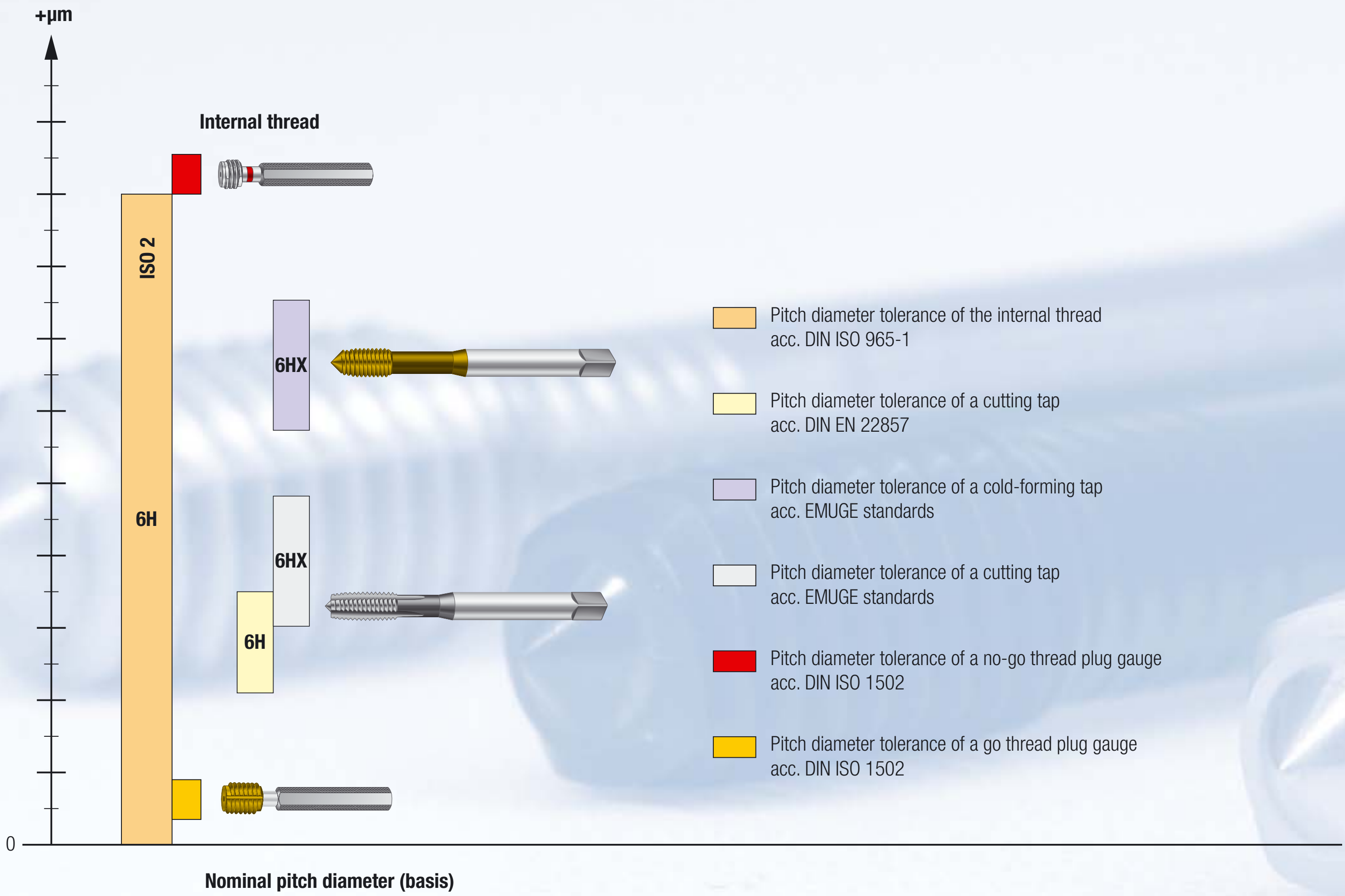

The following diagram demonstrates the difference in torque between thread cutting and cold forming.



## Tolerance of the thread part

The thread part of a cold-forming tap is generally produced with an increased tolerance since the workpiece material will always contract after the plastic forming process, depending on its elasticity.

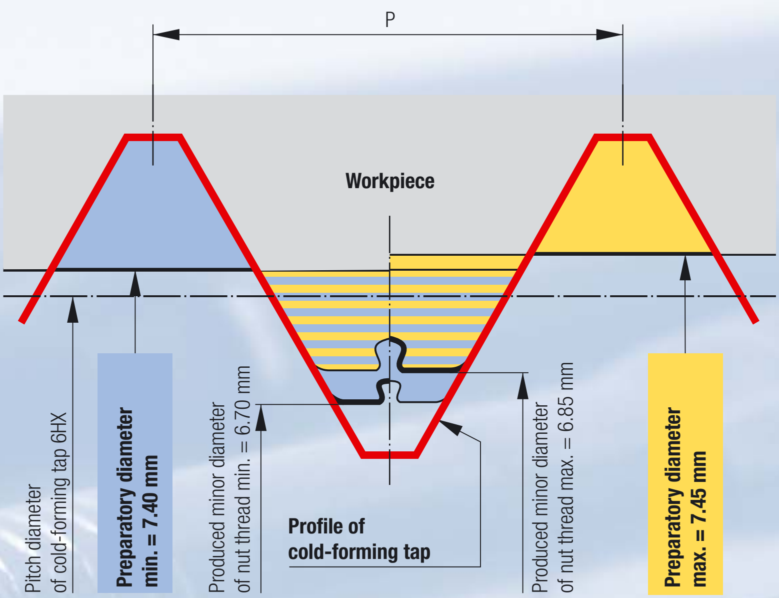
Consequently, the produced thread is always smaller than the thread part of the cold-forming tap. You will never be able to screw the cold-forming tap back into the thread manually after the cold-forming process, as would be possible without any problem with a cut thread and a cutting tap. For this reason, it is necessary to manufacture the thread part of a cold-forming tap closer to the upper tolerance limit of the internal thread.



## The influence of the preparatory diameter

If the preparatory diameter is too small the workpiece material is overformed in the thread root and there are excessive process forces. If the preparatory diameter is too large the thread root is not sufficiently formed, the minor diameter is too small. In order to preclude such negative effects, the tolerance of cold-forming taps is narrowed down from the start. In some cases where the forming characteristics are very extraordinary it may be necessary to go without a standard preparatory diameter entirely, and to find the correct diameter by testing.

It is important to know that the preparatory diameter has a decisive influence on the minor diameter of the nut thread, as the following example shows. Every lack of precision, every kind of surface roughness will be mirrored in the finished internal thread and its minor diameter.




Cold-formed thread M8-6HX in corrosion- and acid-proof material, e.g. material no. 1.4571 or 1.4401, with different preparatory diameters.

Nut height = 2 x d
$v_c$ = 6.4 m/min
n = 255 rpm

Coolant-lubricant: EMUGE thread cutting oil no. 5

While the observation of the pitch diameter tolerance of the internal thread, e.g. ISO metric thread 6H, offers no problems usually, deviations in the minor diameter of the internal or nut thread must be expected, as demonstrated above.

The extended minor diameter tolerances for cold-formed internal threads are specified in DIN 13-50. This standard allows a 7H tolerance for the minor diameter of the nut thread, with a pitch diameter tolerance of 6H.

## Recommended preparatory diameters

Sometimes, the recommended preparatory diameter must be adjusted to the existing work conditions.

### M ISO Metric coarse thread DIN 13

| Thread specification | Preparatory diameter min. | max. | mm |
|---|---|---|---|
| M 3 | 2.79 | 2.82 | 2.8 |
| 4 | 3.69 | 3.73 | 3.7 |
| 5 | 4.64 | 4.68 | 4.65 |
| 6 | 5.55 | 5.60 | 5.6 |
| 8 | 7.41 | 7.48 | 7.45 |
| 10 | 9.28 | 9.37 | 9.35 |
| 12 | 11.16 | 11.25 | 11.25 |
| 16 | 15.02 | 15.14 | 15.1 |

### G Whitworth pipe thread DIN EN ISO 228

| Thread specification | Preparatory diameter min. | max. | mm |
|---|---|---|---|
| G 1/8 | 9.25 | 9.32 | 9.25 |
| 1/4 | 12.48 | 12.56 | 12.55 |
| 3/8 | 15.99 | 16.06 | 16.05 |
| 1/2 | 20.02 | 20.12 | 20.1 |

### MF ISO Metric fine thread DIN 13

| Thread specification | Preparatory diameter min. | max. | mm |
|---|---|---|---|
| M 8 x 1 | 7.55 | 7.60 | 7.6 |
| 10 x 1 | 9.55 | 9.60 | 9.6 |
| 12 x 1.5 | 11.29 | 11.38 | 11.35 |
| 14 x 1.5 | 13.29 | 13.38 | 13.35 |
| 16 x 1.5 | 15.29 | 15.38 | 15.35 |

### UNC Unified coarse thread UNC ASME B1.1

| Thread specification | Preparatory diameter min. | max. | mm |
|---|---|---|---|
| No. 4 - 40 | 2.54 | 2.58 | 2.55 |
| No. 6 - 32 | 3.12 | 3.17 | 3.15 |
| No. 8 - 32 | 3.79 | 3.83 | 3.8 |
| No. 10 - 24 | 4.31 | 4.36 | 4.35 |
| 1/4 - 20 | 5.72 | 5.79 | 5.75 |
| 5/16 - 18 | 7.23 | 7.31 | 7.3 |
| 3/8 - 16 | 8.73 | 8.82 | 8.8 |
| 7/16 - 14 | 10.20 | 10.30 | 10.25 |
| 1/2 - 13 | 11.71 | 11.82 | 11.8 |

### UNF Unified fine thread UNF ASME B1.1

| Thread specification | Preparatory diameter min. | max. | mm |
|---|---|---|---|
| No. 6 - 40 | 3.21 | 3.24 | 3.2 |
| No. 8 - 36 | 3.83 | 3.87 | 3.85 |
| No. 10 - 32 | 4.45 | 4.49 | 4.45 |
| 1/4 - 28 | 5.92 | 5.97 | 5.95 |
| 5/16 - 24 | 7.43 | 7.49 | 7.45 |
| 3/8 - 24 | 9.02 | 9.08 | 9.05 |
| 7/16 - 20 | 10.49 | 10.56 | 10.55 |
| 1/2 - 20 | 12.08 | 12.15 | 12.15 |

## Twist drills

As a service offer to our customers, we can supply twist drills and stepped drills for the more common thread sizes M3 to M16 ex stock.

The diameters of these drills have been chosen to meet our preparatory diameter recommendations for the cold forming of threads.

## Thread gauging – Combination of tolerance classes

Thread gauging in the pitch diameter is done with the usual go/no-go thread plug gauges as specified in the well-known thread standards. It should be noted that for cold-formed metric threads the specifications for tolerances according DIN 13-50 apply.

### 1. Application range

This standard specifies thread tolerances for internal threads to be produced by cold forming (see DIN 8583-5).

The production process cold forming is to be used, preferably, for coarse threads M3 to M16 and for fine threads M8 x 1 to M30 x 2 according DIN ISO 262 and DIN ISO 965-2.

### 2. Tolerances

For internal threads of screw-in class N according DIN ISO 965-1, which are to be produced by cold forming, the following tolerance zones have been specified according to DIN ISO 13-50:

- for the pitch diameter 6H (as in DIN ISO 965-1)
- for the minor diameter 7H (DIN 13-50)

Note: For thread tolerances which are not specified in DIN 13-50, it is usually recommended to proceed in an analogue way, i.e. to raise the minor diameter tolerance in relation to the pitch diameter tolerance – normally by one tolerance step. However, in such cases the user has to check first if the raised tolerance is acceptable in the workpiece to be produced.

**Extract from DIN 13-50**

Limit allowances and tolerances

**M** **ISO Metric coarse thread DIN 13**

| Thread specification | Pitch diameter for tolerance 6H | | Minor diameter for tolerance 7H | | |
|---|---|---|---|---|---|
| | **min.** | **max.** | **min.** | **max.** | **Tolerance in µm** |
| M 3 | 2.675 | 2.775 | 2.459 | 2.639 | 180 |
| 4 | 3.545 | 3.663 | 3.242 | 3.466 | 224 |
| 5 | 4.480 | 4.605 | 4.134 | 4.384 | 250 |
| 6 | 5.350 | 5.500 | 4.917 | 5.217 | 300 |
| 8 | 7.188 | 7.348 | 6.647 | 6.982 | 335 |
| 10 | 9.026 | 9.206 | 8.376 | 8.751 | 375 |
| 12 | 10.863 | 11.063 | 10.106 | 10.531 | 425 |
| 16 | 14.701 | 14.913 | 13.835 | 14.310 | 475 |

**MF** **ISO Metric fine thread DIN 13**

| Thread specification | Pitch diameter for tolerance 6H | | Minor diameter for tolerance 7H | | |
|---|---|---|---|---|---|
| | **min.** | **max.** | **min.** | **max.** | **Tolerance in µm** |
| M 8 x 1 | 7.350 | 7.500 | 6.917 | 7.217 | 300 |
| 10 x 1 | 9.350 | 9.500 | 8.917 | 9.217 | 300 |
| 12 x 1.5 | 11.026 | 11.216 | 10.376 | 10.751 | 375 |
| 14 x 1.5 | 13.026 | 13.216 | 12.376 | 12.751 | 375 |
| 16 x 1.5 | 15.026 | 15.216 | 14.376 | 14.751 | 375 |

### 3. Designation, drawing specification

In addition to the specifications in DIN ISO 965-1, a cold-formed internal thread with the tolerances as outlined in paragraph 2 is described in the following manner:

Example: Fine thread M20 x 2: M 20 x 2 – 6H 7H – cold-formed

- M – Thread specification letter for ISO Metric thread
- 20 x 2 – Thread size (major diameter x pitch)
- 6H – Tolerance zone for the pitch diameter
- 7H – Tolerance zone for the minor diameter

## Lubrication

The choice of the lubrication medium and its supply mode requires special attention. Due to the high friction which is quite common in cold forming, a high-quality lubricant is necessary in order to achieve high performance. We especially recommend high-quality oils, but work is also possible with emulsion or minimum-quantity lubrication systems.

In order to achieve high circumferential speeds and obtain clean thread surfaces and long tool life, we recommend the use of our lubricants or of similar high-performance equivalents.

For machining with minimum-quantity lubrication, we would advise you to observe the lubricant recommendations of the manufacturer of your MQL equipment.


## EMUGE Coolant-lubricants

| Abbreviation | No. | Range of application |
|---|---|---|
| O | 1<br>1 clf | **For the machining of un-alloyed and low-alloyed steels**<br>Can be used for brush and circulation lubrication.<br>Not suitable for the machining of light metals and non-ferrous metals. |
| O | 2<br>2 clf | **For the machining of cast iron, spheroidal and meehanite cast iron, and steels of up to 900 N/mm² tensile strength**<br>Can be used for brush and circulation lubrication. |
| E | 3<br>3 clf | **Should be used as emulsion only (mixture ratio 1:8), and is suitable for nearly all materials, and also for the cold forming of threads, in that form**<br>Should not be used in concentrated form. |
| O | 4<br>4 clf | **For light metals and non-ferrous metals, and their alloys**<br>Can be used for brush and circulation lubrication. |
| O | 5<br>5 clf | **For tough and difficult materials, and especially for the cold forming of threads**<br>Can be used for brush and circulation lubrication. |
| P | 6<br>6 clf | **For tough and difficult materials, and especially for the cold forming of threads**<br>For brush lubrication only;<br>especially useful in horizontal machining,<br>with large thread sizes and through hole threads. |

## Description of abbreviations

| Abbreviation | Range of application |
|---|---|
| E | **Emulsion**<br>(EMUGE Thread cutting oil no. 3)<br>The most common type of cooling/lubrication on machining centres. |
| O | **Thread cutting oil**<br>(EMUGE Thread cutting oils no. 1, 2, 4, 5)<br>Specially adjusted for the workpiece materials to be machined, these oils will help to obtain excellent thread surfaces and long tool life. |
| P | **Thread cutting paste**<br>(EMUGE Thread cutting paste no. 6)<br>Ideal for thread cutting and the cold forming of threads in tough and difficult materials.<br>Especially useful in horizontal machining. |
| M | **Minimum-quantity lubrication (MQL)**<br>Due to the possibility of supplying aerosol through the spindle on modern machining centres, this type of cooling/lubrication is becoming more and more popular. |
| A | **Dry, pressurized air, cooled pressurized air**<br>Real "dry cutting" is normally done only in grey cast iron.<br>For chip removal, the use of air, sometimes cooled, is a common solution. |

EMUGE Coolant-lubricants are made especially for the material to be machined, and for the work conditions as outlined above. They are available in a chlorinated, and alternatively in a chlorine-free (clf) version.

## Tool clamping

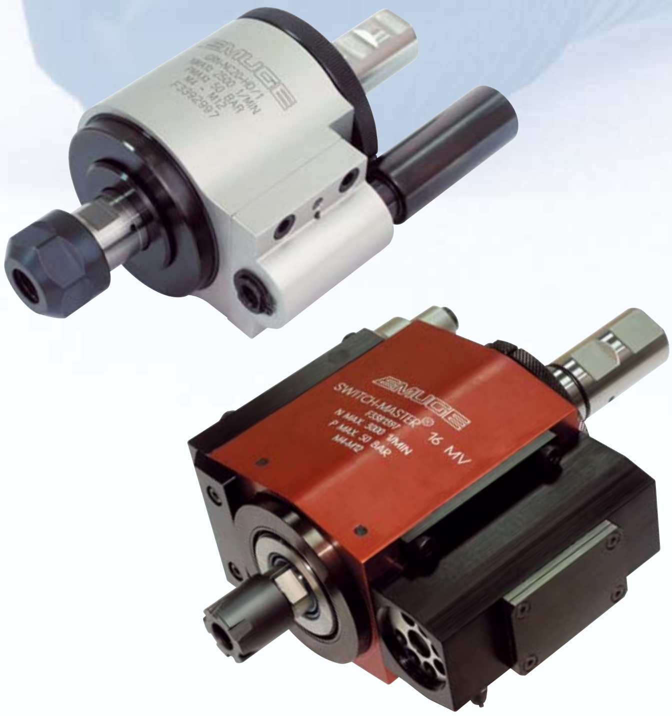
EMUGE offers a comprehensive programme of holders for threading tools, for example:

- quick-change holders
- collet chucks
- tapping attachments

No matter what kind of tool you want to clamp, we have the perfect solution. Depending on the application case and the existing requirements, our holders are equipped with the necessary performance features.


For the adaptation of cutting and cold-forming taps in quick-change holders, we can offer you a wide range of quick-change adapters.

Tapping attachments of our GRN-NC and SWITCH-MASTER® series are made for the production of right-hand threads on CNC-controlled machine tools. Thanks to the integrated change gear, the sense of rotation of the machine spindle does not need to be changed for reversing the tool, which permits enormous time savings due to shorter cycle times, and saves the machine spindle itself by allowing it to keep up a constant right-hand rotation. In addition, the best possible tool life is obtained easily, and power consumption is kept low due to a nearly constant flow of current.



## Clamping system PGR

The clamping system PGR "powRgrip®" is a mechanical alternative to thermal shrink-fit and hydro-expansion chucks, and is suitable for the clamping of both solid carbide and HSS tools. As opposed to shrink-fit technology, there are no heat-related structural changes on the tool holder.

The PGR system permits safe clamping in tolerance h9 (type PGR-GB) or h6 (type PGR) and shows extraordinary performance in the enormous torques it can transfer, as well as in its excellent concentricity characteristics. A special feature for pre-setting the tool is integrated in each collet.

powRgrip® is a registered trademark of REGO-FIX AG.

## Tool monitoring system DDU

With the help of tool holders fitted out with DDU electronics and the complementary analysis unit of ARTIS it is possible to measure the effective machining forces in thread production directly on the tool holder.

The DDU system is a further development of the tool monitoring system ICS, with the additional option of monitoring and documenting not only the effective torque but also the axial forces coming up in the production of threads.

AUSTRIA
**EMUGE Präzisionswerkzeuge GmbH**
Pummerinplatz 2 · 4490 St. Florian
Tel. +43-7224-80001 · Fax +43-7224-80004

BRAZIL
**EMUGE-FRANKEN Ferramentas de Precisão Ltda.**
Av. Dom Pedro II, 288 – 11° Andar · Bairro Jardim - Santo André
São Paulo Brasil - CEP 09080-000
Tel. +55-11-4432-2811 · Fax +55-11-4436-3896

BELGIUM
**EMUGE-FRANKEN B.V.**
Handelsstraat 28 · 6851EH Huissen · NETHERLANDS
Tel. +31-26-3259020 · Fax +31-26-3255219

CANADA
**EMUGE Corp.**
1800 Century Drive · West Boylston, MA 01583-2121 · USA
Tel. +1-508-595-3600, +1-800-323-3013 · Fax +1-508-595-3650

CHINA
**EMUGE-FRANKEN Precision Tools (Suzhou) Co. Ltd.**
No. 72, Loujiang Rd. · Weiting Town (Kuatang Sub-district)
Suzhou Industrial Park · 215122 Suzhou
Tel. +86-512-62860560 · Fax +86-512-62860561

CZECH REPUBLIC
**EMUGE-FRANKEN servisní centrum, s.r.o.**
Tel. +420-5-44423261 · Fax +420-5-44233798

DENMARK
**EMUGE-FRANKEN AB**
Toldbodgade 18, 5.sal · 1253 København K
Tel. +45-70-257220 · Fax +45-70-257221

FINLAND
**Emuge-Franken Cutting Tools Oy**
Heikkiläntie 2A · 00210 Helsinki
Tel. +35-8-207415740 · Fax +35-8-207415749

FRANCE
**EMUGE SARL**
2, Bd de la Libération · 93284 Saint Denis Cedex
Tel. +33-1-55872222 · Fax +33-1-55872229

GREAT BRITAIN
**EMUGE U.K. Limited**
2 Claire Court, Rawmarsh Road · Rotherham S60 1RU
Tel. +44-1709-364494 · Fax +44-1709-364540

HUNGARY
**EFT Szerszámok és Technológiák Magyarország Kft.**
Gyár u. 2 · 2040 Budaörs
Tel. +36-23-500041 · Fax +36-23-500462

INDIA
**EMUGE India**
Plot No.: 92 & 128, Kondhanpur, Taluka: Haveli · District Pune-412 205
Tel. +91-20-24384941 · Fax +91-20-24384028

ITALY
**EMUGE-FRANKEN S. r. l.**
Via Carnevali, 116 · 20158 Milano
Tel. +39-02-39324402 · Fax +39-02-39317407

JAPAN
**EMUGE-FRANKEN K. K.**
Nakamachidai 1-32-10-403 · Tsuzuki-ku Yokohamashi, 224-0041
Tel. +81-45-9457831 · Fax +81-45-9457832

LUXEMBOURG
**Dirk Gerson Otto**
Gässelweg 16a · 64572 Büttelborn · GERMANY
Tel. +49-6152-910330 · Fax +49-6152-910331

MALAYSIA
**EMUGE-FRANKEN (Malaysia) SDN BHD**
No. 603, 6th Fl., West Wing, Wisma Consplant II, No. 7
Jalan SS 16/1, Subang Jaya, Selangor Darul Ehsan
Tel. +60-3-56366407 · Fax +60-3-56366405

MEXICO
**EMUGE Corp.**
1800 Century Drive · West Boylston, MA 01583-2121 · USA
Tel. +1-508-595-3600, +1-800-323-3013 · Fax +1-508-595-3650

NETHERLANDS
**EMUGE-FRANKEN B.V.**
Handelsstraat 28 · 6851EH Huissen
Tel. +31-26-3259020 · Fax +31-26-3255219

NORWAY
**Emuge Franken Teknik AS**
Nedre Åsemulvegen 6 · 6018 Ålesund
Tel. +47-70169870 · Fax +47-70169872

POLAND
**EMUGE-FRANKEN Technik**
ul. Chłopickiego 50 · 04-275 Warszawa
Tel. +48-22-8796730 · Fax +48-22-8796760

PORTUGAL
**EMUGE-FRANKEN**
Av. António Augusto de Aguiar, nº 108 - 8º andar · 1050-019 Lisboa
Tel. +351-213146314 · Fax +351-213526092

ROMANIA
**EMUGE-FRANKEN Tools Romania SRL**
Str. Tulcea, Nr. 24/3 · 400594 Cluj-Napoca
Tel. +40-264-597600 · Fax +40-264-597600

SERBIA
**EMUGE-FRANKEN Tooling Service d.o.o.**
Adi Endre ul.77 · 24400 Senta
Tel. +381-24-817000 · Fax +381-24-817000

SLOVAK REPUBLIC
**EMUGE-FRANKEN nástroje spol. s.r.o.**
Lubovníková 19 · 84107 Bratislava
Tel. +421-2-6453-6635 · Fax +421-2-6453-6636

SLOVENIA
**EMUGE-FRANKEN tehnika d.o.o.**
Streliška ul. 25 · 1000 Ljubljana
Tel. +386-1-4301040 · Fax +386-1-2314051

SOUTH AFRICA
**EMUGE S.A. (Pty.) Ltd.**
2, Tandela House, Cnr. 12th Ave. & De Wet Street · 1610 Edenvale
Tel. +27-11-452-8510/1/2/3/4 · Fax +27-11-452-8087

SPAIN
**EMUGE-FRANKEN, S.L.**
Calle Fructuós Gelabert, 2-4 4º 1ª · 08970 Sant Joan Despí (Barcelona)
Tel. +34-93-4774690 · Fax +34-93-3738765

SWEDEN
**EMUGE FRANKEN AB**
Hagalundsvägen 43 · 70230 Örebro
Tel. +46-19-245000 · Fax +46-19-245005

SWITZERLAND
**RIWAG Präzisionswerkzeuge AG**
Winkelbüel 4 · 6043 Adligenswil
Tel. +41-41-3708494 · Fax +41-41-3708220

THAILAND
**EMUGE-FRANKEN (Thailand) co., ltd.**
1213/54 Ladphrao 94, Khwaeng/Khet Wangthonglang · Bangkok 10310
Tel. +66-2-559-2036,(-8) · Fax +66-2-530-7304

USA
**EMUGE Corp.**
1800 Century Drive · West Boylston, MA 01583-2121
Tel. +1-508-595-3600, +1-800-323-3013 · Fax +1-508-595-3650

**EMUGE-Werk Richard Glimpel GmbH & Co. KG · Fabrik für Präzisionswerkzeuge**
Nürnberger Straße 96-100 · 91207 Lauf · GERMANY · Tel. +49 (0) 9123 / 186-0 · Fax +49 (0) 9123 / 14313

**FRANKEN GmbH & Co. KG · Fabrik für Präzisionswerkzeuge**
Frankenstraße 7/9a · 90607 Rückersdorf · GERMANY · Tel. +49 (0) 911 / 9575-5 · Fax +49 (0) 911 / 9575-327

*info@emuge-franken.com · www.emuge-franken.com · www.frankentechnik.de*

ZP10019 . GB 2T 102007 DO · Rev. B Printed in Germany