VERGNANO

Solid Carbide Taps

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VERGNANO CARBIDE TAPS

The use of carbide tools has increased significantly in the last few years. Nowadays turning, drilling and milling operations are done, for the most part, with these kind of tools. The development of carbide tools, with better wear resistance and higher toughness compared to HSS tools, has been pushed forward by the evolution of CNC machines and the request for higher cutting speeds.

More specifically, in certain tapping applications, the use of carbide is either indispensable, such as in heat-treated steels or very competitive, such as in abrasive materials.

Range

The Vergnano carbide tap range includes:

- Straight fluted taps with chamfer form C for blind and through holes, for machining abrasive materials such as grey cast iron and aluminium-silicon alloys; metric and metric fine threads (types **H**B43 and **H**B45).
- 15° spiral fluted taps for blind holes, for machining aluminium, copper, bronze and plastic materials; metric threads (type **H**B29);
- Straight fluted taps for blind and through holes, for machining heat-treated steel with hardness up to HRC 62; metric threads (type **H**130);
- Forming taps with radial through coolant for blind and through holes, for machining low/medium resistance steel, stainless steel, aluminium; metric threads (type **H**B80 NR).

A carbide twist drill has been included in the carbide product range (type **H**P900) for drilling holes in heat-treated steels with hardness up to HRC 62. The twist drill is oversize compared to normal twist drills in order to increase the toollife of the tap. The twist drill can be used to prepare the pre-hole before tapping with the **H**130 tap.

Advantages

The advantages of using carbide taps compared to standard HSS taps consist in a significant increase in tool life when machining certain types of materials and the possibility to machine hard/heat-treated steels otherwise impossible to machine with HSS tools. In particular, in the machining of abrasive materials such as cast iron or aluminium-silicon alloys (Si > 10%), the tool life can reach 8-10 times that of an equivalent tap in HSS. All taps for cast iron are equipted with through coolant channels to improve chip evacuation and to allow tapping of deep blind holes up to 3xD.

For aluminium and non-ferrous materials, **H**B29 type taps have through coolant channels for better chip evacuation and tapping of deep blind holes up to 3xD. The advantages are an increased tool life and a reduction in cycle times.

Taps for hard steels (type **H**130) are the only solution for tapping heat-treated steels up to HRC 62. Taps in HSS are not capable of machining materials with hardness above HRC 46.

Carbide forming taps (type **H**B80NR) can be used on all types of steels, including stainless steels, and on aluminium and aluminium alloys. In addition to the well-known advantage common to all forming taps of not producing chips, carbide forming taps offer a higher tool life. For example, on steel the increase in tool life compared to HSS taps can reach up to 20 times.

It is important to use carbide taps in combination with quality tapping attachments with micro-compensation and no axial or radial play. The best solution is the use of tapping attachments for synchronised tapping, such as the new Vergnano **S**incro attachment series. It is suggested to use the cutting speeds recommended in the catalogue, starting from the lowest value moving upwards.

Tap item	Material	Thread type	Hole type and depth	Application	Performance	Spindle	Through coolant	Chamfer	Shank	Cutting speed	Geometry
HB43	HM	M	3 x D	3.1-2 4.3-4		S		C (2-3)	DIN 371		
HB45	HM	MF	3 x D	3.1-2 4.3-4		S		C (2-3)	DIN 374		
HB29	HM	M	3 x D	4.1-4 5.3 9.1		S		C (2-3)	DIN 371		R 15
H130	HM	M	1,5 x D	1.7-1.8		S	–	D (4-5)			
HB80 NR	HM	M	3 x D	1.1-5 2.1-2 4.1-3 5.1-2		S		C (2-3)	DIN 371		

* *See legend on page. 5*

Carbide

Carbide can be considered a metallic composite material consisting of a mixture of hard carbide particles, mainly tungsten carbide (WC), in a metallic matrix of cobalt (Co). Other commonly used carbides are titanium carbide (TiC), niobiom carbide (NbC) and tantalum carbide (TaC).

The carbides, which confer hardness and compressive strength to the structure, are responsible for the wear resistance of the tool. The binding element cobalt confers toughness.

The size of the carbide particles is also important since it balances the hardness and the toughness. In general, the mechanical properties of carbides depend on composition (type and concentration of carbides), percentage of binding material, size of carbides and fabrication process.

The main differences between carbides and high speed steels are summerised in the following table:

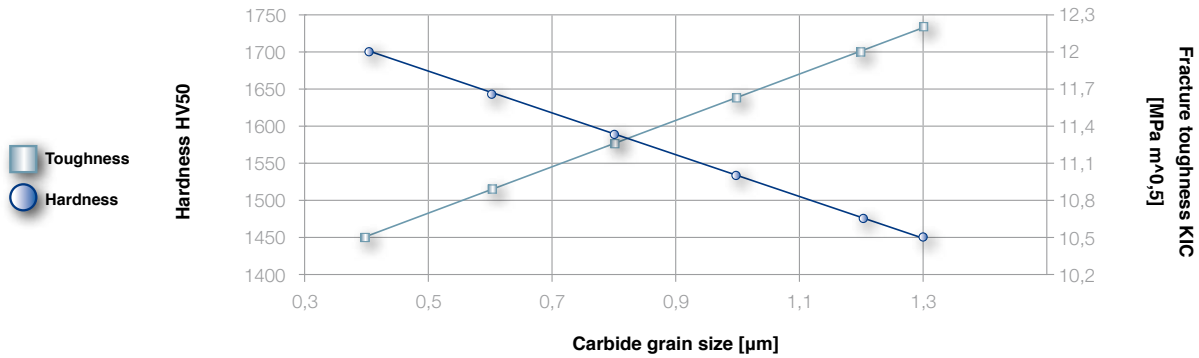
Properties	High speed steel (HSSE/HSSK)	Carbide
Hardness [HV30]	800 - 950	1400 – 1900
Compressive strength [MPa]	3000 - 4000	3000 - 6000
Bending strength [MPa]	2500 - 4500	1000 – 4000
Modulus of elasticity [GPa]	210	460 – 650
Density [kg/dm^3]	8 – 9	10 – 15
Thermal conductivity [W/m/°C]	30 – 50	35 – 120
Thermal expansion coeff. [10^{-6}/°C]	12	4,3 – 6,5

According to the IS0 513 standard, carbides are classified in function of properties and applications.

The ISO standard defines 3 groups of carbides: P (blue colour code), M (yellow colour code), K (red colour code). Subgroups are indicated with a two-digit number which increases with increasing percentage of cobalt binder.

ISO code	Chemical composition			Properties			Machina-bility	Cutting parameters			Working conditions
	%Co	% carbides	Consti-tuents	Hardness	Toughness	Wear resi-stance		Cutting speed	Feed	Cutting force	
P01	−	+	WC TiC TaC NbC Co = 5-17%	−	+	+	Long chip-ping ferrous materials Steel Nodular cast iron	+	−	−	High speed No vibrations
P10											High speed turning
P20											Turning
P30											Low/medium cutting speed
P40											Medium/high chip thickness
P50	+	−		+	−	−		−	+	+	Unfavourable conditions with vibrations
M10	−	+	WC TiC Co = 6-15%	−	+	+	Difficult materials Stainless steel	+	−	−	Medium/high cutting speed
M20											Medium cutting speed
M30											Medium chip thickness
M40	+	−		+	−	−		−	+	+	Unfavourable conditions with vibrations
K01	−	+	WC Co = 4-15%	−	+	+	Short chipping non ferrous materials Cast iron Plastic materials	+	−	−	Finish turning and milling
K10											Turning, milling, drilling, reaming and tapping
K20											Tapping
K30											Turning and milling with unfavourable conditions.
K40	+	−		+	−	−		−	+	+	

As the following graph shows at constant carbide concentration, the hardness increases with decreasing carbide grain size.



Vergnano carbide taps are produced in K grade carbide. The carbide grain size is “ultra-fine” (UF) which guarantees excellent hardness and toughness.

ARTICLE LEGEND:

THROUGH COOLANT

IKZ Axial hole
IKZ-R Radial holes

LUBRICATION

E Emulsion
O Oil
MQL Minimum quantity lubrication
S Dry

TAP MATERIAL

HM Solid carbide

HB43 Product code

● 15 ÷ 20 Ideal tap / cutting speed [m/min]

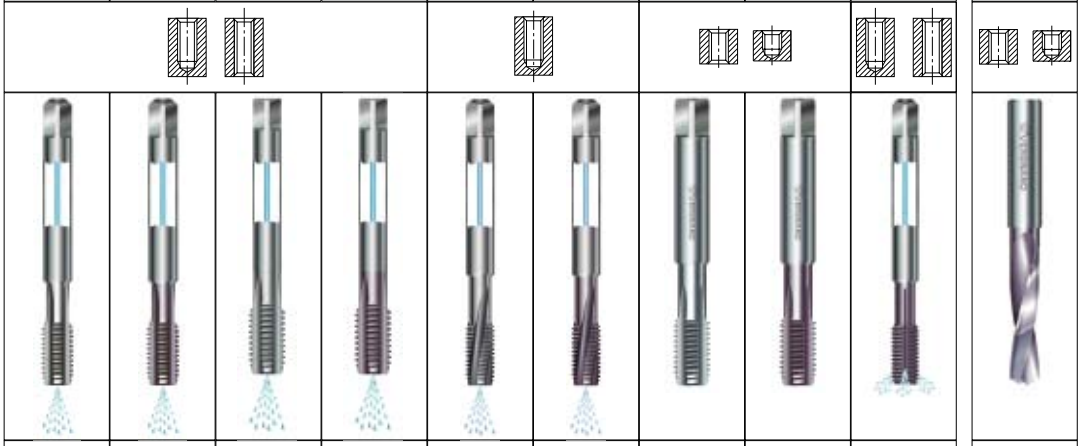
❑ 15 ÷ 20 Suitable tap / cutting speed [m/min]

● 40 - f1 Ideal drill / cutting speed [m/min] - feed rate [mm/rev]

Only for blind holes

Material
Types of hole
Chamfer form DIN 2197 Form D 4 - 5 threads Form C 2 - 3 threads
Chamfer form
M 6H
6HX
MF 6HX
Coolant
Range
Coatings

Material	Group	Description	UTS [N/mm²]	Lubrication
1.Steel	**1.1**	Mild / magnetic steel	200-400	E, O, MQL
	1.2	Construction steel, case hardening steel	350-700	E, O, MQL
	1.3	Carbon steel	350-850	E, O, MQL
	1.4	Alloyed steel / tempered steel	500-850	E, O, MQL
	1.5	Alloyed steel / tempered steel	850-1200	O, MQL
	1.6	Alloyed steel / high strength steel	1200-1400	O, MQL
	1.7	Alloyed steel, Hardness HRC 44-55	-	O, MQL
	1.8	Alloyed steel, Hardness HRC 56-62	-	O, MQL
2.Stainless steel	**2.1**	Ferritic / automatic	< 850	O, MQL
	2.2	Austenitic	< 850	O, MQL
	2.3	Ferritic + austenitic, martensitic, precipitation hardening	< 1000	O, MQL
3.Cast iron	**3.1**	Grey cast iron	< 1000	O, MQL, S
	3.2	Nodular cast iron, malleable cast iron, tempered cast iron	< 1000	E, O, MQL
4.Aluminium Aluminium alloys	**4.1**	Pure aluminium	< 300	E, O, MQL
	4.2	Aluminium wrought and die cast alloys with Si<0,5% (long chipping)	< 500	E, O, MQL
	4.3	Aluminium wrought and die cast alloys with Si<10% (mean chipping)	< 500	E, O, MQL
	4.4	Aluminium die cast alloys with Si>10% (short chipping)	< 600	E, O, MQL
5.Copper Copper Alloys Brass Bronze	**5.1**	Pure copper	250-350	E, O, MQL
	5.2	Copper alloys (long chipping), soft brass	< 700	E, O, MQL
	5.3	Copper alloys (short chipping), hard brass	< 700	E, O, MQL
	5.4	High strength bronze	700-1500	E, O, MQL
6.Magnesium Magnesium alloys	**6.1**	Pure magnesium, magnesium alloys	120-300	E, O, MQL
	6.2	High strength magnesium alloys	240-400	E, O, MQL
7.Titanium Titanium alloys	**7.1**	Pure titanium	400-600	E, O, MQL
	7.2	Titanium alloys	600-1000	O, MQL
8.Nickel Nickel alloys	**8.1**	Pure nickel	400-600	E, O, MQL
	8.2	Nickel alloys	600-1000	O, MQL
9.Plastic materials	**9.1**	Thermoplastic		O, MQL
	9.2	Thermosetting		S

HM	HM	HM	HM	HM	HM	HM	HM	HM	HM
									
C	C	C	C	C	C	D	D	C	-
						H130	H130		HP900
HB43	HB43			HB29	HB29			HB80NR	
		HB45	HB45						
IKZ	IKZ	IKZ	IKZ	IKZ	IKZ	-	-	IKZ-R	-
M3-M10	M3-M10	M12X1,5 M16X1,5	M12X1,5 M16X1,5	M3-M10	M3-M10	M3-M12	M3-M12	M3-M10	2,6-10,4
Bright	TiAlN	Bright	TiAlN	Bright	TiCN	Bright	TiCN	TiCN	TiAlN
									*Vc-f
								● 35 ÷ 50	
								● 35 ÷ 50	
								● 30 ÷ 45	
								● 25 ÷ 40	
								● 15 ÷ 30	
						❑ 2 ÷ 5	❑ 5 ÷ 10		● 40-f1
						● 2 ÷ 3	● 3 ÷ 6		● 30-f2
						● 1 ÷ 2	● 2 ÷ 4		● 30-f2
								● 10 ÷ 25	
								● 10 ÷ 25	
● 15 ÷ 40	● 40 ÷ 80	● 15 ÷ 40	● 40 ÷ 80	❑ 15 ÷ 40	❑ 40 ÷ 80				
● 10 ÷ 20	● 15 ÷ 40	● 10 ÷ 20	● 15 ÷ 40	❑ 10 ÷ 20	❑ 15 ÷ 40				
				● 15 ÷ 30	● 25 ÷ 50			● 40 ÷ 50	
				● 15 ÷ 30	● 25 ÷ 50			● 40 ÷ 50	
● 20 ÷ 30	● 30 ÷ 50	● 20 ÷ 30	● 30 ÷ 50	● 20 ÷ 30	● 30 ÷ 50			● 40 ÷ 50	
● 15 ÷ 20	● 25 ÷ 40	● 15 ÷ 20	● 25 ÷ 40	● 15 ÷ 20	● 25 ÷ 40				
								● 15 ÷ 40	
								● 15 ÷ 30	
❑ 20 ÷ 25	❑ 30 ÷ 40	❑ 20 ÷ 25	❑ 30 ÷ 40	● 20 ÷ 25	● 30 ÷ 40				
				● 5 ÷ 10	● 10 ÷ 15				
❑ 10 ÷ 12	❑ 15 ÷ 20	❑ 10 ÷ 12	❑ 15 ÷ 20						

$$N\ [rev/min] = \frac{\text{Cutting speed [m/min] x 1000}}{3{,}14 \times d_1\ [mm]}$$

f [mm/min] = f [mm/rev] x N [rev/min]

*Feed rate for drill HP900 [mm/rev]		
Diameter	f1	f2
2,6	0,032	0,025
3,4	0,040	0,032
4,3	0,050	0,040
5,1	0,050	0,040
6,9	0,070	0,055
8,6	0,090	0,070
10,4	0,110	0,090

ICONS DESCRIPTION

- HM — Material: solid carbide
- M — ISO Metric Coarse Thread
- MF — ISO Metric Fine Thread
- 1.1-5 2.1-2 4.1-3 5.2 — Application range: materials groups
- DIN 371 — Shank type: DIN 371
- DIN 374 — Shank type: DIN 374
- Shank type: Vergnano standard
- Tap with straight flutes
- R 15 — Spiral tap with 15° right hand spiral
- Forming tap with oil grooves
- Through coolant tap with internal axial hole
- Through coolant tap for blind holes with internal axial hole
- Through coolant forming tap with internal radial holes
- 3 x D — Hole type and depth: through up to 3 x d_1
- 3 x D — Hole type and depth: blind up to 3 x d_1
- 1,5 x D — Hole type and depth: through up to 1,5 x d_1
- High tool life
- S — Tap suitable for rigid tapping attachment (synchronised)
- D (4-5) — Chamfer form D: 4 - 5 threads
- C (2-3) — Chamfer form C: 2 - 3 threads
- High recommended cutting speed

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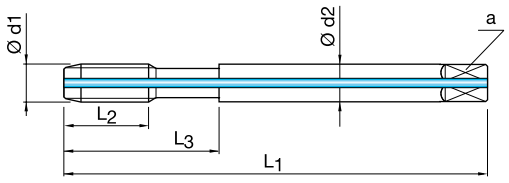
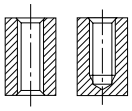
MACHINE TAPS FOR CAST IRON - Straight flutes - Internal axial coolant

For blind and through holes - Solid carbide
ISO Metric coarse thread - DIN 13

DIN 371



			Tool code			
			HB43	**HB43** TiAlN		
						
Material >	**HM**	Tolerance >	**6HX**	**6HX**		
		Chamfer form >	**C / 2-3**	**C / 2-3**		
		Application range >	**3.1-2** **4.3-4.4**			
		Hole type >				

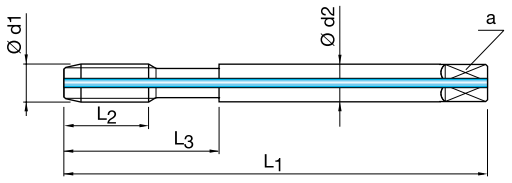
ød1 [mm]	P [mm]	L1 [mm]	L2 [mm]	L3 [mm]	ød2 h6 [mm]	a [mm]	z [-]					
M 3*	0,5	56	8	18	3,5	2,7	3	2,5	129,50 €	155,50 €		
4*	0,7	63	10	21	4,5	3,4	3	3,3	101,30 €	121,50 €		
5	0,8	70	10	25	6	4,9	4	4,2	179,50 €	215,50 €		
6	1	80	12	30	6	4,9	4	5	154,00 €	184,80 €		
8	1,25	90	16	35	8	6,2	4	6,8	232,30 €	278,50 €		
10	1,5	100	18	39	10	8	4	8,5	249,80 €	299,80 €		

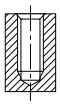
* Taps without through coolant

MACHINE TAPS - Spiral flutes - Internal axial coolant

For blind holes - Solid carbide
ISO Metric coarse thread - DIN 13

DIN 371



			Tool code			
			HB29	**HB29** TiCN		
						
Material >	**HM**	Tolerance >	**6HX**	**6HX**		
		Chamfer form >	**C / 2-3**	**C / 2-3**		
		Application range >	**4.1-4.4** **5.3** **9.1**			
		Hole type >				

ød1 [mm]	P [mm]	L1 [mm]	L2 [mm]	L3 [mm]	ød2 h6 [mm]	a [mm]	z [-]					
M 3*	0,5	56	8	18	3,5	2,7	3	2,5	154,00 €	184,80 €		
4*	0,7	63	10	21	4,5	3,4	3	3,3	136,30 €	163,50 €		
5	0,8	70	10	25	6	4,9	3	4,2	201,30 €	241,30 €		
6	1	80	12	30	6	4,9	3	5	159,30 €	191,30 €		
8	1,25	90	16	35	8	6,2	3	6,8	225,50 €	270,50 €		
10	1,5	100	18	39	10	8	3	8,5	270,00 €	324,00 €		

***** Taps without through coolant

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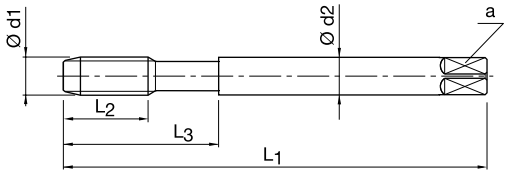
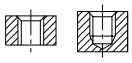
MACHINE TAPS - Straight flutes

For blind and through holes - for alloyed steels up to HRC 62 - Solid carbide
ISO Metric coarse thread - DIN 13

Vergnano standard



			Tool code			
			H130	**H130** TiCN		
						
Material >	**HM**	Tolerance >	**6H**	**6H**		
		Chamfer form >	**D / 4-5**	**D / 4-5**		
		Application range >	**1.7-1.8**			
		Hole type >				

ød1 [mm]	P [mm]	L1 [mm]	L2 [mm]	L3 [mm]	ød2 h6 [mm]	a [mm]	z [-]					
M 3	0,5	56	12	17	3,5	2,7	3	2,6	186,80 €	224,00 €		
4	0,7	63	14	19	4,5	3,4	4	3,4	177,80 €	213,30 €		
5	0,8	70	17	22	6	4,9	4	4,3	204,80 €	245,50 €		
6	1	80	20	-	6	4,9	4	5,1	247,50 €	296,80 €		
8	1,25	90	20	-	8	6,2	5	6,9	292,30 €	350,80 €		
10	1,5	100	24	-	10	8	5	8,6	364,30 €	437,30 €		
12	1,75	110	28	-	12	9	5	10,4	407,00 €	488,50 €		

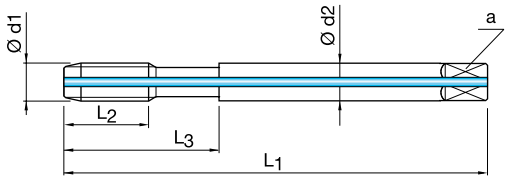
THE HOLE DIAMETERS ARE OVERSIZED.
IT IS RECOMMENDED TO USE TWIST DRILL FOR HARDENED STEEL TYPE HP900 (PAGE 11).

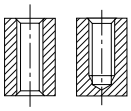
MACHINE COLD FORMING TAPS - With oil grooves and internal coolant

For blind and through holes - Solid carbide

ISO Metric coarse thread - DIN 13

DIN 371



			Tool code			
			HB80 NR TiCN			
						
Material >	**HM**	Tolerance >	**6HX**			
		Chamfer form >	**C / 2-3**			
		Application range >	**1.1-5** **2.1-2** **4.1-3** **5.1-2**			
		Hole type >				

ød1 [mm]	P [mm]	L1 [mm]	L2 [mm]	L3 [mm]	ød2 h6 [mm]	a [mm]	z [-]		
M 3*	0,5	56	6	18	3,5	2,7	4	2,8	270,00 €
4*	0,7	63	7,5	21	4,5	3,4	4	3,7	270,00 €
5	0,8	70	8,5	25	6	4,9	4	4,65	292,80 €
6	1	80	11	30	6	4,9	4	5,55	328,00 €
8	1,25	90	14	35	8	6,2	5	7,4	446,80 €
10	1,5	100	16	39	10	8	5	9,25	512,30 €

***** Taps without through coolant

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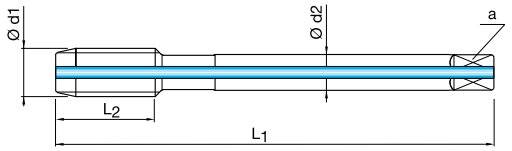
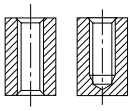
MACHINE TAPS FOR CAST IRON - Straight flutes - Internal axial coolant

For blind and through holes - Solid carbide
ISO Metric fine thread - DIN 13

DIN 374



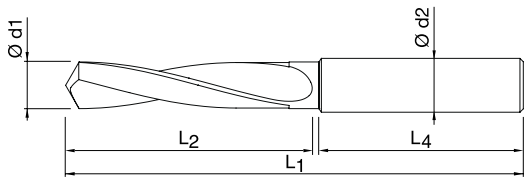
			Tool code			
			HB45	**HB45** TiAlN		
						
Material >	**HM**	Tolerance >	**6HX**	**6HX**		
		Chamfer form >	**C / 2-3**	**C / 2-3**		
		Application range >	**3.1-2** **4.3-4.4**			
		Hole type >				

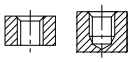
ød1 [mm]	P [mm]	L1 [mm]	L2 [mm]	L3 [mm]	ød2 h6 [mm]	a [mm]	z [-]					
M 12	1,5	100	22	-	9	7	4	10,5	332,00 €	398,50 €		
14	1,5	100	22	-	11	9	4	12,5	399,50 €	479,50 €		
16	1,5	100	22	-	12	9	4	14,5	437,30 €	524,80 €		

TWIST DRILL - Straight shank

For alloyed steels up to HRC 62 - Solid carbide

DIN 6537 K



			Tool code			
			HP900 TiAlN			
						
Material >	**HM**	Shank >	**DIN 6535 HA**			
		Tolerance >	**m7**			
		Type >	**H**			
		Point angle >	**120°**			
		Cutting direction >	**Right hand**			
		Application range >	**1.6-1.8**			
		Hole type >	 <= 3XD			

ød1 m7 [mm]	ød2 h6 [mm]	L1 [mm]	L2 [mm]	L4 [mm]	z [-]	
2,600	6	62	20	36	2	94,00 €
3,400	6	62	20	36	2	97,00 €
4,300	6	66	24	36	2	121,30 €
5,100	6	66	28	36	2	141,80 €
6,900	8	79	34	36	2	201,50 €
8,600	10	89	47	40	2	264,80 €
10,400	12	102	55	45	2	341,30 €

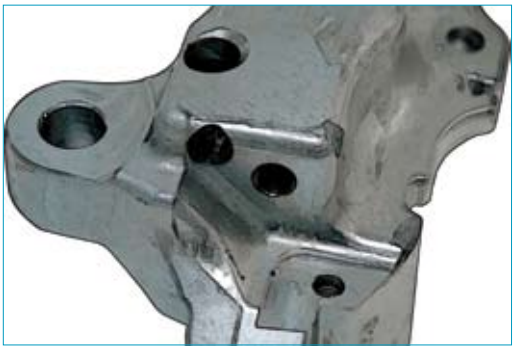
TWIST DRILL **H**P900 SHOULD BE USED ON HARDENED STEELS FOR THE PREPARATION OF THE DRILL HOLE BEFORE TAPPING WITH TAP **H**130.

Applications

Carbide taps find numerous applications, both in the automotive and in the aeronautical industry. In the following case studies, the difference in toollife and in cutting speed can be seen between carbide taps and high speed steel taps.

Applications 1

Workpiece:	Brake caliper
Material:	AlSi7 M.G. 4.3
Thread:	M10
Hole type:	blind
Depth [mm]:	25
Depth:	Emulsion 10% Internal
Machine:	CNC machine vertical
Spindle:	Rigid, with collet



Tap HSSK TiAlN IKZ	Tap HM HB43 TiAlN IKZ
Vc = 25 m/min	Vc = 50 m/min
Tool life = 12.000 threads	Tool life = 100.000 threads

Tool life increase: +730% - Cycle time reduction: -100%

Applications 2

Workpiece:	Connecting rod
Material:	C70 S6 M.G. 1.3
Thread:	M8
Hole type:	blind
Depth [mm]:	16
Depth:	Oil Internal
Machine:	CNC machine vertical
Spindle:	Sincro, with collet

Tap HSSK TiN IKZ	Tap HM HB80NR TiCN
Vc = 15 m/min	Vc = 30 m/min
Tool life = 3.000 threads	Tool life = 10.000 threads

Tool life increase: +230% - Cycle time reduction: -100%

VERGNANO

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