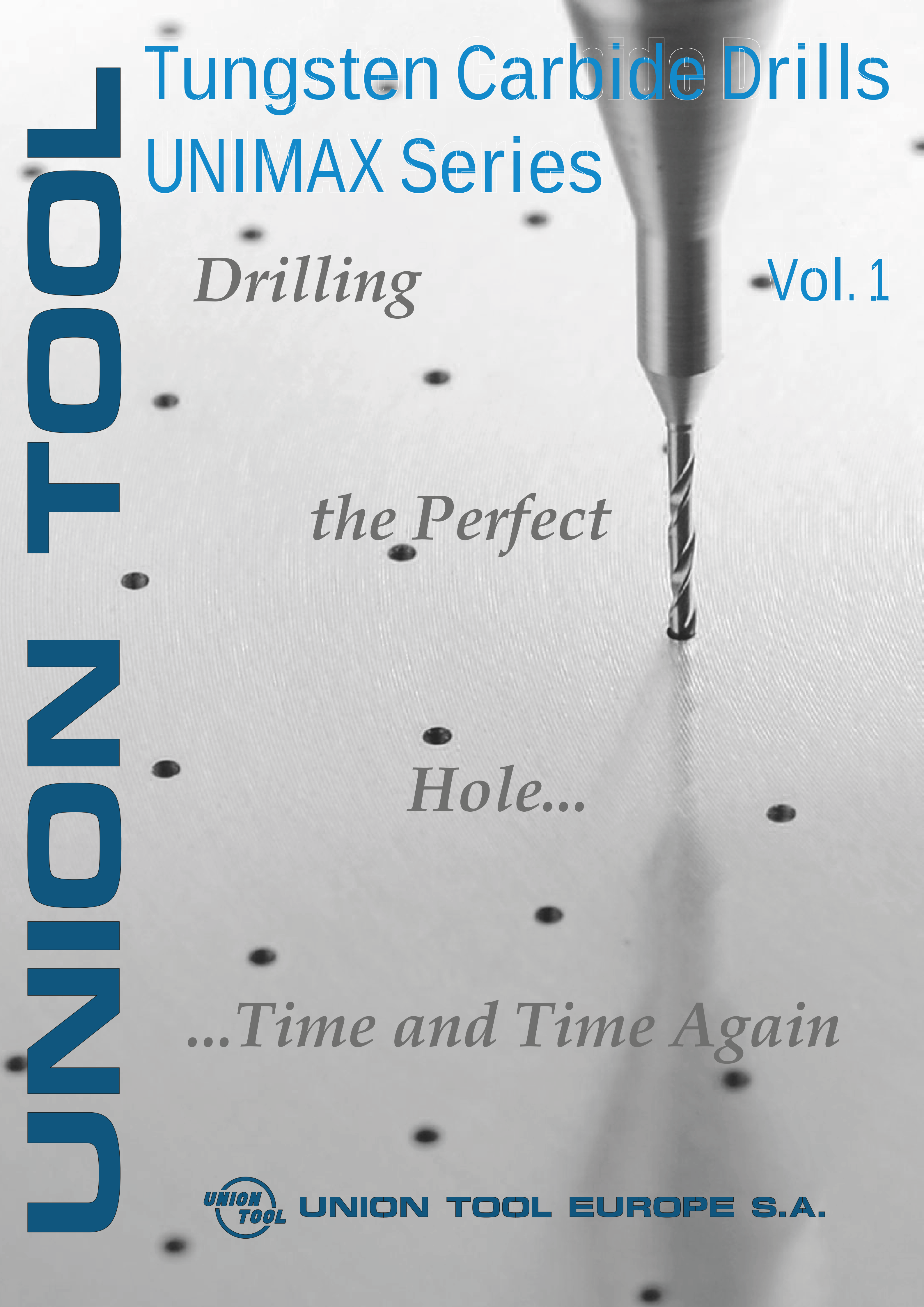


UNION TOOL

Tungsten Carbide Drills UNIMAX Series

Vol. 1

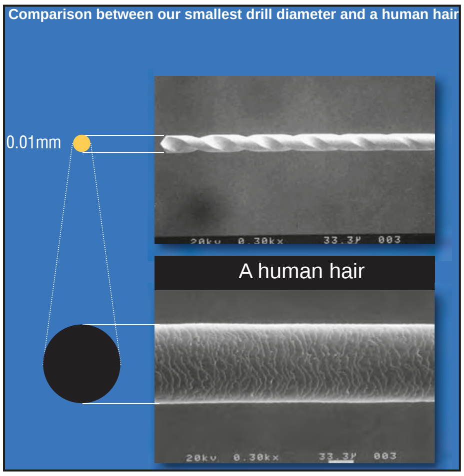
Drilling the Perfect Hole... ...Time and Time Again

UNION TOOL EUROPE S.A.

Union Tool Presentation

Union Tool has a very long history and experience in drilling. Since ***1963*** Union Tool has been manufacturing micro drills for the Printed Circuit Board (PCB) Industry. Today, Union Tool is the world leader in this domain with a production of ***over 32 million micro drills per month!*** 80% of these drills are below 0.30mm in diameter, with the smallest diameter drill coming off our production lines measuring only 0.05mm in diameter (thinner than a human hair).

Union Tool ***develops and manufactures all of its state of the art manufacturing machines*** (grinding and fully automatic fluting machines) internally. This is our guarantee for the repeatability of our product quality, batch after batch, that has become the industry benchmark for quality and precision.



Comparison between our smallest drill diameter and a human hair

Union Tool Europe SA has a pan-European distribution network wich is committed to ***offering the best service and support***. The objectives of our supply chain partners are:

- To be ***close to our customers*** in order to fully understand their needs and requirements.
- To ***support our customers*** in improving their productivity by supplying Union Tool state of the art products.
- To ***offer world-class logistics*** and technical support.

Our relationship with our customers

We foster ***long-term partnerships with our customers*** based on openness, honesty and trust. We focus on the needs and wishes of our customers. Our focus is on intense research into new materials, improved coatings and future-oriented technologies. We will perform customer specific tool developments in our technical centre in Japan and then carry out the qualification trials onsite with the customer.

Japanese Precision and Innovation

At Union Tool Co, ***all metal working cutting tools are "Made in Japan"*** - starting from research and development all the way to the design and production of our own unique manufacturing machines which are used to manufacture our products. This guarantees the renowned Japanese quality and precision. Quality controls in all phases of the manufacturing process ensure compliance with the strict requirements and guarantee that only products of flawless quality are delivered to our customers.

Values that inspire

- Union Tool ***design and Japanese precision***
- Leadership and Excellence and Innovation
- Worldwide Experience
- ISO 9001 / 14001 certified

Precision that speaks for itself

At Union Tool ***"precision" is in our DNA*** and is present in everything that we do. We offer standard tools with +/-3 micron radius tolerances. We also offer this precision and quality time and time again and batch after batch.

Real Drilling Experiences

Hard drilling

A customer was surprised to find drilling 54HRC tool steel easier than he thought and has eliminated drilling with an EDM fast hole drilling machine, thereby saving time and money. His requirement was to drill 0.25 mm holes by 3 mm deep, his target of 20 holes using only one drill was achieved comfortably.

Precision drilling

Another customer that produces large volumes of holes (400 per component) in stainless steel and has comfortably improved his quality of product by using the right tools and strategy. His results show he consistently drills the 400 holes with less than 5μm hole size deviation. This consistency compares better than the previous tooling and strategies he used which gave more erratic results in hole size. In addition, he has reduced his tooling costs by over 40%.

Machine types

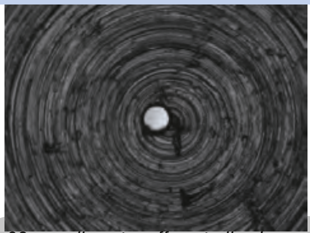
It is important to think about how you will drill the micro hole, in conjunction with other operations that are required on the component. In theory using a machining centre should be easier than a lathe but in practice if you do not follow the correct procedure you will break drills.

Machining Centres

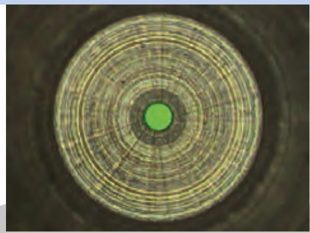
It is useful to know how accurately both the spindle concentricity is running and how the 'Z' axis is moving – how perpendicular is it to the surface to be drilled? Most companies do not check these features, they just assume it is correct – but what tolerances do the machine manufacturers allow in building their machine? Rapid traverse rates on machines are getting faster and faster but also have an effect on the stability of the machine depending on how it has been designed with regard to rigidity. It has been known that a rapid feedrate was too much for a machine and the whole machine column vibrated when using rapid feed.

Sliding Head Lathes or Turning Centres

The easy way to break small drills is when you assume you are drilling on centreline; We have lost count of the number of times it has been proved that the drill is not on centreline.



0.08 mm diameter off centreline by over 0.1 mm - drilled using a live tool holder



0.118 mm diameter drilled on centreline

Another issue associated with turning machines is drill holders not being perpendicular to the work surface so the drill will break as it moves up the flute. Always 'clock-in' your tool holders.

Drill materials

There are 2 kinds of material used in the manufacture of micro diameter drills, HSS (High Speed Steel) and Tungsten Carbide. Although the composition of the material might change, ie the amount of cobalt in HSS or the grain size in tungsten carbide, each material can give different effects when drilling and the correct drill needs to be selected for the material to be machined.

HSS is a flexible more forgiving material if not positioned on centreline and is less likely to break but its flexibility can and does hamper the requirement to drill straight holes, care needs to be taken with feedrates. On drills under 1 mm diameter HSS drills are usually supplied as a 'jobber drill' where the shank diameter is the same as the cutting diameter, which makes it more difficult to check if the drill is running true and concentric.

Typical HSS drill – jobber drill

Tungsten Carbide is a very rigid and brittle material if pressure is not applied in the correct direction (axially). It is therefore very important to ensure the drills are running concentric, or are positioned on centreline in a lathe. Drills below 1 mm diameter are supplied with a reinforced shank (ie it is a standard diameter normally a 3 mm shank), this helps to ensure the drills are running concentrically and are much easier to clock-in with a dial indicator.

Typical tungsten carbide drill with reinforced shank

Which Drill to Use?

Deciding which drill to use

When trying to decide which tool to use to drill a hole, it is a big mistake to think ‘a drill is a drill’. Often, the customers trying to save money, actually spend more money by selecting the wrong drill for the job. A good example of this, is when a company that wanted to drill 66,000 holes, 0.6 mm diameter, in brass selected a jobber type HSS drill. The drill selected was based on price, approximately €2.40 each, by far the cheaper option in comparison to other drills that were much more expensive. However, each drill only produced 200 holes making a total cost of €785 for the drills used. If the customer had instead selected a tungsten carbide drill at a cost of €27.00, he would have used less than 10 drills at a total cost of €271.00 – a big saving. It is also worth mentioning that to ‘clock-in’ the 0.6 mm diameter carbide drills on a 3 mm shank would have been a lot quicker and created less trouble than ‘clocking-in’ the HSS jobber drills with a 0.6 mm shank.

After careful consideration, which type of drill gives better value for money?

The design of drill capability has changed dramatically over the years and now includes a wide variety of drill point angles, length to diameter ratios and even through coolant drills as small as 0.5 mm diameter. However it is the drill point angle (varying from 118° to 150°) that has the greatest effect on cutting performance.

through coolant drill

150° drill point

130° drill point

Each drill point geometry naturally gives a different capability depending on the softness or hardness of the material to be machined.
A university (ELMACT project) carried out tests with different drill point angles and different helix angles to ascertain the best feed and speed for nickel alloys together with the drill geometry that gave the best tool life performance. It was interesting to note the effect the helix angle of the drill had on the performance.

Additional considerations

- Should the drill be uncoated or coated?
- If coated, what coating will give the best results?

If the component to be machined only has a small depth to be drilled and components are small in quantity, the type of coating has less of an effect than the correct selection of drill point geometry.

How to set up your Machine?

Machine set-up and strategies

You can save a considerable amount of time by knowing how important it is to ensure the drill is running concentrically. If you check the concentricity of the drill by 'clocking-in' on the 3 mm reinforced shank using a clock reading .001 or .002 mm, the hole size will be improved and drill breakage will be reduced. Therefore eliminating the need to have more set-up time and the expense of additional drills.

It is useful to make the following important checks

- what the concentricity of your machining centre spindle is
- how well your collet chuck and collets locate and grip the drills
- whether you are using ultra-precision collets on reinforced shanks or just standard ESX collets with 0.25 mm, 0.5 mm or 1.0 mm close down
- if your collets are too old and tired to hold a tool concentrically within a couple of microns.
- Run out Maximum : 5 Microns max.

To drill micro diameter holes it is always best to have ultra-precision collets holding reinforced drill shanks, this is the simplest way to ensure concentricity and minimal set-up time. Consider buying a new collet each year and keep the quality of your tool holders at the highest level.

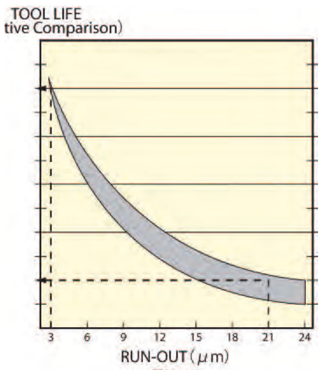


Fig.1

Companies such as Nikken can supply a 'Zero-Fit' tool holder which can eliminate any run-out between the machine spindle and the cutting tool. (See photo left.) The graph (supplied by Nikken) shows the relationship between tool concentricity and tool life. You can see how with an increased tool run-out the tool life is dramatically decreased.

It is easily explained by considering the following

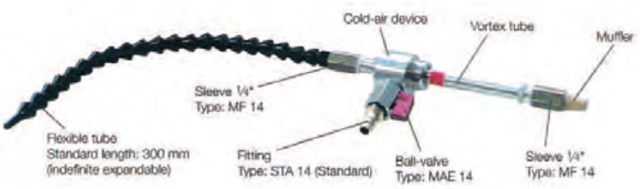
If you had a 0.2 mm drill running out by 10μm (5% run-out), would you also set up a 2.0 mm drill with a 5% run-out? I don't think so, as the run-out would actually be 0.1 mm. It is critical to keep the run-out for micro drills as close as possible to zero.

It is common to think that micro diameter tools should rotate at high revolutions; this is not true when using drills. Micro diameter drills have a proportionally bigger web compared to larger diameter drills and if in constant contact with the workpiece will produce more heat by friction. It is important that the source of this heat is reduced to keep the web intact, so consideration must be made to slowing the spindle speed down. Even when drilling soft materials, we would consider having the spindle speed below 10,000 rpm, as the key to successful drilling in this situation is the feedrate and the use of a pecking cycle.

The feedrate and pecking cycle are controlled by the material to be machined, the type of coolant being used and the rigidity of the machine. For very hard materials a fast feedrate (100 mm) with a short pecking cycle (0.1 mm pecks) gives an action like a hammer drill, short sharp pecks which remove material without the drill being in contact with the workpiece for very long periods, thereby generating excessive heat. Similarly for non-ferrous materials, such as polymers or even aluminium, control of heat build-up is more important as the material can and does stick in the flutes causing blockages and subsequent breakage.

'Through coolant' drills can provide solutions for DEEP holes drilling

The use of through coolant drills will eliminate heat from the drill point and the pressure of the coolant prevents blockages caused by swarf. However these drills are considerably more expensive and require your machine to be fitted with a high pressure coolant pump and fine swarf filter system.



Cold Air Nozzle System

When drilling materials that become very sticky or molten with heat, consider cold coolants, ie water or air, to keep the temperature down.

Frequent Question

Deburring methods
A frequently asked question when using micro diameter drills

We would turn the question around and ask, 'Why create burrs in the first place?'. Why plunge through material with a high feed rate when you know it will produce a burr that the operator is going to have to remove? Think about not using a drill to near destruction when its cutting edges have gone off and you are pushing the material out of the hole. Change the drill reasonably often to avoid the extra deburring operation (think of the cost of that operation compared to using a new drill).

Consider the strategy you are using, why not drill 90% of the depth of the hole at normal feedrate, and the last 10% depth at a slower feedrate giving the drill chance to cut the material rather than push the material.

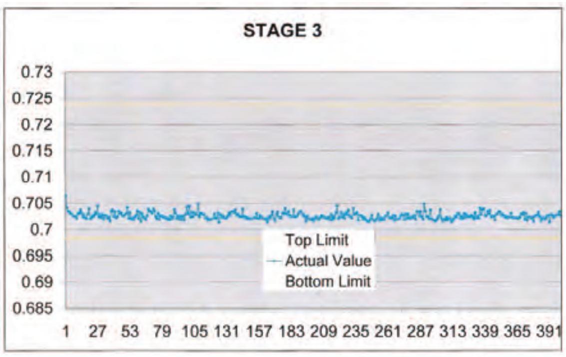
Similarly the sharper the drill point angle, the more likelihood of drilling a hole and producing a 'cap'. Change the geometry of the drill point and you will see totally different results. Micro diameter drill geometry does not normally have web thinning on 2 fluted tools.

Brass drilling without burrs or caps

For drilling brass components we have seen single fluted drills to micro diameter sizes that consistently produce jet holes in components without burrs or caps – very critical in these high volume industries.

A point previously mentioned, referred to the web thickness being of a higher percentage of the drill diameter than larger diameter drills, this then impacts on whether the hole should be started with a centre drill or spotting drill or neither. Our preference is always to use a spotting drill to create a dimple on the work surface bigger than the core diameter of the drill but not larger than the drill diameter size. This enables the cutting edges of the drill to self-centre before the web touches the workpiece material, thus giving a true hole without the drill wandering off its position.

How it looks when you get it right . . .



The graph illustrates what a customer achieved, a hole diameter variation of only 4μm when drilling 400 holes in a Stainless Steel component.

Drill diameter 0.71 mm

How to Drill?

Spot drilling

When we are talking about micro precision, spot drilling is necessary:

For the C-UMD drill, you will spot to a depth corresponding to 80% of the drill diameter. For example : C-UMD 1mm dia. the spot depth will be 0.8mm. That kind of spot will increase the accuracy and stop the drill wandering.

Prevent burring

Burr prevention: saving time and money

To prevent burrs, the philosophy is really easy. You will drill 90% of the hole depth with your parameters, then the last 10% you will drill with 25% feed rate, that will cut the material rather than pushing it out of the exit hole.

Peck drilling

waste of time? save money?

For holes deeper than 1mm we should use peck drilling. The step amount maximum is 30% of the diameter of the drill.
The peck drilling will reduce heat generation, help to evacuate the swarf out of the hole and help coolant to get inside the hole. All of these points will increase the tool life.

Important: retracting the drill out of the hole during pecking will increase the tool life as well.

Run out / concentricity

Tool life? how?

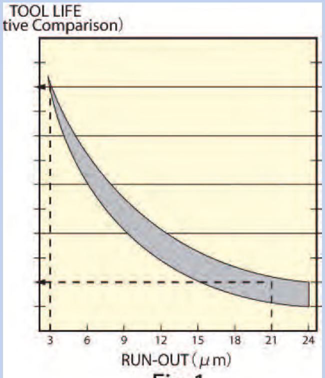


Fig.1

Many characteristics influence the tool life. One of the biggest is the concentricity or run out. As you can see on the picture. Run out has a direct influence on tool life.

Check List

Check list of actions to take when drilling micro diameter holes

1. Have you got the correct drill for the material to be machined?

2. Material – HSS or carbide?

Would a carbide drill produce more holes than an HSS drill, giving a cheaper cost per hole?

3. Type of drill?

Is buying a jobber type drill the most cost effective solution or would you be better with a reinforced shank drill that will save you money by having a reduced set-up time?

4. Drill point?

Would a 150° drill point give you a better diameter tolerance on the hole with less potential for burrs? Or would a 120° drill point give you the results you require?

5. Is the drill running concentrically?

Run out less than 5 microns?

6. Spindle – check for cleanliness and run-out?

7. Is the tool holder and collet in good condition and clean?

8. Do you need to centre drill or spot the material?

9. Are you using the correct parameters?

Spindle speed?
Feed rate?
Depth of pecks?
Coolant for the job?

Turning centres

10. Is the drill really positioned on centre line with no ‘pips’ from the facing operation?

11. Is the drill holder perpendicular to the material surface?

Index

Tool Description

Model Number	Page	Characteristics

Drill

Model Number	Appearance	Size	Number of Flutes	Point Angle	Aspect Ratio L/D	Helix Angle	Geomertry Design
C-UMD		Ø0.1 - Ø3	2	150°	10X	24°	Standard design
UTDLX		Ø0.3 - Ø3	2	130°	15X	30°	Web Thinning design
UTDSX		Ø0.3 - Ø2	2	130°	5X	30°	Web Thinning design

Icons Definition

Tool Material

Super MG — Super Micro Grain

Shank Diameter Tolerance

Shank Dia 0/-0.005 — Tolerance of Shank Diameter : 0/-0.005

Coating

MICRO COAT — UT MICRO COAT

Helix Angle

24° — Helix Angle 24°

30° — Helix Angle 30°

Geometry

X Thinning — X Thinning Design

Parameters - Materials

Materials: Categories	Materials: Examples	Materials: Hardness	Applications: Mould & Die	Applications: Medical	Applications: Dental	Applications: Watch Making	Applications: Aerospace	Applications: General Engineering
Carbon Steels	S45C, C45E, 1.1201 1045, XC48H1	180-250 HB						✓
Standard Steels	SS400, S185, Gr.58, Q195, S235J0	102-140 HB						✓
Alloy Steels	316L, X6CR13, SUS305, 1CR12, 1.4300	160-220 HV		✓		✓		
Alloy Steels	16MnCr5, X210Cr12, 1.7131, 5115	30 - 45 HRC	✓					
Alloy Steels	C45E, 1.1191, 42CrMo4, XC42	45 - 60 HRC	✓					
Titanium	Grade 5, Ti Al 6 V4			✓	✓	✓	✓	✓
Ni - Cr Alloys	Inconel, NiCr20Fe18MoNb						✓	
Cast Iron	GG20,GGG40	to 200HB						✓
Malleable Cast Iron	GG20,GGG40	> 200HB						✓
Aluminium	AlCu4MgSi, 2017A, AU4G T4, 3.1325						✓	✓
Ceramics soft state	Zirconium				✓			

Categories	Ø0.1 Spindle Speed (rpm)	Ø0.1 Chip load per revolution	Ø0.1 Feed Rate (mm / min)	Ø0.5 Spindle Speed (rpm)	Ø0.5 Chip load per revolution	Ø0.5 Feed Rate (mm / min)	Ø 1 Spindle Speed (rpm)	Ø 1 Chip load per revolution	Ø 1 Feed Rate (mm / min)	Ø 3 Spindle Speed (rpm)	Ø 3 Chip load per revolution	Ø 3 Feed Rate (mm / min)	Tools: C-UMD	Tools: UTDLX	Tools: UTDSX
Carbon Steels	6000	0.003	18	6000	0.006	54	9000	0.012	108	3700	0.04	148	●	●	●
Standard Steels	6000	0.003	18	6000	0.006	54	9000	0.012	108	3700	0.04	148	●	●	●
Alloy Steels (160-220 HV)	7000	0.004	28	9500	0.008	48	6000	0.017	102	2500	0.045	113	●	●	●
Alloy Steels (30 - 45 HRC)	7000	0.004	28	9500	0.008	48	6000	0.017	102	2500	0.045	113	●	●	●
Alloy Steels (45 - 60 HRC)	7000	0.004	28	9500	0.008	48	6000	0.017	102	2500	0.045	113	●	•	•
Titanium	6000	0.003	18	7000	0.003	29	9500	0.01	95	3500	0.03	105	●	•	•
Ni - Cr Alloys	6000	0.003	18	7000	0.003	29	9500	0.01	95	3500	0.03	105	●	•	•
Cast Iron	7000	0.003	21	8000	0.006	54	9000	0.02	180	3700	0.04	148	•	•	•
Malleable Cast Iron	7000	0.003	21	8000	0.006	54	9000	0.02	180	3700	0.04	148	•	•	•
Aluminium	8000	0.003	24	9000	0.006	60	10000	0.02	200	6400	0.05	320	●	●	●
Ceramics soft state	8000	0.003	24	9000	0.006	60	10000	0.02	200	6400	0.05	320	•	•	•

Peck Drilling : when the hole is deeper than 1mm, we recommend to use the Peck Drilling as follow: Step amount maximum = 30% of the diameter of the drill.

Applicable Work Material (● most suitable, • suitable)

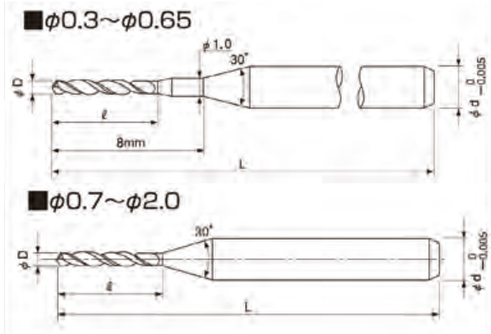
2 Flute

UTDSX

Drill
Size Ø0.3 - Ø2
Aspect Ratio: 5X

Number of Flutes	*Work Material*										
	Carbon Steels	Standard Steels	Alloy Steels (160 - 220 HV)	Alloy Steels (30 - 45 HRC)	Alloy Steels (45 - 30 HRC)	Titanium	Ni - Cr Alloys	Cast Iron	Malleable Cast Iron	Aluminium	Ceramics soft state
2	●	●	●	●	•	•	•	•	•	●	•

Applicable Work Material (● most suitable, • suitable)



Diameter Tolerance: Ø D 0/-0.01mm
Point Angle : 130°

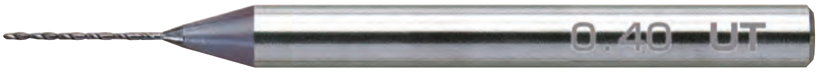
Diameter Tolerance: Ø D 0/-0.01mm
Point Angle : 130°
With the Micro Coating tool life is greatly improved and our test shows that with the UTDLX you can drill 3000 holes in Stainless Steel without any trouble and many more again.
The new drill design and geometry offer stable drilling performance with increased tool life and accuracy.
The web thinning helps to reduce the cutting force.

Unit (mm)

Model Number	Diameter ØD	Flute Length ℓ	Overall Length L	Shank Diameter Ød
UTDSX 2030-015	0.30	1.5	38	3
UTDSX 2035-018	0.35	1.8	38	3
UTDSX 2040-020	0.40	2	38	3
UTDSX 2045-023	0.45	2.3	38	3
UTDSX 2050-025	0.50	2.5	38	3
UTDSX 2055-028	0.55	2.8	38	3
UTDSX 2060-030	0.60	3	38	3
UTDSX 2065-033	0.65	3.3	38	3
UTDSX 2070-035	0.70	3.5	38	3
UTDSX 2075-038	0.75	3.8	38	3
UTDSX 2080-040	0.80	4	38	3
UTDSX 2085-043	0.85	4.3	38	3
UTDSX 2090-045	0.90	4.5	38	3
UTDSX 2095-048	0.95	4.8	38	3
UTDSX 2100-050	1.00	5	38	3
UTDSX 2105-053	1.05	5.3	38	3
UTDSX 2110-055	1.10	5.5	38	3
UTDSX 2115-058	1.15	5.8	38	3
UTDSX 2120-060	1.20	6	38	3
UTDSX 2125-063	1.25	6.3	38	3
UTDSX 2130-065	1.30	6.5	38	3
UTDSX 2135-068	1.35	6.8	38	3
UTDSX 2140-070	1.40	7	38	3
UTDSX 2145-073	1.45	7.3	38	3
UTDSX 2150-075	1.50	7.5	38	3
UTDSX 2155-078	1.55	7.8	38	3
UTDSX 2160-080	1.60	8	38	3
UTDSX 2165-083	1.65	8.3	38	3
UTDSX 2170-085	1.70	8.5	38	3
UTDSX 2175-088	1.75	8.8	38	3
UTDSX 2180-090	1.80	9	38	3
UTDSX 2185-093	1.85	9.3	38	3
UTDSX 2190-095	1.90	9.5	38	3
UTDSX 2195-098	1.95	9.8	38	3
UTDSX 2200-100	2.00	10	38	3

2 Flute

C-UMD



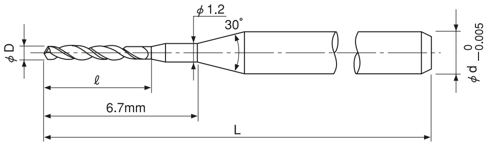
Drill
Size Ø0.1 - Ø3
***Aspect Ratio: Min 4X to 12X** (depending on the Dia.)*

Super MG | MICRO COAT | 24° | Shank Dia 0/-0.005

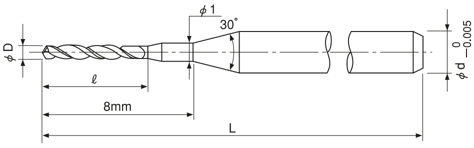
Number of Flutes	Work Material										
	Carbon Steels	Standard Steels	Alloy Steels (160 - 220 HV)	Alloy Steels (30 - 45 HRC)	Alloy Steels (45 - 30 HRC)	Titanium	Ni - Cr Alloys	Cast Iron	Malleable Cast Iron	Aluminium	Ceramics soft state
2	●	●	●	●	●	●	●	•	•	●	•

Applicable Work Material (● most suitable, • suitable)

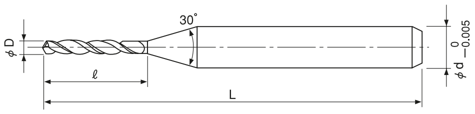
■ϕ 0.1 〜ϕ 0.25



■ϕ 0.26 〜ϕ 0.65



■ϕ 0.66 〜ϕ 3



225 Models available: from Ø 0.1 mm to Ø 3 mm by increments of 0.01mm

Diameter tolerance : ØD ≤ 3 : ØD $^{0}_{-0.01}$
Point Angle : 150°

With the Micro Coating the tool life is greatly improved and our test shows that with the C-UMD drill you can drill 500 holes in Stainless Steel without any trouble and many more again.
The 150° point angle offers a very good compromise for materials such as Titanium, Aluminium in order to avoid burrs and material deformations for through holes.
The 150° point angle cuts the malleable material rather than pushing it (creation of burrs).

Unit (mm)

Model Number	Diameter ØD	Flute Length ℓ	Overall Length L	Shank Diameter Ød
C-UMD 2010-012	0.1	1.2	38	3
C-UMD 2011-012	0.11	1.2	38	3
C-UMD 2012-014	0.12	1.4	38	3
C-UMD 2014-014	0.14	1.4	38	3
C-UMD 2015-020	0.15	2	38	3
C-UMD 2019-020	0.19	2	38	3
C-UMD 2020-025	0.20	2.5	38	3
C-UMD 2024-025	0.24	2.5	38	3
C-UMD 2025-030	0.25	3	38	3
C-UMD 2029-030	0.29	3	38	3
C-UMD 2030-050	0.30	5	38	3
C-UMD 2034-050	0.34	5	38	3
C-UMD 2035-060	0.35	6	38	3
C-UMD 2039-060	0.39	6	38	3
C-UMD 2040-070	0.40	7	38	3
C-UMD 2069-070	0.69	7	38	3
C-UMD 2070-080	0.70	8	38	3
C-UMD 2079-080	0.79	8	38	3
C-UMD 2080-100	0.80	10	38	3
C-UMD 2159-100	1.59	10	38	3
C-UMD 2160-120	1.60	12	38	3
C-UMD 2300-120	3.00	12	38	3

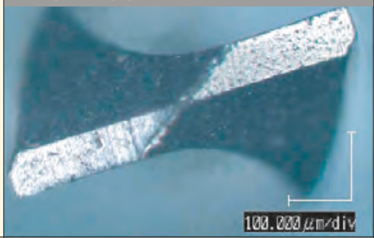
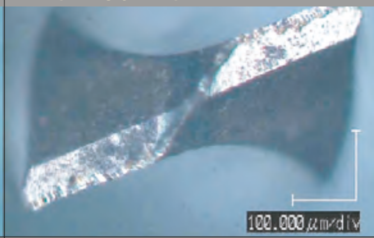
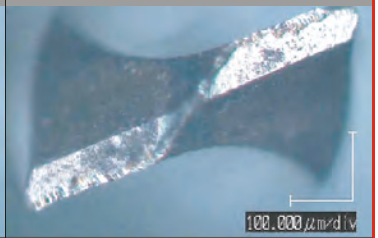
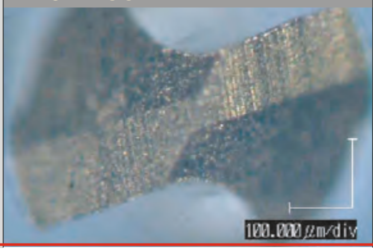
2 Flute

Drilling Example 1 on Stainless Steel (SUS304)

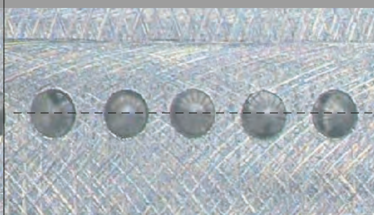
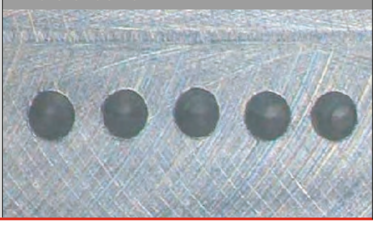
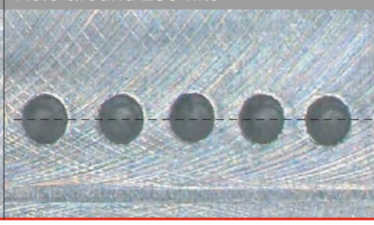
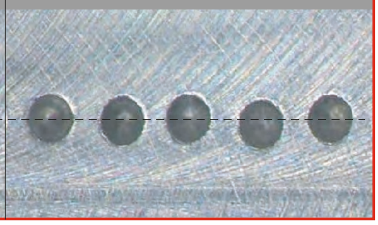
Drilling Condition

Tool:	Ø 0.6 × Flute Length 7mm	Work Material:	SUS304（1.4301）
Spindle Speed:	8,000min⁻¹	Overhang Length:	10mm
Velocity:	15m/min	Coolant:	Water Soluble Cutting Oil (Nozzle)
Z Feed Rate:	50mm/min	Number of Holes:	500 Holes
Chip Load:	0.00625mm/rev	Drilling Time:	25 min/100 holes
Step Amount:	0.12 mm/time		
Hole Depth:	2.4mm		

Comparison of Tip Damage

	New Tool	After 250 hits	After 500 hits
C-UMD 2060-070 Ø0.6 Flute Length 7mm			
	New Tool	After 250 hits	After 500 hits
Company A High Speed Steel Drill			

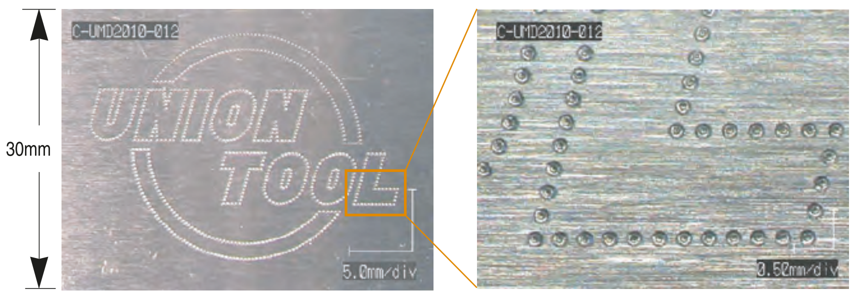
Comparison of Hole Position

	Hole around 1 hit	Hole around 250 hits	Hole around 500 hits
C-UMD 2060-070 Ø0.6 Flute Length 7mm			
	Hole around 1 hit	Hole around 250 hits	Hole around 500 hits
Company A High Speed Steel Drill			

Drilling Example 2 on Stainless Steel (SUS304)

Drilling Condition

Tool:	C-UMD 2010-012 Ø 0.1
Work Material:	SUS304 (1.4301)
Number of Holes:	800 holes



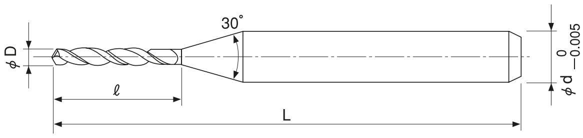
2 Flute

UTDLX

Drill
Size Ø0.3 - Ø3
Aspect Ratio: 15X

Number of Flutes	Work Material										
	Carbon Steels	Standard Steels	Alloy Steels (160 - 220 HV)	Alloy Steels (30 - 45 HRC)	Alloy Steels (45 - 30 HRC)	Titanium	Ni - Cr Alloys	Cast Iron	Malleable Cast Iron	Aluminium	Ceramics soft state
2	●	●	●	●	•	•	•	•	•	●	•

Applicable Work Material (● most suitable, • suitable)



Diameter Tolerance: Ø D 0/-0.01mm
Point Angle : 130°
With the Micro Coating the tool life is greatly improved. our test shows that with the UTDLX you can drill 3000 holes in Stainless Steel without any trouble and many more again.
The new drill design and geometry offer stable drilling performance with increased tool life and accuracy.
The web thinning helps to reduce the cutting force.

Unit (mm)

Model Number	Outside Diameter Ø D	Flute Length ℓ	Overall Length L	Shank Diameter Ø d
UTDLX 2030-045	0.3	4.5	38	3
UTDLX 2035-053	0.35	5.3	38	3
UTDLX 2040-060	0.4	6	38	3
UTDLX 2045-068	0.45	6.8	38	3
UTDLX 2050-075	0.5	7.5	38	3
UTDLX 2055-083	0.55	8.3	38	3
UTDLX 2060-090	0.6	9	45	3
UTDLX 2065-098	0.65	9.8	45	3
UTDLX 2070-105	0.7	10.5	45	3
UTDLX 2075-113	0.75	11.3	45	3
UTDLX 2080-120	0.8	12	45	3
UTDLX 2085-128	0.85	12.8	45	3
UTDLX 2090-135	0.9	13.5	45	3
UTDLX 2095-143	0.95	14.3	45	3
UTDLX 2100-150	1	15	50	3
UTDLX 2105-158	1.05	15.8	50	3
UTDLX 2110-165	1.1	16.5	50	3
UTDLX 2115-173	1.15	17.3	50	3
UTDLX 2120-180	1.2	18	50	3
UTDLX 2125-188	1.25	18.8	50	3
UTDLX 2130-195	1.3	19.5	50	3
UTDLX 2135-203	1.35	20.3	60	3
UTDLX 2140-210	1.4	21	60	3
UTDLX 2145-218	1.45	21.8	60	3
UTDLX 2150-225	1.5	22.5	60	3
UTDLX 2155-233	1.55	23.3	60	3
UTDLX 2160-240	1.6	24	60	3
UTDLX 2165-248	1.65	24.8	60	3
UTDLX 2170-255	1.7	25.5	60	3
UTDLX 2175-263	1.75	26.3	60	3
UTDLX 2180-270	1.8	27	60	3
UTDLX 2185-278	1.85	27.8	60	3
UTDLX 2190-285	1.9	28.5	60	3
UTDLX 2195-293	1.95	29.3	60	3
UTDLX 2200-300	2	30	60	3

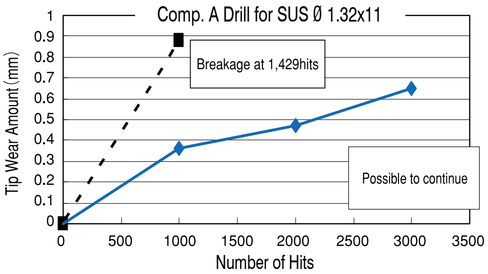
55 models available in total from Diameter 0.3mm to 3mm. For more details please ask your distributor.

2 Flute

SUS420J2 (Raw Material) Comparison of UTD (Carbide) and HSS Drill Bit

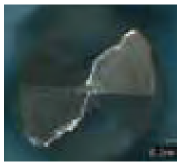
UTD can drill more than 2 times the number of holes as compared to an HSS model

Tool	Ø1.32×12 UTD prototype
Spindle Speed	5000 min^{-1} (Vc:21m/min)
Feed Rate	200 mm/min (f:0.04mm/rev.)
Step	1.3 min
Depth	7mm blind hole



Flank wear comparison with HSS

UTD prototype

New	After 1000 hits	After 2000 hits	After 3000 hits
			

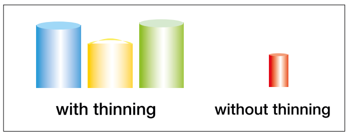
HSS Drill (Company A: Ø3 shank diameter with TiN coating for SUS)

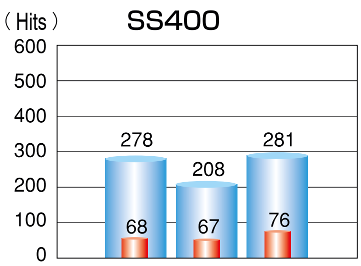
New	After 1000 hits	After 2000 hits
		

Drilling test with **various** material (with thinning / without thinning)

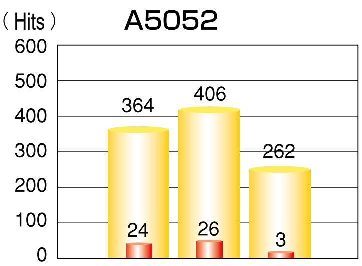
Smooth chip evacuation using the X-thinning design, offers greater resistance to breakage and more accurate drilling

Drill Size : φ 1.0x15
Tool : UTDLX2100-150 (with thinning)
Test Tool: φ 1.0x15 (without thinning)

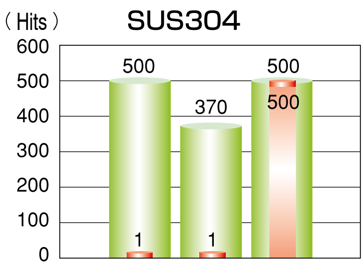




Spindle Speed	9500 min^{-1} (Vc:30m/min)
Feed Rate	400 mm/min (f:0.042mm/rev.)
Step	0.2 mm
Depth	14 mm blind hole



Spindle Speed	15900 min^{-1} (Vc:50m/min)
Feed Rate	1500 mm/min (f:0.094mm/rev.)
Step	0.7 mm
Depth	14 mm blind hole



Spindle Speed	6400 min^{-1} (Vc:20m/min)
Feed Rate	150 mm/min (f:0.023mm/rev.)
Step	0.2 mm
Depth	14 mm blind hole

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