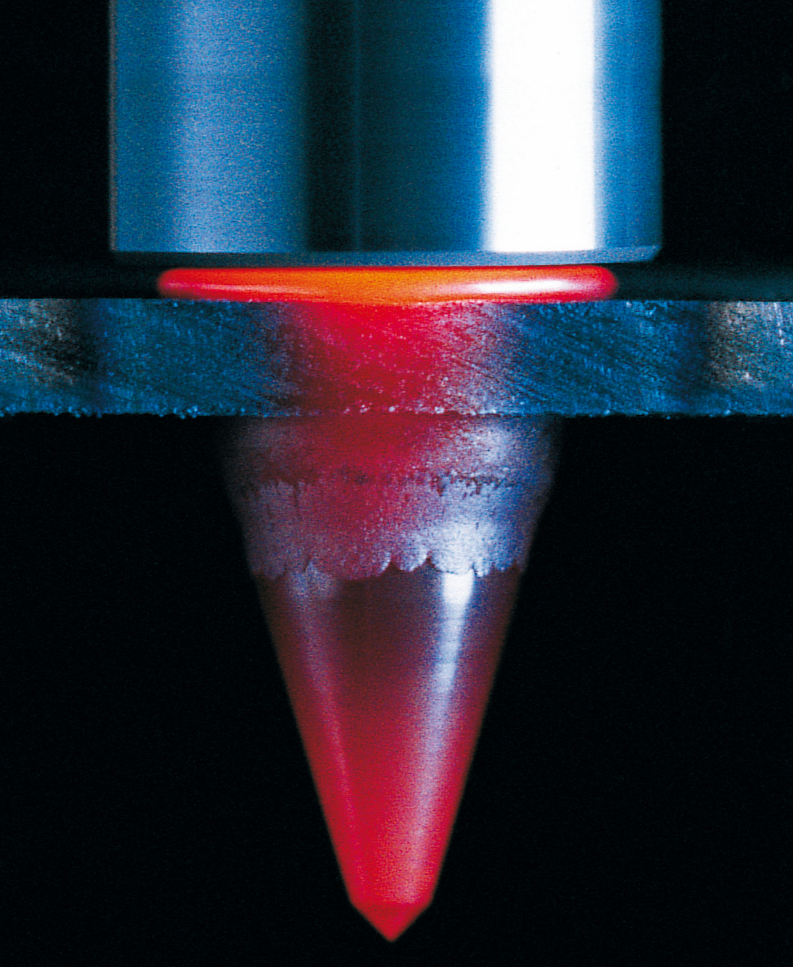


Flow Punch Forming with Fdrill

Fdrill Technology

…we are your experts for flow drilling.

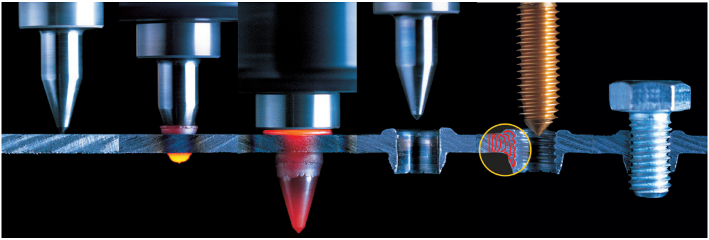
For over 12 years, our products promote precision and productivity with tools "Made in China ".

With a secure feeling for technical practicability we are developing and producing intelligent solutions for your specific needs. Short response times and well balanced storage solutions make us the reliable partner you can depend on for all your flow forming needs.

We offer you our specific products and unique services, represented by our global distributor network.

History Thermal Flow Drilling

Reports from the 1920ies document that the idea to produce holes or bushings by forming them with a punch/drill like rotating tool is known. However, this process did not succeed because of the low thermal stability of the materials available then.
About the 1960s and with the availability of solid carbide materials, there are the first industrial applications. Since that time, the process gains increasing knowledge and acceptance in the metalworking industry. Thus, the "center drill" was introduced more than 15 years ago, and by the ongoing further development in regards to form, materials, and quality it is steadily gaining market acceptance all over the world.



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Thread Forming with Ftap:

The **Fdrill** Process

The **Fdrill** process is a hot forming process for creating holes in thin-walled metal components. The chip less drilling process is ideal to make bushings, including bearing bushings, soldering holes, or threads in sheet metals, tubular materials, of metal profiles. This solution eliminates the need for welded bracings or inserts to achieve the required strength for the particular part feature and thus greatly benefit the profitability.

The flow forming process is similar to a drilling process. A fast rotating Solid Carbide Form Tool is trusted against the material. The created frictional heat plasticizes the material and allows the punch type tool to enter the material surface, thus creating additional heat by friction. By the feeding tool pressure, it is advancing into the material surface while creating a hole.

The forming process forms the metal around the tool flowing about 1/3 of the displaced metal to escape on top of the material, while the remaining material is flowing below the material surface forming an integral bushing in the material around the tool. A thread is then created by applying a second process, using a form tap. The length of the bushing or thread is varying with the volume of the material displaced, thus varying with the thickness of the material and the size of the hole created. The length of the formed bushing may be up to 4-times the original material thickness. Besides the geometrical form of the flow forming tool, particular process parameters (speeds and feeds) are required depending on the tool diameter, the wall thickness of the material and the material type.

Because of the high tool pressure required and the high spindle torque demanded, the flow forming process requires the selection of machine tools satisfying these process parameters.

Here the technical data in summary details:

- Materials with a thickness from 1mm to 12mm can be flow formed
- Flow forming holes with a diameter from 1.5mm to 32mm is possible
- Bushing Length of up to 4-times of the original material thickness is possible.
- The tool presses required range from 500N to 4500N
- The spindle torque needed ranges from 2.5 to 60Nm
- The spindle speed required is from 1000 – 6000rpm
- The resulting temperatures are between 600 and 800 degree Celsius

The particular geometrical form of the **Fdrill** tool and the proprietary solid carbide material used, result to a tool life of several thousand hole forming cycles, varying with material type and wall thickness.

The Advantages

Economic Benefits

- Chipless forming process: no connecting elements needed
- A single operation for the manufacture of eyelets
- Process can be automated
- A column drill is sufficient: no additional equipment costs
- Minimum setup times

Benefits in practice:

- High precision and reproducibility
- Less material and lower weight due to the use of thin profiles
- Counterpieces (e.g. punches / dies, etc.) are not required, thus even profiles with difficult to access interiors can be processed
- Increase in the drawing forces of threads (thread forming)
- Tightness of the clearance holes
- Only one basic material, thus avoidance of electrochemical corrosion
- High load capacity of bearing bushes
- Material hardening

Ecological Benefits

- High-strength connections can be produced using the **Fdrill** process without additional materials. The basic material remains unalloyed and easy to recycle! Chip removal is not necessary.
- Fdrill connections are detachable and offer significant advantages for subsequent dismantling compared to other processes.

Processable Materials

Flow forming process can be used with virtually all thin-walled metals (excluding tin or zinc), for example all

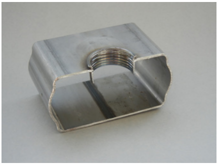
- Welding steels
- Stainless steels
- Aluminum
- Copper
- Brass
- Bronze
- Magnetic materials
- Special alloys

If the material is coated in most cases the coating must be removed before flow forming.

Application Examples

Generalizing from our experiences the flow forming process is used with flat sheet metal parts, round or rectangular tubing materials by the following industries:

- Automotive Industries
- Metal Furniture Manufacturers (Metal Desks, Metal Chairs, Wall Separators, etc.)
- Exercise Equipment Manufacturers
- Spa and Fitness Equipment Manufacturers
- Cleaning System and Washing Machine and Washing System Manufacturers (Flush- and flume systems)
- Solar Energy System Manufacturers and Related Industries
- Industrial Lightening System and Light Fixture Manufacturers
- Machine Tool Manufacturers
- Agricultural Machine Manufacturers
- Bicycle Manufacturers and Related Industries
- Manufacturers making any type of tubular products or equipment
- Building Industry (Air-condining-, Heat-systems, Water Distribution Systems, Radiators, Towel Heater, Floor Heating Systems, Heat System Manifolds and Distributors.)
- Conveyor System Manufacturers
- Lifting System Manufacturers (e.g. Vacuum Systems)
- Fixturing System Manufactuers (e.g Tubular Clamps)
- etc.






Application Examples

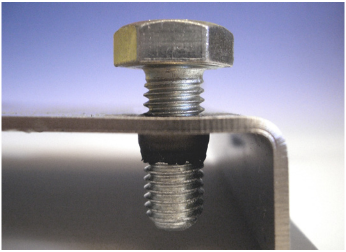


Fig. 7-1: without collar in square tubes

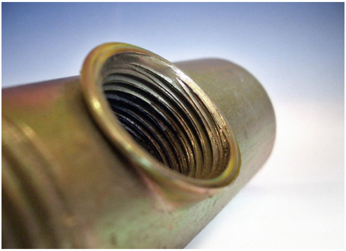


Fig. 7-2: with collar in round tubes

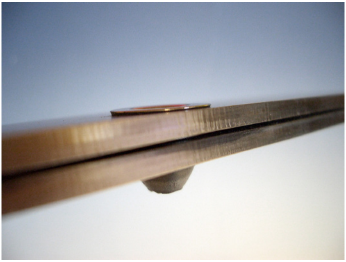


Fig. 7-3: Fdrill in two sheets


Fig. 7-4: Fdrill with pre-hole

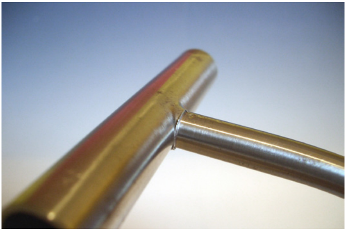
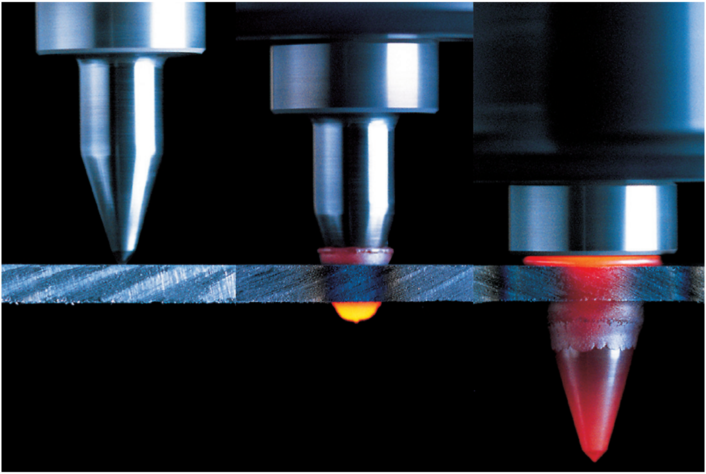


Fig. 7-5: solar - connection - assembly


Fig. 7-6: Fastening system pipe clamp

The **Fdrill** Process in Detail

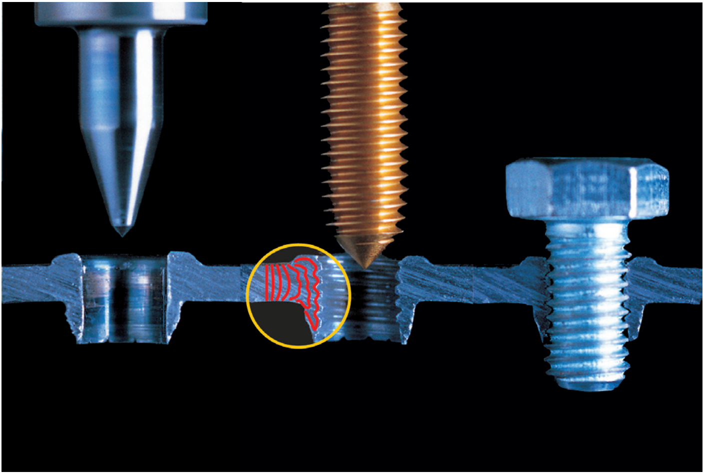


The point of the **Fdrill** is positioned so that it just touches the material, then it is pressed down on the material with high axial force and speed.

Feed pressure and speed generate the necessary frictional heat of approximately 600° Celsius that is needed to render the material plastic and thus formable. The **Fdrill** penetrates the material in a matter of seconds.

The **Fdrill** displaces the metal horizontally and vertically, whereby the material is displaced primarily downward, producing a bushing. The feed pressure decreases and the feed rate increases gradually as the **Fdrill** penetrates through the metal.

...Thread Forming with **Ftap**



The flow formed bushing is now complete. The material displaced against the direction of feed has been transformed into a sealing edge in the form of a collar. This collar can be removed by cutting during the same operation with the **Fdrill** flat version that uses cutters ground into the belt.

The bushing is immediately ready without stock removal for chipless production of a thread using the **Ftap**. The cold-formed thread increases the hardness of the material.

The result: loadable connections that can withstand high drawing forces. Without drilling and subsequent riveting down or welding screw nuts into place.

Design of the Fdrill

The **Fdrill** consists of a centering point, a tapered and a cylindrical forming piece, a belt, and a support shank. Based on this design principle, several standardized flow formers were developed for different purposes. They vary basically in the length of the cylindrical forming piece and the design of the belt area.

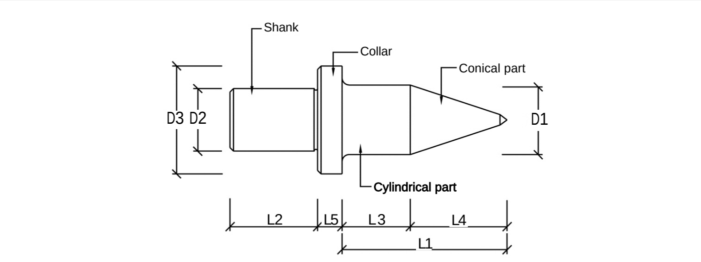


Fig. 10-1: Design of the **Fdrill**

Standard Fdrill

The standard type include the **Fdrill** short and long models. They differ only in the length of the cylindrical part; the angle of the conical part is identical. When using these types the material displaced against the direction of feed remains on the surface of the workpart and forms a collar. Both models are also available in the flat version, with cutters ground into the belt that remove the collar in the same operation, resulting in a smooth surface.

Fig. 10-2: Type short

Fig.10-3: Type long

Fig.10-4: Type short-flat

Fig.10-5: Type long-flat

Which **Fdrill** Type for which Application?

Core Hole for Threads

Type short: For example, if an M8 thread is to be produced in a 2mm thick plate made S235JR (St37/2), we recommend the short **Fdrill** Ø 7.3 mm - a former with a cylindrical part that is only long enough that the produced bushing tapers slightly at the end.

Type long: For the same application in a 3 mm thick plate, we recommend the long **Fdrill**, because the version with the short cylindrical part would not form the bush correctly.

Type short-/long-flat: If for the above applications the surface of the processed part should be flat or smooth, we recommend the short/flat or long/flat **Fdrill**.

Through-hole

To produce through-holes we generally recommend the long **Fdrill**, because its extended cylind-rical part forms the bush fully.

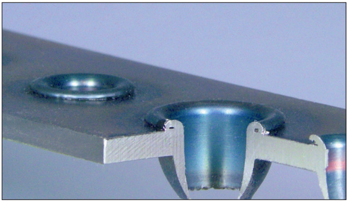


Fig. 11-1: Bore with collar, formed with the short or long **Fdrill** type

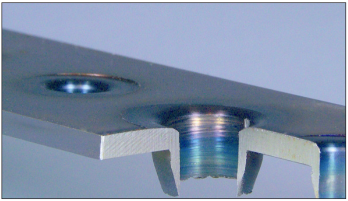


Fig. 11-2: Bore without collar, formed with the short/flat or long/flat **Fdrill** type

Flow Forming Tools in Special Design

If our standard products cannot be used or are not adequate for your specific application, we also manufacture custom **Fdrill** according to drawings. We will be happy to consult with you regar-ding your special requirements. The following are examples of such special designs:

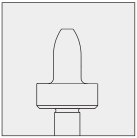


Fig. 11-3: Cut-off tip

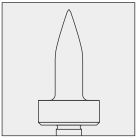


Fig.11-4: Extended cylindrical working part

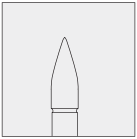


Fig. 11-5: No belt

Max. Wall Thickness with Standard **Fdrills**

The standard **Fdrills** can be used up to the following wall thicknesses:

Thread	Fdrill diameter Ø (mm)	Max. material thickness short mm	short-flat mm	long mm	long-flat mm	Total length working part L1 short mm	L1 long mm	Collet-Ø mm
Metric ISO thread per DIN 13								
M3 x 0,5	2,7	1,7	2,0	2,4	3.7	6,7	8,7	6,0
M4 x 0,7	3,7	1,8	2,2	2,6	4,2	8,1	10,3	6,0
M5 x 0,8	4,5	1,9	2,4	2,7	4.6	9,2	11,7	8,0
M6 x 1	5,3	2,0	2,5	3,0	5,0	10,3	13,4	8,0
M8 x 1,25	7,3	2,2	3,0	3,0	6,0	13,9	18,4	8,0
M10 x 1,5	9,2	2,6	3,2	3,7	6,6	17,2	22,6	10,0
M12 x 1,75	10,9	2,8	3,5	4,0	7,2	20,5	26,5	12,0
M14 x 2	13,0	3,0	3,9	4,5	7,9	24,3	31,3	14,0
M16 x 2	14,8	3,3	4,2	4,8	8,5	27,9	35,2	16,0
M18 x 2,5	16,7	3,5	4,6	5,2	9,2	30,4	41,0	18,0
M20 x 2,5	18,7	3,8	5,0	5,7	9,9	35,1	44,3	18,0
Whitworth pipe thread per DIN ISO 228								
G1/8" x 28	9,2	2,6	3,2	3,7	6,6	17,2	22,6	10,0
G1/4" x 19	12,4	2,9	3,8	4,3	7,8	22,4	29,8	12,0
G3/8" x 19	15,9	3,4	4,5	5,0	8,9	28,9	37,9	16,0
G1/2" x 14	19,9	4,0	5,2	5,9	10,0	36,3	47,0	18,0
G3/4" x 14	25,4	4,8	6,2	7,0	10,4	46,4	59,6	20,0

Special **Fdrills** for higher wall thicknesses can be produced. Please contact us.

Fdrill Core Hole Ø for Thread Forming

Metric ISO standard thread

thread	thread pitch (mm)	Fdrill diameter Ø (mm)
M3	0,50	2,7
M4	0,70	3,7
M5	0,80	4,5
M6	1,00	5,3
M8	1,25	7,3
M10	1,50	9,2
M12	1,75	10,9
M14	2,00	13,0
M16	2,00	14,8
M18	2,50	16,7
M20	2,50	18,7

Metric ISO fine thread

thread	thread pitch (mm)	Fdrill diameter Ø (mm)
MF4	0,50	3,8
MF5	0,50	4,8
MF6	0,75	5,6
MF6	0,50	5,8
MF8	1,00	7,5
MF8	0,75	7,6
MF10	1,25	9,3
MF10	1,00	9,5
MF12	1,50	11,2
MF12	1,00	11,5
MF14	1,50	13,2
MF16	1,50	15,2
MF18	1,50	17,2
MF20	1,50	19,2
MF20	1,00	19,5

Note: **Fdrill** core hole Ø for stainless steels:
+0.1 mm for M8 and larger

Whitworth pipe thread

thread	Thread per inch (mm)	Fdrill diameter Ø (mm)
G 1/8"	28	9,2
G 1/4"	19	12,4
G 3/8"	19	15,9
G 1/2"	14	19,9
G 3/4"	14	25,4
G 1"	11	31.9

UNC thread

thread	Thread per inch (mm)	Fdrill diameter Ø (mm)
Nr. 04	40	2,5
Nr. 05	40	2,9
Nr. 06	32	3,1
Nr. 08	32	3,8
Nr. 10	24	4,3
Nr. 12	24	4,9
1/4	20	5,7
5/16	18	7,2
3/8	16	8,7
7/16	14	10,2
1/2	13	11,7
9/16	12	13,2
5/8	11	14,7
3/4	10	17,8

NPT thread

thread	Thread per inch (mm)	Fdrill diameter Ø (mm)
1/16"	27	7,0
1/8"	27	9,4
1/4"	18	12,4
3/8"	18	15,8
1/2"	14	19,6
3/4"	14	24,9
1"	11,5	31,4

Requirements for Flow Forming Process

Necessary Mechanical Equipment

Any column drilling machine with sufficient power or NC/CNC machining center, etc., with the required speed and kilowatt output is basically suitable for flow forming (see process data on page 15).

Tool holders：Collet Chucks with Cooling Ring

Due to the extreme thermal fluctuation and the radial load, proper clamping of the workpart and the **Fdrill** is critical. The warmth generated during the process must not be allowed to enter the spindle but instead must be deflected or cooled. Customary three-part chucks can cause breakage of the Fdrill if it is not clamped centrally! For this reason a collet chuck with cooling ring was developed especially for flow punch forming with **Fdrill**, with which the heat can be dissipated ideally and a secure clamping can be ensured. The spindle holding fixture MC2 is standard for Fdrill up to Ø 16mm. For bigger sizes we recommend an MC3. For CNC machining centers, HSK, SK, BT, etc . holding fixtures can also be used.

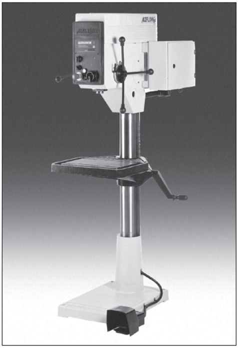


Fig. 14-1: Column drilling machine

Collets

For optimal concentricity and secure clamping, a special collet is used for locating the **Fdrill**.

Parting Paste

Moistening the **Fdrill** with our highly heat-resistant parting paste, matched to the respective material to be processed, is important for the life of the **Fdrill**. The paste can be applied manu-ally or with a spray device. The **Fdrill** parting paste is water soluble and free of oils.

Fig. 14-2: Collet chucks with cooling ring

Fig. 14-3: Collets

Fig. 14-4: Parting paste

Process Data for Flow Forming and Thread Forming

Reference values for material S235JR (St37/2) with 2 mm wall thickness:

Thread	Fdrill diameter Ø (mm)	Flow Forming RPM	Flow Forming Torque Nm	Flow Forming machine output kW	Thread Forming RPM	Thread Forming Torque Nm
Metric ISO thread per DIN 13						
M3	2,7	3000	2,5	0,6	1350	1,3
M4	3,7	2600	3,0	0,7	1000	3,0
M5	4,5	2500	4,0	0,8	800	4,9
M6	5,3	2400	5,0	1,0	650	9,3
M8	7,3	2200	7,0	1,3	500	19,0
M10	9,2	2200	10,0	1,5	400	39,0
M12	10,9	1800	14,0	1,7	330	50,0
M14	13,0	1600	16,0	2,0	300	55,0
M16	14,8	1400	19,0	2,2	250	57,0
M20	18,7	1200	29,0	2,7	200	105,0
Whitworth pipe thread						
G1/8"	9,2	2000	10	1,5	400	13,0
G1/4"	12,4	1600	16	2,0	360	34,0
G3/8"	15,9	1400	24	2,3	300	46,0
G1/2"	19,9	1200	32	3,0	270	94,0
G3/4"	25,4	1000	55	3,5	200	128,0

Please note Reference values for:

- **Stainless steels:** Fdrill core hole diameter +0.1 mm for M8 and higher 10-20% lower speed
- **Non-ferrous metals:** up to 50% higher speed
- **Feed rate:** 50 - 150 mm/min

Feedrate + RPM + wall thickness influence the torque!

Depending on the application and the properties of the machine the process data can vary.

CNC Programming - Examples

Type short: Reference values for material S235JR (ST37/2)

Fdrill diameter Ø (mm)	max. thickness (mm)	RPM	tool lenght L1 (mm)	working path* (mm)	path (mm)	feed rate (mm/min)
M6 - Ø 5.3 short (short-flat)*	2,0 (2,5)*	2400	10,3	9,5 (10,3)*	0 - 2	150
					2 - 4	250
					4 - 6	350
					6 - 8	550
					8 - end	200 (900)*

Type long: Reference values for material S235JR (ST37/2)

Fdrill diameter Ø (mm)	max. thickness (mm)	RPM	tool lenght L1 (mm)	working path* (mm)	path (mm)	feed rate (mm/min)
M6 - Ø 5.3 long (long-flat)*	3,0 (5.0)*	2400	13,4	12,3 (13,4)*	0 - 2	150
					2 - 4	250
					4 - 6	350
					6 - 11	550
					11 - end	200 (900)*

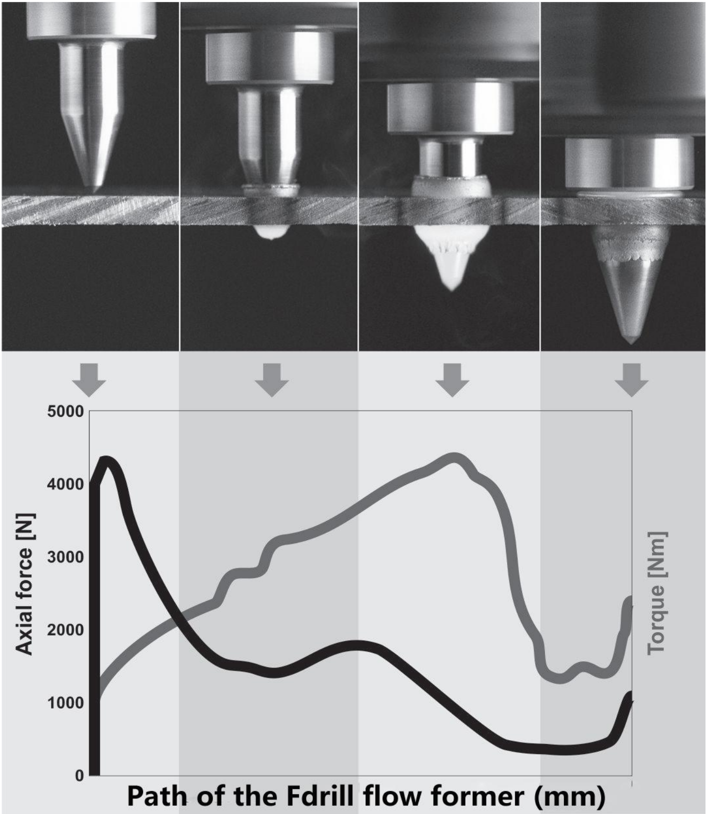
Increasing the feed rate at the end of the process allows better removal of the collar.
* If the collar is removed (Fdrill flat) the working path is longer.

By regulating the feed rate:

- The process time can be optimized
- The quality of the formed bush and the collar can be influenced
- The lifetime of the **Fdrill** can be influenced.

All other CNC data can be supplied on request.

Axial Forces and Torques during Flow Forming



Thread Forming with **Ftap**

Thread forming with **Ftap** offers the exact same advantages as flow forming. It is a chip-less pro-cess in which the material is rendered flowable and displaced from the thread root into the crests. It is similar in principle to the rolling of external threads. **Ftap** is available for all common thread sizes.

Advantages of Thread Forming

- Non-cutting manufacturing process
- Reinforced orientation of the material fibers results in threads that can withstand
- high drawing forces (Fig. 18-1)
- Highly accurate threads, therefore miscutting is not possible
- Low wear after multiple connections due to increased hardness
- 3 to 10 times faster than thread cutting
- Increased lifetime due to special TiN coating
- Reduced friction, less burr formation and scoring
- Can be automated

Because the material on the thread flanks is compressed during the process, the drawing forces of the formed threads are greater than for cut threads!

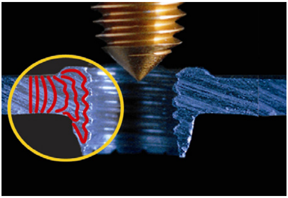


Fig. 18-1: Fiber orientation of the formed thread

Fig. 18-2: **Ftap** thread former

Requirements for Thread Forming

Required mechanical equipment for thread forming with Ftap

Any customary thread cutting device can be used for thread forming. However, a processing speed is required that is from 3 to 10 times faster than for thread cutting. If a machine is not available on which the direction of rotation of the spindle can be switched, we recommend using a special thread cutting unit. **See process data on page 15.**

Thread tapping chuck

For location of the thread formers in machines with switchable direction of rotation we recommend a chuck with longitudinal compensation in tensile and compressive direction and "pressure point mechanism". This will allow operation of the thread former independent of the axial force and compensate for a possible trailing of the machine spindle in the reversal point. Combined with the appropriate quick-change unit with overload coupling, this ensures the safety function both for the tool as well as for the machine spindle.

Lubrication during thread forming

VThe use of our lubricant is highly recommended during thread forming. It should be applied before each operation on the centertap. Our lubricant is ecologically tested according to DIN.
The **Ftap** oil does not contain any chlorine!

CNC Programming - Examples

Reference values for material S235JR (ST37/2):

Thread	spindle speed RPM	feed rate (mm/min)	cutting speed RPM
M5	800	720	14,1
M6	650	700	13,2
M8	500	750	15,1
M10	400	570	11,9

Drawing Forces of the Formed Thread

Determined drawing forces in kN for material S235JR (ST37/2)

The stated values are empirical values and vary depending on the type of former, material, and material thickness. For stainless steel the value is slightly higher. For aluminum it is much lower.

Thread	material thickness (mm)	kN	Thread	material thickness (mm)	kN
M4	1.0	5 - 6	M10	3.0	46 - 53
	2.0	8 - 9		4.0	68 - 72
M5	1.0	8 - 10	M12	3.0	50 - 72
	1.5	11 - 13		4.0	84 - 91
	2.0	14 - 15		5.0	84 - 106
M6	1.5	12 - 16	M16	3.0	94 - 97
	2.0	16 - 17		4.0	94 - 115
	3.0	23 - 24		5.0	126 - 141
M8	2.0	22 - 27	M20	3.0	122 - 142
	3.0	36 - 42		4.0	147 - 162
	4.0	43 - 45		5.0	196 - 200

Determined Overtorques

Determined overtorques in Nm with material S235JR (ST37/2)

material thickness (mm)	Thread M4	M5	M6	M8	M10	M12	M16
1.0	5	8					
1.5	7	11	17				
2.0	9	13	20	28			
3.0			27	50	66	136	197
4.0				67	98	163	

FAQs about **Fdrill** and **Ftap**

1. What do I need to start?

For trouble-free flow forming the Fdrill must run centrically. It should be clamped using a collet in a Fdrill collet chuck with cooling ring. The cooling ring prevents overheating by deflecting the heat away from the machine spindle. Parting lubricant is also needed for flow punch forming.

2. What mechanical equipment do I need for flow forming?

Any machine with a rotating unit that can achieve the required speed and with a motor that has the necessary kilowatt output can be used. Normally, this means a column drilling machine or NC or CNC machines. To produce a through-hole for an M8 thread in 2 mm thick sheet steel, you will need a machine with a minimum speed of approx. 2100 rpm and an output of 1.5 KW.
See process data on page 15.

3. Can I also use in a portable drilling machine?

Usually no. As mentioned above, a minimum speed and kilowatt output is required. The drilling machine should be fixed in a drill rig.

4. Can I also use a three jaw chuck?

No, because of the danger that the **Fdrill** will break and the spindle in the drill unit will overheat. The use of a drill chuck will invalidate the warranty.

5. Do I have to lubricate?

A parting paste must be used. The **Fdrill** parting paste prevents metal from building up on the **Fdrill** or from baking onto it. Depending on the type and thickness of the material, it should be applied in small quantities every 5 to 10 drillings. Too much paste can cool the former down too much and thus adversely affect the quality of the formed hole and the collar.

6. What metals can I process with flow forming?

Virtually all thin-walled metals (except tin and zinc); in other words, all:

- Welding steels
- Stainless steels
- Aluminum
- Copper
- Brass
- Bronze
- Magnetic materials
- Special alloys

(Continued on the next page)

FAQs about **Fdrill** and **Ftap**

7. Can I process zinc-plated materials?
Only in some cases. Because zinc has a different melting point than standard steel, this has a very negative effect on the quality of the flow formed hole and the collar. Depending on the thickness of the zinc, this effect is even more pronounced.

8. What process sequence do you recommend to produce a flow formed hole and a thread in zinc-plated material?
For the reasons explained above, it is generally better to zinc-plate the material after flow forming. If this is not possible the zinc layer, if it is too thick and uneven, should be removed before flow forming. If the workpart is zinc-plated after the thread forming, the threads must be cut afterward if it wasn't closed with a plug beforehand.

9. What is the maximum thickness that can be flow formed?
There are known applications with a wall thickness of 12 mm in which **Fdrill** was used. In our experience most applications involve a material thickness from 1 - 3 mm. Thinner material can also be processed, but an underlayment beneath the workpart is required because of the risk of deflection. Flow forming in solid material is not possible (see table "Maximum Wall Thicknesses" on page 12).

10. Should I use a short or a long Fdrill?
Every former tip consists of a cylindrical and a conical part. The cylindrical part is responsible for forming the core hole. If a thread is formed afterward, we recommend leaving the core hole slightly tapered at the end so that the thread is well formed. However, if the core hole is fully formed because it functions as a through-hole, the cylindrical part must have a corresponding length. The length of the **Fdrill** depends on the thickness of the sheet steel, the desired core hole, the type of metal, and the desired surface (with or without collar). Refer to the table "Maximum Material Thickness" on page 12. For pipe profiles the working length of the **Fdrill** must not exceed the inside width of the profile.

11. Examples of a former selection:

- A core hole for an M8 is to be flow formed in 2 mm thick sheet metal made of S235JR/ST37: required is a machine with a speed of 2100 rpm and an output of at least 1.5 KW. Recommended is a short flow former Ø 7.3 mm; alternatively, if the surface should be smooth, a short/flat flow former Ø 7,3 mm.
- The same core hole as above in 4 mm thick sheet metal. In this case the long or long/flat type Ø 7.3 mm should be used. If problems occur during thread forming that result in the thread former "squeaking" and wearing excessively, the cylindrical part should be extended. That means that a special flow former must be fabricated.
- The same core hole as above in 2 mm thick sheet metal made of stainless steel: in this case we recommend the above mentioned flow former, but with a 0.1 mm larger diameter, i.e., Ø 7.4 mm.

FAQs about Fdrill and Ftap

12. The collar formed by material that is displaced upward, is a problem. How can I achieve a smooth surface?

For this we recommend the flat type **Fdrill**. With this model the collar is removed in the last part of the operation. Of course, this results in a smooth surface only for flat sheet metal. With round pipes leftover metal remains on two sides and must be removed mechanically.

13. Is the thread formed in the same operating step?

No, if the thread were produced in the same operating step it would be destroyed again when the larger-diameter flow punch former is extracted.

14. The Fdrill gets dark red during forming? Is that dangerous?

No. Usually, the **Fdrill** develops a temperature of up to 600° and begins to glow dark red. If the color changes to bright red or yellow, that means that the **Fdrill** is too hot. This reduces the tool life and adversely affects the quality of the core hole.

15. How can I reduce the material that runs inward?

The best way to achieve this is predrill a hole before beginning the standard flow forming process. With the predrilled hole a reduction of the bushing toward the inside and smoother edges of the bushing can be achieved. However, this also reduces the number of possible thread turns.

16. The bushing that emerges toward the inside is too long or torn.

Predrilling of an appropriate hole will reduce the length of the bushing and prevent tearing on the edges of the bushing.

Definitions

Process parameters:
Frictional heat and feed pressure produce the material deformation and displacement. The frictional heat is generated through the rotational speed, the corresponding axial force (contact pressure) and feed rate. This means that, independently of the core hole size, the drill unit to be used must be capable of a speed of up to 500 rpm, a machine output of up to 5 KW, and a feed rate of up to 1000 mm/min.

The right combination of feed rate and speed depends on the type (stainless steels, steel, or non-ferrous metals) and thickness of the material. For optimized results, the material must retain the correct temperature during forming and not cool down too rapidly. Data listed later in this document are intended as reference values only and can vary greatly for different material grades and thicknesses.

Axial force:
As shown on page 17, the required axial force at the start of the flow punch forming process is very high and decreases toward the end of the process when the core hole is fully formed. When processing thin materials, underlayment may be necessary to prevent deflection.

Rotational speed RPM:
The normal speed (see page 15) for small core hole diameters is relatively high, at approx. 3000 rpm, and can be as high as 4500 rpm for non-ferrous metals. For larger core hole diameters such as M20, the necessary speed is only approx. 1000 rpm. Stainless steel, with a lower thermal conductivity, can be processed at speeds up to 20% lower.

Machine output KW:
To generate the required axial force and torque, a machine with sufficient kilowatt output is indispensable (see page 15). For small core hole diameters a lower axial force and kilowatt output is required than for larger diameters. The machine output determines the optimum process speed. Speedy machining of the metal is a determining factor for the quality of the core hole and especially for the life of the flow punch former.

Definitions

Torque:
As shown on page 17, the progression of the torque is inverted relative to the axial force until the end of the complete flow punch forming process. The maximum torque is then required, when the material to be formed transfers from the tapered into the cylindrical part. The maximum application of force (pressure) is required at this point.

If a machine is not sufficiently capable of this performance, the flow punch former will penetrate the metal too slowly and remains too long in one place, and the tool will wear severely at the transfer from conical to cylindrical part. In addition, the metal will cool down and lead to a poor quality of the collar.

Feed rate mm/min:
A speedy execution of the flow punch forming process is critical for achieving the desired quality of the formed hole. The feed rate varies from 100 - 150 mm/min (+/- 20 %) with 1 - 3 mm thick material for all thread sizes. This means that to produce a core hole with Ø 7.3 mm in a 2 mm thick metal piece, approximately 2 - 3 seconds are required between initial contact and retraction of the flow punch former at a feed rate of 150 mm/min.

The feed rate can be increased for the individual process steps and thus increases productivity, particularly when working with CNC machines. When using the flat type flow punch former we recommend increasing the feed rate significantly in the last step of the process so the material removed when the collar is taken off can separate from the flow punch tool.

Troubleshooting **Fdrill** & **Ftap**

1. The collar that is formed is rough or torn:
The **Fdrill** is too cold and has not yet reached operating temperature. Two or three additional holes should be formed. Another possible cause is that too much parting powder was applied, which cooled down the former. Check also if the feed rate and the flow punch former speed are matched up correctly.

2. The Fdrill gets bright red to bright yellow:
The flow punch former is overheating, caused by a feed rate that is too slow. That means that the entire production process takes too long. For a core hole of Ø 7.3 mm for an M8 thread in 2 mm thick steel S235J/ST37, only about 2 - 4 seconds are needed between first contact and exiting of the former at the end of the process.

3. The Fdrill gets stuck in the metal:
The KW output of the machine is too low or the former is not located securely in the chuck and is not turning as it should.

4. The Fdrill breaks off during forming:

- The workpart to be processed is not securely clamped and moves when the former makes contact and when it exits, so that the former tilts. Canting can also occur if the workpart becomes deflec ted due to the high axial force. In these cases, underlayment is required.
- The flow former may be clamped in a 3-jaw chuck. This should be replaced with an original center drill draw-in collet chuck with vent spokes to avoid problems and preserve the warranty.
- The flow former is not securely and centrally clamed in the collet chuck. Check the seating of the chuck in the collet chuck.
- Generally the chuck should be tightened after beginning the flow punch forming.
- An attempt was made to form a hole that was already formed.

5. The Fdrill breaks off when it makes contact with the workpart:
The former should only just touch the workpart! The zero point for the forming process should be approx. 0.5 above the workpart. The process begins then with a feed rate of about 150 mm/min. For core holes > M10 the feed rates should be reduced.

6. The Fdrill slips off the workpart:
If the former is on an inclined surface, an edge, or a round pipe, it is useful to mark a centerline on the workpart.

7. Grooves or debris are produced on the conical part of the flow punch tool:
The feed rate is too low; the former is turning too long in one position. This can also happen if the output or axial force of the machine is too low.

8. The thread former gets very hot; the tool life is too short:
Depending on the thickness and grade of the metal, check if the core hole is large enough. Also, ensure that lubrication is performed regularly with the proper lubricant.

Safety Information

For working with **Fdrill** and Ftap the following safety rules should be obeyed:

Always wear safety goggles.

When working with the flat **Fdrill** that are used to remove the collar, proper protective clothing and safety goggles should be worn if no safety guard is installed on the machine to protect against flying chips.

The **Fdrill** is glowing hot initially after use and should not be touched without proper safety gloves or before it has cooled down.

The workpart gets very hot and should not be touched without proper safety gloves or before it has cooled down.

The safety instructions for the recommended parting medium should be obeyed. The safety data sheets will be supplied if needed.

At the start of the flow forming process, the collet chuck should be tightened after 5 to 10 forming operations to prevent the part from slipping or falling out.

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