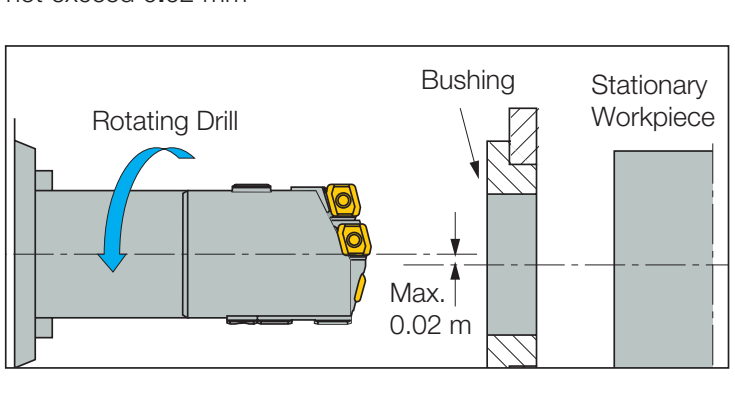
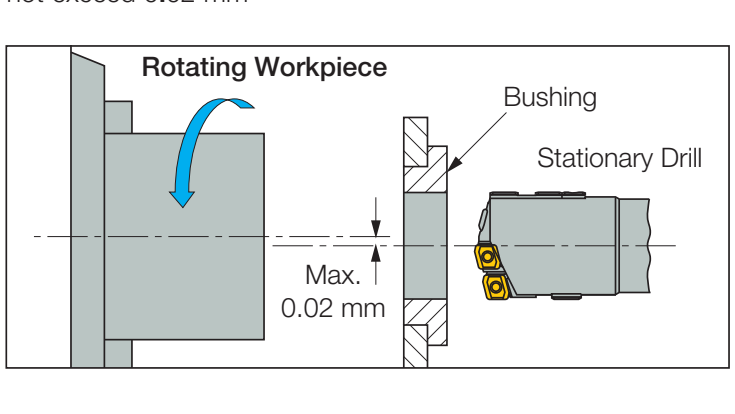
Drill Setup

Rotating Drill
- Can be applied on symmetrical and non-symmetrical workpieces
- Drill to bushing center misalignment should not exceed 0.02 mm

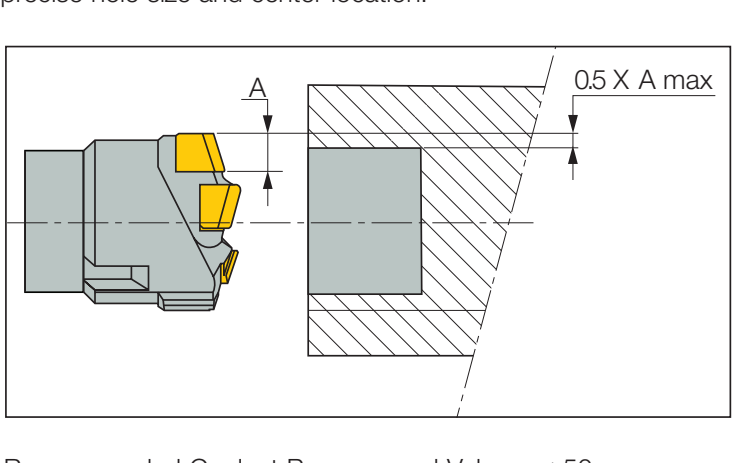


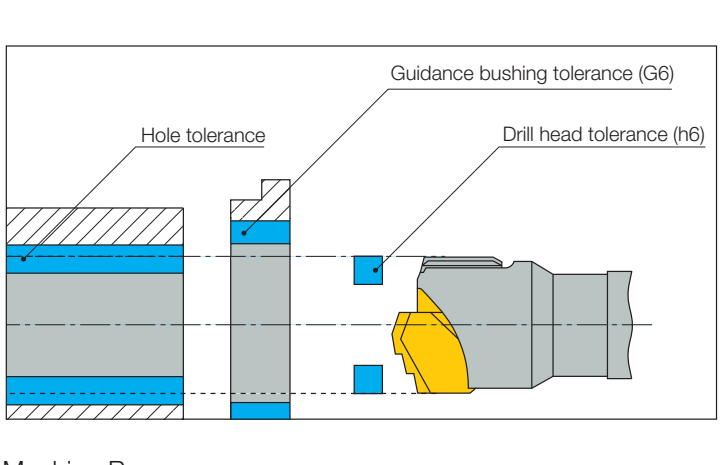
Stationary Drill
- Applied on symmetrical workpieces
- Improved hole straightness and bushing wear
- Drill to bushing center misalignment should not exceed 0.02 mm



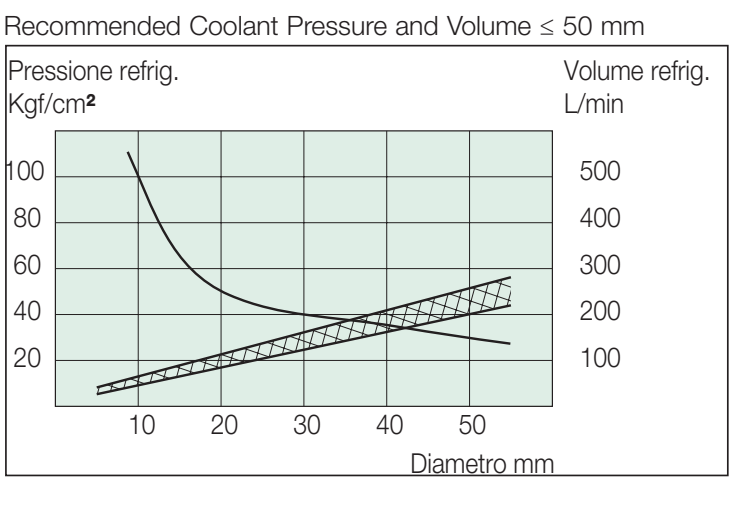
Drill Bushing and Workpiece Tolerance Relative Positioning

Pre-drilled Hole
A large pre-drilled hole (larger than D-a) ensures precise hole size and center location.

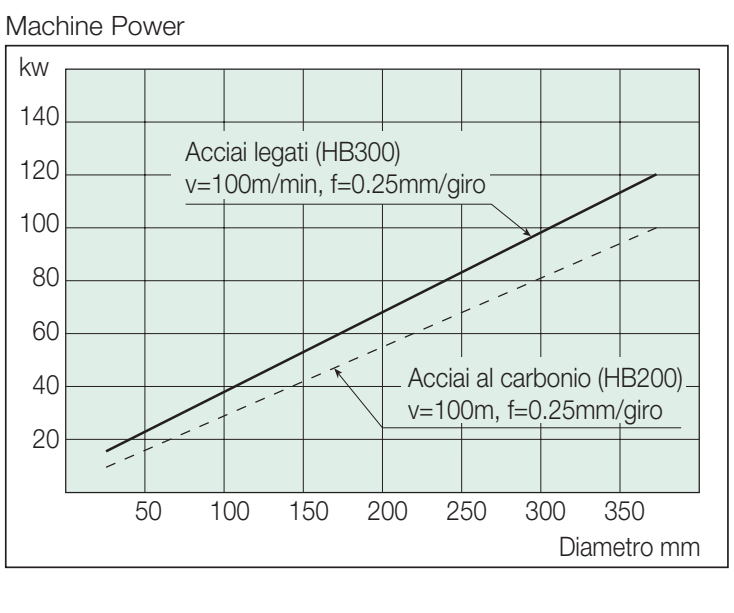




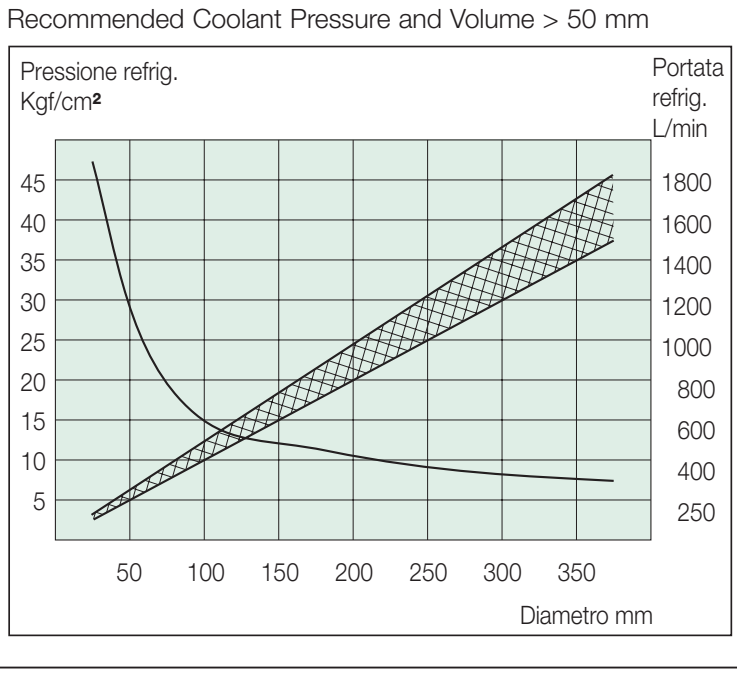
Recommended Coolant Pressure and Volume ≤ 50 mm



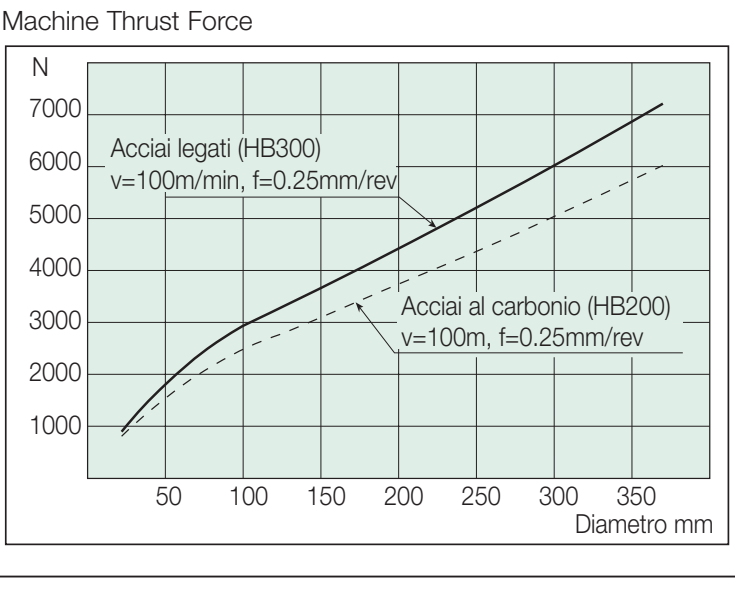
Machine Power



Recommended Coolant Pressure and Volume > 50 mm



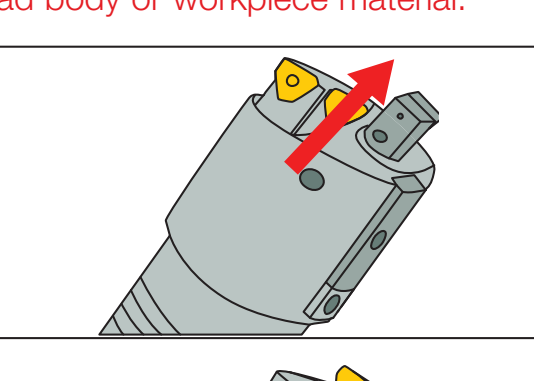
Machine Thrust Force



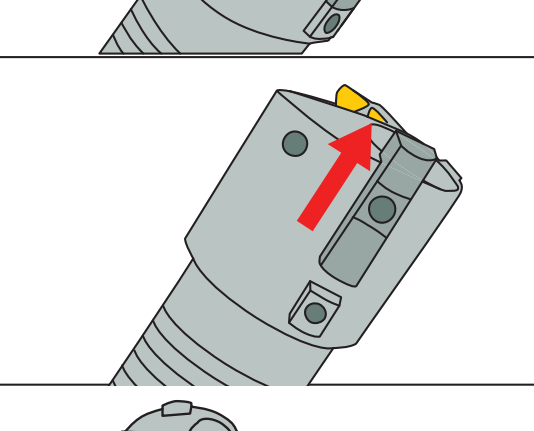
Technical Information - Cartridge Style Drill Head Diameter Setting

The drill head diameter is set and inspected with a master insert in our final inspection. However, the inserts in the market have a tolerance fluctuation so each time you index the insert, the diameter must be adjusted as per the following method.

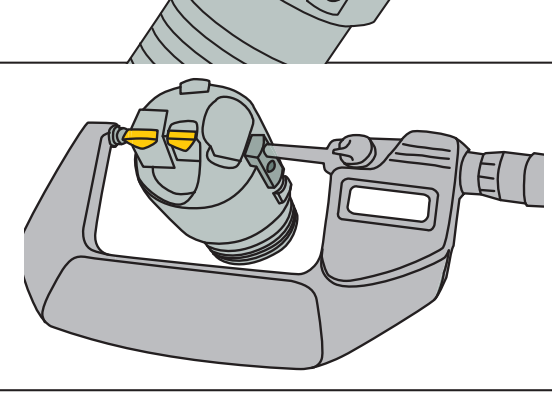
Note: When a corner change is made on the insert, it must be adjusted to the correct size or damage can be caused to the head body or workpiece material.



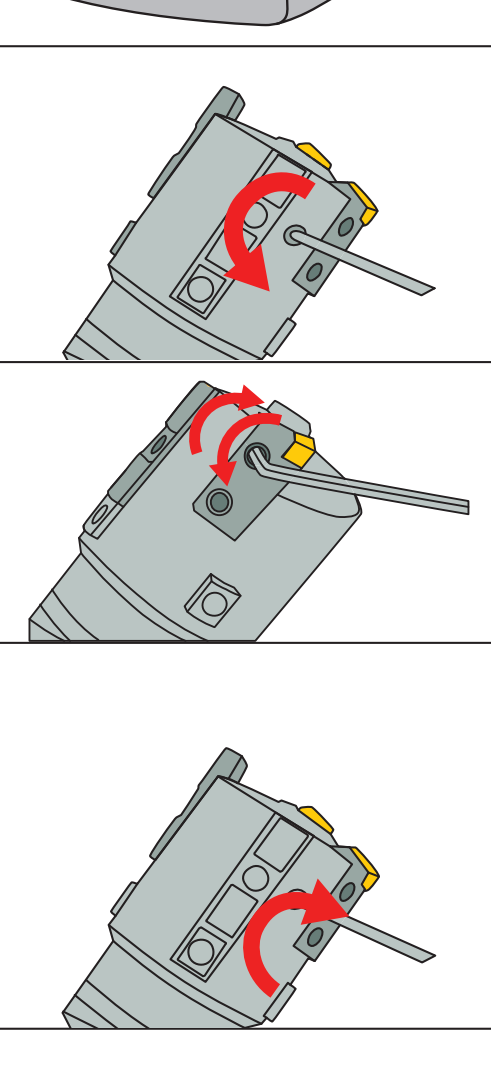
1. Remove the inner cartridge to avoid interference with the guide screw.



2. The dimensional guide pad must be slid forward to measure the diameter.
   2.1 Loosen the lock screw and slide the guide pad forward.
   2.2 Re-tighten the lock screw at the measuring position.



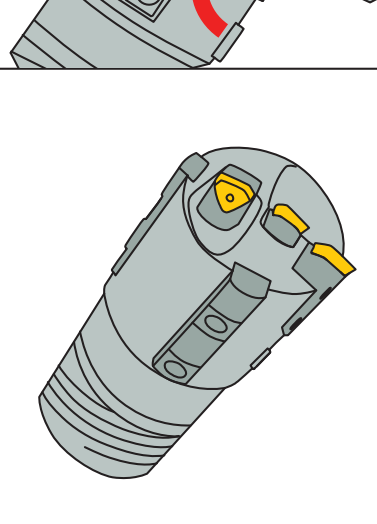
3. Measure the diameter with a micrometer.
   We recommend setting the tool diameter at h8 tolerance to the cutting diameter.
   If the diameter is incorrect, go to step 4 below.
   If it's correct, go to step 5 below.



4. Adjust the outer cartridge
   4.1 First loosen the lock screw of the outer cartridge and then tighten it slightly.

   4.2 Proceed to adjust the diameter, using the 2 adjustment screws and measure with a micrometer.

   4.3 When set to the size, re-tighten the lock screw.
   4.4 Recheck the diameter with a micrometer.
   If it is still out of tolerance, repeat the procedure from steps 1-4.
   Note: Please make sure to tighten the lock screw firmly before use. If loose, the cartridge may move and cause serious problems during machining.



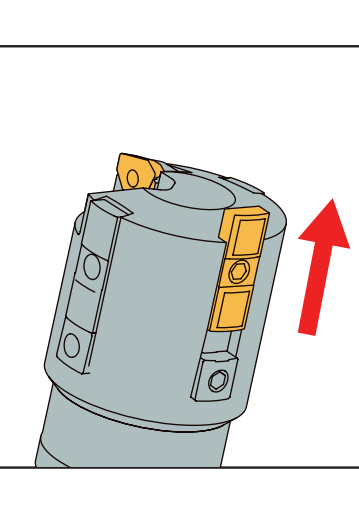
5. Slide the dimensional guide pad back to the original position and tighten the lock screw.

6. Replace the inner cartridge and tighten he lock screw.
   Note: Please check that all lock screws are firmly tightened, as they may come loose if vibration occurs during drilling.

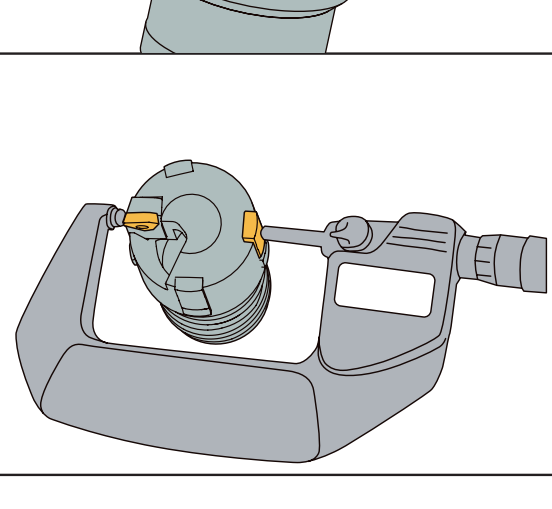
Diameter Setting

The drill head diameter is set and inspected with a master insert in our final inspection. However, the inserts in the market have a tolerance fluctuation so each time you change or index the insert, the diameter must be adjusted as per the following method.

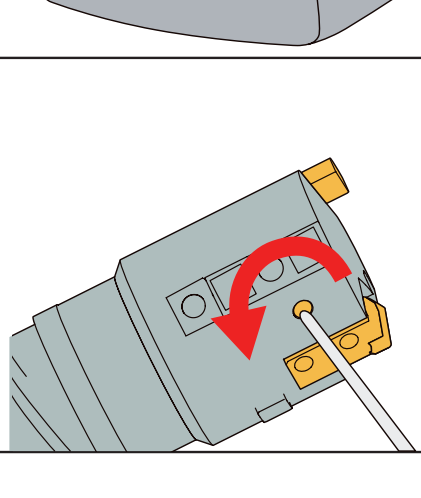
Note: When a corner change is made on the insert, it must be adjusted to the correct size or damage can be caused to the head body or a work piece material.



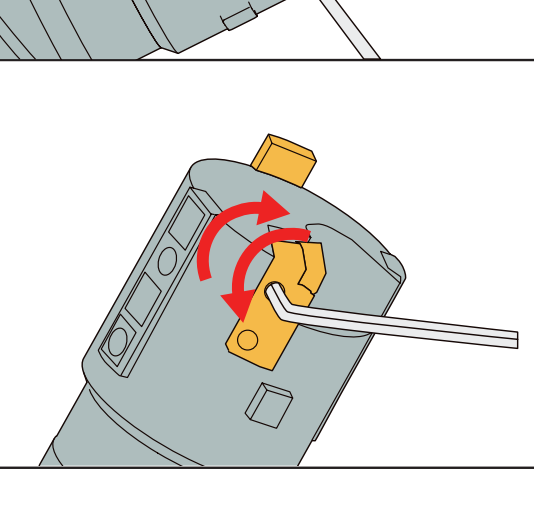
1. The dimensional guide pad must be slid forward to measure the diameter.
   1.1 Loosen the lock screw and slide the guide pad forward.
   1.2 Retighten the lock screw at the measuring position.



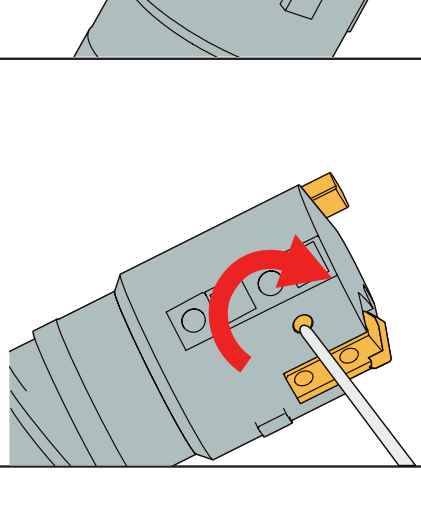
2. Measure the diameter with a micrometer.
   We recommend setting the tool diameter at h8 tolerance to the cutting diameter.
   Note: If the diameter is incorrect, go to **step 3.**
   If it's correct, go below **step 4**



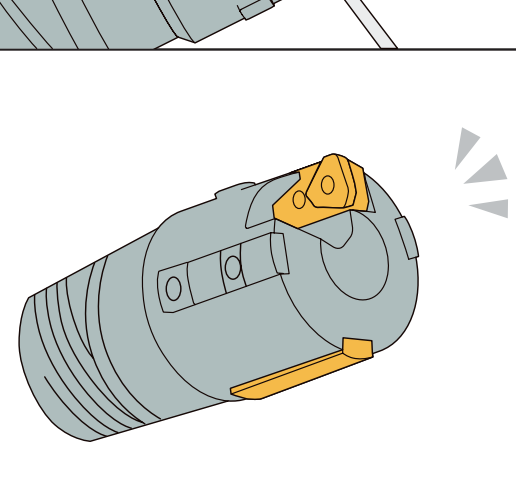
3. Adjust the outer cartridge
   3.1 First loosen the lock screw of the outer cartridge and then tighten it slightly.



   3.2 Proceed to adjust the diameter, using the 2 adjustment screws and measure with a micrometer.

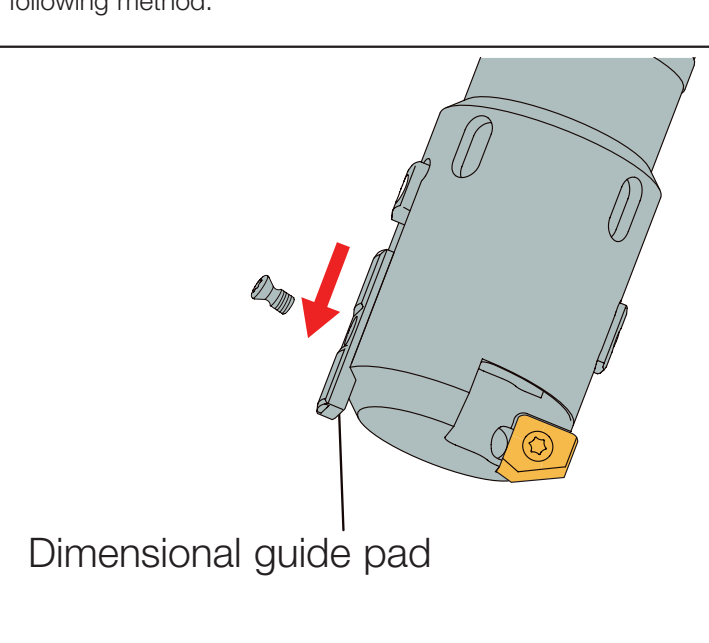


   3.3 When set to the size, re-tighten the lock screw.
   3.4 Recheck the diameter with a micrometer.
   If it is still out of tolerance, repeat the procedure from step 3.1.
   Note: Please make sure to tighten the lock screw firmly before using. If loose, the cartridge may move and cause serious problems during machining.

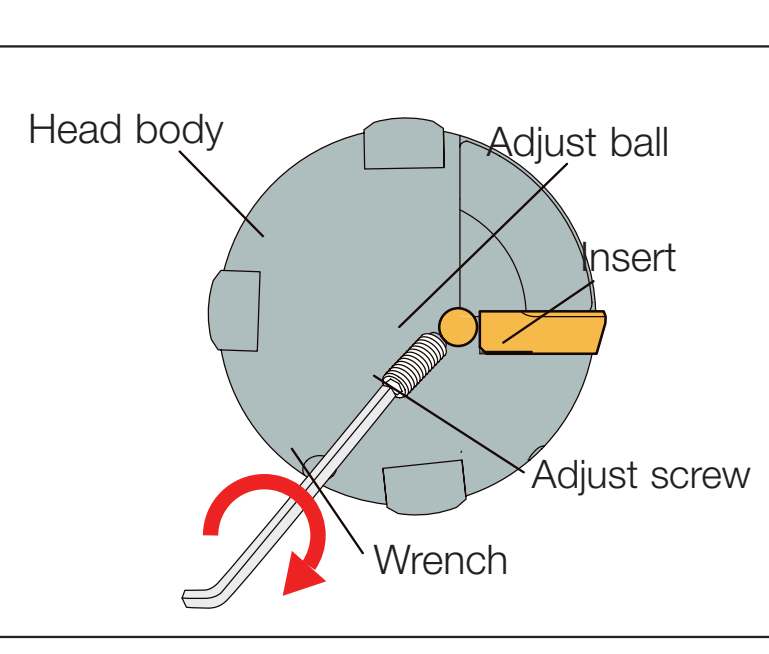


4. Slide the dimensional guide pad back to the original position and tighten the lock screw.
   Please check all the lock screws are firmly tightened as they may come loose if vibration occurs during drilling.

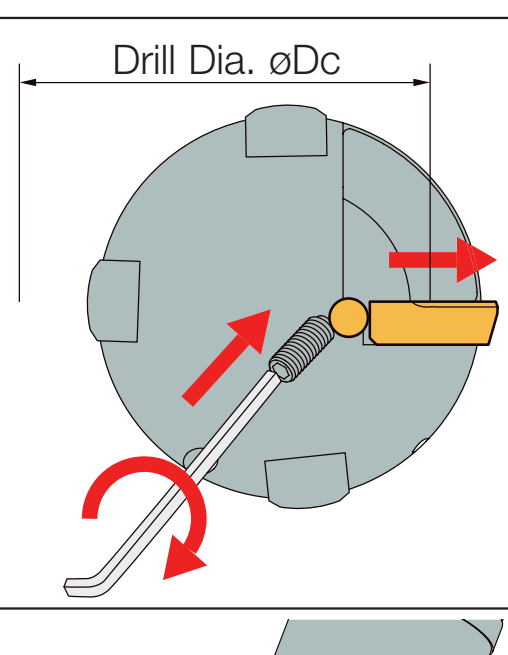
Drill diameter is adjusted with an adjust ball for diameter ø25 - ø39.99mm with the following method.



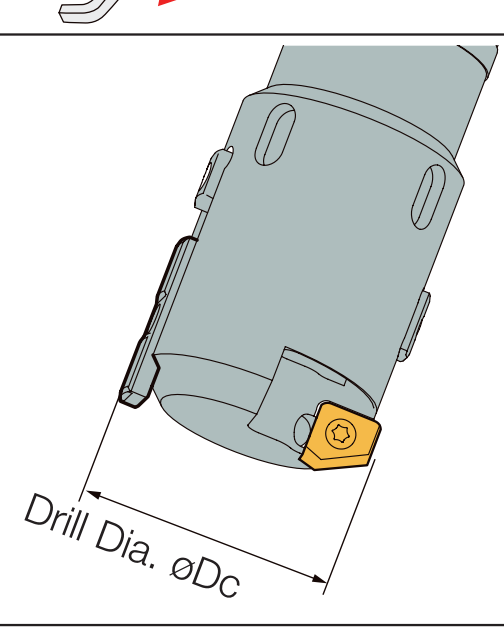
1. Slide the dimensional guide pad forward and then retighten the lock screw at the measuring position.



2. Tighten the adjust screw.



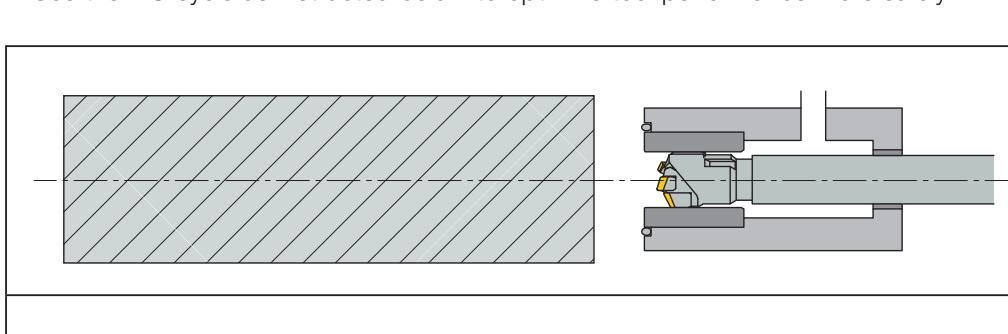
3. As the adjust screw moves forward, insert moves peripheral direction.



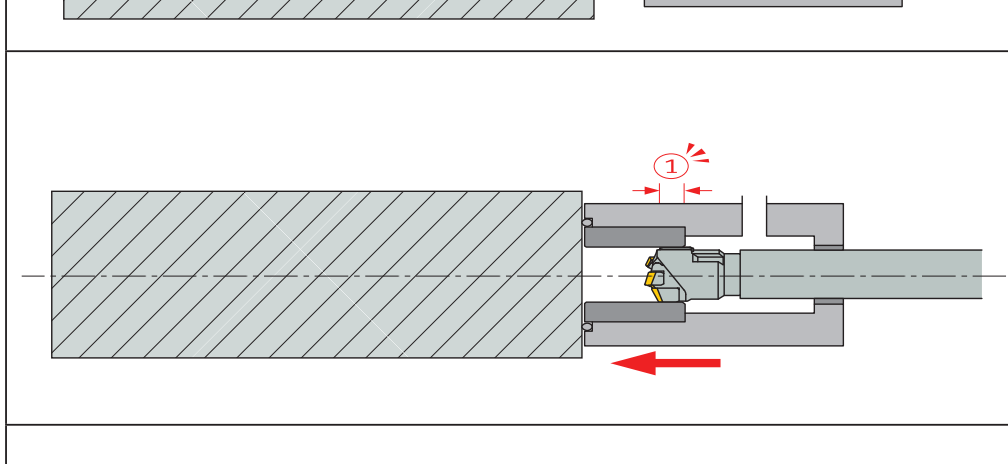
4. Measure the diameter with a micrometer. If the diameter is larger than expected, loosen the adjust screw and insert screw, then retighen the insert screw.
   Repeat the procedure from step 2

Technical Information - NC Cycle

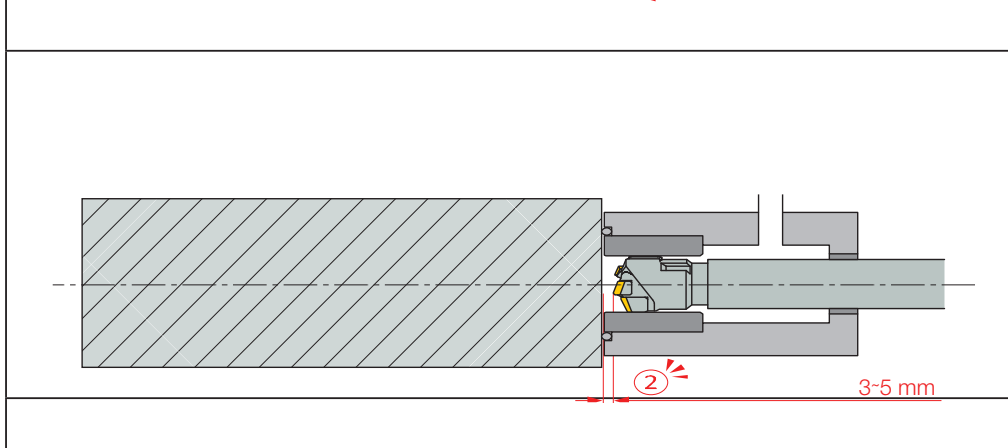
Use the **NC** cycle as instructed below to optimize tool performance more safely.



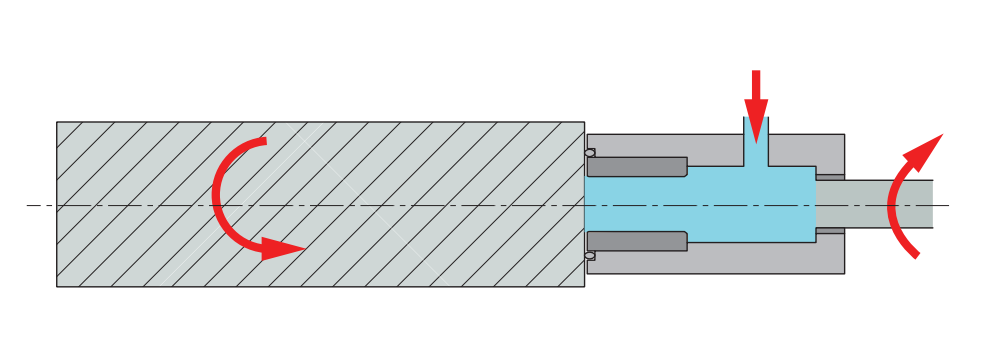
1. **Start NC operation cycle.**



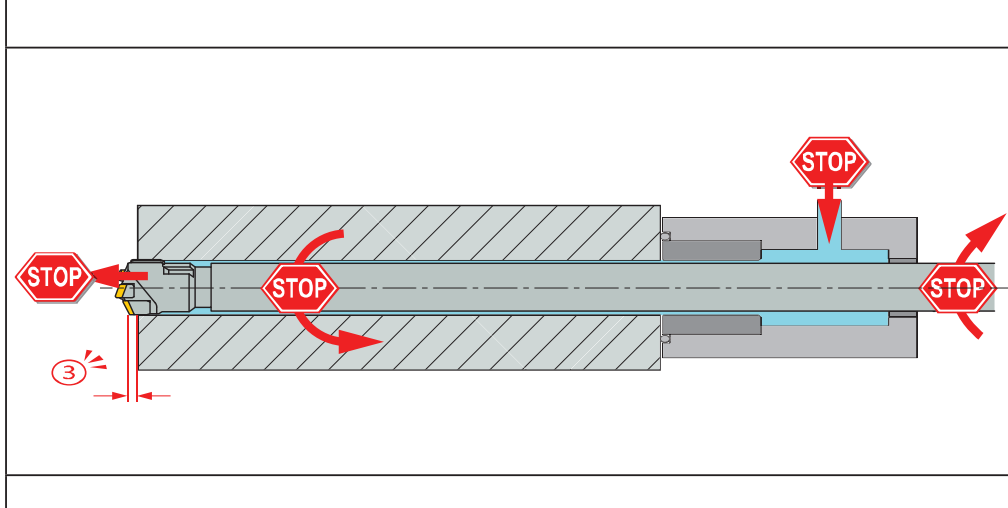
①
2. **Oil pressure head moves until it touches the workpiece**
   Set the starting point of the main axis of the tool so that the guide pad remains inside the guide bush when the oil pressure head moves forward.



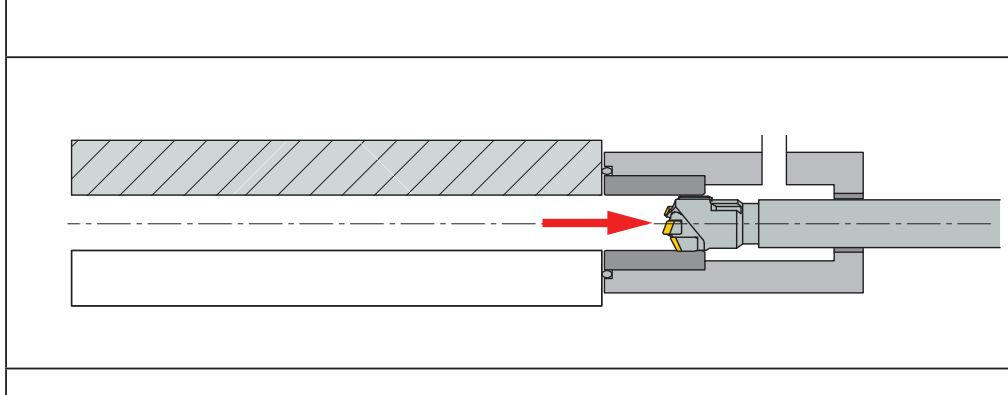
②
3. **Move tool workpiece**
   Move the tool 3 to 5 mm from the edge of the workpiece.
   If the available NC machine can support this approach, the operation process may start from this point



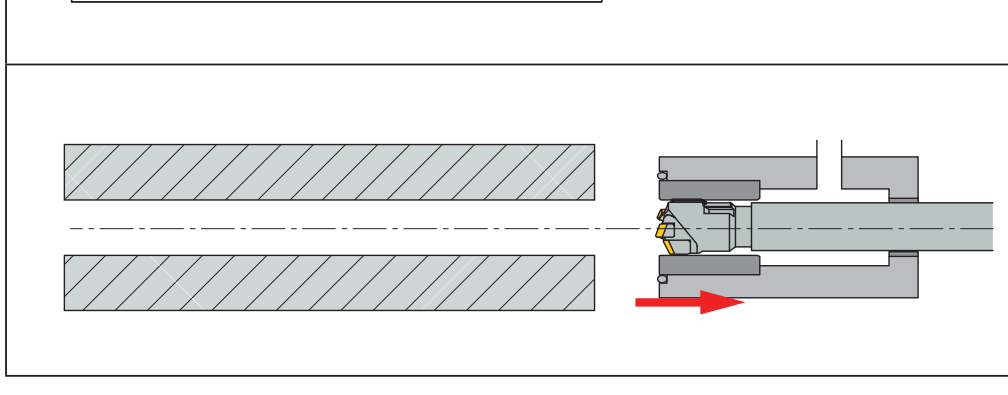
4. **Start cutting**
   - Start coolant supply
   - Start rotating (tool / workpiece / tool & workpiece)
   - Start feeding



③
5. **Stop cutting**
   - Stop feeding
   - Stop rotating (tool / workpiece / tool & workpiece)
   - Stop coolant supply
   Stop rotation when the outer tip is at the edge of the workpiece.



6. **Tool main axis back to starting point**

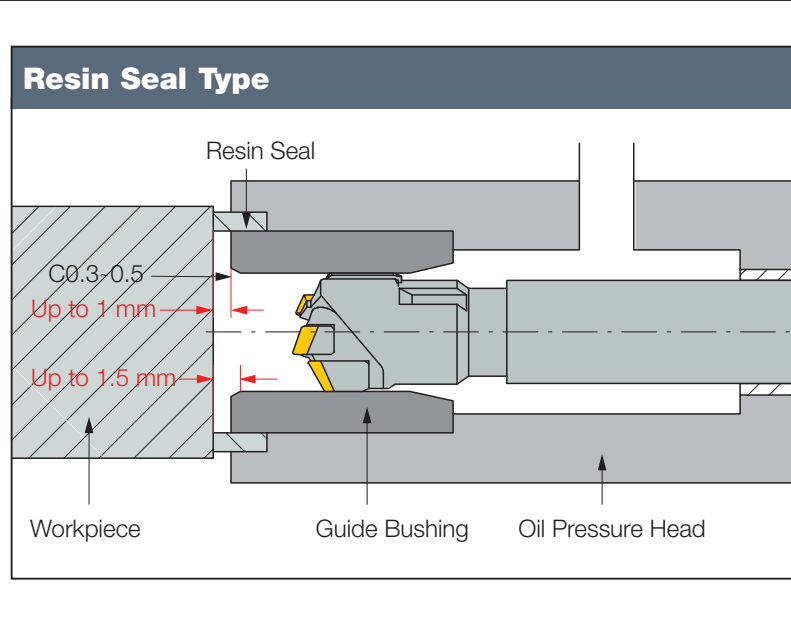


7. **Oil pressure head back to starting point**

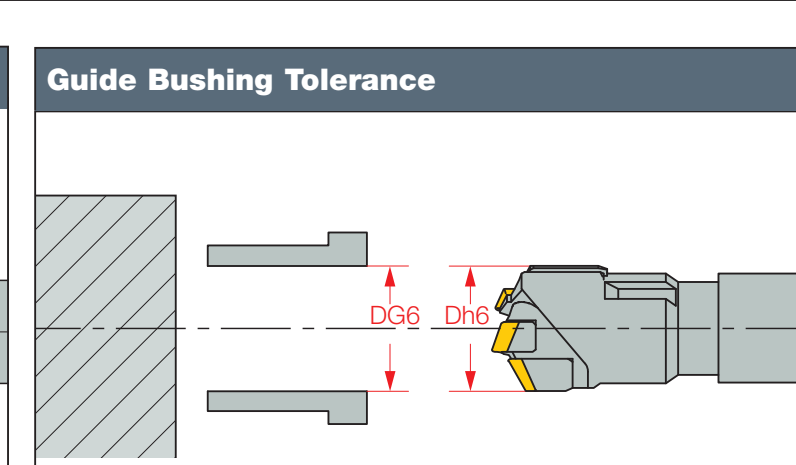
Technical Information - Notes for Guide Bushing Installation

Many of the problems in **BTA** drilling are caused by incorrect use of the guide bushing. The shape, type and tolerance greatly affect cutting accuracy and tool life. Please note the following when using one in your application.

Resin Seal Type

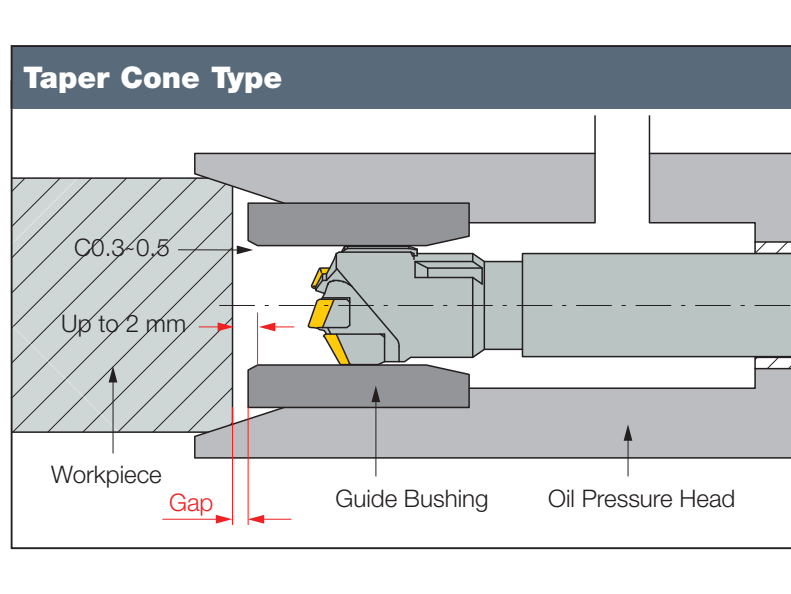


Guide Bushing Tolerance

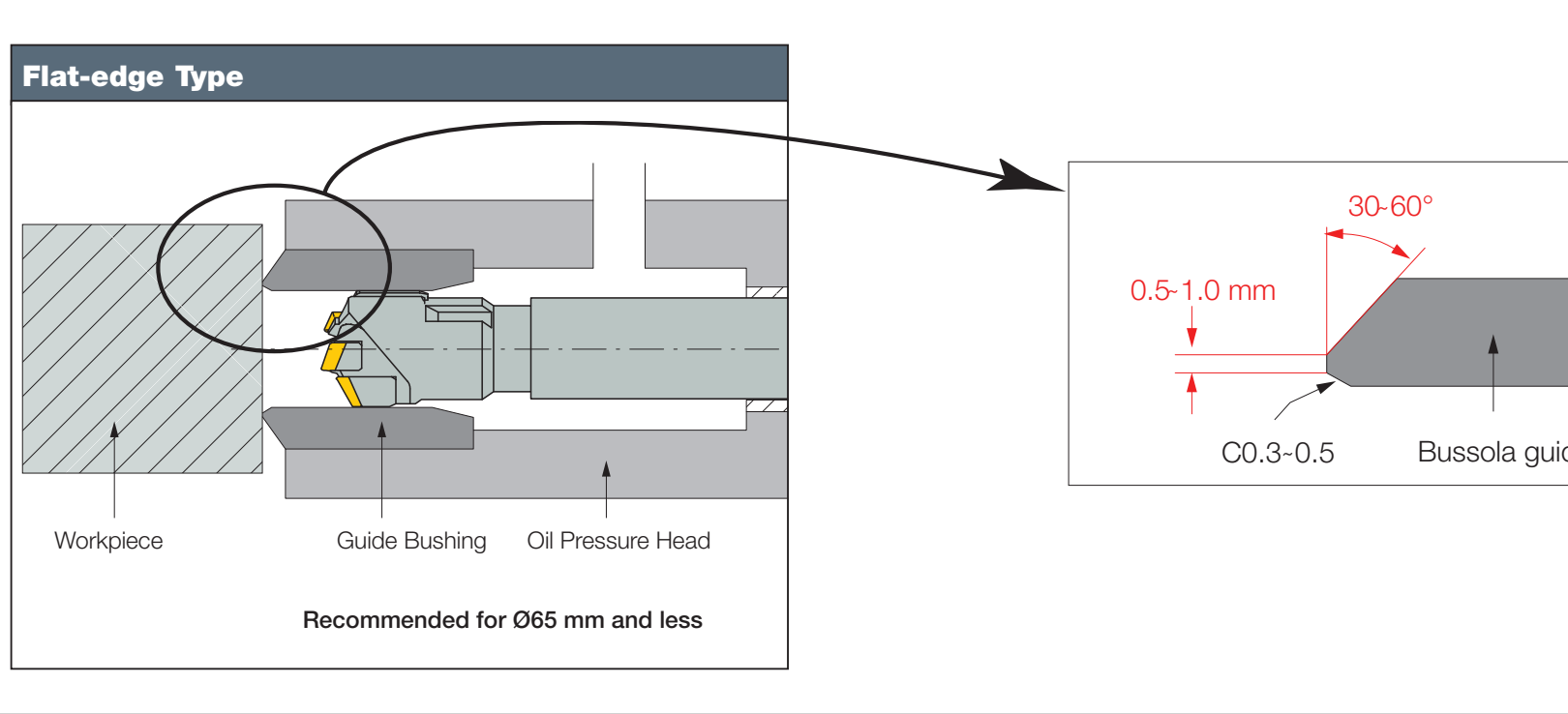


Tool Diameter D (mm)	G6 Tolerance (mm)
8.00 - 10.00	+0.005 ~ +0.014
10.01 - 18.00	+0.006 ~ +0.017
18.01 - 30.00	+0.007 ~ +0.020
30.01 - 50.00	+0.009 ~ +0.025
50.01 - 80.00	+0.010~ +0.029
80.01 - 120.00	+0.012 ~ +0.034
120.01 - 180.00	+0.014 ~ +0.039
180.01 - 245.99	+0.015 ~ +0.044

Taper Cone Type



Flat-edge Type



Recommended for Ø65 mm and less

Technical Information - Cutting Fluid Management

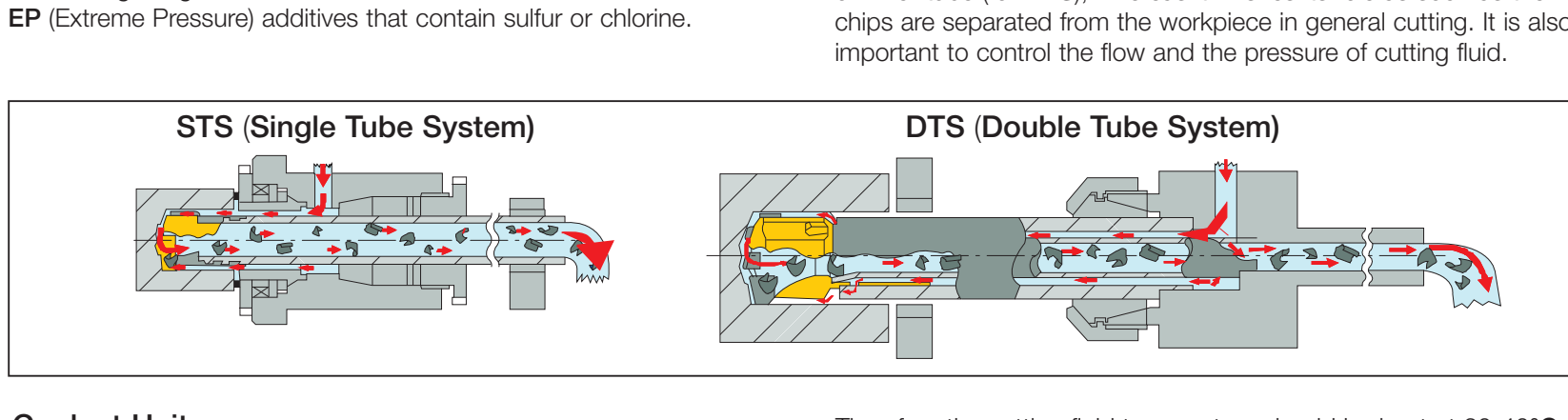
Successful deep hole drilling can be achieved not only by tooling but also by an optimized combination of the tool, the machine and the cutting fluid. The cutting fluid is one of the essential components to obtain safe, stable and cost efficient deep hole drilling. Therefore, it is very important to choose and use the cutting fluid correctly.

Cutting Fluid
The cutting fluid plays a large role in lubrication of the tool, cooling of cutting edges and chips and evacuation of chips in deep hole drilling. It also contributes to improved tool life, surface finish and cutting accuracy when being fed continuously during cutting.

Lubrication
Lubrication of cutting edges and guide pads is necessary in deep hole drilling. To get efficient lubrication, it is recommended to use **EP** (Extreme Pressure) additives that contain sulfur or chlorine.

Heat dissipation
The coolability of cutting fluid depends on thermal characteristics such as thermal conductivity and specific heat. The cutting fluid of good coolability increases tool life, but a water-soluble type is not preferred in deep hole drilling because of a lesser lubrication effect. If water-soluble fluid is used, the concentration is recommended to be 10% (dilution rate 1/10) or more.
Cooling of chips is important as well as cooling of cutting edges and guide pads in deep hole drilling. Temperature control is also important to maintain long tool life, stable cutting conditions and cutting accuracy.

Chip evacuation
Cutting fluid has an important role in deep hole drilling as it evacuates chips through to the back end of boring bar (for **STS**) or inner tube (for **DTS**), whereas it finishes its role as soon as the chips are separated from the workpiece in general cutting. It is also important to control the flow and the pressure of cutting fluid.



Coolant Unit
The coolant unit is also important to obtain the optimal effect of the cutting fluid, which has an important role in deep hole drilling.

Supply cutting fluid continuously at constant pressure and flow. Fluid pressure and flow are recommended to be continuously variable and monitored with a pressure gauge and a flow gauge. Screw pumps with an inverter are suitable.

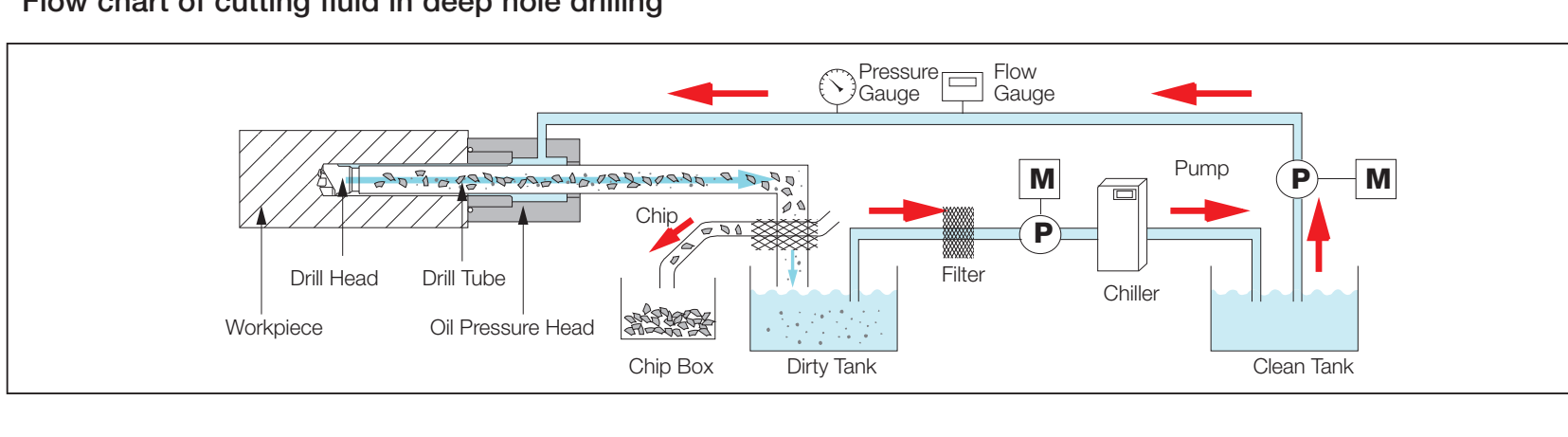
Maintain constant temperature
The cutting fluid is heated by factors such as:
- Cutting edge
- Friction of guide pad
- Contact duration of heated chips and cutting fluid
- Pump

Maintenance of the constant cutting fluid temperature is important for stable cutting conditions, chip formation and cutting accuracy.
The temperature should be lower than 40°**C** (100°**F**) for **EP** additives to provide sufficient lubrication.

Therefore the cutting fluid temperature should be kept at 30-40°**C** (90-100°**F**) throughout the cutting operation.

Filtration
A lot of particles are contained in cutting fluid after finishing cutting and chip evacuation; thus filtration is necessary to remove them. The filter size should be selected to catch particles but not **EP** additives. The size depends on the cutting fluid, but generally it is suggested to be around 10-20 µm. For iron-based workpieces, a magnetic separator will be helpful, which decreases filter maintenance frequency.

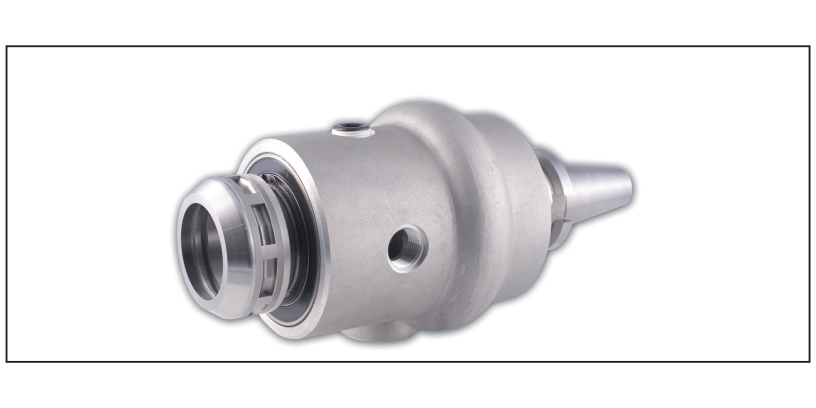
Flow chart of cutting fluid in deep hole drilling



Deep Hole Drilling Systems

Problem	Possible Cause	Solution
The drill breaks or insert chips	Chip evacuation problems	Check that the coolant passages are clear and that the Venturi slots are not damaged
	Center misalignment of drill to workpiece	Check center alignment of drill to workpiece Check workpiece and drill clamping rigidity
Poor surface finish	Workpiece or drill clamping rigidity problem	Improve workpiece or drill clamping
	Inadequate coolant oil	Check the coolant oil and replace if necessary
	Cutting speed too low	Increase the cutting speed
Excessive leakage of the coolant	Chips block the fluid passages	Clear the chips
	'ncorrectly assembled, or the Venturi slots of the internal tube are located in the wrong direction	Check all connections and the direction of the internal tube
Insufficient coolant flow at the cutting zone, despite correct fluid supply	Chips block the fluid passages	Clear the chips
	Worn bushing or sealing device	Check the bushing and seal and replace if necessary
	Venturi slots are too wide (worn)	Replace the internal tube
	Internal tube shorter than the external tube	Replace the internal tube to one with a correct length
Chips jam in the front end of the drill	Insufficient coolant flow	Adjust the fluid flow by raising the pressure; check the filter and fluid quality

Connection Adapters
Various kinds of rotating and non-rotating drill connectors are available upon request.



Oil Pressure Heads
Oil pressure heads are available on request.

Special Heads
Special form heads for trepanning or any other special contours can be produced on request.

ISO	Material		Condition	Tensile Strength [N/mm²]	Hardness HB	Material No.	Adjustable Counterboring Heads DSD-EF-FB, DDD-EF-FB, DSD-IF-FB: Dia. Range / Vc (m/min)	25.00 - 43.00 Feed Rate f (mm/rev)	43.01 - 65.00 Feed Rate f (mm/rev)	Adjustable Solid Drill Heads DSD-EC, DDD-EC, DSD-IC: Dia. Range / Vc (m/min)	38.00-39.99 Feed Rate f (mm/rev)	40.00-51.99	52.00-63.99	64.00-84.99	85.00-
P	Non-alloy steel and cast steel, free cutting steel	< 0.25 %C	Annealed	420	125	1	70-130	0.1-0.3	0.12-0.35	60-120	0.08-0.15	0.1-0.2	0.13-0.23	0.15-0.25	0.18-0.3
		>= 0.25 %C	Annealed	650	190	2	70-130	0.1-0.3	0.12-0.35	60-120	0.08-0.15	0.1-0.2	0.13-0.23	0.15-0.25	0.18-0.3
		< 0.55 %C	Quenched and tempered	850	250	3	70-130	0.1-0.3	0.12-0.35	60-120	0.08-0.15	0.1-0.2	0.13-0.23	0.15-0.25	0.18-0.3
		>= 0.55 %C	Annealed	750	220	4	70-130	0.1-0.3	0.12-0.35	60-120	0.08-0.15	0.1-0.2	0.13-0.23	0.15-0.25	0.18-0.3
			Quenched and tempered	1000	300	5	70-130	0.1-0.3	0.12-0.35	60-120	0.08-0.15	0.1-0.2	0.13-0.23	0.15-0.25	0.18-0.3
	Low alloy steel and cast steel (less than 5% of alloying elements)		Annealed	600	200	6	70-120	0.1-0.3	0.12-0.35	60-100	0.08-0.15	0.1-0.2	0.13-0.23	0.15-0.25	0.18-0.3
			Quenched and tempered	930	275	7	60-120	0.1-0.3	0.12-0.35	60-100	0.08-0.15	0.1-0.2	0.13-0.23	0.15-0.25	0.18-0.3
				1000	300	8	60-120	0.1-0.3	0.12-0.35	50-100	0.08-0.15	0.1-0.2	0.13-0.23	0.15-0.25	0.18-0.3
				1200	350	9	60-120	0.1-0.3	0.12-0.35	50-100	0.08-0.15	0.1-0.2	0.13-0.23	0.15-0.25	0.18-0.3
	High alloyed steel, cast steel, and tool steel		Annealed	680	200	10	70-130	0.1-0.3	0.12-0.35	60-120	0.08-0.15	0.1-0.2	0.13-0.23	0.15-0.25	0.18-0.3
			Quenched and tempered	1100	325	11	70-130	0.1-0.3	0.12-0.35	60-120	0.08-0.15	0.1-0.2	0.13-0.23	0.15-0.25	0.18-0.3
	Stainless steel and cast steel		Ferritic/martensitic	680	200	12	70-130	0.1-0.3	0.12-0.35	60-110	0.08-0.15	0.1-0.2	0.13-0.23	0.15-0.25	0.18-0.3
			Martensitic	820	240	13	70-130	0.1-0.3	0.12-0.35	60-110	0.08-0.15	0.1-0.2	0.13-0.23	0.15-0.25	0.18-0.3
M	Stainless steel		Austenitic	600	180	14	70-130	0.1-0.3	0.12-0.35	60-110	0.08-0.15	0.1-0.2	0.13-0.23	0.15-0.25	0.18-0.3
K	Grey cast iron (GG)		Ferritic/pearlitic		180	15	50-110	0.1-0.25	0.12-0.35	60-100	0.08-0.13	0.1-0.15	0.13-0.18	0.15-0.2	0.18-0.23
			Pearlitic		260	16	50-110	0.1-0.25	0.12-0.35	60-100	0.08-0.13	0.1-0.15	0.13-0.18	0.15-0.2	0.18-0.23
	Nodular cast iron (GGG)		Ferritic		160	17	60-110	0.1-0.25	0.12-0.35	60-100	0.08-0.13	0.1-0.15	0.13-0.18	0.15-0.2	0.18-0.23
			Pearlitic		250	18	60-110	0.1-0.25	0.12-0.35	60-100	0.08-0.13	0.1-0.15	0.13-0.18	0.15-0.2	0.18-0.23
	Malleable cast iron		Ferritic		130	19	70-110	0.1-0.25	0.12-0.35	60-100	0.08-0.13	0.1-0.15	0.13-0.18	0.15-0.2	0.18-0.23
			Pearlitic		230	20	70-110	0.1-0.25	0.12-0.35	60-100	0.08-0.13	0.1-0.15	0.13-0.18	0.15-0.2	0.18-0.23
N	Aluminum-wrought alloy		Not cureable		60	21	65-130	0.1-0.25	0.12-0.35	60-130	0.08-0.2	0.1-0.25	0.13-0.28	0.15-0.3	0.18-0.33
			Cured		100	22	65-130	0.08-0.23	0.12-0.27	60-130	0.08-0.2	0.1-0.25	0.13-0.28	0.15-0.3	0.18-0.33
	Aluminum-cast, alloyed	<=12% Si	Not cureable		75	23	65-130	0.08-0.23	0.12-0.27	60-130	0.08-0.2	0.1-0.25	0.13-0.28	0.15-0.3	0.18-0.33
			Cured		90	24	65-130	0.08-0.23	0.12-0.27	60-130	0.08-0.2	0.1-0.25	0.13-0.28	0.15-0.3	0.18-0.33
		>12% Si	High temperature		130	25	65-130	0.08-0.23	0.12-0.27	60-130	0.08-0.2	0.1-0.25	0.13-0.28	0.15-0.3	0.18-0.33
	Copper alloys	>1% Pb	Free cutting		110	26	65-130	0.08-0.23	0.12-0.27	60-130	0.08-0.2	0.1-0.25	0.13-0.28	0.15-0.3	0.18-0.33
			Brass		90	27	65-130	0.08-0.23	0.12-0.27	60-130	0.08-0.2	0.1-0.25	0.13-0.28	0.15-0.3	0.18-0.33
			Electrolitic copper		100	28	65-130	0.08-0.23	0.12-0.27	60-130	0.08-0.2	0.1-0.25	0.13-0.28	0.15-0.3	0.18-0.33
	Non-metallic		Duroplastics, fiber plastics			29	20-50	0.08-0.23	0.12-0.27	20-65	0.08-0.15	0.1-0.2	0.13-0.23	0.15-0.25	0.18-0.3
			Hard rubber			30	20-50	0.08-0.23	0.12-0.27	20-65	0.08-0.15	0.1-0.2	0.13-0.23	0.15-0.25	0.18-0.3
S	High temp. alloys	Fe based	Annealed		200	31	20-50	0.08-0.23	0.12-0.27	20-65	0.08-0.15	0.1-0.2	0.13-0.23	0.15-0.25	0.18-0.3
			Cured		280	32	20-50	0.08-0.23	0.12-0.27	20-65	0.08-0.15	0.1-0.2	0.13-0.23	0.15-0.25	0.18-0.3
		Ni or Co based	Annealed		250	33	20-50	0.08-0.23	0.12-0.27	20-65	0.08-0.15	0.1-0.2	0.13-0.23	0.15-0.25	0.18-0.3
			Cured		350	34	30-60	0.08-0.23	0.12-0.27	30-100	0.08-0.15	0.1-0.2	0.13-0.23	0.15-0.25	0.18-0.3
			Cast		320	35	30-60	0.08-0.23	0.12-0.27	30-100	0.08-0.15	0.1-0.2	0.13-0.23	0.15-0.25	0.18-0.3
	Titanium Ti alloys			RM 400		36									
			Alpha+beta alloys cured	RM 1050		37									
H	Hardened steel		Hardened		55 HRC	38									
			Hardened		60 HRC	39									
	Chilled cast iron		Cast		400	40									
	Cast iron		Hardened		55 HRC	41									