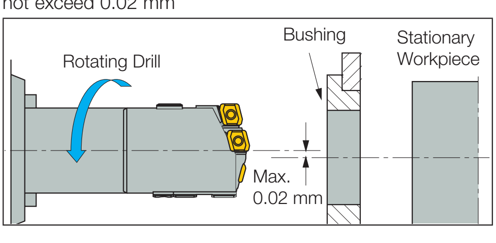
Technical Information - Drill Setup

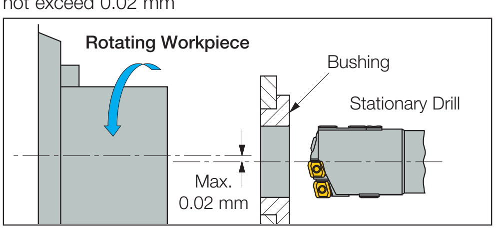
Rotating Drill

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



Stationary Drill

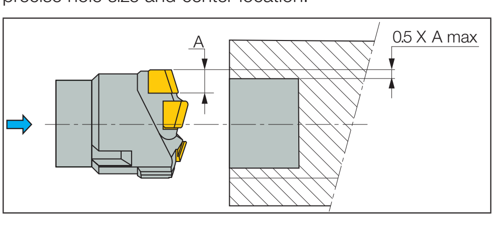
- Applied on symmetrical workpieces
- Improved hole straightness and bushing wear
- Drill to bushing center misalignment should not exceed 0.02 mm

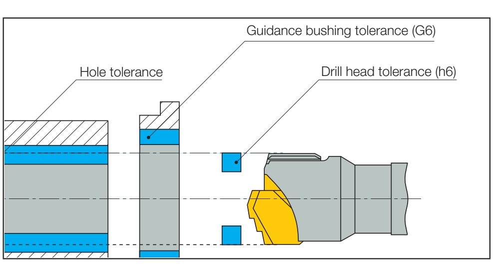


Drill Bushing and Workpiece Tolerance Relative Positioning

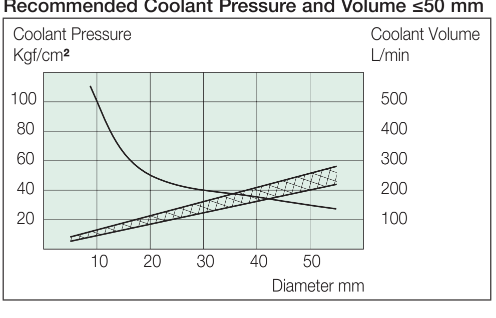
Pre-drilled Hole

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

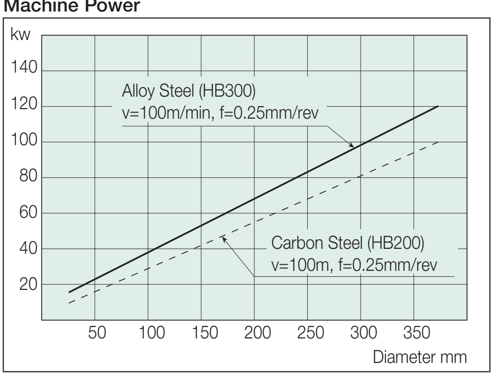




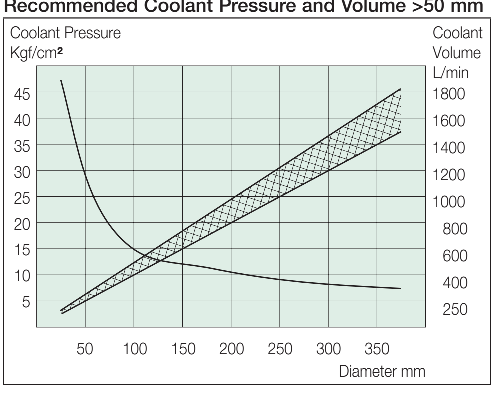
Recommended Coolant Pressure and Volume ≤50 mm



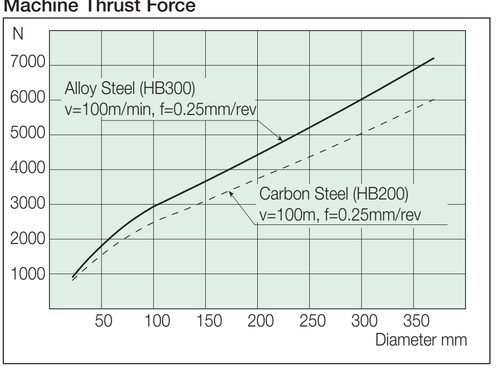
Machine Power



Recommended Coolant Pressure and Volume >50 mm

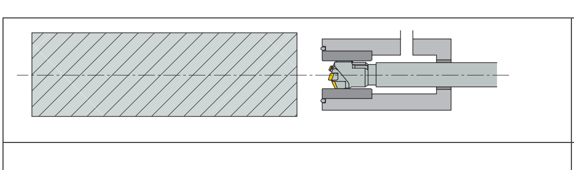


Machine Thrust Force

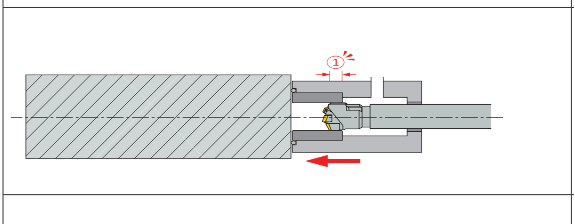


Technical Information - NC Cycle

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

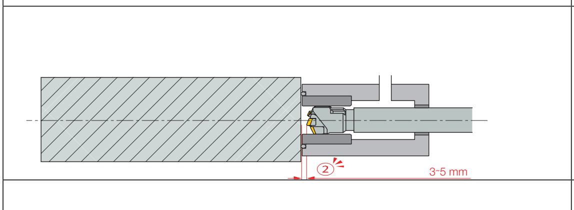


1 Start NC operation cycle.



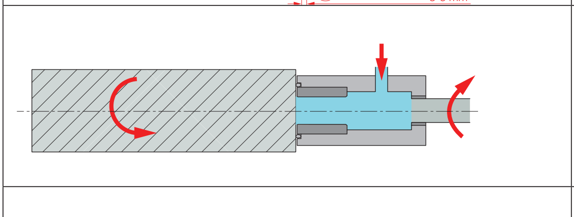
①

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.

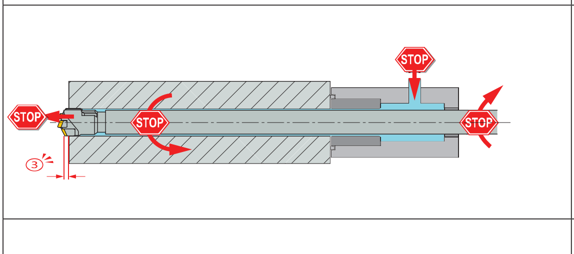


②

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



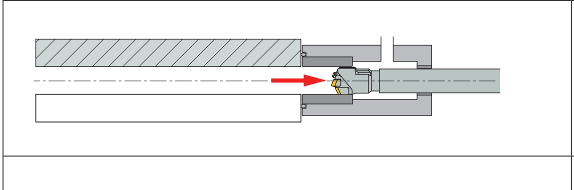
4 Start cutting
- Start coolant supply
- Start rotating (tool / workpiece / tool & workpiece)
- Start feeding



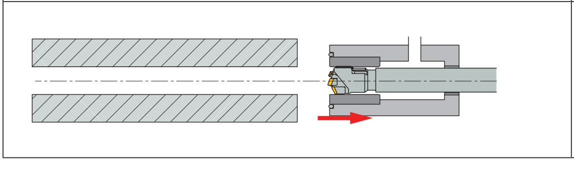
③

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

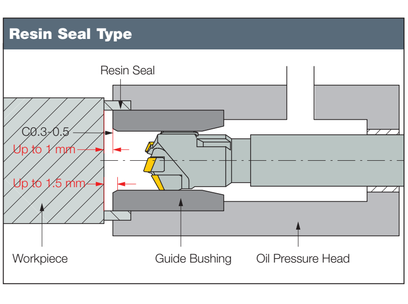


7 Oil pressure head back to starting point

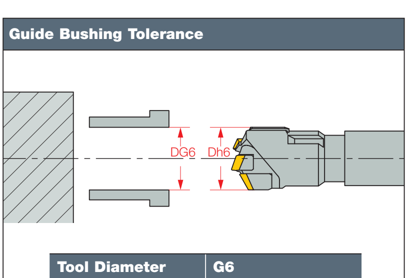
Technical Information - Notes for Guide Bushing Installation

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

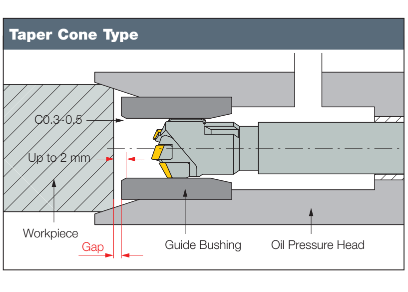


Guide Bushing Tolerance

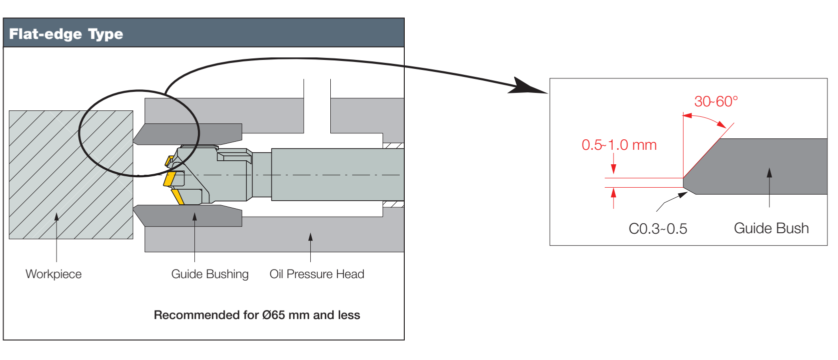


Tool Diameter D (mm)	G6 Tolerance (mm)
8.00 - 10.00	+0.005 ~ +0.014
10.01 - 18.00	+0.006 ~ +0.017
18.01 - 30.00	+0.007 ~ +0.020
30.01 - 50.00	+0.009 ~ +0.025
50.01 - 80.00	+0.010~ +0.029
80.01 - 120.00	+0.012 ~ +0.034
120.01 - 180.00	+0.014 ~ +0.039
180.01 - 245.99	+0.015 ~ +0.044

Taper Cone Type



Flat-edge Type



Coolant

Successful deep hole drilling is achieved by an optimal combination of the tool, the machine and the coolant. Coolant plays an essential role in achieving secure and cost-efficient deep hole drilling operations. Therefore, it is very important to choose the correct type of coolant and use it appropriately.

Coolant

Coolant plays an essential role in lubricating tools, cooling cutting edges, chips and guide pads, as well as evacuating chips when drilling. It also improves tool life, surface finish and cutting accuracy when continuously supplied during the machining process.

1 Lubrication

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

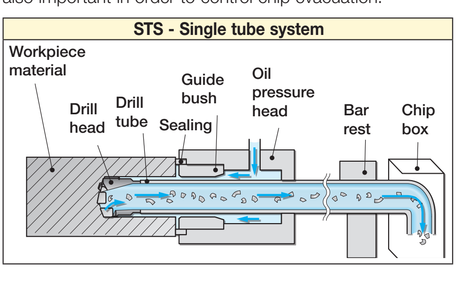
2 Temperature reduction

The ability to cool down the cutting edge and chips depends on such characteristics as thermal conductivity and relative heat. Coolant with good cooling ability increases tool life, but water-soluble coolant is not preferred in deep hole drilling because it reduces effectiveness. If water-soluble coolant is used, the recommended concentration is 10% (dilution rate 1/10) or more.

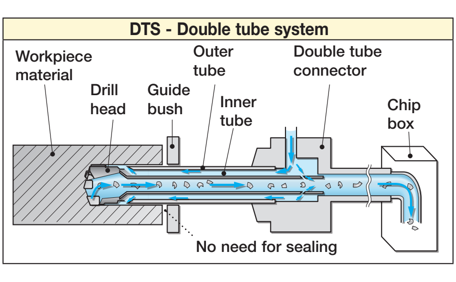
3 Chip evacuation

Coolant helps push chips through the back end of the boring bar (for STS) or inner tube (for DTS) until the chips are separated from the workpiece in general cutting conditions. The flow and the pressure of coolant are also important in order to control chip evacuation.

STS - Single tube system



DTS - Double tube system



Coolant unit

A coolant unit is also important to obtain the best effect from the coolant.

1 Coolant pressure and volume should be fixed and continuous.

An ideal coolant unit should be able to set any valve of coolant pressure and volume and monitor the condition with gauges. A system that can detect trapped chips by a pressure gauge and the screw pumps with an inverter controller are both recommended.

2 Coolant temperature should be maintained.

Coolant is heated by factors, such as:

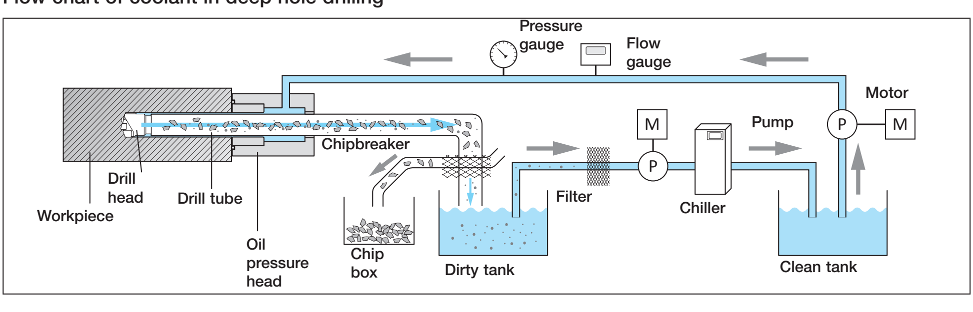
- Cutting edge
- Friction on guide pad
- Contact time of heated chips and coolant
- Pump

Maintaining coolant temperature is important to keeping 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 coolant temperature should be kept between 30 - 40°C (90 - 100°F) throughout the cutting operation.

3 Filtering

Unwanted particles are contained in coolant after the cutting operations, thus filtration is necessary to remove them. The filter size should be selected carefully to catch particles but not EP additives. Filter size depends on the coolant, but around 10 - 20 µm is generally suggested. For iron-based workpieces, a magnetic separator is helpful as it decreases the frequency of filter maintenance.

Flow chart of coolant in deep hole drilling



Deep Hole Drilling Systems

Problem	Possible Cause	Solution
The drill breaks or insert chips	• Chip evacuation problems • Center misalignment of drill to workpiece	• Check that the coolant passages are clear and that the Venturi slots are not damaged • Check center alignment of drill to workpiece • Check workpiece and drill clamping rigidity
Poor surface finish	• Workpiece or drill clamping rigidity problem • Inadequate coolant oil • Cutting speed too low	• Improve workpiece or drill clamping • Check the coolant oil and replace if necessary • Increase the cutting speed
Excessive leakage of the coolant	• Chips block the fluid passages • The drill was incorrectly assembled, or the Venturi slots of the internal tube are located in the wrong direction	• Clear the chips • 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 • Worn bushing or sealing device • Venturi slots are too wide (worn) • Internal tube shorter than the external tube	• Clear the chips • Check the bushing and seal and replace if necessary • Replace the internal 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.

Machining Recommendations for TRIDEEP BTA Drilling Heads

ISO	Material		Condition	Tensile Strength [N/mm²]	Material Group No.	Hardness (HB)	Chipbreaker	Cutting speed V_c (m/min)	Feed : f (mm/rev) Drill dia. (mm) Ø16-18	Ø18.01-40
P	Non-alloy steel and cast steel, free cutting steel	<0.25% C	Annealed	420	1	125	GF	50-100	0.03-0.10	0.03-0.10
							DT	80-140	0.05-0.10	0.05-0.10
		≥0.25% C	Annealed	650	2	190	GF	50-100	0.03-0.10	0.03-0.10
							DT	80-140	0.05-0.10	0.05-0.10
		<0.55% C	Quenched and tempered	850	3	250	GF	50-100	0.03-0.10	0.03-0.12
							DT	80-140	0.05-0.16	0.05-0.20
		≥0.55% C	Annealed	750	4	220	GF	50-100	0.03-0.10	0.03-0.12
							DT	80-140	0.05-0.16	0.05-0.20
			Quenched and tempered	1000	5	300	GF	50-100	0.03-0.10	0.03-0.12
							DT	80-140	0.05-0.16	0.05-0.20
	Low alloy and cast steel (less than 5% of alloying elements)		Annealed	600	6	200	GF	50-100	0.03-0.10	0.03-0.10
							DT	80-140	0.05-0.10	0.05-0.10
			Quenched and tempered	930	7	275	GF	50-100	0.03-0.10	0.03-0.10
							DT	80-140	0.05-0.10	0.05-0.10
				1000	8	300	GF	50-100	0.03-0.10	0.03-0.10
							DT	80-140	0.05-0.10	0.05-0.10
				1200	9	350	GF	50-100	0.03-0.10	0.03-0.10
							DT	80-140	0.05-0.10	0.05-0.10
	High alloyed steel, cast steel and tool steel		Annealed	680	10	200	GF	50-100	0.03-0.10	0.03-0.12
							DT	80-120	0.05-0.16	0.05-0.20
			Quenched and tempered	1100	11	325	GF	50-100	0.03-0.10	0.03-0.12
							DT	80-120	0.05-0.16	0.05-0.20
	Stainless steel and cast steel		Ferritic/martensitic	680	12	200	GF	50-100	0.03-0.06	0.03-0.06
							DT	60-100	0.05-0.10	0.05-0.10
			Martensitic	820	13	240	GF	50-100	0.03-0.06	0.03-0.06
							DT	60-100	0.05-0.10	0.05-0.10
M	Stainless steel and cast steel		Austenitic, duplex	600	14	180	GF	50-100	0.03-0.06	0.03-0.06
							DT	60-100	0.05-0.10	0.05-0.10
K	Grey cast iron (GG)		Ferritic/pearlitic		15	180	GF	50-100	0.03-0.15	0.05-0.18
							DT	80-140	0.05-0.25	0.05-0.3
			Pearlitic/martensitic		16	260	GF	50-100	0.03-0.15	0.05-0.18
							DT	80-140	0.05-0.25	0.05-0.3
	Nodular cast iron (GGG)		Ferritic		17	160	GF	50-100	0.03-0.15	0.05-0.18
							DT	80-140	0.05-0.25	0.05-0.3
			Pearlitic		18	250	GF	50-100	0.03-0.15	0.05-0.18
							DT	80-140	0.05-0.25	0.05-0.3
	Malleable cast iron		Ferritic		19	130	GF	50-100	0.03-0.15	0.05-0.18
							DT	80-140	0.05-0.25	0.05-0.3
			Pearlitic		20	230	GF	50-100	0.03-0.15	0.05-0.18
							DT	80-140	0.05-0.25	0.05-0.3
N	Aluminum-wrought alloys		Not hardenable		21	60	GF	80-160	0.03-0.15	0.03-0.015
							DT	100-200	0.05-0.20	0.05-0.20
			Hardenable		22	100	GF	80-160	0.03-0.15	0.03-0.015
							DT	100-200	0.05-0.20	0.05-0.20
	Aluminum-cast alloys	≤12% Si	Not hardenable		23	75	GF	80-160	0.03-0.15	0.03-0.015
							DT	100-200	0.05-0.20	0.05-0.20
			Hardenable		24	90	GF	80-160	0.03-0.15	0.03-0.015
							DT	100-200	0.05-0.20	0.05-0.20
		>12% Si	High temperature		25	130	GF	80-160	0.03-0.15	0.03-0.015
							DT	100-200	0.05-0.20	0.05-0.20
	Copper alloys	>1% Pb	Free cutting		26	110	GF	80-160	0.03-0.15	0.03-0.015
							DT	100-200	0.05-0.20	0.05-0.20
			Brass		27	90	GF	80-160	0.03-0.15	0.03-0.015
							DT	100-200	0.05-0.20	0.05-0.20
			Electrolitic copper		28	100	GF	80-160	0.03-0.15	0.03-0.015
							DT	100-200	0.05-0.20	0.05-0.20
S	High temp. alloys	Fe based	Annealed		31	200	GF	50-100	0.03-0.06	0.03-0.06
							DT	60-100	0.05-0.10	0.05-0.10
			Hardened		32	280	GF	50-100	0.03-0.06	0.03-0.06
							DT	60-100	0.05-0.10	0.05-0.10
		Ni / Co based	Annealed		33	250	GF	20-50	0.03-0.06	0.03-0.08
							DT	20-50	0.04-0.08	0.04-0.10
			Hardened		34	350	GF	20-50	0.03-0.06	0.03-0.08
							DT	20-50	0.04-0.08	0.04-0.10
			Cast		35	320	GF	20-50	0.03-0.06	0.03-0.08
							DT	20-50	0.04-0.08	0.04-0.10
	Titanium alloys		Pure	400	36	190	GF	30-60	0.03-0.10	0.03-0.12
							DT	30-60	0.05-0.13	0.05-0.15
			Alpha+Beta alloys hardened	1050	37	310	GF	30-60	0.03-0.10	0.03-0.12
							DT	30-60	0.05-0.13	0.05-0.15
H	Hardened steel		Hardened		38	55 HRC	GF	40-100	0.03-0.08	0.03-0.08
							DT	50-100	0.04-0.08	0.04-0.10