Deep Hole Drilling Systems

**GUNDRILL**
Internal Coolant Delivery
External Chip Exhaust

**BTA**
External Coolant Delivery
Internal Chip Exhaust

Deep hole drilling is accomplished productively using a variety of different tools, determined by finished tolerance objectives and starting condition of parts.

In addition to the machine dimensions, power and dynamics, compatibility of these tools with various machines is primarily determined by the fluid delivery and chip exhaust systems. The two most common deep hole drilling systems are Gundrilling and BTA.

Innovations by tooling manufacturers have caused machines to require an array of specialized options to support various fluid delivery and discharge strategies.

UNISIG will provide application advice after reviewing part drawings, tolerance requirements and production volume. Feed and speed recommendations are made by UNISIG based on reputable tooling manufacturer’s technical data and our experience drilling many varieties of standard and exotic materials.

Additional deep hole drilling references can be accessed at www.unisig.com, including more detailed information, videos, machines, and applications.
TOOLS FOR CREATING HOLES FROM SOLID

- **GUN DRILLING**
  - 1 - 50 mm [0.04 - 2.00 in] Internal coolant
  - 20 - 200 mm [0.79 - 7.87 in] External coolant
  - High-pressure coolant is introduced through the machine spindle and tool center.
  - Chips are discharged along the v-shaped groove on the outside of the tool body.
  - Special forms can be ground in tool tip to form tool operation.
  - Brazed, solid carbide, and insert tools are available.

- **BTA**
  - 20 - 630 mm [0.79 – 24.8 in] External coolant
  - High-pressure coolant is introduced through the space between the finished hole and the outside of the tool.
  - Chips are discharged through the tool center and machine spindle.
  - Compared to gun drilling, BTA method provides higher penetration rates (5-10 times faster) and has higher power requirements.

- **EJECTOR DRILLING**
  - 20 - 200 mm [0.79 - 7.87 in] internal and external coolant
  - Also called a dual tube system, consists of a drill head, outer tube, and inner tube.
  - High-pressure coolant enters through space between inner and outer tubes.
  - Chips are discharged through the inner diameter of the inner tube and exhausted through an adapter mounted to the front of the machine spindle.
  - Typically used to remove lathes or machining parts for deep hole drilling.
  - Chip evacuation is less efficient than BTA (Due to smaller area for chip fluid discharge).
  - Limited depth to diameter ratio compared to BTA system.

- **TREPANNING**
  - 20 - 500 mm [0.79 - 20.0 in] External coolant
  - Process performed on blank material without pre-drilled hole.
  - The tool leaves a solid core in the middle of the hole, rather than removing the entire machined area as chips.
  - Consumes less power than solid drilling, for the same hole diameter.
  - Trepanning in blind hole applications may not be practical due to the difficulty in removing the core.

TOOLS FOR SECONDARY Machining and Finishing

- **COUNTER BORING/ REAMING**
  - 20 - 630 mm [0.79 – 24.8 in] External coolant
  - A special configuration of counterboring in which the tool enlarges the existing hole as it is pulled back through the workpiece, keeping the boring bar in tension rather than compression for better control over straightness.
  - Can be used to straighten a hole with off-center hole geometry used.

- **BOTTOM FORMING**
  - 20 - 500 mm [0.79 – 20.0 in] External coolant
  - Bottom forming is essentially a form tooling operation for finishing off the base of a hole.
  - After deep hole drilling, the drilling may require a specific form to the hole.
  - Bottom forming tools are guided with wear pads along the finished hole diameter, and have very specific designs depending on customer needs.
  - Radius, steps, and flat bottom forms are common.

- **SKIVING AND ROLLER BURNISHING**
  - 20 - 500 mm [0.79 – 20.0 in] External coolant
  - A skiving tool can be visualized as a modified floating reamer, used to finish the outside of the tool.
  - Chips are discharged along the v-shaped groove on the outside of the tool body.

- **BOTTLE BORING** Special application External coolant
  - Bottle boring is also known as internal profiling or chamfering.
  - The tool is extended and retracted to produce the intended contour inside the workpiece.
  - The internal profile is then bigger within the part than at the entry and exit.
  - CNC is used to coordinate multiple axes simultaneously to achieve desired profiles.
  - Bottle boring tools are typically produced for specific profiles.

- **TUBE FINISHING** LARGE DIAmETER COUNTERBORE
  - 300 - 1200 mm [11.81 – 47.24 in] Internal coolant
  - Tube finishing for extremely large diameters requires specially configured counter boring tools.
  - This process can be visualized as a push counter boring operation with a gun drilling type of coolant supply, and BTA type indexable tooling.
  - In deep hole applications, skiving knives and burnishing rollers are often combined in the same tool.

DEEP HOLE DRILLING PROCESS PARAMETERS

**Cutting Speed** (M/min or M/S)

\[
\text{Cutting Speed} = \frac{\text{mm/rev} \times \text{RPM}}{25.4} = \frac{\text{FPM} \times 0.305}{\text{DIAMETER} (\text{inches})}
\]

**Feed Rate** (M/min or M/S)

\[
\text{Feed Rate} = \frac{\text{mm/rev} \times \text{RPM}}{25.4} = \frac{\text{FPM} \times 0.305}{\text{DIAMETER} (\text{inches})}
\]

**Cutting Fluid Flow Rate** (GPM or l/min)

\[
\text{Cutting Fluid Flow Rate} = \frac{\text{mm/rev}}{\text{rpm}} \text{L/min}
\]

**Approximate starting values:**

- 3.7 - 4.5 L/min per mm of tool diameter
- 75 - 100 ml/min per inch of tool diameter

**Cutting Fluid Pressure** (bar or PSI)

Pressure is developed due to the restriction of flow through process. Pressure is typically monitored for safety and tool condition and programmed for a maximum value. Coolant flow is of primary importance.