Description

Image

Image caption

(1) Heads of a milling machine © Blickpixel at Pixabay [Public domain] (2) Compact electric drilling machine © Byrev at Pixalbay [Public domain] (3) Titanium-carbon multi-material vibration drilling (aeronautical application) © Mitis at Wikimedia Commons (CC BY 3.0)

The process

DRILLING uses a rotary end cutting tool with one or more cutting lips and usually one or more flutes for the passage of chips and the admission of cutting fluid. Drilling is the fastest and most economical method of cutting a hole in solid metal. Shaped drills allow stepped holes and countersinking. Almost any material can be drilled; glass, stone and ceramic require drills with tungsten carbide or diamond tips.

Process schematic

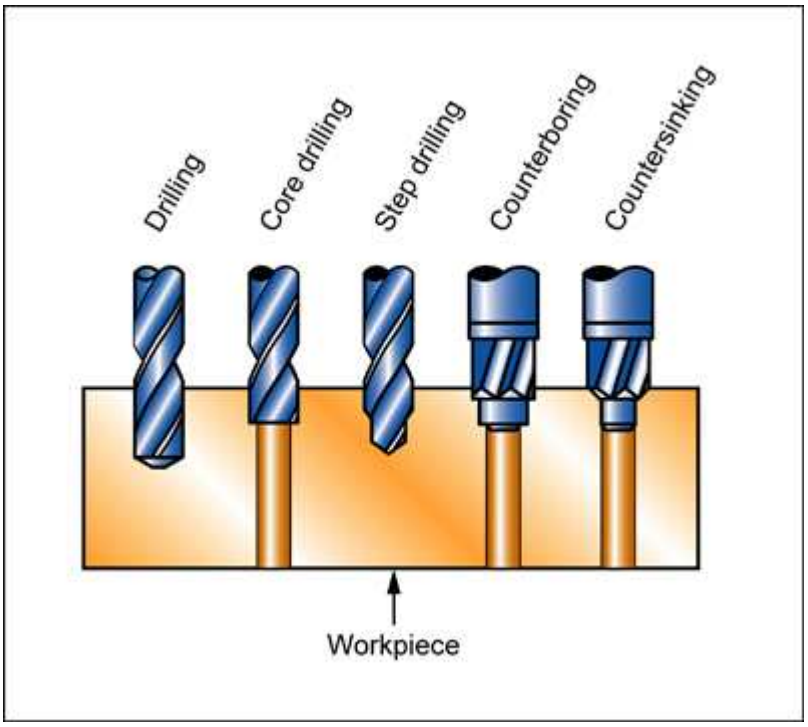

Figure caption

Drilling

Material compatibility

Ceramics	✓
Composites	✓
Foams	✓
Glasses	✓
Metals - ferrous	✓
Metals - non-ferrous	✓
Natural materials	✓
Polymers - thermoplastics	✓
Polymers - thermosets	✓

Shape

Circular prismatic	✓
Non-circular prismatic	✓
Flat sheet	✓
Dished sheet	✓
Solid 3-D	✓
Hollow 3-D	✓

Economic compatibility

Relative tooling cost	low			
Relative equipment cost	medium			
Labor intensity	high			
Economic batch size (units)	1	-	1e7	

Physical and quality attributes

Range of section thickness	0.1	-	500	mm
Tolerance	0.03	-	0.4	mm
Roughness	0.4	-	12.5	µm
Surface roughness (A=v. smooth)	B			

Process characteristics

Primary shaping processes	✗
Machining processes	✓
Discrete	✓
Prototyping	✓

Supporting information

Design guidelines

Holes with depth greater than three times the diameter (such as gun barrels) require different tooling, equipment and techniques.

Typical uses

Drilling is the principal way of creating circular holes in castings, blanks and other components. It can be used for metals with a hardness below Rockwell 50 Rc, ceramics, glasses and polymers.

The economics

Manual drilling is slow, making it expensive for all but the simplest jobs. Equipment varies from manual drill presses for small quantities to multiple-spindle systems for very high production levels. Automation increases output, at the penalty of greater tooling and equipment costs. In both cases the cost rises steeply with complexity of shape because of the need to reposition the workpiece and change tooling.

The environment

Lubricants and cutting fluids can pose an environmental problem. Special precautions are essential when machining composites because of glass or carbon dust, and when machining toxic materials such as beryllium

Links

MaterialUniverse

Reference