# Types of Holes in Engineering

Learn about the primary types of holes in engineering, how they are used and what is their callout symbol

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# Introduction

Holes play a fundamental role in engineering and serve numerous purposes in a variety of applications. From the simplest designs to the most complex machines, the presence of holes is integral to the functionality and integrity of engineering products.

What is a hole in engineering? What are the primary types of holes? What is a hole callout in engineering? What are the main differences between hole definitions? This e-book introduces the holes in engineering, exploring their various types, their applications, and the principles that guide their design.

You will find twelve types of holes in engineering: blind hole, through hole, interrupted hole, simple hole, counterbored hole, spotface hole, countersink hole, counterdrill hole, tapered hole, screw clearance hole, tapped hole, and threaded hole.

Each type has unique characteristics and plays specific roles in engineering designs, from structural components in aerospace engineering to complex parts in electronic devices.

# Fundamentals of Hole Design

The fundamental principles of hole design in engineering revolve around precision, functionality and integration. A well-designed hole is not just about its size and shape; it is about the material it is made of and how it interacts with the purpose it is serving. This involves a thorough understanding of the material properties, the forces applied to the hole and how it fits the end-use requirements of the product.

The applications of these various hole types are as diverse as the fields of engineering themselves. In aerospace, precision holes are critical for reducing weight while maintaining strength. In electronics, holes are essential for component mounting and heat dissipation. The automotive industry relies on various hole types for assembly, airflow management, and aesthetic purposes.

# What is a Simple Hole?

A simple hole in engineering refers to a circle that has been cut out of an object. There are different kinds.

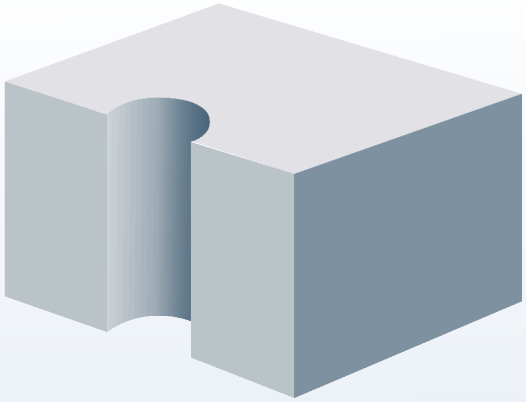
## What is the callout symbol for a simple hole?

The symbol used for a simple hole is ‘Ø.’ Simple holes are revealed on engineering drawings by giving the diameter and the specific depth of the hole.

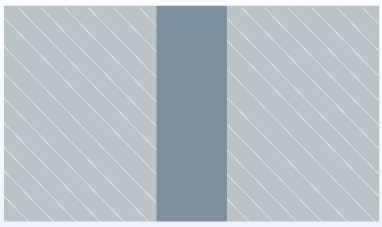

## How are simple holes used in engineering?

Simple holes serve many various purposes in engineering, from clearance, location, or assembly purposes to creating holes for fasteners to connect to.

isometric view



2D view



# What is a Blind Hole?

A blind hole is a hole that does not go completely through the material. This type has been reamed, drilled, or milled to a specified depth without going through to the workpiece's other side.

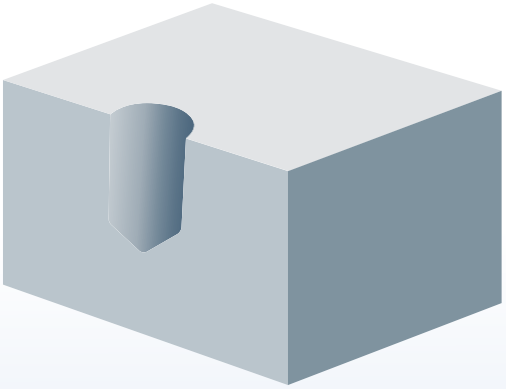
## What is the callout symbol for a blind hole?

There isn't a callout symbol for blind holes. A blind hole is specified with a diameter and a depth specification or the remaining amount of the workpiece.


## How are blind holes used in engineering?

Blind holes are used in engineering to measure residual stresses. CNC milling machines are used to make blind holes by running a thread milling cycle. There are three methods of threading blind holes: conventional tapping, single-point threading, and helical interpolation.

isometric view



2D view

# What is a Through Hole?

A through hole is a hole made to go completely through the material. A through hole goes all the way through the workpiece. It is sometimes called a thru-hole.

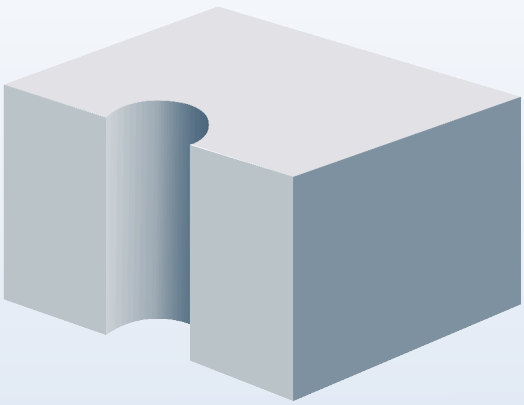
## What is the callout symbol for a through hole?

The callout symbol used for a through hole is the diameter ‘Ø’ symbol. Through holes are shown on engineering drawings by stating the hole’s diameter and depth. For example, a 10-diameter hole that goes straight through the component would be represented as “Ø10 Through.”

## How are through holes used in engineering?

Through holes are used for a variety of purposes in engineering. For example, through holes are often used for electronic components, such as holes drilled in printed circuit boards (PCBs).

isometric view



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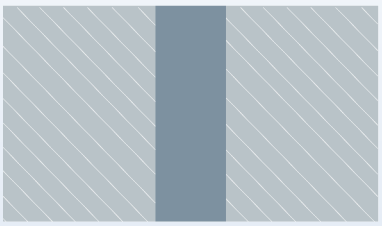
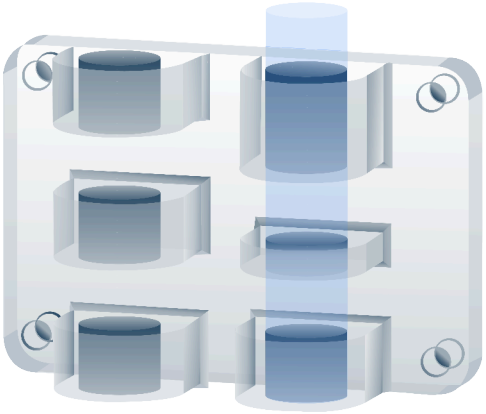


# What is an Interrupted Hole?

As the name suggests, an interrupted hole is a hole where another feature intersects the hole. A new hole-making operation drills a sequence of coaxial holes with gaps in the workpiece (the material is interrupted by empty space). Each drilling cycle is made of cutting and non-cutting moves.

isometric view



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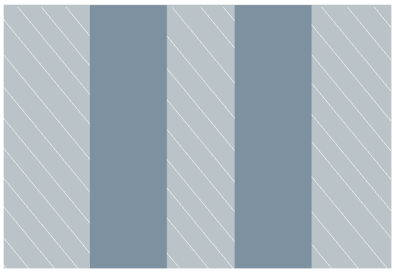
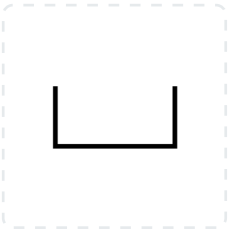


# What is a Counterbored Hole?

A counterbored hole is an enlarged cavity in a material for recessing the head of a fastener. There are different kinds.

## What is the callout symbol for counterbored holes?

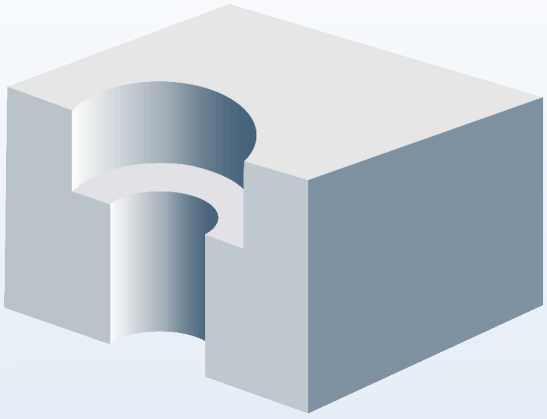
The callout symbol for counterbored holes is '⌴'. The diameter symbol and depth number are also added.



## How are counterbored holes used in engineering?

Counterbored holes are often used for PCBs. This type of hole is used in machining operations for socket-head screws. Counterbore holes are used for applications where the bolt or screw must sit beneath the surface.

isometric view



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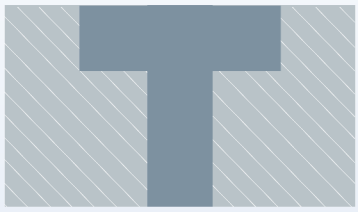


# What is a Spotface Hole?

A spotface hole is similar to a counterbored hole, but is shallow. It allows a fastener to sit flat.

## What is the callout symbol for a spotface hole?

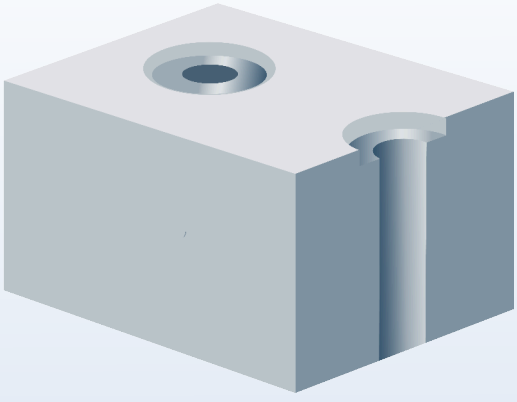
The callout symbol for a spotface hole is the counterbore symbol of ‘⌴’ with the letters ‘SF’ inside it.


## How are spotfaces holes used in engineering?

Spotfaces holes are used in engineering to create a smooth, flat surface on a machined part. A part made through casting may not have a smooth and flat surface like a machined component.

This means a spotface hole is machined, guaranteeing that the part being connected to a component with a rough exterior is located correctly.

isometric view



2D view

# What is a Countersunk Hole?

As opposed to a counterbore hole, a countersink hole has a more conical shape. A countersunk hole is a simple hole with a conical hole above it. Drilling this cone-shaped hole requires a little more calculation and precision than drilling a counterbore hole.

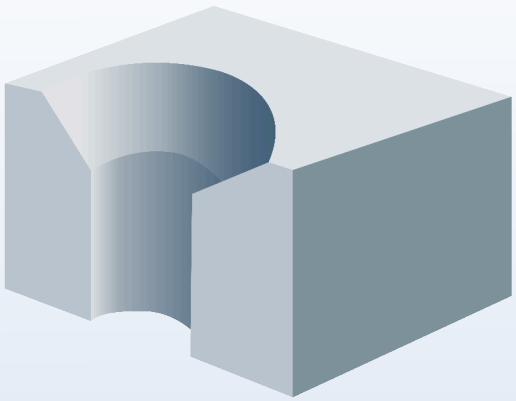
## What is the callout symbol for countersink holes?

The callout symbol for countersink holes is '⌵'.

## How are countersunk holes used in engineering?

Countersunk holes are used in engineering when a countersunk bolt or screw is required. Countersink holes like counterbored holes allow a bolt or screw to sit below the surface.

isometric view



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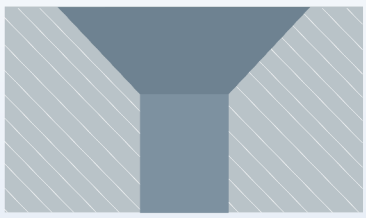


# What is a Counterdrilled Hole?

A counterdrilled hole is similar to a countersink hole, but has a recess above it.

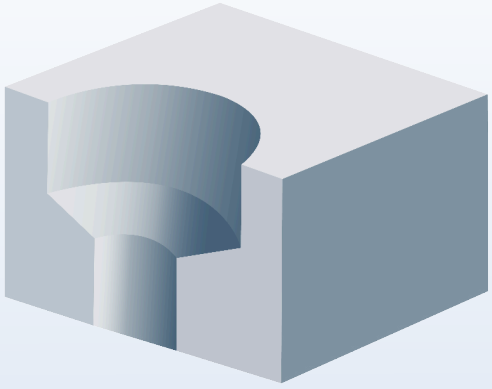
## What is the callout symbol for counterdrill holes?

The callout symbol for a counterdrilled hole is the same as a countersink hole, '⌵' but with a depth listed.

## How are counterdrilled holes used in engineering?

Counterdrilled holes, like countersunk holes, are used in engineering when a countersunk bolt or screw is needed. In addition, they are often used for PCBs.

isometric view



2D view

# What is a Tapered Hole?

A tapered hole is when the start diameter of the hole is a different width than the end diameter of the hole. It is wider at one end than the other.

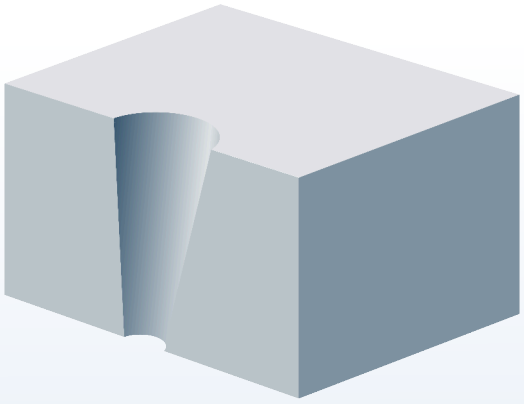
## What is the callout symbol for tapered holes?

The callout symbol for a tapered hole is a triangle with a line through it. The end diameter and ratio are also listed.

## How are tapered holes used in engineering?

Tapered holes are used in engineering for many different applications. One common example is to secure cutting tools or other tool holders.

isometric view



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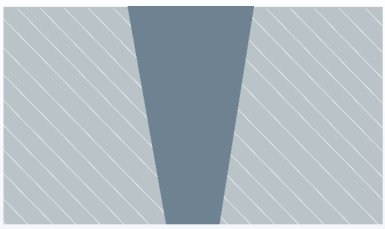


# What is a Screw Clearance Hole?

A screw clearance hole is a simple hole with a slightly bigger diameter than a screw thread so that the screw can pass through. It allows an object large enough to enable threads of a screw or bolt to pass through but not the head of the screw or bolt being used.

## What is the callout symbol for screw clearance holes?

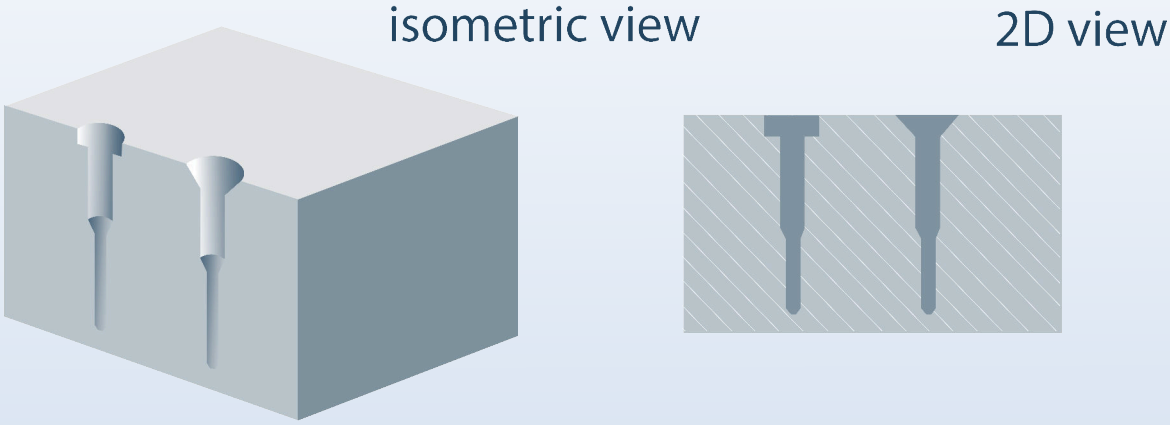
The callout symbol for a screw clearance hole is the same as a simple hole and has the specified depth.


## How do I pick the size of a screw clearance hole?

The size of a screw clearance hole is calculated by adding the diameter of the screw and the diameter of the screw head and then dividing the sum by two. This method of selecting the size will yield the largest hole that will fit under the head of the fastener. Many CNC milling machines can create a screw clearance hole.

## How are screw clearance holes used in engineering?

Screw clearance holes are used in engineering for parts that need a screw or bolt to go through them.



# What is a Tapped Hole?

A tapped hole is a hole drilled before a machine screw is inserted. It has threads cut into the hole's inside surface through the tapping process.

## What is the callout symbol for a tapped hole?

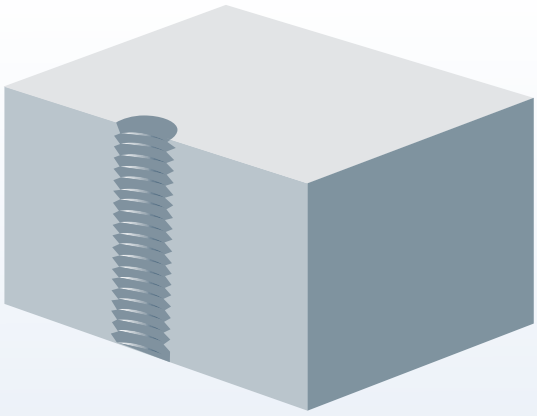
The callout symbol for a tapped hole, for metric holes, has the diameter symbol replaced with an 'M'.

M

## What are tapped holes used for in engineering?

They are used in engineering with metals where a nut and bolt cannot be used. They hold threaded components with their internal threads.

isometric view



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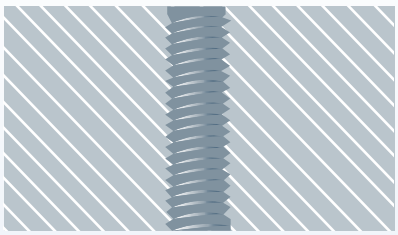


# What is a Threaded Hole?

Threaded holes are holes with threads. They are similar to tapped holes but are made differently.

## What is the callout symbol for threaded holes?

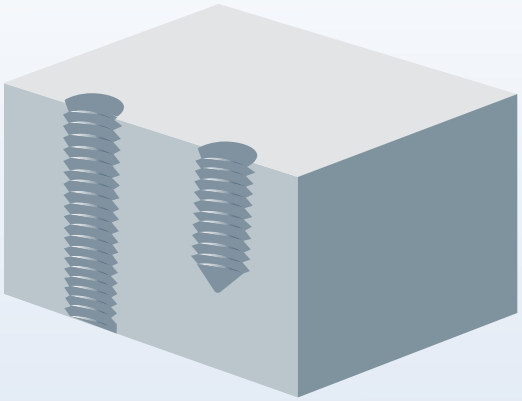
The callout symbol for threaded holes is the ‘Ø’ diameter symbol, unless they are metric, in which case the diameter symbol is replaced with an ‘M’. The threaded depth is written.

M

## What are threaded holes used for in engineering?

In engineering, threaded holes are integral aspects of mechanically fastened parts. They are easy to add with CNC machines. Threads are usually added last after most other elements of the part have been machined.

isometric view



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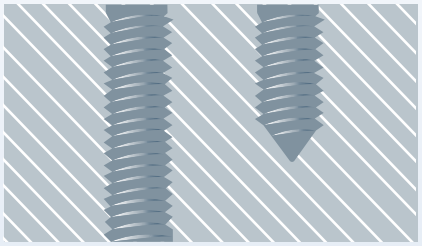
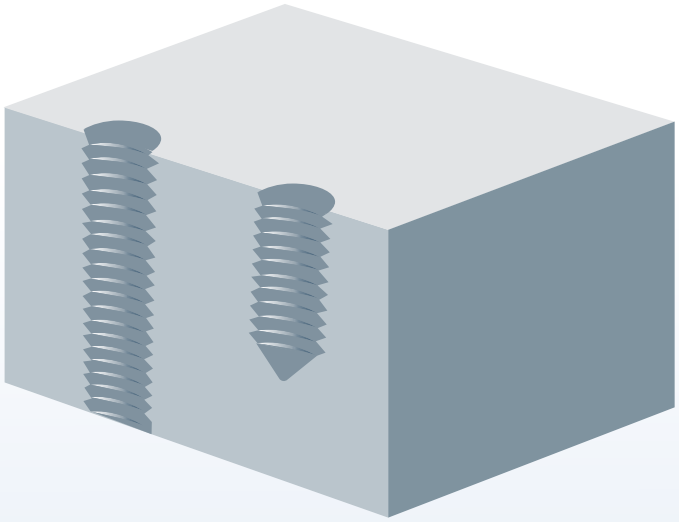


# Tapped Holes vs. Threaded Holes

Cut and milled taps are similar, but are produced by two different machining processes. The main difference between cutting and milling is the tool and the surface to which the processes are applied.

In thread milling, the thread profile is milled into the surface in detail using a milling tool. This applies to both internal and external threads. In the tapping process, the thread profile is cut out with a tap that fits into the core hole, like a drill, or removed from the outside with an external tap shaped like a nut.



# Summary

This ebook provided a summary of the various types of holes used in engineering designs, how they are called out symbolically, and what conditions drive their use.

The design and production of holes brings its own challenges, especially when working with advanced materials or complex geometries. Engineers must overcome issues related to tool wear, maintaining dimensional accuracy, heat generation during machining and the potential for material stresses. Furthermore, integrating the holes into a larger assembly requires careful consideration to ensure that it does not compromise the functionality or durability of the component.

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