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# Mechanical Workshop

## Module 6: Drilling

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PREPARED BY

**IAT Curriculum Unit**

January 2010

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## Module 6: Drilling

### Module Objectives

After the completion of this module, student should be able to:

1. Describe the operation of a drill press.
2. Identify the drill press parts.
3. Identify the parts of a twist drill.
4. Determine the drill size by measurements or direct reading.
5. Identify the drill and work holding devices.
6. Describe and follow the procedure when performing the drilling operation.
7. Explain and apply the safety rules that should be followed before and during the drilling operation.

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## 1. Introduction to Drilling

Drilling is used to create round holes. It is accomplished by a rotating tool that is typically has two cutting edges. The tool is fed in a direction parallel to its axis of rotation into the work-part to form the round hole as shown in Fig.6.1.

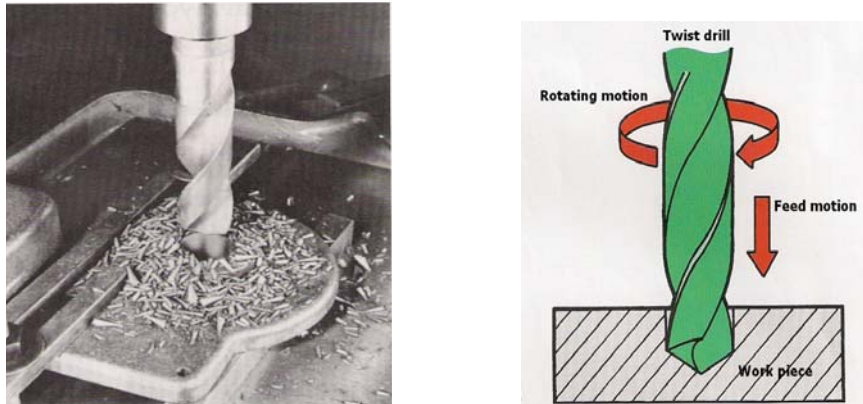


Fig. 6.1: The drilling process.

## 2. The Main Parts of The Floor Drill Press

The floor (pedestal) drill press is a drill press which sits on the floor. It is used to drill small to medium sized holes and other light drilling operations. The main parts of the floor drill press are shown in Fig. 6.2.

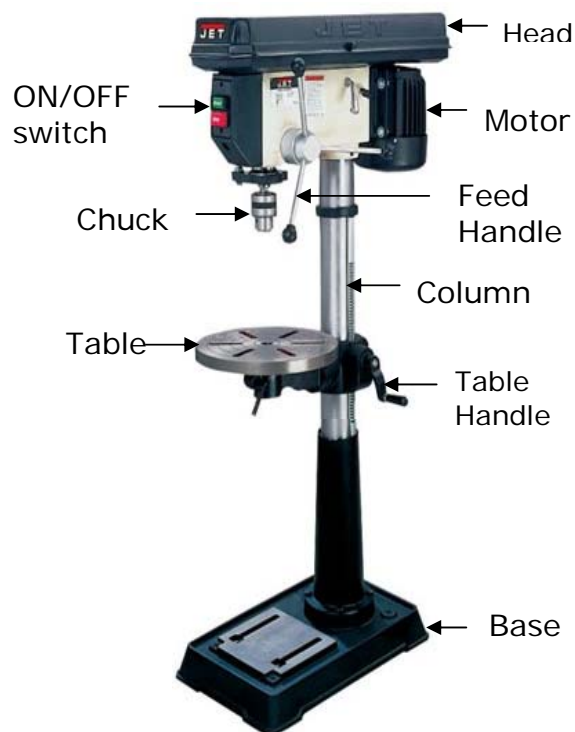


Fig. 6.2: The main parts of the floor drill press.

### 3. Twist Drills

The most common tool used in a drill press to cut a hole is the twist drill shown in Fig.6.3a.

The twist drill is a rotary cutting tool that is made of a piece of round steel stock. The cutting edges down near the point of the drill cut away material as the drill is moved into contact with the workpiece.

The main parts of the twist drill are listed below and are shown in Fig.6.3b.

1. Shank
2. Body
3. Point
4. Web
5. Tang

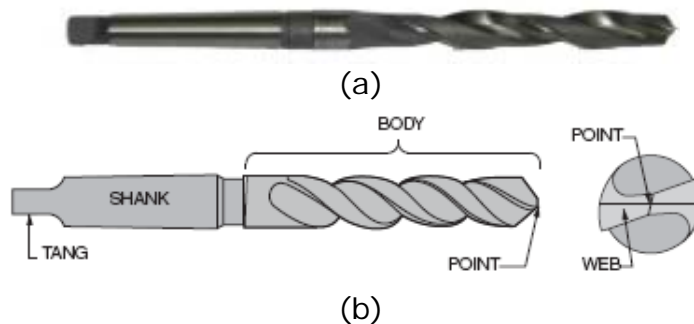


Fig. 6.3: (a) Twist drill. (b) Main parts of a twist drill.

### 4. Types of Drill shanks

Drills are classified according to the shape of the shank into two main types:

#### 4.1. Straight (Parallel) shank drill

Straight shank or parallel shank drill is shown in Fig.6.4a. Most of small drills up to 13 mm in diameter have straight shanks.

#### 4.2. Morse taper shank drill

Morse taper shank drill is shown in Fig.6.4b. Tapered drills are supplied in diameters ranging from 3 mm to 100 mm diameter. Most drills that are larger than 13 mm are tapered.



Fig.6.4: (a) Straight shank drill.

(b) Taper shank drill.

## 5. Determining The Drill Size

Most drills have the diameter size stamped on the shank. However, generally, the micrometers and drill gauges are used to determine and check the drill diameters. Fig 6.5. shows a drill gauge that is used to determine the drill bit size.

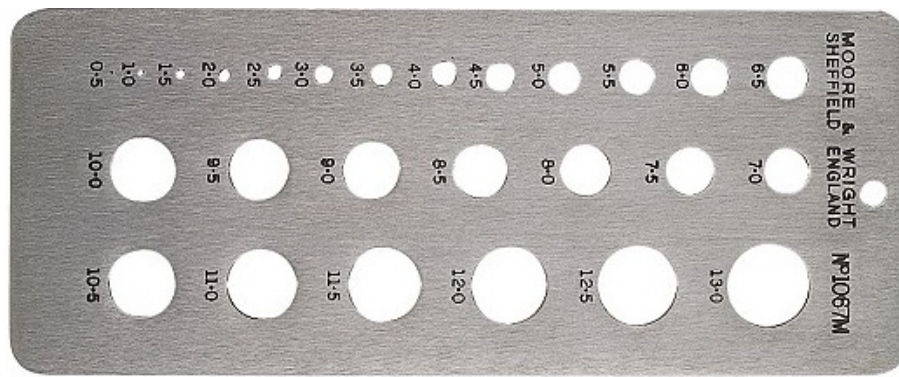


Fig. 6.5: Drill gauge.

## 6. Practical Task 1

### Determine the size of a drill

1. Select 5 drills of different sizes.
2. Measure the diameter of the drill at the margin of the drill tip (Fig.6.6) using a micrometer.
3. Enter the reading in the table below and compare the measured size with the size stamped on the shank.

Drill	Micrometer Reading	Drill Specification
1		
2		
3		
4		
5		



Fig.6.6: The proper location for measuring the drill size.

## 7. Drill-Holding Devices

The holding device is used to hold the drill during the drilling operation. There are two main methods to hold the drill.

### 7.1 Chucks

The chuck is an adjustable moving jaw mechanism mainly used for drills with straight shanks. The chuck and chuck key are shown in Fig.6.7.



Fig. 6.7: Drill chuck and chuck key.



Drift

## 7.2 Tapered spindles

A tapered opening is used for drills with taper shanks.

The drill is locked in the spindle with friction and is removed from the spindle by using a drift as shown in Fig.6.8.

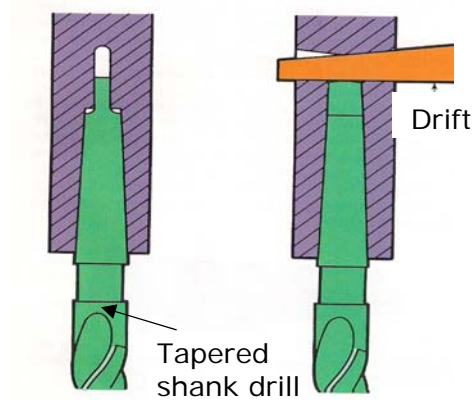


Fig. 6.8: Ejection of a tapered shank drill from the spindle.

## 8. Work-Holding Devices

Work-holding devices are used to hold the workpiece during the drilling operation.

### 8.1 Vises

Vises are widely used to hold the workpiece during the drilling process. The vise must be bolted to the drill table to ensure a safe and proper practice as shown in Fig.6.9.

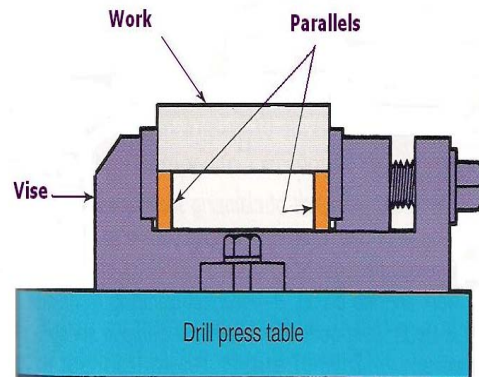


Fig. 6.9: Drill press vise.

### 8.2 T-bolts and Clamps

The T-bolts and clamps are used to hold a round workpiece onto the drill press table as shown in Fig.6.10.

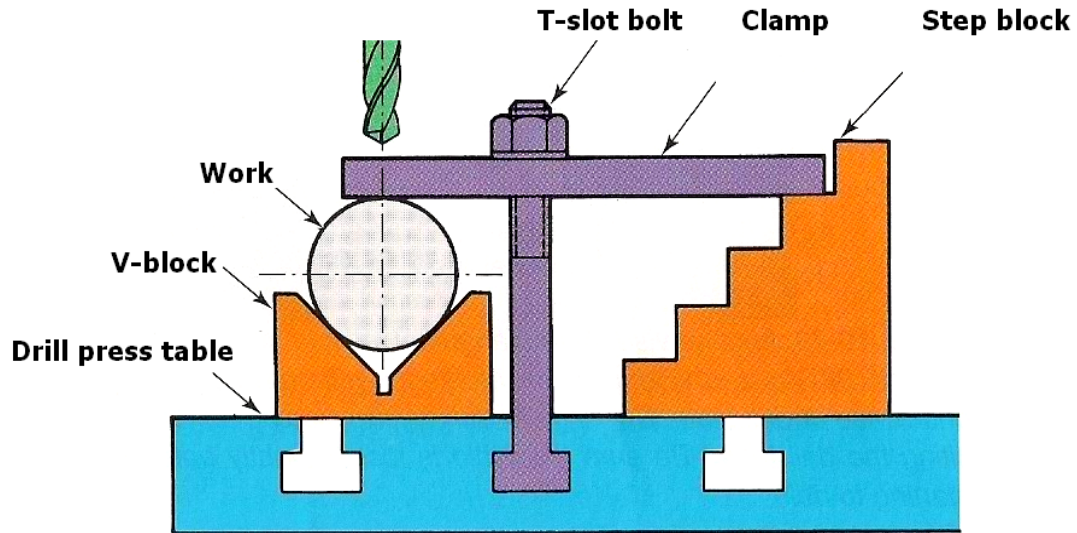


Fig. 6.10 T-bolts and Clamps.

## 9. Cutting Speed and Different Materials

Cutting speed is the speed at the outside edge of the tool as it is cutting the workpiece. Cutting speeds depend on the type of material being cut and the type of cutting tool being used.

The hardness (the ability of the material to resist being scratched) of the work material has a great impact on selecting the cutting speed. The harder the work material, the slower the cutting speed. The softer the work material, the faster the cutting speed as explained in Fig.6.11.

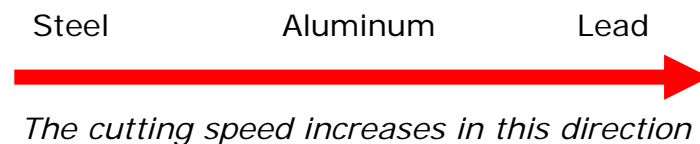


Fig.6.11: Comparing the cutting speed of different materials.



## 10. Drilling Procedures

When drilling a hole in a material by using a drilling machine, the following steps should be followed.

### 10.1 Before drilling (while the machine is powered off)

1. Wear the safety gear required which includes wearing a safety shoe, a goggle, an overall, a hair net to secure long hair and also remove watches and jewelry and follow other safety rules explained by your instructor.
2. Use measuring tools and layout tools to locate the centers of the holes to be drilled.
3. Use a center punch to make an indentation (marking) at the centers of the holes locations.
4. Determine the drill size to be used.
5. Place the drill in the chuck or drilling machine spindle.
6. Tighten the chuck with a chuck key, or turn the shank until the tang fits in the slot.
7. If a chuck is used, remove the chuck key as shown in Fig. 6.12.
8. Adjust the table to the desired height by using the table handle.
9. Turn the feed handle to lower the drill. Ensure that the drill can be lowered enough to drill the hole as shown in Fig. 6.13.
10. Use the work-holding device to secure the material to be drilled.
11. Set the drilling machine to the correct speed.
12. Turn the feed handle to align the first center punch mark under the drill.



Fig. 6.12: Remove the chuck key after tightening the chuck firmly.



Fig. 6.13: Using the feed handle to lower the drill.

### **10.2 During drilling (while the machine is turned on)**

1. Turn the feed handle to lower the drill to the material.
2. Apply light pressure to the feed handle to start drilling the hole. Be careful that too much pressure could break small drills.
3. Withdraw the drill and turn the drilling machine off.
4. Remove the workpiece from the table.
5. Remove the drill, store the drill in its proper place and clean the drilling machine table using a brush.

## **11. Drilling Safety**

When using any drilling machine you must observe the safe working practice at all times;

1. Know the position of the emergency stop.
2. Wear all the safety gear required for the job.
3. Make sure the chuck key is removed.
4. Tighten the clamps, vise and table locks.
5. Do not wear loose clothing (wear overall).
6. Do not hold the work in your hand (use a clamp).

## 12. Practical Task2

### 12.1 Objective

To drill the holes in the drill gauge project (see the drill gauge project document) according to the indicated diameters shown in Fig.6.14.

### 12.2 Required Tools

SR	Tool	SR	Tool
1	Bench drill	3	Brush
2	Set of drilling bits	4	Micrometer

### 12.3 Procedure

1. Wear the safety gear required.
2. Follow the drilling procedure while the machine is powered off as explained in section 10.1.
3. Turn on the machine and follow the drilling procedure as explained in section 10.2.

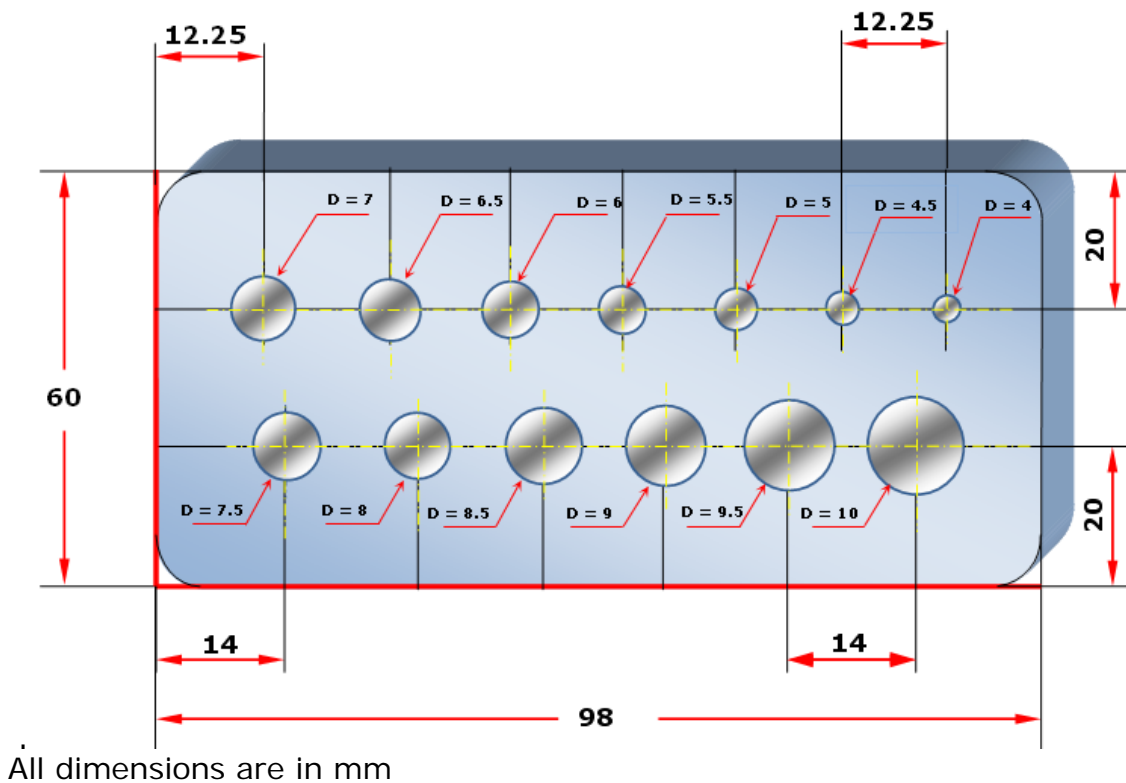


Fig 6.14: The drill gauge detailed drawing

Student's notes

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