



LEARNING OBJECTIVES

1. To know about the fasteners like bolts, nuts, washers, screws.
2. To know about threads, types and its uses.
3. To know about the nomenclature of thread.
4. To know about the key, key ways and its uses.

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8.1 INTRODUCTION

- Fastener may be defined as a machine element used for holding or joining two or more parts of a machine or a structure. This process of joining the parts is known as fastening.
- Machines, vehicles, playthings are made by joining some spare part together.
- Bolt and Nut, screws, rivet, cotters, key and keyways, couplings, welding and soldering are methods which are used to assemble many machines and others

8.2. TYPES OF FASTENERS

The fasteners are classified into two types depends upon whether the assembled parts can be dismantled or not.

1. Temporary Fasteners
2. Permanent Fasteners



8.2.1. Temporary Fasteners

The temporary fasteners are fasteners that can be dismantled from connecting parts without damaging the parts.

Ex.: Screws, bolts, nuts, studs, keys and couplings

8.2.2. Permanent Fasteners

The permanent fasteners are fasteners that cannot be dismantled from connecting parts without damaging the parts.

Ex.: Welded, riveted joints and soldered joints.

8.2.3. Difference between Temporary Fasteners and Permanent Fasteners

Temporary Fasteners	Permanent Fasteners
Parts can be disassembled without damaging.	Cannot be disassembled, parts will be damaged
Parts which are worn can be replaced	Cannot be replaced
Assembling and disassembling are easy	Assembling and disassembling are very tough
Strength of this fastening is limited	Strength of this fastening is very strong
Less cost	More cost

8.3. BOLTS

Bolt is a metal shaft with external thread that is used to fasten two different parts together.

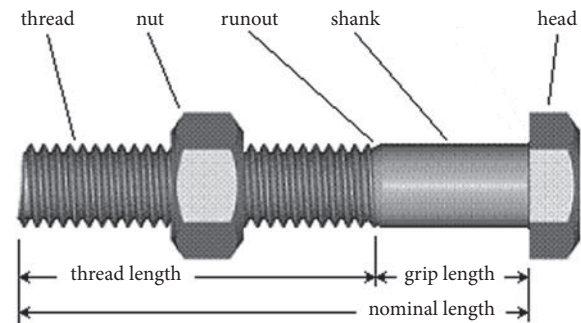


Figure 1 Bolt

8.3.1. Bolt Nomenclature

A bolt consists of two parts known as a shank and a head.

Shank: It is a thread-less part of the bolt between the head and thread. It increase the shearing capacity of the bolt.

Thread: It is a helical groove cut on the cylinder surface of the bolt.

Head: It is the part to hold the bolt and to fit the corresponding tightening tools. The shape of the bolt head is used depending upon the purpose for which the bolt is used.

8.3.2. Types of Bolts

Some important types of bolts are

1. Through Bolt
2. Tap Bolt
3. Stud Bolt

Through Bolt: Through bolts are used to connect two parts which have unthreaded holes on them. The bolt is inserted in to the hole and the other end is tightened with a nut



Figure 2 Through Bolt

Tap Bolt: A tap bolt differs from an ordinary bolt. The two parts to be connected, one is threaded hole and another one is plain hole. The bolt is screwed into a threaded hole without the nut, while it passes freely through a plain hole on the upper part.



Figure 3 Tap Bolt

Stud Bolt: Bolts that do not have a head is called as stud bolt. The center of the bolt may have a collar or square section. The stud is threaded at both ends. One end of the stud is screwed into a tapped hole of the parts to be fastened, while the other end receives a nut on it. It is used to cover the engine and pump cylinders, valves etc.



Figure 4 Stud Bolt

8.4. NUTS

An element used with a bolt or a stud to join two or more parts together temporarily is known as a nut. It has a threaded through hole to accommodate the bolt or stud.



Figure 5 Nuts

8.4.1. Types of Nuts

Some important types of nuts are

1. Square Nut
2. Hexagonal Nut

8.5. THREAD

Thread is a helical groove cut on the outer or inner of the cylindrical surface of the bolt.

8.5.1. Nomenclature of Thread

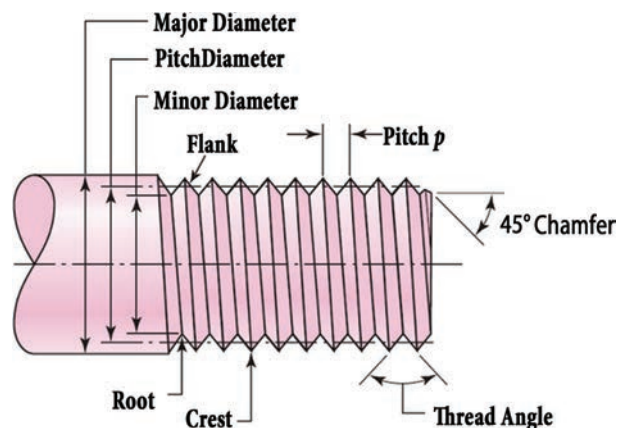


Figure 6 Thread Nomenclature

Name of the Part	Description
Major Diameter	This is the largest diameter of a screw thread, touching the crests of an external thread. A screw thread is specified by its major diameter.
Minor Diameter	This is the smallest diameter of a screw thread, touching the roots or core of an external thread.







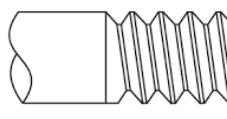



Name of the Part	Description
Crest	It is the peak edge of the screw thread that connects adjacent flanks of a thread at the top
Root	It is the bottom edge of the thread that connects the adjacent flanks of a thread at the bottom.
Flank	The inclined flat surface of the thread which connects the crest and the root
Depth of Thread	The depth of the thread is the distance between the crest and root which is measured right angle to the axis.
Pitch	Pitch is the distance measured parallel to the axis, between one thread to the corresponding point on the adjacent screw threads.
Lead	It is defined as the distance which a screw moves axially in one complete rotation. Lead is equal to 1/TPI and is equal to pitch. (TPI- No. of Number of Threads per Inch)

8.5.2. Types of Threads

Thread are classified into two types V-shaped thread and square shaped thread, and further divided into the following in table.

Types	Pictures	Applications
Right Hand Thread		Used on bolts and nuts

Types	Pictures	Applications
Left Hand Thread		Left pedals of cycles, Blade assembly of a mixer grinder
Single Start Thread		Screws and screw-in hooks
Multi Start Thread		Gate valves, Vertical turret lathe, planetary screws
External Thread		All types of screws and bolts, taps
Internal Thread		All type of nuts and dies

8.5.3. Forms of Threads

The thread form is the configuration of the thread in an axial plane. It is the profile of the thread, composed of crest, root and flanks.

Common standards followed in threads

1. British Standard Whitworth Thread (BSW)
2. British Association Thread (BA)
3. Metric Thread
4. Acme Thread

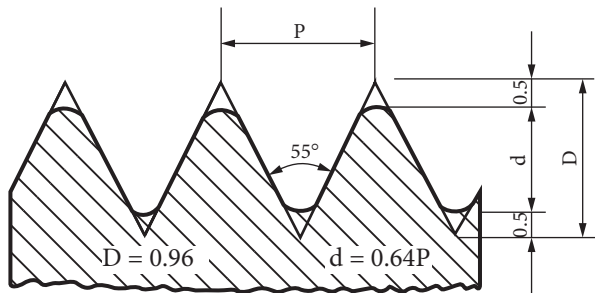
British Standard Whitworth Thread:

This form of thread is used as a Standard thread in Britain. It is the modified form of 'V' thread having angle of 55°. British





Standard Fine (BSF) and British Standard Pipe (BSP) threads have the same profile of the BSW threads. It is widely used in machine parts. The British Standard threads with fine pitches (B.S.F) are used where more strength is required.



Whitworth Thread Form

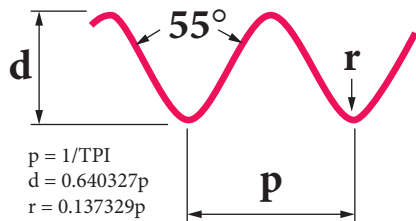


Figure 7 British Standard Whitworth Thread

British Association Thread: The angle of BA thread is $47\frac{1}{2}^\circ$. It has fine pitches. This form of thread is generally used at precious instrument like micrometer and vernier caliper, etc... screw having diameters less than $\frac{1}{4}$ inch.

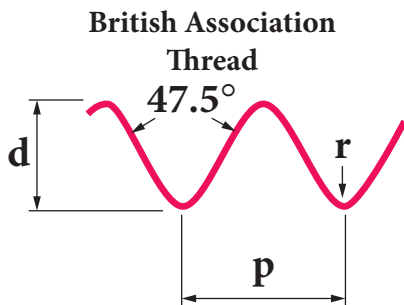
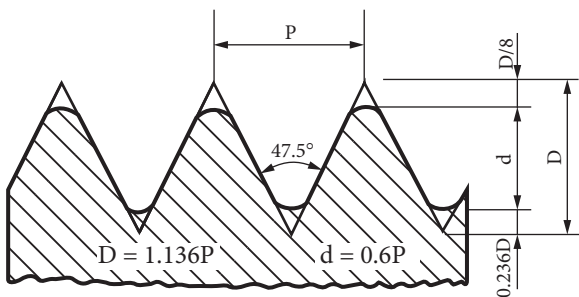
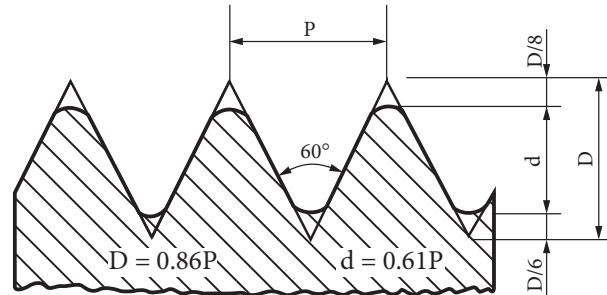


Figure 8 British Association Thread

Metric Thread: The angle of metric thread is 60° . It is an Indian Standard Thread and similar to B.S.W thread. This types of thread is mostly used in industries.



Metric Thread

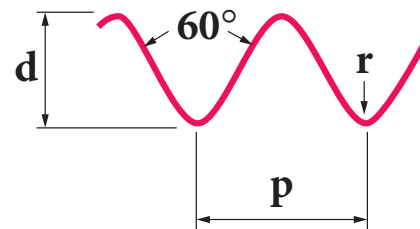


Figure 9 Metric Thread

Acme Thread: The angle of the thread is 29° . It is modification of square thread. It is stronger than square thread. This type of thread is used in lathe lead screws and radial drilling machine etc.

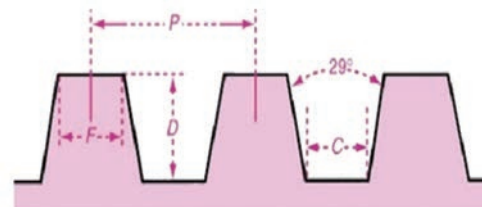
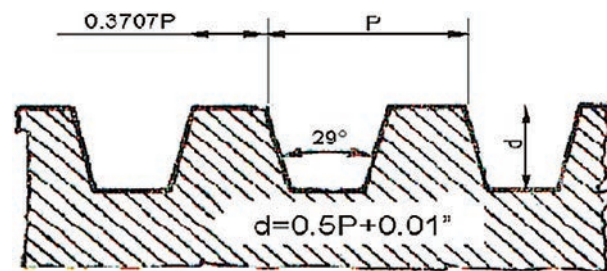


Figure 10 Acme Thread



8.6. WASHERS

A circular disc of a metal, having a hole in centre for inserting a bolt is known as a washer. It is placed between the nut and surface and head of bolt and surface to provide a perfect seating for the nut and bolt. The washer is generally specified by its hole diameter.



Figure 11 Washer

8.6.1 Uses of Washers

- To provide perfect seating on bolt
- The pressure applied on the nut is limited
- If the hole is bigger than the head of the bolt, the washer is used

8.6.2. Types of Washers

The washers are classified into two types as follows

1. Plain Washer
2. Spring Washer



Figure 12 Split Washer

8.7. KEYS AND KEYWAYS

Keys are machine elements used to connect a shaft and the parts, such as pulleys, gears, couplings etc. so the shaft rotates along with gears, (or) Flange also rotates which connected with shaft. It is subjected to

shearing and torsion stresses, hence it is always made of steel.

The groove cut on the shaft and the groove cut inside the pulleys, gears and flange, which is parallel to their axis is called “key way”.

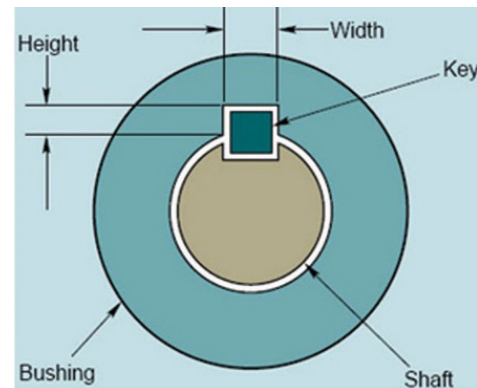
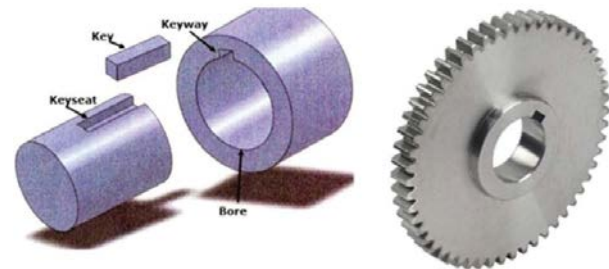
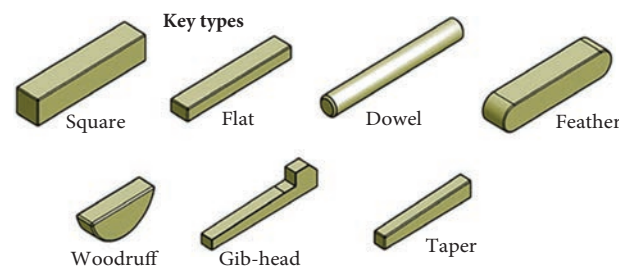


Figure 13 Key and Key Way

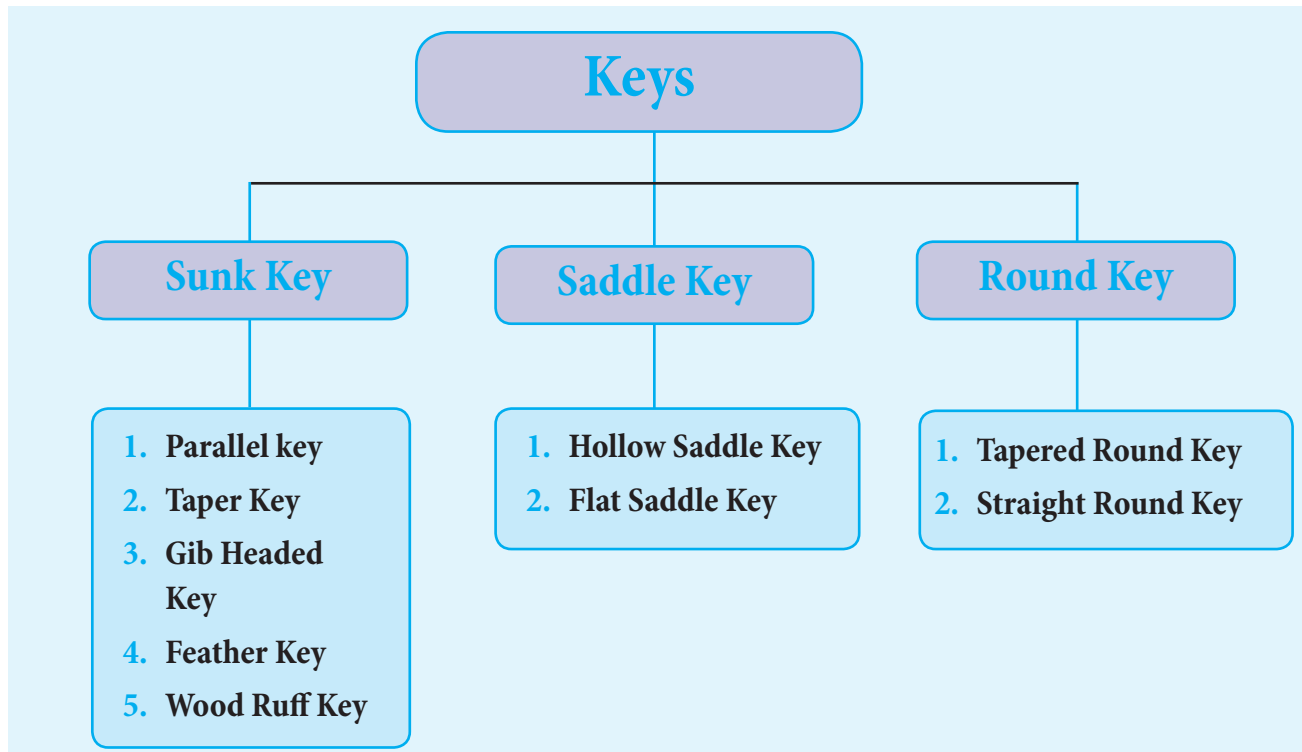
8.7.1. Types of Key



Sunk Key

This is a standard form of key and it may be either rectangular or square in cross section.

Parallel Key: A parallel key is rectangular or square in cross-section and uniform in width and thickness, throughout its length. These keys are generally used where pulleys, gears or other similar parts



are secured to the shaft permitting relative axial movement.

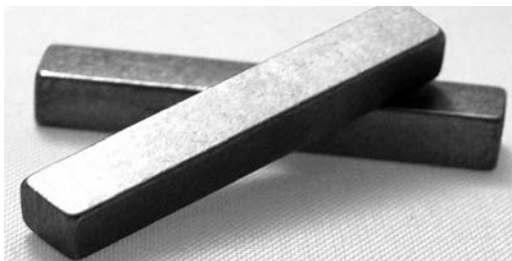


Figure 14 Parallel Key

Taper Key: A taper key is uniform in width but tapered in thickness. The bottom surface of the key is flattened and the top surface is tapered. The magnitude of the taper is 1:100.

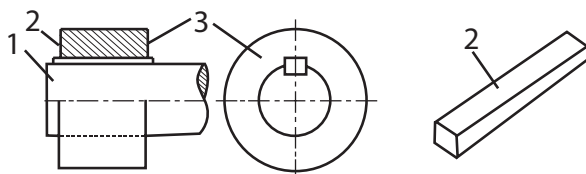


Figure 15 Taper Key

Gib-Headed Key: A taper key is generally removed by hammering at its thinner end, when that end is inaccessible.

The key is usually provided with a head called gib-head which enable to remove the key. This type of key is used when the connected parts are to be separated occasionally for the purpose of repair.

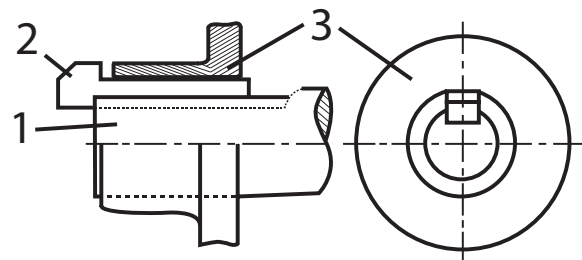


Figure 16 Gib-Headed Key

Feather Key: A Feather key is attached to one member of the pair, screwed to the shaft. Feather keys are parallel keys and permit relative axial movement of the pair. It may be rectangular, square, dovetail (or) rounded in cross-section.



Figure 17 Feather Key





Woodruff Key: A Woodruff key is also known as a half-moon key, is a semi-circular machine shaft that prevents gears, hubs, or other components from moving independently of a rotating shaft or spindle.

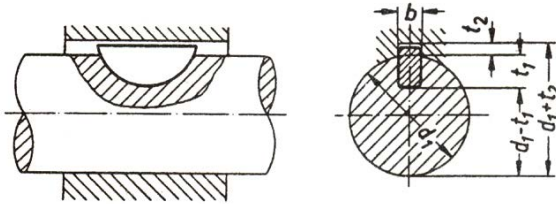


Figure 18 Woodruff Key

Saddle Key

The top of this key is fixed into the keyway of the hub. The bottom of the key is mounted on the shaft. There is no key-way in the shaft. Saddle keys are used for low power transmission.

Hollow Saddle key: A hollow saddle key has a concave shaped bottom to suit the curved surface of the shaft on which it is used. The keyway is only cut in the hub of the wheel. The relative rotation is prevented by the friction between the key and the shaft.

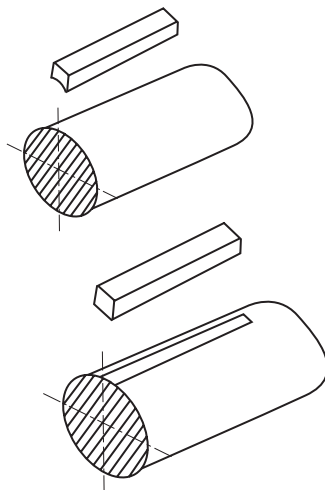


Figure 19 Saddle Key

Flat Saddle Key: It is similar to the hollow saddle key except that the bottom surface of it is flat. It fits on the flat surface provided on the shaft. It gives more gripping than a hollow saddle key.

Rounded Key

Keys of circular cross-section are called rounded keys, usually tapered along the length. A round key fits in the hole drilled partly in the shaft and partly in the hub. It is generally used for light duty transmission of power.

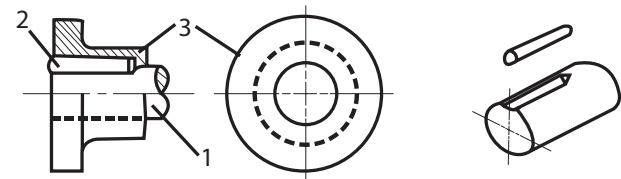


Figure 20 Rounded Key

8.7.2. Important Dimensions of Keys

- D** - Diameter of the shaft
- T** - Thickness of the key
- W** - Width of the key
- R** - Radius of the key
- L** - Length of the key
- d** - diameter of the key

Taper Ratio is 1 : 100

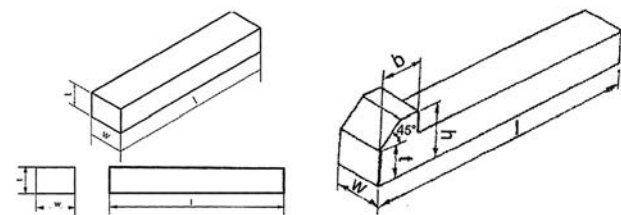


Figure 21 Dimensions of Key



Glossary

1.	Fasteners	இணைப்புப் பொருட்கள்
2.	Helical groove	சுருள் பள்ளம்
3.	Pulley	கப்பி
4.	Keys	சாவிகள்
5.	Shaft	உருளை தண்டு
6.	keyway	சாவிப்பள்ளம்

Activities

1. Collect different types of Bolts, Nuts, Washers, Keys.

QUESTIONS



PART A

I. Choose the correct option :

1. An example for Permanent fastener is
 - a) Welded Joint
 - b) Screwed Joint
 - c) Keyed Joint
 - d) Couplings
2. A screw or bolt is specified by its
 - a) Major diameter
 - b) Minor diameter
 - c) Pitch diameter
 - d) Pitch
3. The washer is generally specified by its
 - a) Outer diameter
 - b) Hole diameter
 - c) Thickness
 - d) Mean diameter

4. keys are made of
 - a) Tungston
 - b) Steel
 - c) Cast Iron
 - d) Lead

5. The angle of metric thread is
 - a) 55°
 - b) 47°
 - c) 60°
 - d) 30°

PART B

II. Answer the following questions in one or two sentences:

6. Define 'pitch' of a thread?
7. What are the types of bolt?
8. Mention the types of sunk keys?
9. Mention the angles of following threads.
 - a) BSW thread
 - b) Metric thread
 - c) Acme thread
10. Mention the form of threads?





PART C

III Answer the following questions in about a page?

11. Define “Temporary Fasteners” and “Permanent Fasteners” with examples.
12. Mention the types of threads and its uses.
13. Define ‘Washer’ and write its uses.
14. What are different types of keys?
15. What are the important dimensions of key?

PART D

IV. Answer the following questions in detail:

16. Write the difference between Temporary fasteners and Permanent fasteners?
17. Draw any one of assembled view of the keys and explain about it.
18. Draw and mention the nomenclature of threads.
19. Draw and explain any two forms of thread.