Combination drill - Appropriate selection of size from chart, drill chucks

Objectives : At the end of this lesson you shall be able to
- **state what is centre drilling**
- **state the purpose of centre drilling**
- **state the defects in centre drilling**
- **indicate the causes for the defects**
- **state the remedies to avoid the defects.**

Centre drilling (Fig 1)

It is an operation of drilling and countersinking a hole on the face of the work, and on the axis of the work. It is done by a cutting tool known as centre or combination drill held in a drill chuck. The drill chuck is mounted in a tailstock spindle and the feeding on the drill to work is done by rotating the tailstock hand wheel. The spindle speed for the work rotation is calculated, taking into consideratiion the plain drilling diameter and the recommended cutting speed for the drilling. (Fig 2)

Fig 1

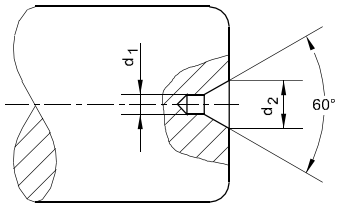
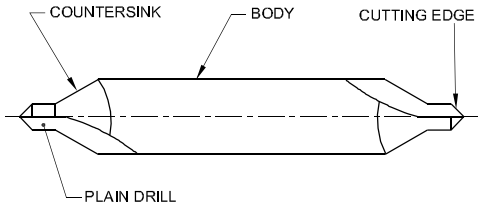


Fig 2

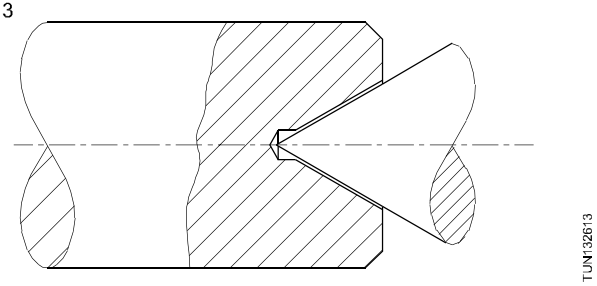


Defects in centre drilled holes

The two major defects in centre drilling are:

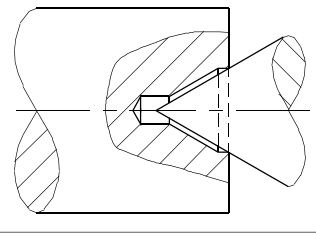
- insufficient depth of plain drilled portion (Fig 3)

Fig 3



- centre drilling-done too deep. (Fig 4)

Fig 4



The first defect results in making the tip of the centre to contact the work surface, and the conical portion of the centre does not have any contact with the bearing surface of the centre drilled hole. Undue friction and overheating will be noticed which will damage the tip of the centre. Sometimes breakage is also possible and the broken part of the centre may get welded to the centre hole. By feeding the centre drill up to 3/4th of the 60° countersink, this defect is avoided.

when the centre arm feeding is too much, a plain drilled portion by the body of the centre drill will be formed at the nose of the bearing surface of the centre hole, and the area of contact between the bearing surface and the work-supporting centre will be the only point of contact, as illustrated in Fig 4. This will not provide proper support to the work and any operation if carried out, may result in dimensional inaccuracy, chatter and poor surface finish.

To rectify this defect, face the work, if the length of the work permits, and feed the centre drill to the recommended length.

Centre drills

It is made of high speed steel and is cylindrical in shape. At both the ends, it has a plain drill and countersink *as* its integral part. It is hardened and ground. It is available in standard sizes.

Classification as per Indian Standard

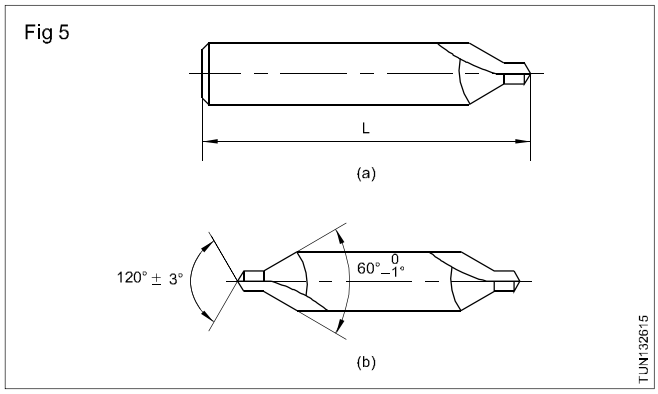
Indian Standard classifies centre drills into three types. They are Type A, Type B and Type R.

The difference lies in the formation of the countersink by each type.

Uses and specifications

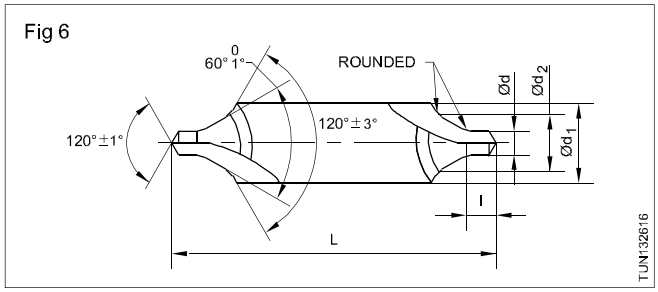
Type 'A' centre drill is used to produce centre holes with plain drilled portion and countersink. It is designated as Centre Drill A. 1.6 x 4.0 JS : 6708 which means that the centre drill is of Type 'A' with the plain drill portion having a diameter .of 1.6 mm and a shank diameter 4 mm. (Fig 5a and b)

Fig 5



Type 'B' centre drill is used to produce a centre hole with a plain drilled portion and a countersink, and has a further conical portion to form additional countersinking to protect the centre hole. The countersinking for providing the bearing surface for centres has an angle of 60° and the countersinking surface has an angle of 120°. This type is designated as Centre Drill B1.6 x6.3 IS: 6709 which means that the pilot diameter is 1.6 mm and shank diameter is 6.3 mm (Fig 6)

Fig 6



The third type, 'R' is designated as Centre Drill R 1.6 x 4.0 IS : 6710. This also has provision to provide a protected centre hole. This has an enlarged radius, machined along with the countersinking portion. (IS : 6710) (Fig 7)

Fig 7

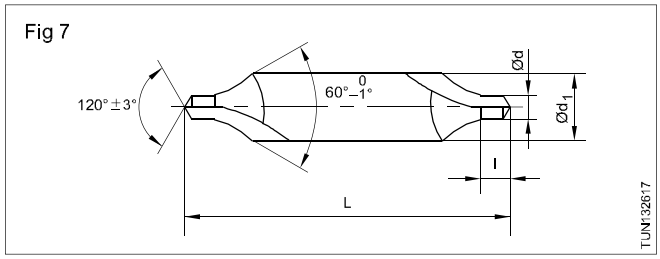


CHART OF COMBINATION DRILL

TABLE 1

d	d_1
K_{12}	h_g
(0.5)	3.15
(0.63)	3.15
(0.8)	3.15
1.0	3.15
(1.25)	3.15
1.6	4.0
2.0	5.0
2.5	6.3
3.15	8.0
4.0	10.0
(5.0)	12.5
6.3	16.0
(8.0)	20.0
10.0	25.0

TABLE 2

d	d_1	d_2
K_{12}	h_g	K_{12}
1.0	4.0	2.12
(1.25)	5.0	2.65
1.6	6.3	3.35
2.0	8.0	4.25
2.5	10.0	5.30
3.15	11.2	6.70
4.0	14.0	8.50
(5.0)	18.0	10.60
6.3	20.0	13.20
(8.0)	25.0	17.00
10.0	31.5	21.20.

TABLE 3

d	d_1
K_{12}	h_g
1.0	3.15
(1.25)	3.15
1.6	4.0
2.0	5.0
2.5	6.3
3.15	8.0
4.0	10.0
(5.0)	12.5
6.3	16.0
(8.0)	20.0
10.0	25.0

Data for centre Holes : Types A, B and R
(Dimensions in mm)

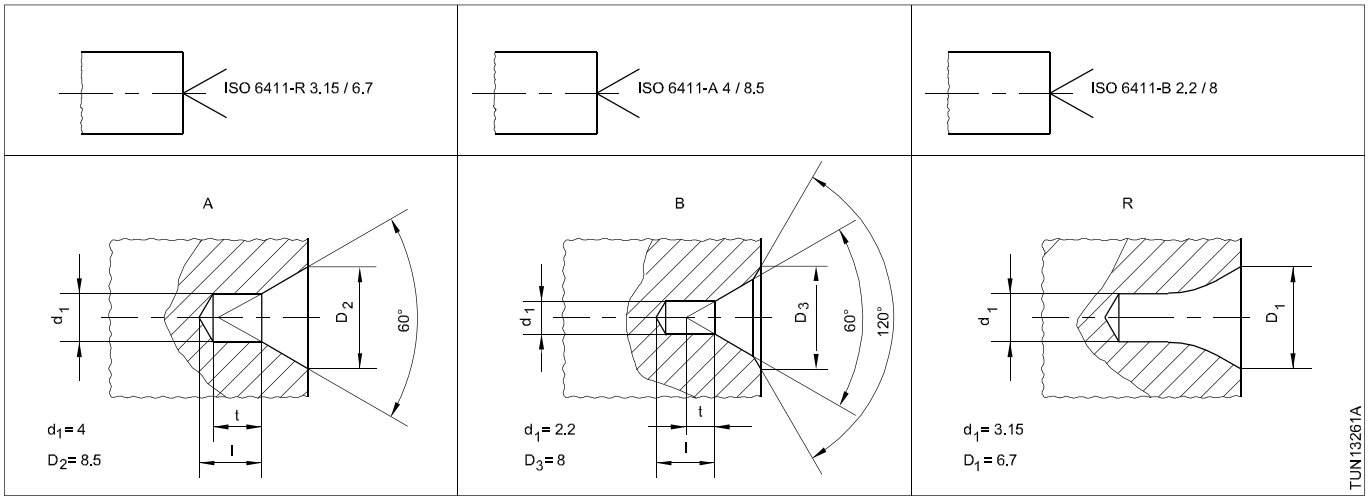
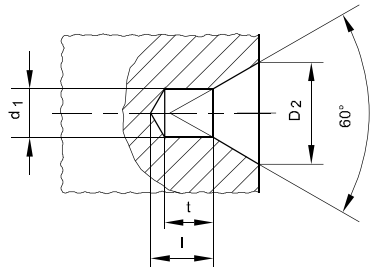


Figure 6 is an additional class of centre hole formed. The end of the bearing surface has a protective countersinking of its convex radius.

The protective countersinking and convex radius are provided to safeguard the bearing surface of the centre holes from getting damaged. (Fig 8 & Fig 9)

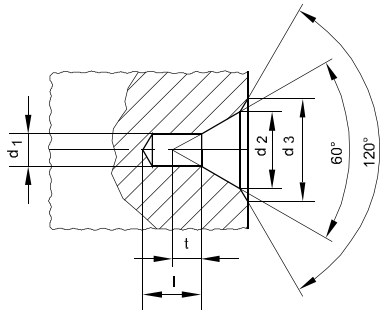
Any damage caused to the bearing surface will not allow the work to run true.

Fig 8



WITHOUT PROTECTIVE CHAMFER AND WITH STRAIGHT RUNNING SURFACES

Fig 9



WITH CONICAL PROTECTIVE CHAMFER AND STRAIGHT RUNNING SURFACES

Drill chuck

Objectives : At the end of this lesson you shall be able to
- **state what is a drill chuck**
- **list out the various types of drill chucks**
- **name the parts of a 3 jaw drill chuck**
- **state the constructional features and functioning of the 3 jaw drill chuck**
- **brief the number drills and letter drills.**

Drill chuck

A drill chuck is a holding device, used to hold straight shank drill bits up to 13 mm diameter. It can be fitted in the tapered bores of the lathe tailstock spindle and in the drilling machine spindle.

Types of drill chucks

Various types of drill chucks are available according to the construction and utility. The three commonly used drill chucks are:

- 3 jaw drill chuck (Fig 1)
- 2 jaw drill chuck
- quick releasing drill chuck.

Parts of a 3 jaw drill chuck (Fig 2)

The figure shows the different parts of a 3 jaw drill chuck. They are :

1 Sleeve

2 Jaws

3 Tang

4 Shank

5 Arbor hole in chuck body (the arobor assembled in the hole)

6 Chuck key

7 Taper to fit the arbor hole in the chuck body

8 Chuck key slot

Fig 1

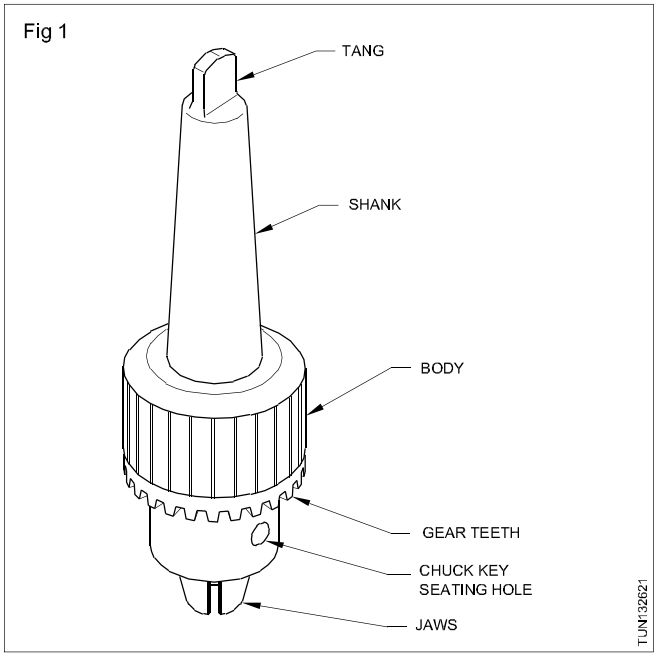
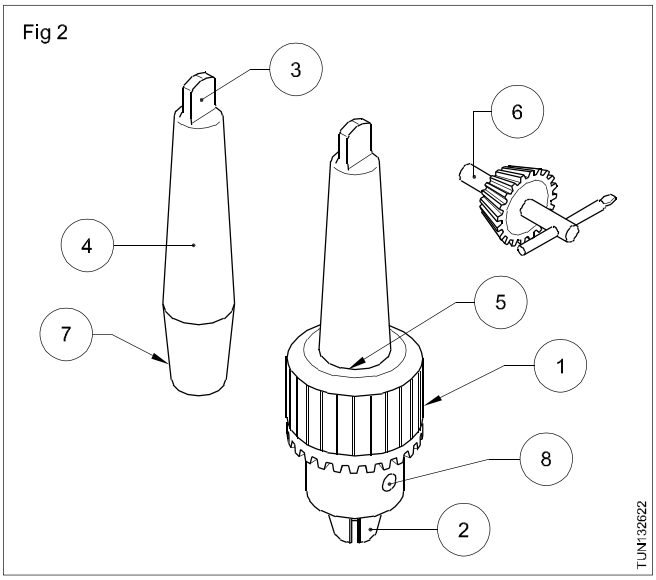
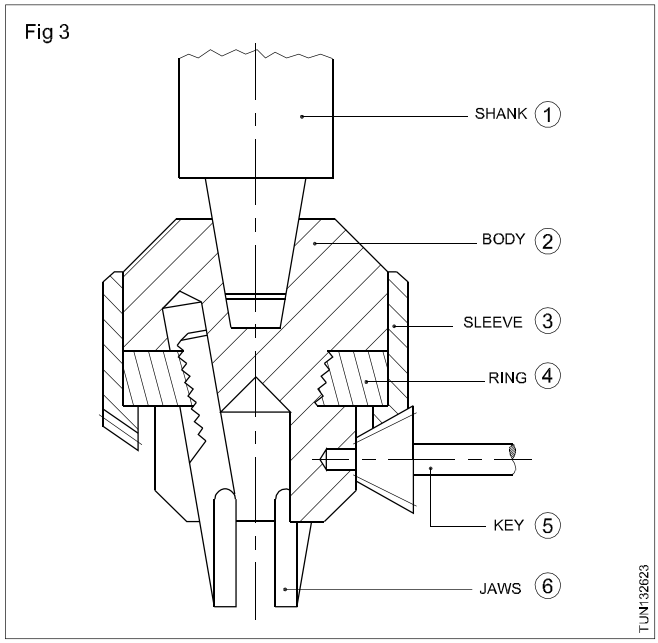


Fig 2



Constructional features and functioning of a 3 jaw drill chuck (Fig 3)

Fig 3



The figure shows the sectional view of a 3 jaw drill chuck. The drill bit is gripped by the jaws (6). These jaws can expand grid contract while moving in the slot of the body (2). The jaws have teeth which are in mesh with threads of the inside surface of the ring (4). The chuck key (5) has a pinion' which meshes with the bevel teeth of sleeve (3). When the chuck key is rotated, the sleeve rotates along with the ring which drives the jaw up and down, according to the direction of rotation. The taper shank (1) serves to mount the chuck into the tailstock spindle.

Uses of drill chucks

- It is very useful for drilling operations.
- It can hold varity of drill sizes.
- It is very easy to clamp and remove the drill.
- It can be used in all type of drilling machine.
- It is very useful specifically useful for portable drilling machines widly used by plumbers, electricians, etc,.

Lathe accessories, independent chuck, self chuck, collet etc,.

Objectives : At the end of this lesson you shall be able to
- **identify and name the accessories used on a centre lathe.**
- **identify the accessories used for in-between centre work.**
- **name the types of lathe carriers.**
- **state the uses of each type of lathe carriers.**

The lathe accessories are machined, independent units supplied with the lathe. The accessories are essential for the full utilization of the lathe. The accessories can be grouped into:

- work-holding accessories
- work-supporting accessories.

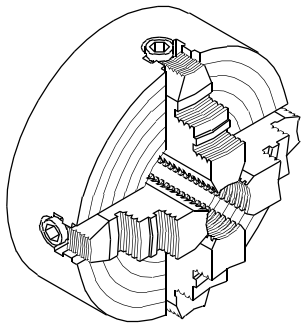
Work-holding accessories

The work can be directly mounted on these accessories and held.

The accessories are :

- four jaw independent chuck (Fig 1)

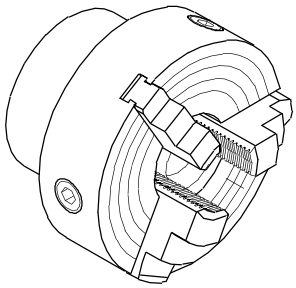
Fig 1



TUN1132711

- three jaw self-centering chuck (Fig 2)

Fig 2



TUN1132712

- face plates (Fig 3)
- lathe mandrels. (Fig 4)

Fig 3

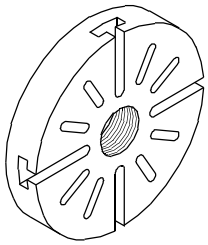


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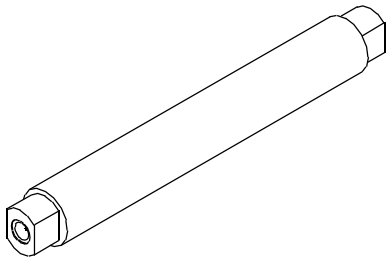
Fig 4



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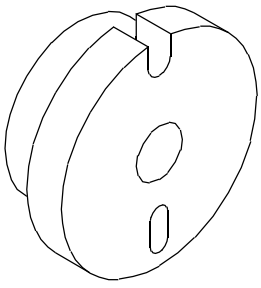
These accessories do not hold the work themselves. They support the work. The following are the work sup-porting accessories.

- Catch plate (Fig 5)

Fig 5



CATCH PLATE

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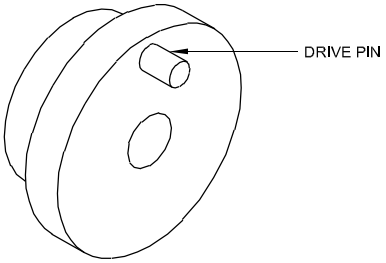
- Driving plate (Fig 6)

Fig 6



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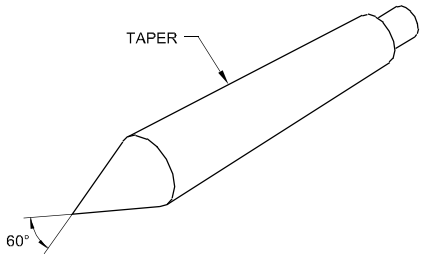
- Lathe centres (Fig 7)

Fig 7



60° TAILSTOCK CENTRE

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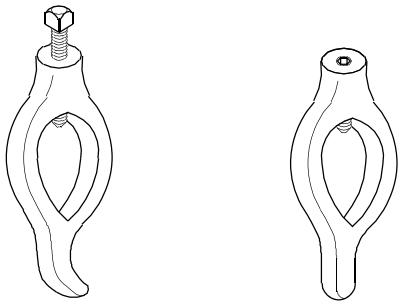
- Lathe carriers (Fig 8)

Fig 8

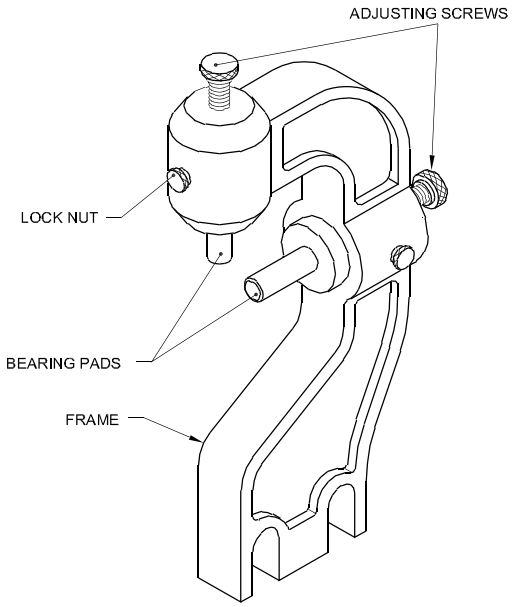


BENT TAIL STRAIGHT TAIL

TUN132718

- Lathe fixed steady (Fig 9)
- Lathe travelling steady (Fig 10)

Fig 9



TRAVELLING STEADY

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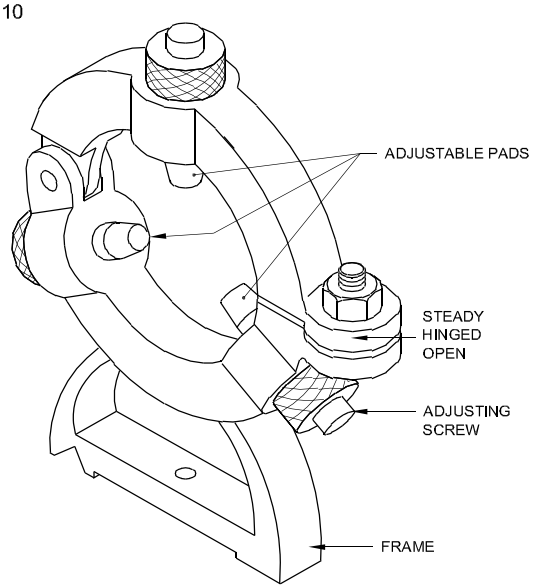
Fig 10



FIXED STUDY

TUN13271A

Lathe accessories - work - holding devices : 3 Jaw chuck

Objectives : At the end of this lesson you shall be able to

- **name the parts of a 3 jaw chuck**
- **state the constructional features of a 3 jaw chuck**
- **distinguish between a 3 jaw chuck and a four jaw chuck**
- **state the merits and demerits of the 4 jaw chuck over a 3 jaw chuck**
- **specify a chuck.**

The 3 jaw chuck (Fig 1)

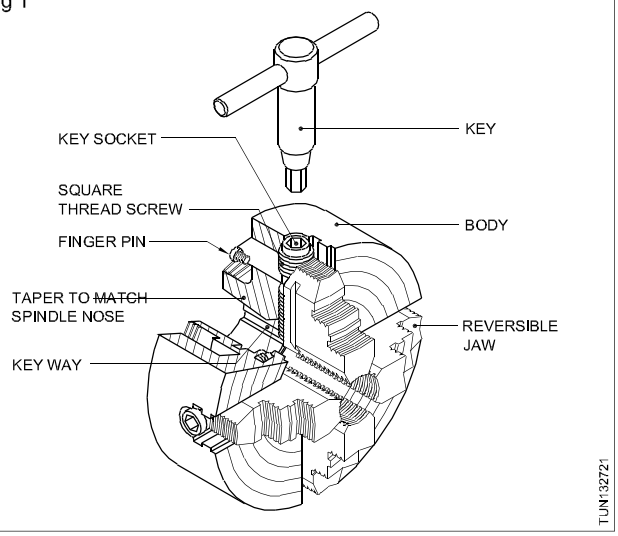
The 3 jaw chuck is also known as self-centering chuck. The majority of the chucks have two sets of jaws for holding internal and external diameters. Only perfectly round work, or work with equally spaced flats, divisible by three, should be held in a 3 jaw chuck.

The construction of a 3 jaw chuck shows that the scroll not only clamps a component in place but also locates the component. This is fundamentally a bad practice, since any wear in the scroll and / or the jaws impairs the accuracy of location. Further, there is no means of adjustment possible to compensate for this wear.

The jaws of this type of chuck are not reversible, and separate internal and external jaws have to be used.

Parts of a 3 jaw chuck (Fig 1)

Fig 1



- Back plate
- Body
- Jaws
- Crown wheel
- Pinion

Back plate

The back plate is fastened at the back of the body by means of allen screws. It is made out of cast iron. Its bore is tapered to suit the taper of the spindle nose. It has a key-way which will fit into the key provided on the spindle nose. There is a step in the front on which the thread is cut. The threaded collar, which is mounted on the spindle, locks the chuck by means of the thread, and locates by means of the taper and the key.

Body

The body is made out of cast steel, and the face is hardened. The body has three openings - 120° apart to assemble the jaws and operate them. Three pinions are fixed on the periphery of the body to operate the jaws by means of a chuck key. The body is hollow in cross-section. The crown wheel is housed inside the body.

Jaws

The jaws are made out of high carbon steel, hardened and tempered, which slide on the openings of the body. Generally there are two sets of jaws, viz. external jaws and internal jaws. External jaws are used for holding solid works. Internal jaws are used for holding hollow works. The steps on the jaws increase the clamping range. The back side of the jaws are cut out of scroll thread. Each jaw is numbered in a sequential manner, which will help in fixing the jaws in the corresponding numbered slots.

Crown wheel

The crown wheel is made out of alloy steel, hardened and tempered. On one side of the crown wheel a scroll thread is cut to operate the jaws and the other side is tapered on which bevel gear teeth are cut to mesh the pinion. When the pinion is rotated by means of the chuck key, the crown wheel rotates, thus causing the jaws to move inward or outward depending upon the rotation.

Pinion

The pinion is made out of high carbon steel, hardened and tempered. It is fitted on the periphery of the body. On the top of the pinion, a square slot is provided to accommodate the chuck key. It has a tapered portion on which the bevel gear teeth are cut, which match with the crown wheel.

Comparison Between a 3 Jaw Chuck and 4 Jaw Chuck

3 Jaw Chuck	4 Jaw Chuck
Only cylindrical or hexagonal work can be held	A wide range of regular and irregular shaped
Internal and external jaws are available	Jaw are reversible for external and internal
Setting up of work is easy	Setting up of work is difficult
Less gripping power	More gripping power
Depth of cut is comparatively less	More depth of cut can be given
Heavier jobs cannot be turned	Heavier jobs can be turned
Workpieces cannot be set for ecentric turning	Workpieces can be set for ecentric turning
Concentric circles are not provided on the face	Concentric circles are provided
Accuracy decreases as chuck gets worn out	There is no loss of accuracy as the chuck gets

Merits of a 4 jaw chuck

A wide range of regular and irregular shapes can be held.

Work can be set to run concentrically or eccentrically at will.

Has considerable gripping power; hence, heavy cuts can be given.

The jaws are reversible for internal and external work.

Work can be readily performed on the end face of the job.

There is no loss of accuracy as the chuck gets worn out.

De-merits of a 4 jaw chuck

Workpieces must be individually set.

The gripping power is so great that a fine work can be easily damaged during setting.

Merits of a 3 jaw chuck

Work can be set quickly and trued easily.

A wide range of cylindrical and hexagonal work can be held.

Internal and external jaws are available.

De-merits of a 3 jaw chuck

Accuracy decreases as chuck gets worn out.

Run out cannot be corrected.

Only round and hexagonal components can be held.

When accurate setting or concentricity with an existing diameter is required, a self-centering chuck is not used.

Specification of a chuck

To specify a chuck, it is essential to provide details of the:

- type of chuck
- capacity of the chuck
- diameter of the body
- width of the body
- the method of mounting to the spindle nose.

Examples

3 jaw self-centering chuck

Gripping capacity 450 mm

Diameter of the body 500 mm

Width of the body 125 mm

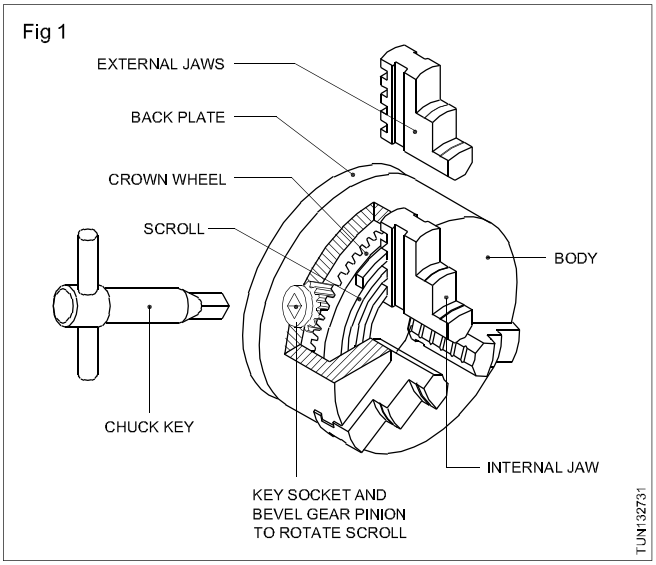
Tapered or threaded method of mounting

Lathe accessories - work - holding devices : 4 Jaw chuck

Objectives : At the end of this lesson you shall be able to
- **name the parts of a 4 jaw chuck**
- **state the constructional features of a 4 jaw chuck.**

4 jaw chuck (Fig 1)

Fig 1



The four jaw chuck is also called as independent chuck, since each jaw can be adjusted independently; work can be trued to within 0.001" or 0.02 mm accuracy.

This type of chuck is much more heavily constructed than the self-centering chuck, and has much greater holding power. Each jaw is moved independently by a square thread screw, and is reversible.

The independent 4 jaw chuck has four jaws, each working independently of the others in its own slot in the chuck body and actuated by its own separate square thread screw. By suitable adjustment of the jaws, a workpiece can be set to run either true or eccentric as required. 'T' slots are provided on the face of the chuck to accommodate 'T' bolts for clamping irregular works or for assembling balance weights.

To set the job for the second time it can be trued with the

help of a dial test indicator. The check on the workpiece should be carried out near the chuck and repeated as far from it as the workpiece permits, to ensure that the work is not held in the chuck at an angle to the axis of rotation.

The independent adjustment also provides the facility of deliberately setting the work off-centre to produce an eccentric workpiece.

Figure 1 shows a setting of an independent 4 jaw chuck for turning on eccentric crankpin.

The parts of a 4 jaw chuck are:

- back plate
- body
- jaws
- screw shaft

Back plate

The back plate is fastened to the back of the body by means of Allen screws. It is made out of cast iron/steel. Its bore is tapered to suit the taper of the spindle nose. It has a keyway which fits into the key provided on the spindle nose. There is a step in front on which the thread is cut. A threaded collar which is mounted on the spindle locks the chuck by means of the thread, and locates by means of the taper and key. Some chucks do not have back plates.

Body

The body is made out of cast iron/cast steel and the face is flame-hardened. It has four openings at 90° apart to assemble the jaws and operate them. Four screw shafts are fixed on the periphery of the body by means of finger pins. The screw is rotated by means of a chuck key. The body, hollow in the cross-section, has equi-spaced circular rings provided on the face, which are marked by numerical numbers. Number 1 starts in the middle and increases towards the periphery.

Jaws

Jaws are made out of high carbon steel. hardened and tempered, which slide on the openings of the body. These jaws are reversible for holding hollow work.

The back side of the jaws are square-threaded which will help in fixing the jaws with the operating screws.

Screw shaft

Screw shaft is made out of high carbon steel, hardened, tempered and ground. The top portion of the screw shaft is provided with a square slot to accommodate the chuck key. On the body portion, a left hand square thread is cut. In the middle of the screw shaft, a narrow step is made and held by means of finger pins. The finger pins permit the screws to rotate but not to advance.

Chucks other than 3 Jaw and 4 Jaw types and their uses

Objectives : At the end of this lesson you shall be able to
- **list the name of the chucks other than the 3 jaw and 4 jaw types**
- **state their constructional features**
- **state the uses of each of these chucks.**

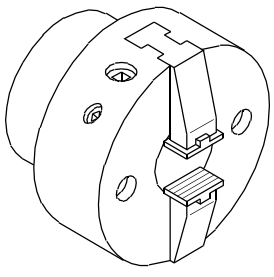
Apart from the four jaw independent chucks and self-centering chucks, other types of chucks are also used on a centre lathe. The choice depends upon the component, the nature of the operation, the number of components to be machined.

Some of the other types of chucks are:

- two jaw concentric chuck
- combination chuck
- collect chuck
- magnetic chuck
- hydraulic chuck or air operated chuck.

Two jaw concentric chuck (Fig 1)

Fig 1



TWO JAW CONCENTRIC CHUCK

TUN132741

The constructional features of this chuck are similar to those of 3 jaw and 4 jaw chucks.

Each jaw is an adjustable jaw which can be operated independently. In addition to this feature, both jaws may be operated concentric to the centre. Irregular shaped works can be held. The jaws may be specially machined to hold a particular type of job.

Combination chuck

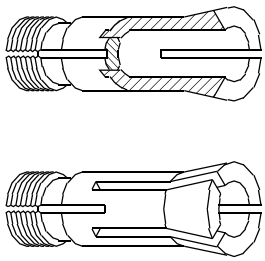
The combination chuck is normally a four jaw chuck in which the jaws may be adjusted either independently as done in a 4 jaw chuck, or together, as done in a 3 jaw universal chuck.

This kind of chuck is used in places where duplicate workpieces are to be machined. One piece is accurately set as done in a 4 jaw chuck, and the subsequent jobs are held by operating the centering arrangement.

Collet chuck (Fig 2)

A collet is a hardened steel sleeve having slits cut partly along its length. It is held by a draw-bar which can be drawn in or out in the lathe spindle. The collet is guided in the collet sleeve, and held with the nose cap. It is possible to change the collet for different cross-sections depending on the cross-section of the raw material.

Fig 2



SPLIT COLLET

TUN132742

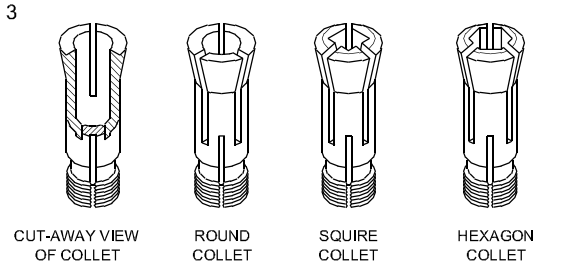
There are three most commonly used types of collet chucks.

- Push-out chucks
- Draw-in chucks

- Dead length bar chucks

The operation of these chucks may be manual, pneumatic, hydraulic or electrical. They are mainly used to hold round, square, hexagonal or cast profile bars. (Fig 3)

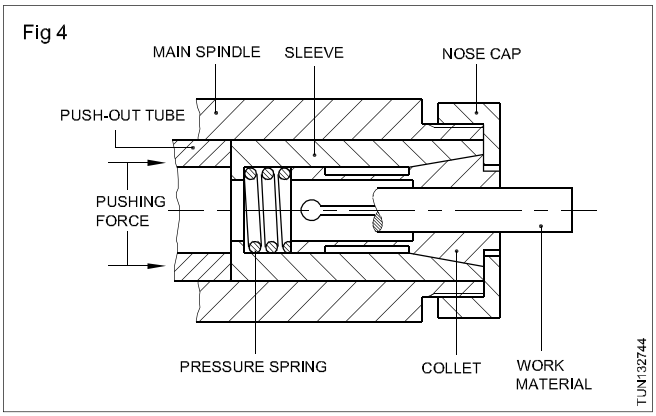
Fig 3



Push-out chucks (Fig 4)

the collet closes on the workpiece in a forward direction and consequently an end-wise movement of the work results. The cutting pressure tends to reduce the grip of the collet on the workpiece.

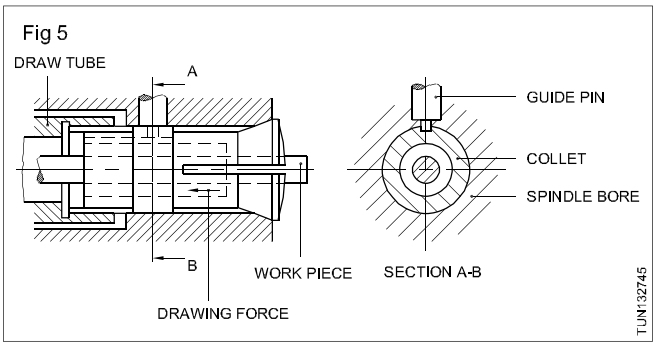
Fig 4



Draw-in chuck (Fig 5)

The collet closes on the workpiece in a backward direction and movement of the work. Take special care to avoid increases the grip of the collet on the workpiece.

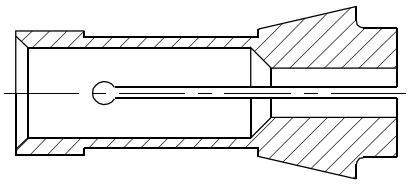
Fig 5



Dead length bar chucks (Fig 6)

These chucks are widely used in modern machines as they provide an accurate end-wise location of the workpiece. The chuck does not move end-wise during gripping or closing operation. These chucks are made to hold round, hexagonal or square bars, and when they are not gripping, they maintain contact with the core thus preventing swarf and chips collecting between the collet and the core

Fig 6



The disadvantage with these chucks is that each collet cannot be made to grip bars which vary by more than about 0.08 mm without adjustment.

Magnetic chuck (Figs 7a & 7b)

This chuck is designed to hold the job by means of magnetic force. The face of the chuck may be magnetized by inserting a key in the chuck and turning it to 180°. The amount of magnetic force may be controlled by reducing the angle of the key. The truing is done with a light magnetic force, and then the job is held firmly by using the full magnetic force.

Fig 7a

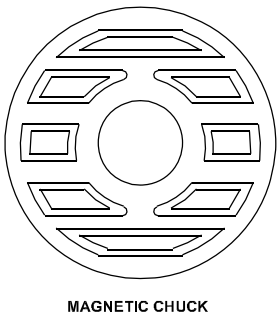
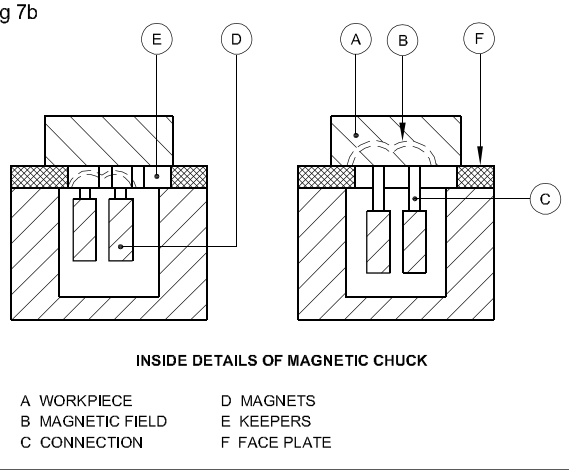


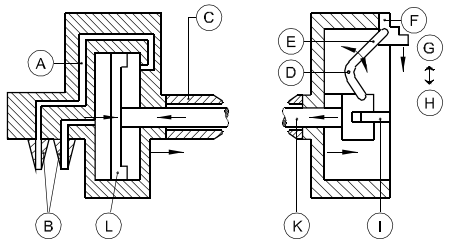
Fig 7b



Hydraulic chuck or air-operated chuck (Fig 8)

These chucks are mainly used for getting a very effective grip over the job. This mechanism consists of a hydraulic or an air cylinder which is mounted at the rear end of the headstock spindle, rotating along with it. In the case of a hydraulically operated chuck the fluid pressure is transmitted to the cylinder by operaring the valves. This mechanism may be operated manually or by power. The movement of the piston is transmitted to the jaws by means of connecting rods and links which enable them to provide a grip on the job.

Fig 8



A. AIR PASSAGE
B. VALVES
C. HEADSTOCK
D. PIVOT HINGE
E. LINK
F. JAW
G. CHUCK OPENING
H. CHUCK CLOSING
I. GUIDE
K. PISTON ROD
L. PISTON

TJN132748

Uses of a two jaw concentric chuck

It is mainly employed to hold an irregularly shaped job. As the chuck is designed with two jaws, it can be used as a turning fixture.

Uses of a combination chuck

This chuck may be used both as a universal 3 jaw chuck and as a 4 jaw independent chuck. This chuck is very useful where duplicate workpieces are involved in the turning.

Uses of a collet chuck

It is mainly used for holding jobs within a comparatively small diameter. The main advantage of collets lies in their ability to centre work automatically and maintain accuracy for long periods. It also facilitates to hold the bar work.

Uses of a magnetic chuck

This type of a chuck is mainly used for holding thin jobs which cannot be held in an ordinary chuck. These are suitable for works where a light cut can be taken on the job.

Uses of hydraulic or air-operated chuck

These chucks are mainly used in mass production because of their speedy and effective gripping capacity.