Tool setting

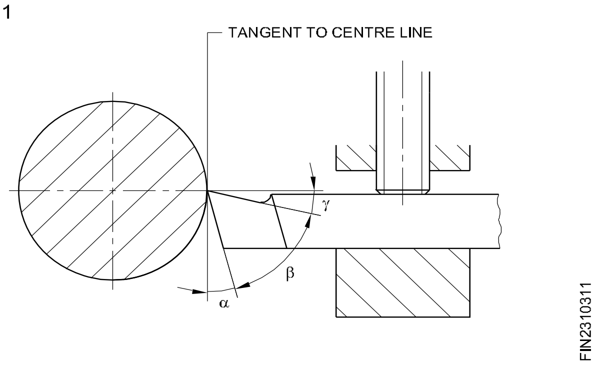
Objectives: At the end of this lesson you shall be able to
- **set the tool in the tool post for performing the operation.**

For optimum cutting, the effective rake angle and clearance angle of the clamped tool must be equal to the ground angles of the tool. This requires clamping of the tool to have its axis perpendicular to the lathe axis, with the tool tip at the workpiece centre. (Fig 1)

It is difficulat to determine the effective angles of the tool when it is not set to the centre height.

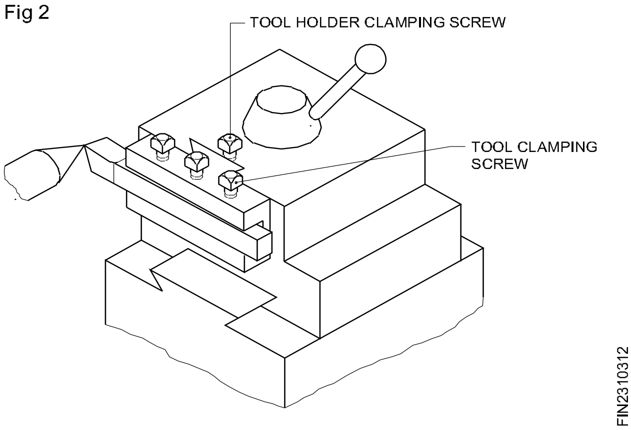
The tool nose can be set to the work centre by means of a tool-holder with adjustable height. (Fig 1)

Fig 1



The tool nose can be set to the exact centre height by placing the tool in the tool post on the shims or packing strips. These packing strips should be preferably a little less in width than the wideth of the tool but should never be more. The length of these strips should be according to the shank length and the tool seating face of the tool post. (Fig 2)

Fig 2



The procedure to follow is given below.

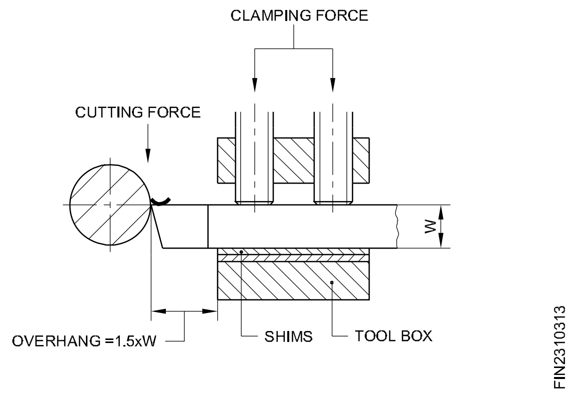
Clean the tool post seating face, and place the shims on the seating face.

Use a minimum number of shims for height adjustment.

Shims must be flushed with the edge of the seating face.

Place the tool in the tool post on the shims, with the rear butting against the wall of the seating face. (Fig 3)

Fig 3

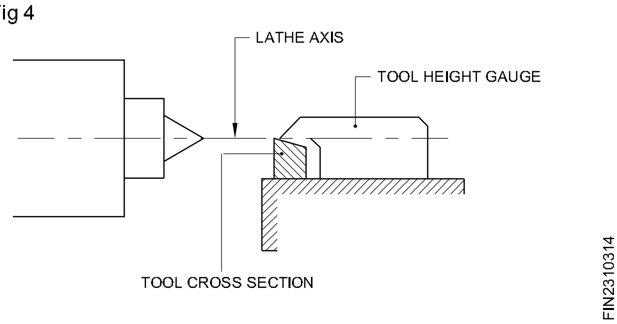


The unsupported length of the overhanging end of the turning tool should be kept to a minimum. As a rule, the overhanging length of tool is equal to the tool shank width x 1.5.

Tighten the tool with the centre screw of the tool post.

Check the centre height with a height setting gauge. (Fig 4)

Fig 4



Remove or add shims and check the height when the tool is tightened by the centre screw.

Tighten the other two tool-holding scews alternate applying the same amount of pressure.

When both the screws have a full gripping pressure, tighten the centre screw fully.

Check once again with a tool height setting gauge.

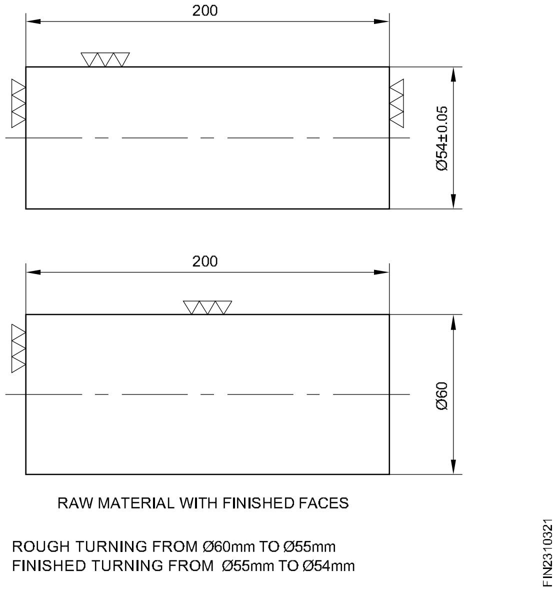
> **Note: The gauge should be made according to the size of the machine. If a gauge is not available, use a surface gauge and set the pointer tip to the dead centre height fixed in the tallstock. Use this as the height to which the tool is to be set.**

Parallel or straight turning

Objectives: At the end of this lesson you shall be able to
- **define plain turning**
- **distinguish between the two stages of plain turning.**

Plain turning (Parallel turning) (Fig 1)

Fig 1

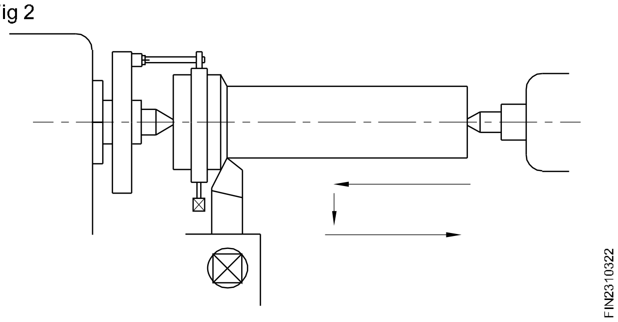


This operation involves removal of metal from the work and it has a cylinder for the full travel of the tool on the work, keeping the same diameter throughout the length.

Plain turning is done in two stages.

- Rough turning, using roughing tool or knife tool. (Fig 2)

Fig 2

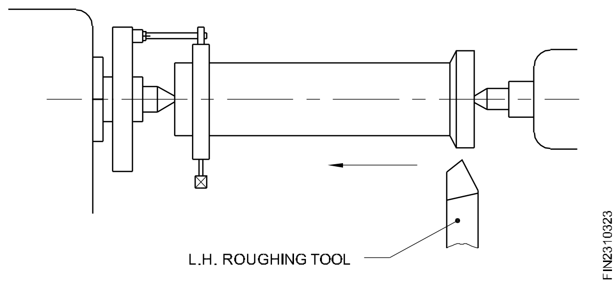


The spindle speed is calculated according to the material being turned, the tool material and the recommended cutting speed.

Rough turning

By rough turning the maximum amount of material is removed and the job is brought close to the required size,

Fig 3



leaving sufficient metal for finishing. Surface finish and accuracy are not good. While rough turning, the spindle speed is less and the feed is more. A roughing tool or a knife tool is used.

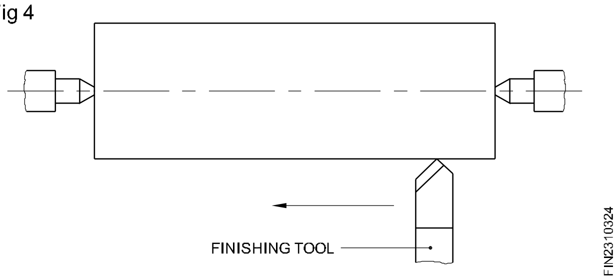
While plain turning for roughing or finishing, long jobs are held between centres. It is necessary to change the ends to obtain a true parallel surface throughout the length. (Fig 3)

Finish turning

It is done, after the rough turning is completed to bring the size of the work to the required accuracy and good surface finish by removing the rough marks produced by the rough turning. For finish turning, the speed is higher (1 to 2 times more than for rough turning) and the feed is very less. A round nose finish turning tool or a knife with a larger nose radius than normal is used for finish turning.

- Finish turning using a finishing tool. (Fig 4)

Fig 4



Step turning

Objective: At the end of this lesson you shall be able to
- **define step turning**

Step turning

It is an operation of producing various steps of different diameters in the work piece as shown in Fig 1 & 2. This operation is carried out in the similar way as plain turning.

Fig 1

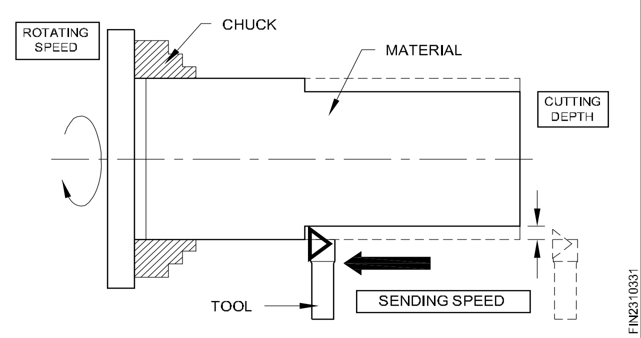
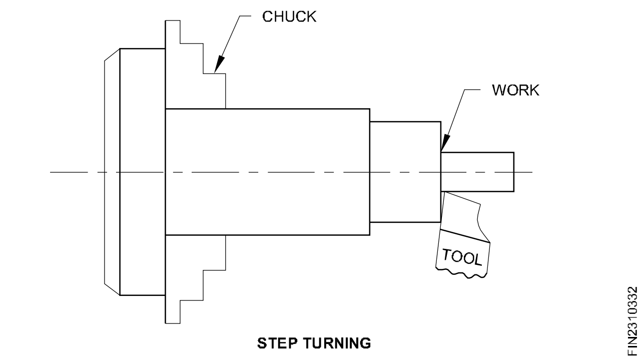


Fig 2



STEP TURNING

Grooving

Objectives: At the end of this lesson you shall be able to
- **state what is grooving**
- **name the types of grooves**
- **state the specific uses of each type of groove.**

Grooving

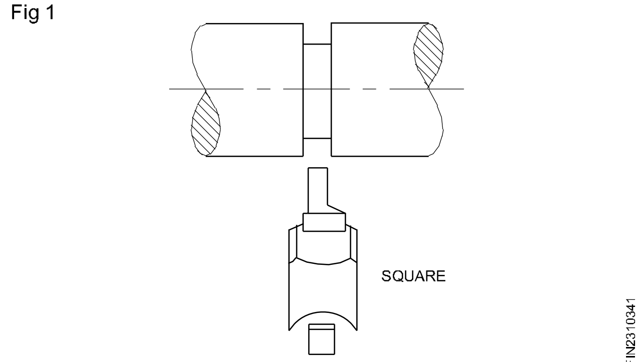
Grooving is the process of turning a grooved form or channel on a cylindrically turned workpiece. The shape of the cutting tool and the depth to which it is fed determine the shape of the groove.

Types of grooves

Square grooves

Square grooves are frequently cut at the end of a section to be threaded in order to provide a channel into which a threading tool may run. A square groove cut against a shoulder allows a matching part to fit squarely against the shoulder. (Fig 1)

Fig 1



When a diameter is to be finished to size by grinding, a groove is generally cut against the shoulder to provide clearance for the grinding wheel and to ensure a square corner.

Square grooves are cut with a tool bit ground to the width of the square groove to be formed.

A square groove also serves the purpose of providing space for forks of shift levers in sliding gear assemblies.

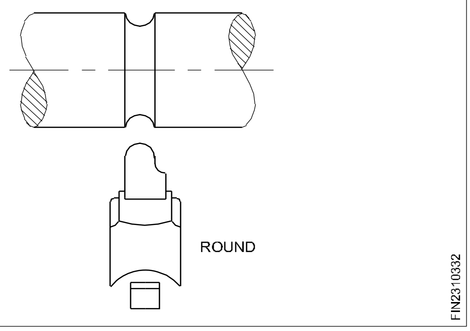
Round groove

Round grooves serve the same purpose as square grooves. They are generally used on parts subjected to stress. The round groove eliminates the sharpness of the square corners and strengthens the part at the point where it tends to fracture. A tool bit with a round nose ground to the required radius is used to cut round grooves. (Fig 2)

'V' shaped groove

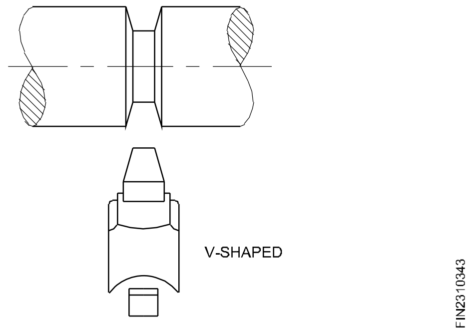
'V' shaped grooves are most commonly found on pulleys driven by 'V belts. The 'V shaped groove eliminates much of the slip which occurs in the other forms of the belt drive. A 'V groove may also be cut at the end of a thread to provide a channel into which the threading tool may run. (Fig 3)

Fig 2



A tool bit ground to the desired angle is used to cut a shallow 'V' groove. Larger 'V' grooves such as those found on pulleys should be cut with the lathe compound rest to form each face of the groove individually.

Fig 3



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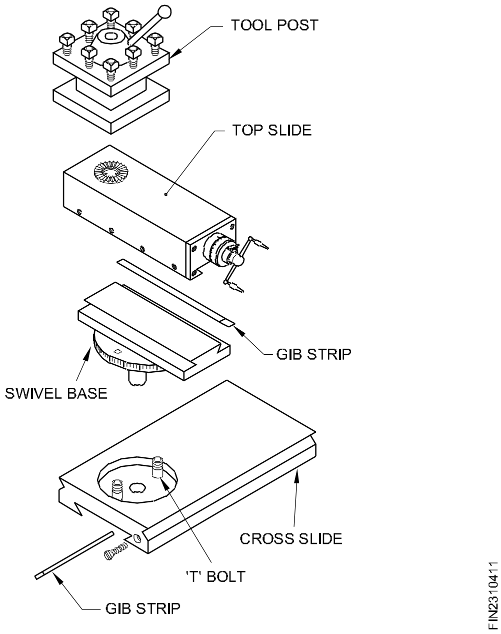
Tool post

Objectives: At the end of this lesson you shall be able to
- **name the commonly used types of tool posts**
- **compare the features of different types of tool posts.**

The tool post holds and firmly supports the tool or tools. The tool post is fitted on the top slide. (Fig 1)

Fig 1

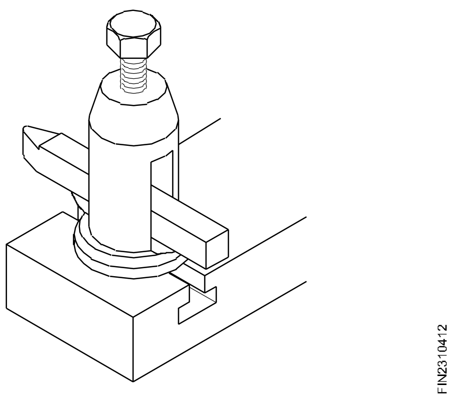


The commonly used types of tool posts are:

- American type tool post or single way tool post.
- Indexing type tool post or square tool post.
- Quick change tool post.

Single way tool post (Fig 2)

Fig 2

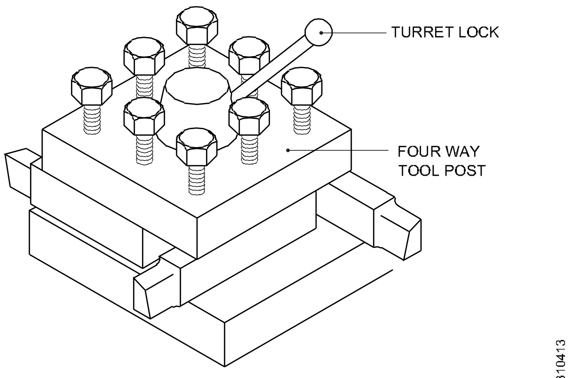


It consists of a circular tool post body and a pillar with a slot for accommodating the tool or tool-holder. A ring base, a rocker arm (boat piece) and a tool clamping screw complete the assembly of this type of tool post.

The tool is positioned on the boat piece and clamped. The centre height of the tool tip can be adjusted with the help of the rocker arm and the ring base. Only one tool can be fixed in this type of tool post. The rigidity of the tool is less as it is clamped with only one bolt.

Indexing type tool post (Fig 3)

Fig 3



INDEXING TYPE TOOL POST

It is also called as square tool post or a four-way tool post. Four tools can be fixed in this type of tool posts, and any one can be brought into the operating position, and the square head is clamped with the help of the handle lever. By loosening the handle lever, the next tool can be indexed and brought in to the operating position. The indexing is manually.

The advantages are as follows.

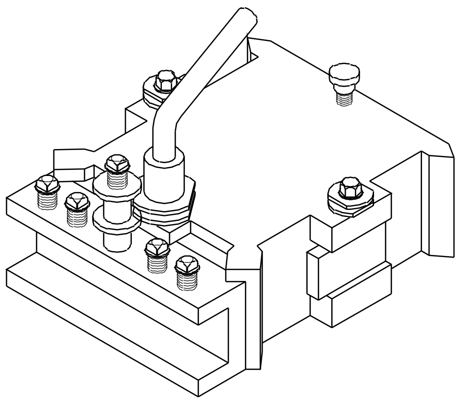
Each tool is secured in the tool post by more than one bolt, and, therefore, the rigidity is more.

Frequent changing of the tool for different operations need not be done as all the four tools can be clamped at the same time.

The disadvantage is that skill is required to set the tools, and it takes more time to set to the centre height.

Quick change tool post (Fig 4)

Fig 4



QUICK CHANGE TOOL POST

Modern lathes are provided with this type of tool posts. Instead of changing the tools, the tool holder is changed in which the tool is fixed. This is expensive and requires a number of tool-holders. But it can be set to the centre height easily, and has the best rigidity for the tool.

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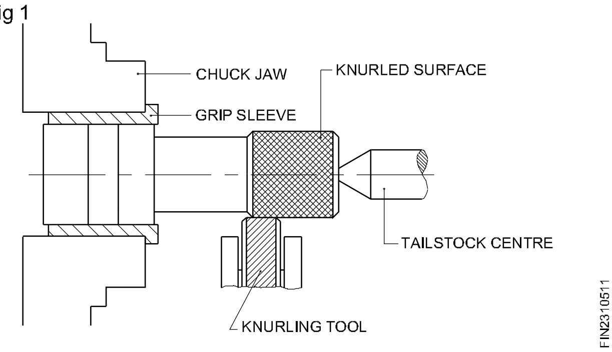
Lathe operation - Knurling

Objectives: At the end of this lesson you shall be able to
- **define knurling operation**
- **state the purpose of knurling**
- **list the different types of knurls and knurling patterns**
- **name the grades of knurls**
- **distinguish between the various types of knurling tool-holders.**

Knurling (Fig 1)

Fig 1



It is the operation of producing straight lined, diamond shaped pattern or cross lined pattern on a cylindrical external surface by pressing a tool called knurling tool. Knurling is not a cutting operation but it is a forming operation. Knurling is done at a slow spindle speed (1/3 the turning speed). However speed & feed given for knurling is to be divided according to the job material and the finish required.

Purpose of knurling

The purpose of knurling is to provide:

- A good grip and make for positive handling.
- Good appearance
- For raising the diameter to a small range for assembly to get a press fit.

Types of knurls and knurling patterns

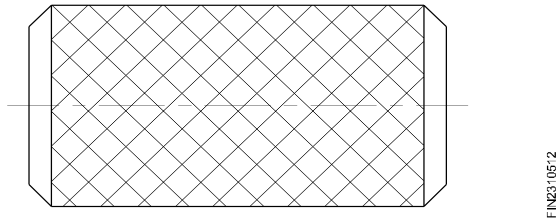
The following are the different types of knurling patterns.

Diamond knurling, Straight knurling, Cross knurling, Concave knurling and Convex knurling.

Diamond knurling (Fig 2)

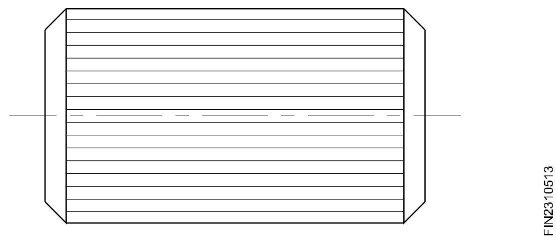
It is a knurling of diamond shaped pattern. It is done by using a set of rolls. One roller has got right hand helical teeth and the other has left hand helical teeth.

Fig 2



Straight knurling (Fig 3)

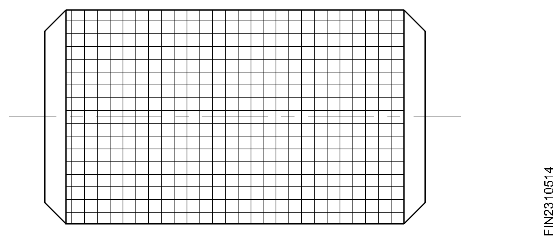
Fig 3



It is a knurling of straight lined pattern. This is done by using either a single roller or a double roller with straight teeth.

Cross knurling (Fig 4)

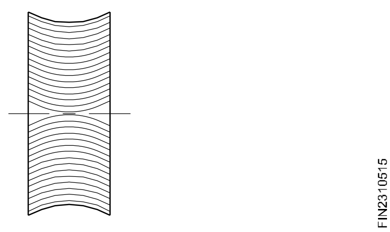
Fig 4



It is a knurling having a square shaped pattern. It is done by a set of rollers, one having straight teeth the other having teeth at right angles to the axis of knurl.

Concave knurling (Fig 5)

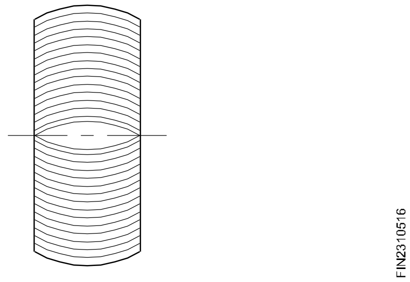
Fig 5



This is done by a convex knurl on a concave surface. This is done only by plunging the tool. The tool should not be moved longitudinally. The length of the knurling is limited to the width of the roller.

Convex knurling (Fig 6)

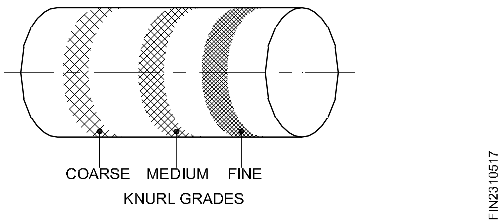
Fig 6



This is done by using a concave knurl on a convex surface. This is also done by plunging the tool.

Grades of knurling (Fig 7)

Fig 7



Knurling can be done in three grades.

Coarse knurling, Medium knurling and Fine knurling

Coarse knurling is done by using coarse pitched knurls of 1.75 mm pitch. (14 TPI)

Medium knurling is done by using medium pitched knurls of 1.25 mm pitch. (21 TPI)

Fine knurling is done by using fine pitched knurls of 0.75 mm pitch. (33 TPI)

Types of knurling tool-holders

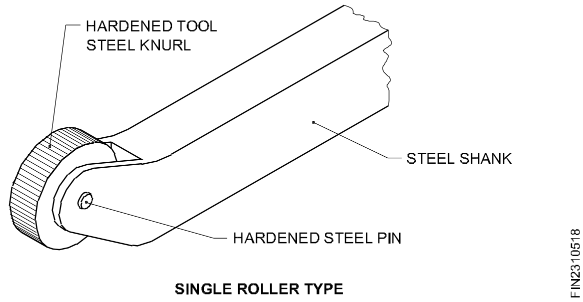
The different types of knurling tool-holders are:

- Single roller knurling tool-holders (parallel knurling tool-holders)
- Knuckle joint type knurling tool-holders
- Revolving type knurling tool-holders (universal knurling tool-holders).

A knurling tool-holder has a heat-treated steel shank and hardened tool steel knurls. The knurls rotate freely on hardened steel pins.

Single roller knurling tool-holder (Fig 8)

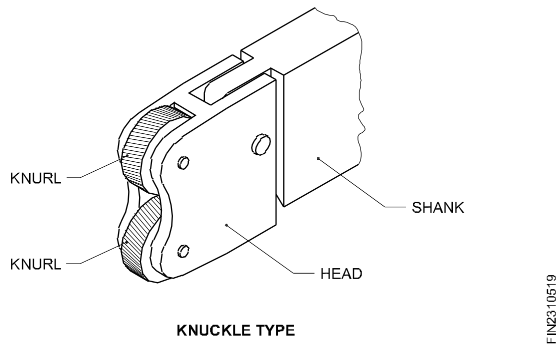
Fig 8



It has only one single roller which produces a straight lined pattern.

Knuckle joint type knurling tool-holders (Fig 9)

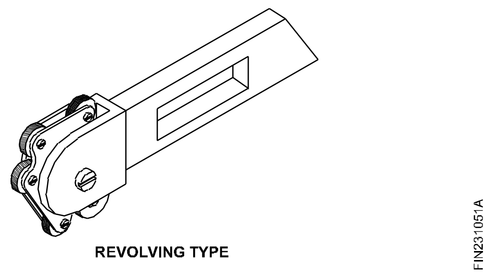
Fig 9



This tool holder has a set of two rollers of the same knurling pitch. The rollers may be of straight teeth or helical teeth. It is self-centering.

Revolving head knurling tool (Fig 10)

Fig 10



This tool-holder is also called a universal knurling tool-holder. It is fitted with 3 pairs of rollers having coarse, medium and fine pitches. These are mounted on a revolving head which pivots on a hardened steel pin. It is also self-centering.

Difference between different types of knurling tool-holders

Single roller	Knuckle joint	Revolving type
Only one roller is used	A pair of rollers are used	Three pairs of rollers are used
Only one pattern of knurling can be produced with this type of knurling tool-holder	Cross of diamond knurling pattern can be produced	Knurling patterns of different pitches can be produced
It is not self-centering	It is self-centering	It is self-centering

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Standard tapers

Objectives: At the end of this lesson you shall be able to
- **define a taper**
- **state the uses of tapers**
- **state the method of expressing tapers**
- **state the methods to be adopted while specifying tapers**
- **distinguish between the features of self-holding and self-releasing tapers**
- **name the different types of self-holding tapers and state their features**
- **state the features of self-releasing tapers**
- **state the features of pin taper and keyway taper.**

Definition of Taper

Taper is a gradual increase or decrease in the dimention along its length of the job.

Tapers are used for:

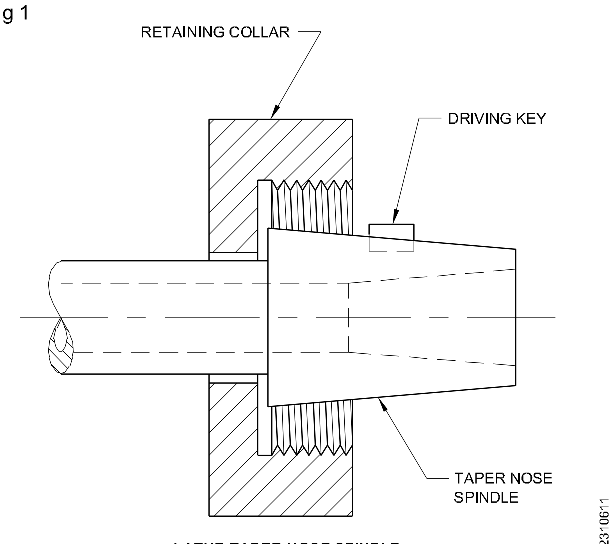
- Self-alignment/location of components in an assembly.
- Assembling and dismantling parts easily.
- Transmitting drive through assembly.

Tapers have a variety of applications in engineering assembly work.(Figs 1,2 & 3)

Tapers of components are expressed in two ways.

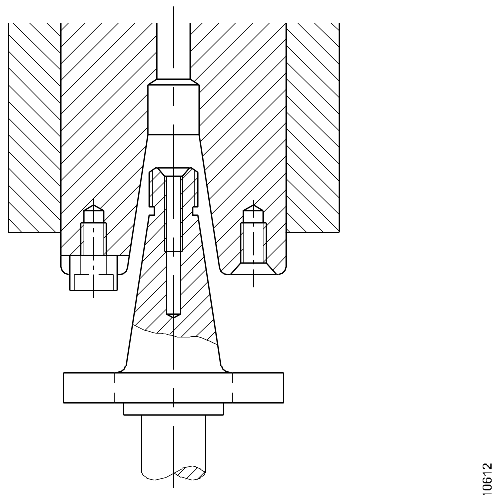
- Degree of arc (Fig 4)
- Gradient (Fig 5)

Fig 1



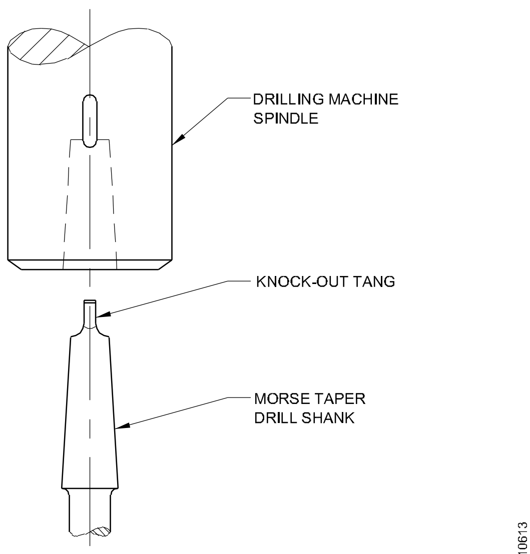
LATHE-TAPER NOSE SPINDLE

Fig 2



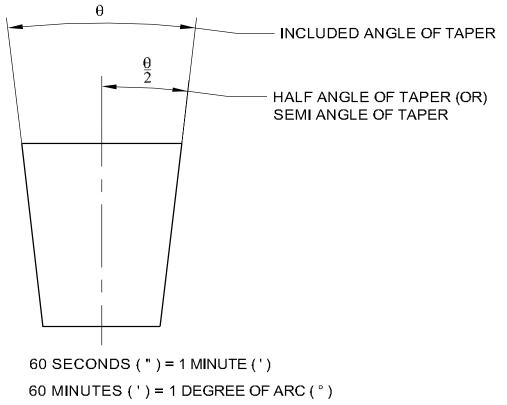
MILLING MACHINE SPINDLE

Fig 3



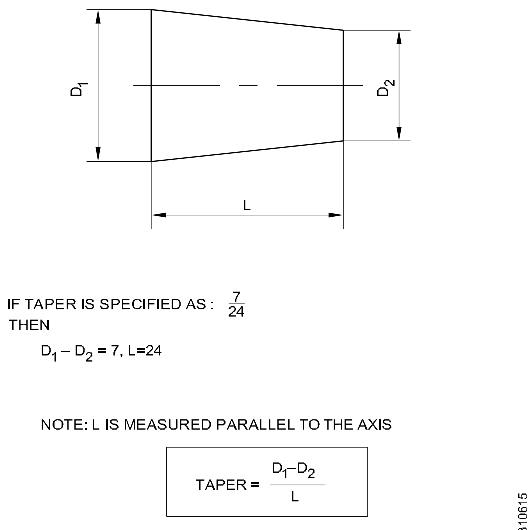
DRILLING MACHINE SPINDLE AND DRILL WITH TAPER SHANK

Fig 4



AN ANGLE EXPRESSED IN DEGREES OF ARC

Fig 5



AN ANGLE EXPRESSED AS A GRADIENT

The method adopted for expressing tapers depends on:

- The steepness of the tapers
- The method adopted for measuring.

Specification of tapers

While specifying taper in drawings it should indicate the:

- Angle of the taper
- Size of the component. (Figs 6,7, 8 & 9)

Fig 6

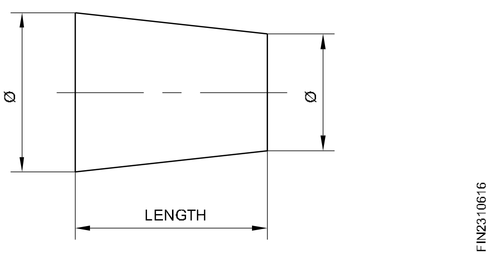


Fig 7

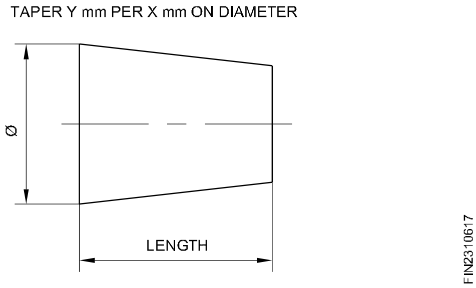


Fig 8

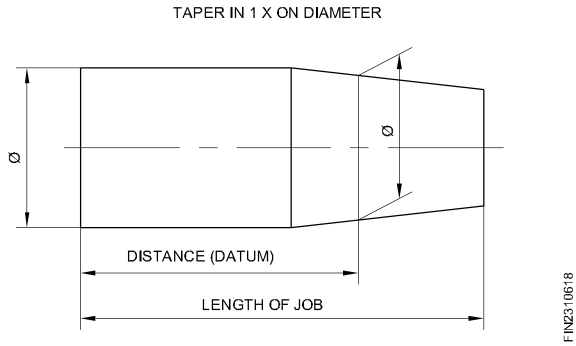
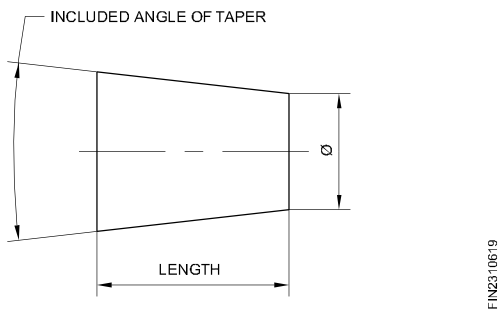


Fig 9



Standard tapers

Tapers for tool-holding

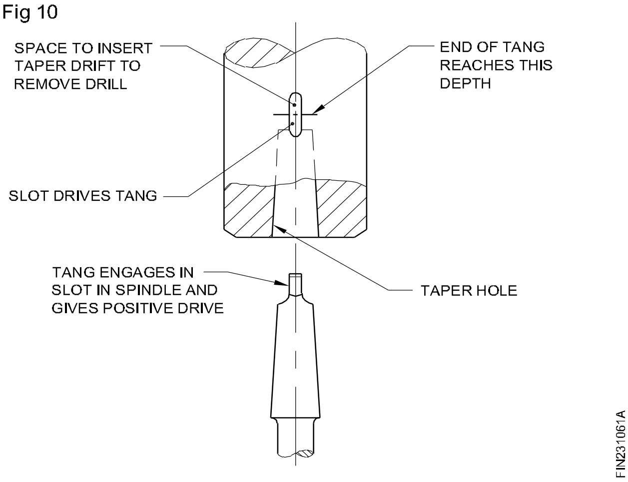
Two types of tapers are used for tool-holding on machines.

- Self-holding tapers
- Self-releasing tapers

Self-holding tapers

Self-holding tapers have less taper angle. These are used for holding and driving cutting tools like drills, reamers etc. without any locking device. (Fig 10)

Fig 10



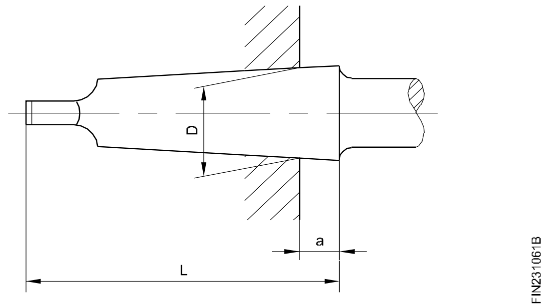
The standard tapers used for this are:

- The metric taper
- The morse taper.

Metric taper

The taper on diameter is 1:20. The commonly used shank sizes in metric tapers are metric 4, 6, 80, 100, 120, 160 and 200. The shank size indicating the metric taper is the diameter at D. (Fig 11)

Fig 11



Morse taper

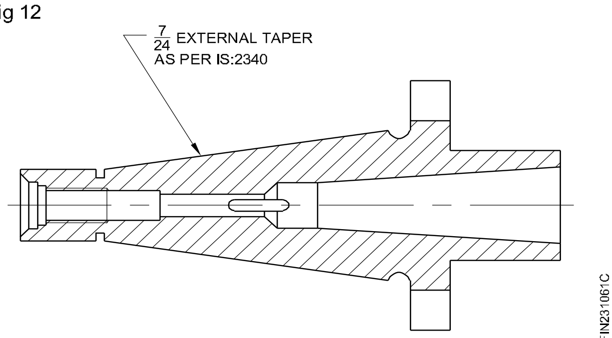
The commonly used taper shank sizes are:

0, 1, 2, 3, 4, 5 and 6.

The taper is varying according to the size of the Morse taper. It varies from 1:19.002 to 1:20.047.

Self-releasing 7/24 taper (Fig 12)

Fig 12



Spindle noses and arbors used on milling machines are usually provided with self-releasing tapers. The standard self-releasing taper is 7/24. This is a steep taper which helps in the correct location and release of the components in the assembly. This taper does not drive the mating component in the assembly. For the purpose of driving, additional features are provided.

The commonly used 7/24 taper sizes are: 30,40,45,50 and 60.

The taper of a 7/24 taper of No.30 will have a maximum diameter of (D) 31.75 mm and No.60, 107.950 mm. All other sizes fall within this range.

Tapers used in other assembly work

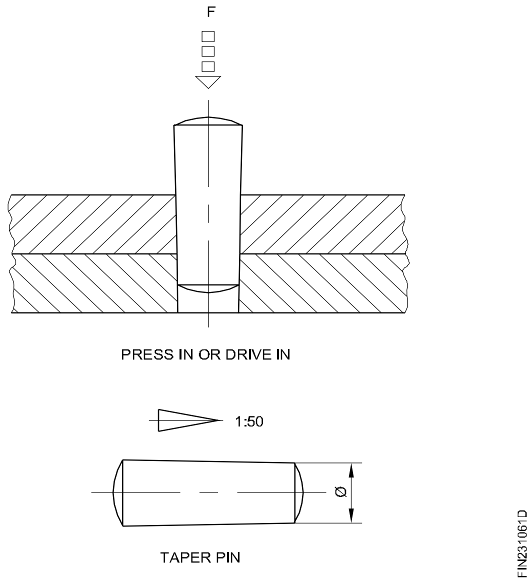
A variety of tapers are used in engineering assembly work. The most common ones are:

- pin taper
- key and keyway taper.

Pin taper

This is the taper used for taper pins used in assembly. (Fig 13)

Fig 13



The taper is 1:50.

The diameter of taper pins is specified by the small diameter.

Taper pins help in assembling and dismantling of components without disturbing the location.

Key and keyway tapers

This taper is 1:100. This taper is used on keys and keyways. (Figs 14 and 15)

Fig 14

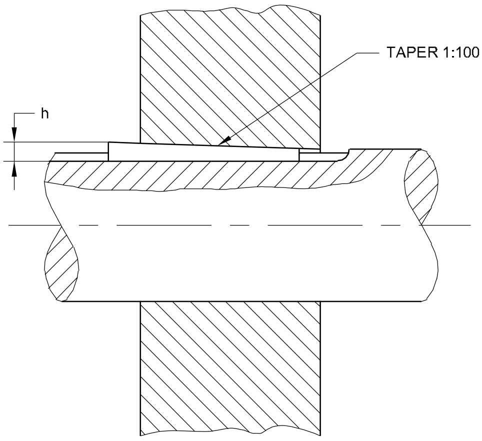
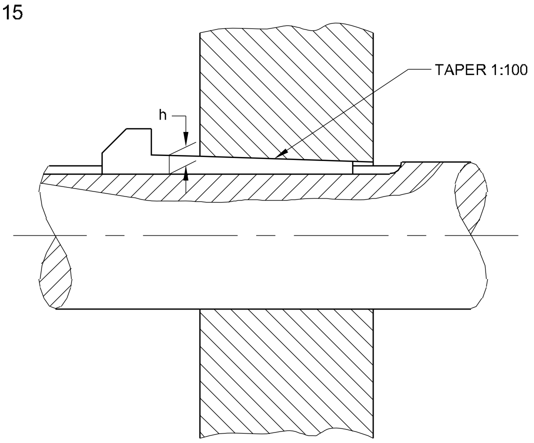


Fig 15



Note: For further information about the tapers used for special application refer to: IS: 3458 - 1981.

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