

# 1 Importance of Lathe Machine in Engineering Field and its usage

2 Jahnvi Madireddy<sup>1</sup>

3 <sup>1</sup> MLR Institute of Technology

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## 6 Abstract

7 Introduction-The lathe, probably one of the earliest machine tools, is one of the most versatile  
8 and widely used machine tool, so also known as mother machine tool. An engine lathe is the  
9 most basic and simplest form of the lathe. It is called so because in early lathes, power was  
10 obtained from engines. The job to be machined is held and rotated in a lathe chuck; a cutting  
11 tool is advanced which is stationary against the rotating job. Since the cutting tool material is  
12 harder than the work piece, so metal is easily removed from the job. Some of the common  
13 operations performed on a lathe are facing, turning, drilling, threading, knurling, and boring  
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16 *Index terms*— machine tool, early lathes, power was obtained from engines.

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25 knurling, and boring etc.

## 26 2 II.

## 27 3 Lathe Machine Parts

28 Bed: Supports all other machine parts. Carriage: Slides along the machine ways.

29 Head stock: Power train of system (spindle included). Tail Stock: Fixes piece at end opposite to the head  
30 stock. Swing: Maximum diameter of the machinable piece.

## 31 4 Sequence of Operations

32 Cutting Tool Used V.

## 33 5 Types of Operation a) Facing Operation

34 Facing is the operation of machining the ends of a piece of work to produce a flat surface square with the axis.  
35 The operation involves feeding the tool perpendicular to the axis of rotation of the work piece.

36 A regular turning tool may be used for facing a large work piece. The cutting edge should be set at the same  
37 height as the center of the work piece. The tool is brought into work piece from around the center for the desired  
38 depth of cut and then is fed outward, generally by hand perpendicular to the axis of rotation of the work piece.

### 39 6 b) Rough Turning Operation

40 Rough turning is the operation of removal of excess material from the work piece in a minimum time by applying  
41 high rate of feed and heavy depth of cut. The depth of cut for roughing operations in machining the work ranges  
42 from 2 to 5 mm and the rate of feed is from 0.3 to 1.5 mm per revolution of the work. c) Finish Turning Operation  
43 It requires high cutting speed, small feed, and a very small depth of cut to generate a smooth surface. The depth  
44 of cut ranges from 0.5 to 1 mm and feed from 0.1 to 0.3 mm per revolution of the work piece.

### 45 7 d) Step Turning

46 Is the operation of making different diameters of desired length. The diameters and lengths are measured by  
47 means of outside caliper and steel rule respectively. e) Taper Turning A taper may be defined as a uniform  
48 increase or decrease in diameter of a piece of work measured along its length. In a lathe, taper turning means to  
49 produce a conical surface by gradual reduction in diameter from a cylindrical work piece.

50 A taper may be turned by any one of the following methods: i. Form tool method ii. Tail stock set over  
51 method iii. Swiveling the compound rest and iv. Taper turning attachment Taper turning by swiveling the  
52 compound rest:

53 This method employs the principle of turning taper by rotating the work piece on the lathe axis and feeding  
54 the tool at an angle to the axis of rotation of the work piece. The tool mounted on the compound rest is attached  
55 to a circular base, graduated in degrees, which may be swiveled and clamped at any desired angle. Once the  
56 compound rest is set at the desired half taper angle, rotation of the compound slide screw will cause the tool to  
57 be fed at that angle and generate a corresponding taper.

58 The setting of the compound rest is done by swiveling the rest at the half taper angle. This is calculated by  
59 the equation.

### 60 8 $\tan \theta = (D-d) / 2L$

61 Where  $\theta$  = Half taper angle f) Knurling Knurling is the process of embossing a diamond shaped pattern of the  
62 surface of a work piece. The purpose of knurling is to provide an effective gripping surface on a work piece to  
63 proven it from slipping when operated by hand. Knurling is performed by a special knurling tool which consists  
64 of a set of hardened steel rollers in a holder with the teeth cut on their surface in a definite pattern. The tool is  
65 held rigidly on the tool post and the rollers are pressed against the revolving surface of work piece to squeeze the  
66 metal against the multiple cutting edges, producing depressions in a regular pattern on the surface of the work  
67 piece.

68 Knurling is done at the slowest speed and oil is flowed on the tool and work piece. Knurling is done at the  
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### 70 9 g) Chamfering

71 Chamfering is the operation of beveling the extreme end of a work piece. This is done to remove the burrs,  
72 to protect the end of the work piece from being damaged and to have a better look. The operation may be  
73 performed after the completion of all operations. It is an essential operation after thread cutting so that the nut  
74 may pass freely on the threaded work piece.

## 75 10 VI.

### 76 11 Metal Cutting Parameters

77 The cutting speed of a tool is the speed at which the metal is removed by the tool from the work piece. In a  
78 lathe, it is the peripheral speed of the work past the cutting tool expressed in meters/minute VII.

## 79 12 Procedure

80 a) The work piece and HSS single point cutting tool are securely held in the chuck and tool post respectively. b)  
81 Operations such as facing, rough turning and finish turning are performed on a given mild steel bar one after the  
82 other in sequence up to the dimensions shown. Then the step turning is performed using parting tool. c) Then  
83 the compound rest is swiveled by calculated half taper angle and taper is generated on the work piece. Rotation  
84 of the compound slide screw will cause the tool to be fed at the half-taper angle.

85 d) HSS single point cutting tool is replaced by the knurling tool and knurling operation is performed at the  
86 slowest speed of the spindle.

87 e) The knurling tool is replaced by the HSS single point tool again; the work piece is removed from the chuck  
88 and refixed with the unfinished part outside the chuck. This part is also rough turned, finish turned and facing  
89 is done for correct length. f) Finally, the chamfering is done at the end of the work piece.

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## 13 VIII.

91 Precautions a) Operate the machine at optimal speeds b) Do not take depth of cut more than 2 mm. c) Knurling  
92 should be done at slow speeds and apply lubricating oil while knurling d) Care should be taken to obtain the  
93 required accuracy.

94 IX.

## 14 Lathe -Thread Cutting

96 In order to V-thread cutting on a lathe forming right hand and left hand metric threads as shown in fig.

97 We require Mild steel bar of 24 mm diameter and 100 mm length.

## 15 Principle of Thread Cutting

99 The principle of thread cutting is to produce a helical groove on a cylindrical or conical surface by feeding the  
100 tool longitudinally when the job is revolved between centers or by a chuck. The longitudinal feed should be equal  
101 to the pitch of the thread to be cut per revolution of the work piece. The lead screw of the lathe, through which  
102 the saddle receives its traversing motion, To calculate the wheels required for cutting a screw of certain pitch, it  
103 is necessary to know how the ratio is obtained and exactly where the driving and driven wheels are to be placed.  
104 Suppose the pitch of a lead screw is 12 mm and it is required to cut a screw of 3 mm pitch, then the lathe spindle  
105 must rotate 4 times the speed of the lead screw that is

## 16 Thread Cutting Operation

107 In a thread cutting operation, the first step is to remove the excess material from the work piece to make its  
108 diameter equal to the major diameter of the screw thread. Change gears of correct size are then fitted to the end  
109 of the bed between the spindle and the lead screw.

110 The shape or form of the thread depends on the shape of the cutting tool to be used. In a metric thread, the  
111 included angle of the cutting edge should be ground exactly  $60^\circ$ . The top of the tool nose should be set at the  
112 same height as the center of the work piece. A thread tool gauge is usually used against the turned surface to  
113 check the cutting tool, so that each face of the tool may

## 17 VI Version I

115 Importance of Lathe Machine in Engineering Field and its usage longitudinal feed and rotation of the head stock  
116 spindle should therefore be found out so that the relative speeds of rotation of the work and the lead screw will  
117 result in the cutting of a screw of the desired pitch. This is affected by change gears arranged between the spindle  
118 and the lead screw or by the change gear mechanism or feed box used in a modern lathe.

119 has a definite pitch. A definite ratio between the be equally inclined to the center line of the work piece as  
120 shown.

121 The speed of the spindle is reduced by one half to one -fourth of the speed require for turning according to  
122 the type of the material being machined and the half -nut is then engaged. The depth of cut usually varies from  
123 0.05 to 0.2 mm is given by advancing the tool perpendicular to the axis of the work.

124 After the tool has produced a helical groove up to the desired length of the work, the tool is quickly withdrawn  
125 by the use of the cross slide, the half-nut disengaged and the tool is brought back to the starting position to give  
126 a fresh cut. Before re-engaging the halfnut it is necessary to ensure that the tool will follow the same path it has  
127 traversed in the previous cut, otherwise the job will be spoiled. Several cuts are necessary before the full depth  
128 of thread is reached arising from this comes the necessity to "pick-up" the thread which is accomplished by using  
129 a chasing dial or thread indicator.

## 18 a) Chasing dial or thread indicator

131 The chasing dial is a special attachment used in modern lathes for accurate "picking up" of the thread. This  
132 dial indicates when to close the split of half nuts. This is mounted on the right end of the apron. It consists of a  
133 vertical shaft with a worm gear engaged with the lead screw. The top of the spindle has a revolving dial marked  
134 with lines and numbers. The dial turns with the lead screw so long the half nut is not engaged.

135 If the half-nut is closed and the carriage moves along the dial stands still. As the dial turns, the graduations  
136 pass a fixed reference line. The half-nut is closed for all even threads when any line on the dial coincides with  
137 the reference line. For all odd threads, the half-nut is closed at any numbered line on the dial determined from  
138 the charts. If the pitch of the thread to be cut is an exact multiple of the pitch of the lead screw, the thread is  
139 called even thread, if otherwise the thread is odd thread.

140 In a chasing dial, the rule for determining the dial division is: In case of metric threads, the product of the  
141 pitch of lead screw and the no. of teeth on the worm wheel must be an exact multiple of the pitch of the threads  
142 to be cut. In case of English threads, the product of the threads per inch to be cut and the number of teeth on  
143 the worm wheel must be an exact multiple of the number of threads per inch of the lead screw. For example,  
144 if the pitch of the lead screw is 6 mm and the worm wheel has 15 teeth. The product will be 90. so any pitch

145 which is exactly divisible by 90, such as 1, 1.75, 2.25, 3, 3.75, 4.5, 5, 6, 7.5, 9, 10, 15, 30, 45, 90 may be picked up when  
146 any line of the dial coincides with the reference line.

### 147 19 b) Right hand and left-hand thread

148 If the bolt advances into the nut when rotated in clockwise direction, the thread is called right-hand thread.  
149 When cutting a right-hand thread the carriage must move towards the head stock.

150 If the bolt advances into the nut when rotated in counter-clockwise direction, the thread is called lefthand, for  
151 a left hand thread the carriage moves away from the head stock and towards the tail stock. The job moves as  
152 always in the anti-clock wise direction when viewed from the tail stock end. The direction at which the carriage  
153 moves in relation to lathe head stock is controlled by means of the tumbler gears or bevel gear feed reversing  
mechanism.<sup>1</sup>



Figure 1:

154

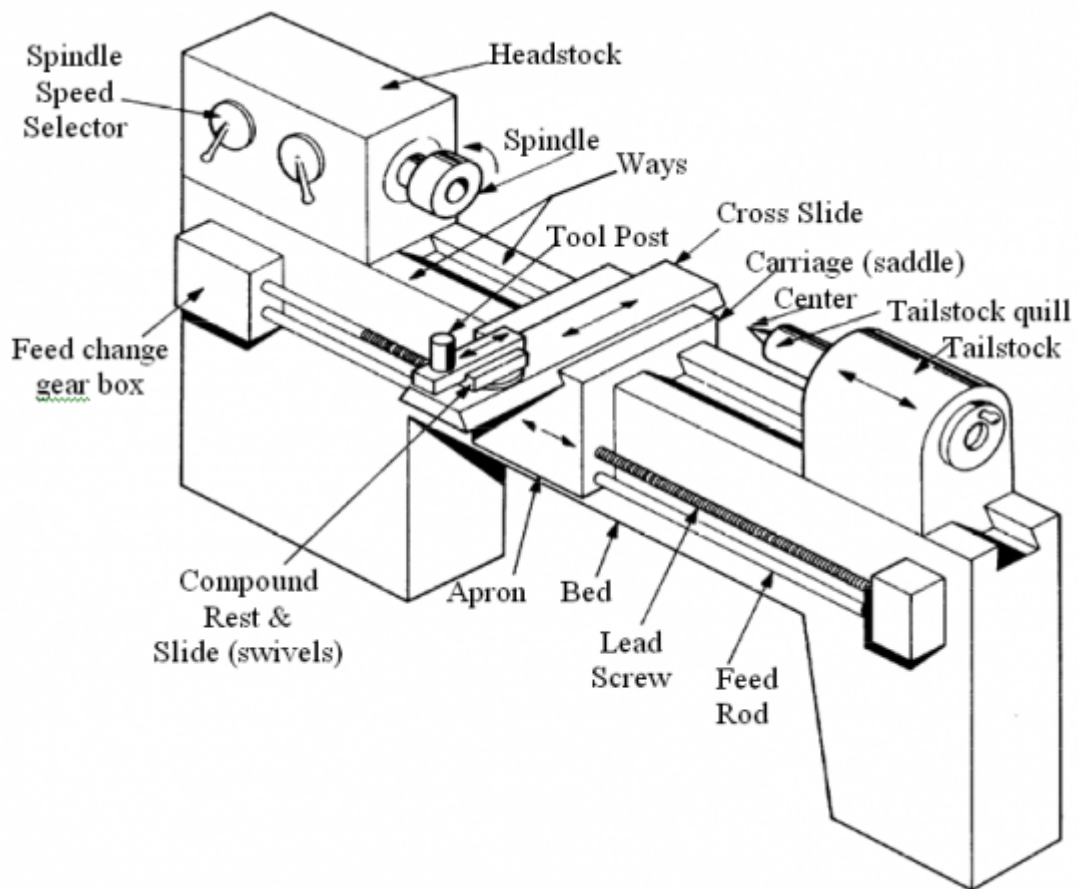


Figure 2:



Figure 3:

(a) Straight turning

(b) Taper turning

(c) Profiling

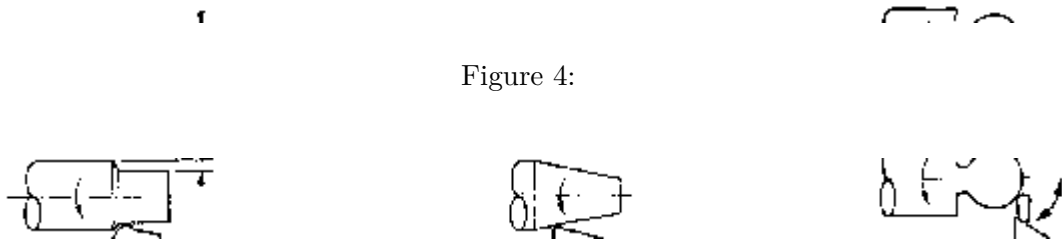


Figure 4:



Figure 5:



Figure 6:

(d) Turning and external grooving

(e) Facing

(f) Face grooving



Figure 7: