

## ***MILLING***

**Purpose:** To study the operation of milling.

Milling machine is one of the most versatile conventional machine tools with a wide range of metal cutting capability. Many complicated operations such as indexing, gang milling, and straddle milling etc. can be carried out on a milling machine. This training module is intended to give you a good appreciation on the type of milling machines and the various types of milling processes. Emphasis is placed on its industrial applications, operations, and the selection of appropriate cutting tools. On completion of this module, you will acquire some of these techniques from the training exercises as illustrated in figure 1. However, to gain maximum benefit, you are strongly advised to make yourself familiar with the following notes before undertaking the training activities, and to have a good interaction between yourself and the staff in charge of your training. Assessment of your training will be based on a combination of your skill and attitude in getting the work done.

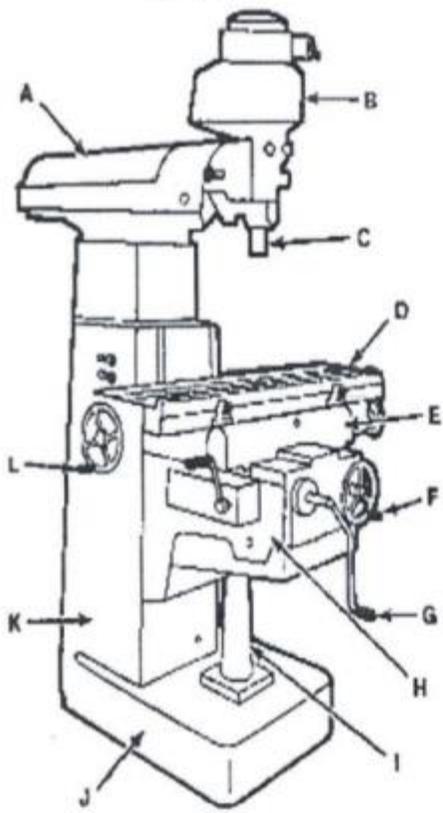
### **WORKING PRINCIPLE OF MILLING MACHINE**

Working of a milling machine is based on the fact that milling cutter is fed against workpiece. This is achieved by developing relative motion with precise control between workpiece and rotating milling cutter. Feed motion is generally given to the workpiece through its holding device. Cutting mechanism of the workpiece in milling operations is Milling cutter work piece This cutting takes place due to plastic deformation of metal by the cutting tool. Milling machine can also hold more than one cutter at a time. The holding device is supported by mechanism that can offer a selective portion of the workpiece to milling cutter for its processing. Indexing is one of the examples of this type of processing machines

### **INDEXING**

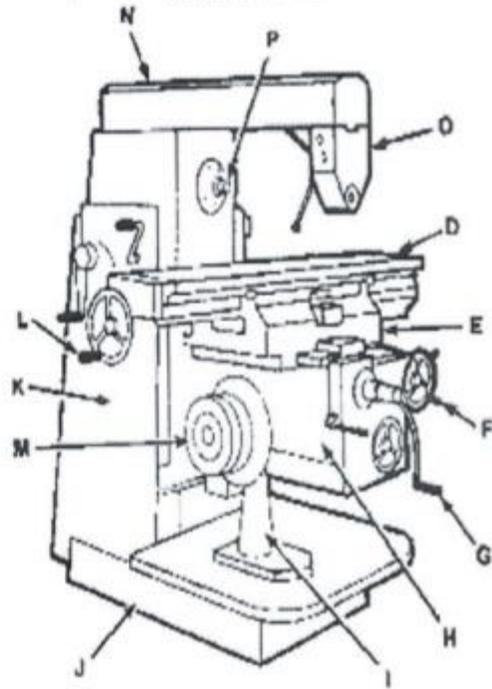
Indexing is the operation of dividing the periphery of a workpiece into any number of equal parts. For example if we want to make a hexagonal bolt. Head of the bolt is given hexagonal shape. We do indexing to divide circular workpiece into six equal parts and then all the six parts are milled to an identical flat surface. If we want to cut „n“ number of teeth in a gear blank. The circumference of gear blank is divided into „n“ number of equal parts and teeth are made by milling operation one by one. The main component used in indexing operation is universal dividing head.

**VERTICAL**



- A RAM
- B VERTICAL HEAD
- C QUILL
- D TABLE
- E SADDLE
- F CROSSFEED HANDLE
- G VERTICAL FEED CRANK

**HORIZONTAL**



- I VERTICAL POSITIONING SCREW
- J BASE
- K COLUMN
- L TABLE HANDWHEEL
- M TABLE TRANSMISSION
- N RAM TYPE OVERARM
- O ARBOR SUPPORT

## Operations:

A. Secure the workpiece in the table of the milling machine using the vice.

1. Clean milling machine vise thoroughly.
2. Place parallels under the workpiece to raise the surface to be milled above the level of the vise jaws.
3. After the workpiece is in place, tighten the vise securely, then tap the workpiece lightly with a dead blow hammer to seat it. Do not tighten the vise again because this would alter the position of the workpiece and tightness of the parallels.

B. Machine Setup

1. Check the diameter of the cutter with a vernier calipers.
2. Calculate RPM for cutting speed = 140 ft/min.

$$RPM = \frac{V(ft/min) \times 12}{\pi D(in)}$$

3. When using the White Chevalier Mills.  
Set the speed of mill by adjusting the RPM knob and reading the speed on the analog meter. "H" and "L" scales represent high and low gear ranges.  
*Note:* do not cut at a speed lower than 500 rpm while in the high gear range.  
(Check with the lab instructor to verify your setup before you continue).
4. Calculate feed (in inch/min) for a feed per tooth = 0.003".

Feed= feed per tooth x no. of cutter teeth x RPM

*Note: Power feed: speed is displayed on the digital readout. Adjust with the dial while moving away from your part.*

If power feed is not available, use handles for manual feed.

*Note: The direction of feed is optional on a vertical milling machine.*

## Items to be included in the report

1. Measured dimensions of the finished part (all the dimensions shown on the drawing)
2. Cutting conditions used for each feature