

Milling Machine

Definition and Applications of Milling Machine

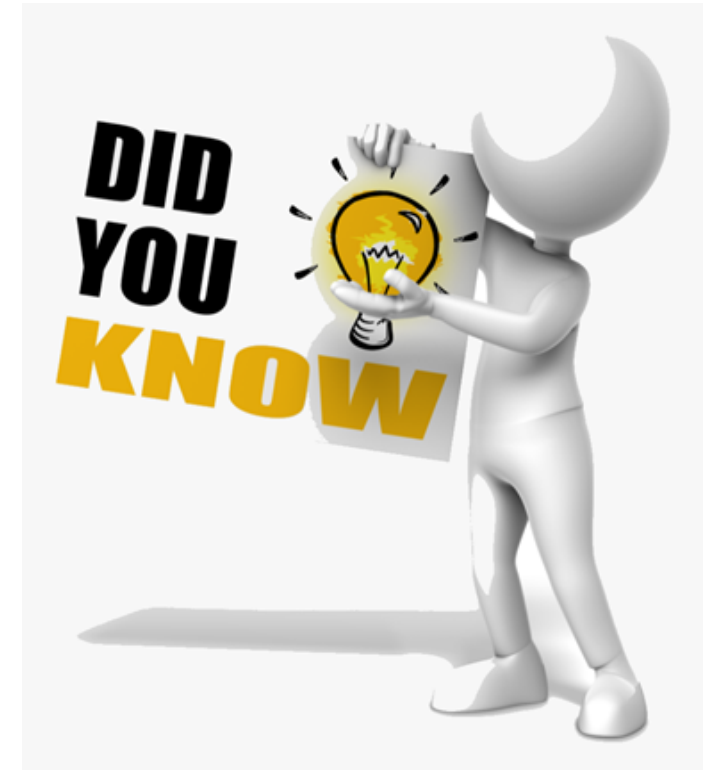
Objective

Upon completion of the course the student shall be able to:

- Know the use of Milling Machine .
- Understand the applications of Milling machine.

Did you Know?

- A Milling machine uses a milling cutter to remove material from the surface of a work piece.
- This process is known as milling operation. Generally cutters have multi edges.



Introduction to Milling Machine

- **Definition** : Milling machine does the process of machining using rotary cutters to remove material by advancing the cutter into a workpiece.
- This may be done by varying direction on one or several axes, cutter head speed, and pressure.
- Milling covers a wide variety of different operations.
- It is used to machine the flat, rough and irregular surfaces and this is done by feeding the workpiece against a rotating milling cutter.



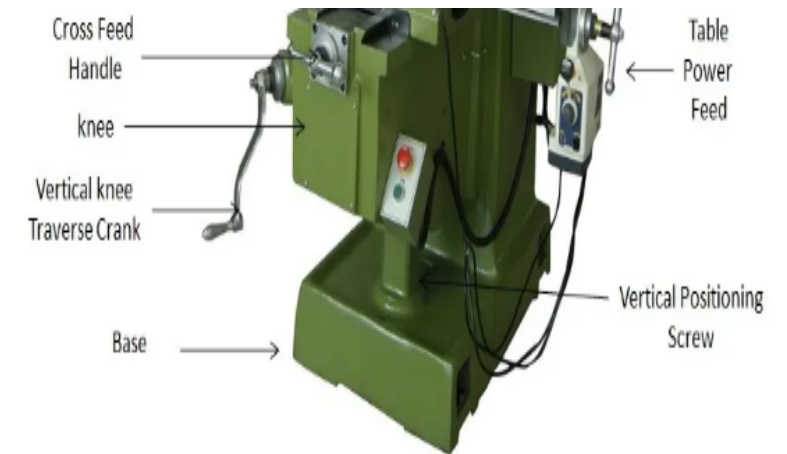
Parts of Milling Machine

1. Column & Base :

- Column including base is the main casting that supports all other parts of milling machine.

2. Knee :

- It is a casting that supports the saddle and table.
- All gearing mechanism is enclosed within the knee part. It is fastened to the column by dovetail guide ways.
- The knee is supported and adjusted by a vertical positioning screw known as elevating screw.



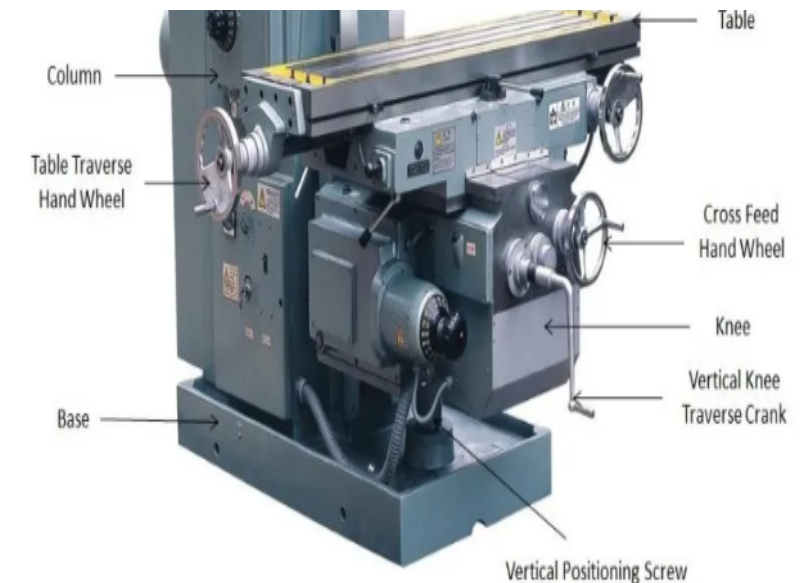
Parts of Milling Machine

3. Saddle and Swivel Table :

- The saddle is present on the knee and supports the table.
- It slides on a horizontal dovetail ways on the knee.

4. Power Feed Mechanism :

- The knee which contains the power feed mechanism. It is used to control the longitudinal (left and right), transverse (in and out) and vertical (up and down) feeds.



Parts of Milling Machine

5. Table

- It is a rectangular casting which is present on the top of saddle.
- It is used to hold the work or work holding devices.



6. Spindle

- It is the shaft that is used to hold and drives the cutting tools of the milling machine.
- The spindle is mounted on the bearings and supported by the column.
- Spindle is driven by the electric motor through gear trains.



Parts of Milling Machine

7. Over Arm / Overhanging Arm :

- It is a horizontal beam present at the top of the column.
- It may be a single casting which slides on the dovetail ways present on the top face of the column. The overhanging arm in the vertical machine is called ram.

8. Arbor Support :

- It is a casting with bearing that supports the outer end of the arbor.
- It also helps in aligning the outer end of the arbor with the spindle.



Types of Milling Machine

1. Horizontal Milling Machine

In horizontal milling machine the axis of rotation of the spindle is horizontal to the table. And due the axis of spindle horizontal, it is called as horizontal milling machine.



2. Vertical Milling Machine

The milling machine in which the spindle axis is perpendicular to the table is called vertical milling machine.



Types of Milling Machine

3. Knee-Type Milling Machine

The milling machine which has a knee like projection at the middle is called knee-type milling machine. It is characterized by a vertical adjustable work table resting on a saddle supported by a knee.



4. Ram-Type Milling Machine

A milling machine which has a ram on the top of the column is called ram type milling machine. Generally ram is used in vertical milling machine. It can be moved on the column in transverse direction.



Types of Milling Machine

5. Universal Milling Machine

- The universal milling machine is suitable for milling planes, bevels, grooves, etc. using a variety of bar milling cutters, circular milling cutters, and angle milling cutters.
- If you use the universal milling head, round table, indexing head and other milling machine accessories, you can expand the processing range of the machine.
- The machine has sufficient rigidity and power, and has powerful machining capabilities for high-speed and heavy-duty cutting operations and gear machining.



Specifications of Milling Machine

A Milling machine can be specified as per:

- Working Surface
- Number of T-slots
- width of T-slots
- Pitch of T-slots
- Maximum distance from spindle centre to underside of over support



Applications of Milling machine

- Milling machines are usually used to machine flat surfaces, but can also produce irregular surfaces.
- They can also be used to drill, bore, cut gears, and produce slots.

From the above Topic we learnt about :

- The uses of Milling machine
- Applications of Milling machine
- The specification of Milling machine

Check Your Understanding

1. Up milling is also called as ?

- A. End Milling
- B. Face milling
- C. Climb milling
- D. Conventional milling

2. The cutting tool in a milling machine is mounted on ?

- A. Spindle
- B. Arbor
- C. Column
- D. Knee

Check Your Understanding

3. The universal milling machine is suitable for milling planes, bevels, grooves, etc.

- A. True
- B. False

4. The milling machine which has a knee like projection at the middle is called knee-type milling machine.

- A. True
- B. False

Check Your Understanding

5. Generally ram is used intype milling machine ?

- A. Vertical
- B. Horizontal
- C. Flexible
- D. None of these

6. In horizontal milling machine the axis of rotation of the spindle is to the table. ?

- A. Vertical
- B. Horizontal
- C. Angular
- D. None

Check Your Understanding

7. Which of the following is a type of milling machine ?

- A. Knee-type
- B. Ram-type
- C. Both A and B
- D. None of them

8. Which of the following work can be done in milling?

- A. Flat surface machining
- B. T-slut making
- C. Groove cutting
- D. All of These

Answer Key

1. D. Conventional milling
2. B. Arbor
3. A. True
4. A. True
5. A. Vertical
6. B. Horizontal
7. C. Both A and B
8. D. All of These

Milling Machine

Cutting Tools used for Milling

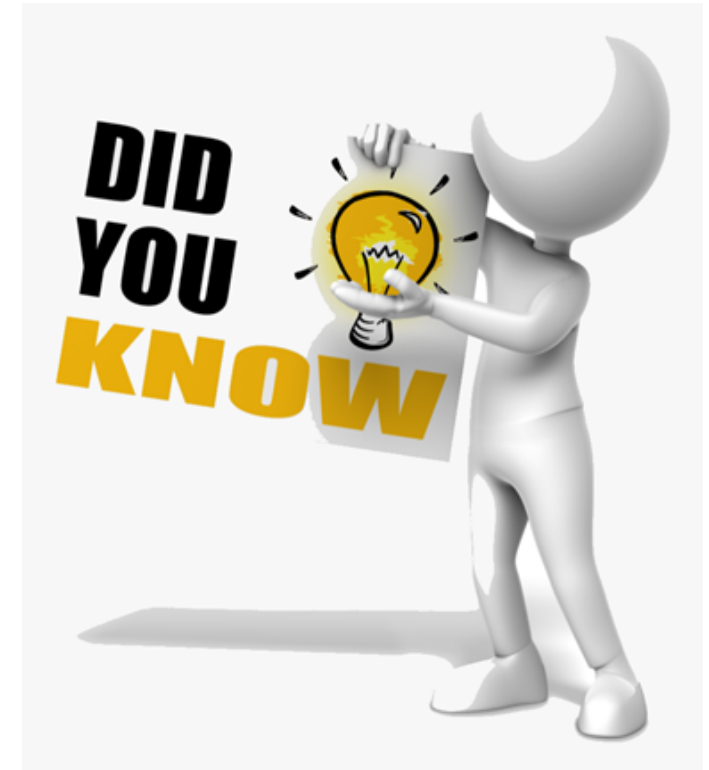
Objective

Upon completion of the course the student shall be able to:

- Know the cutting tools used in milling.
- Types of cutters used in milling.

Did you Know?

- The cutting tools used for milling is known as Milling cutters. For different operations we select different cutting tools. Usually cutters used in milling are multi point cutting tools.



Cutting tools used for Milling

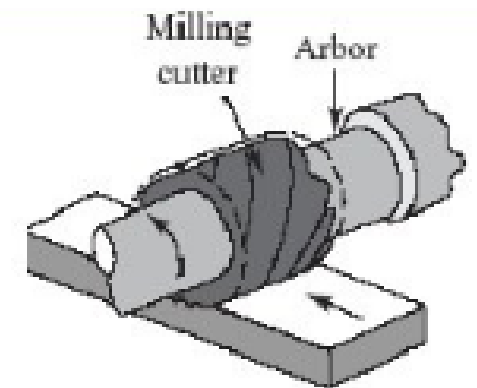
Following are the types of milling cutters that we use in different milling machines:

End Milling cutter:

End mill cutters are the type of cutters used in the milling which has teeth at the end or at the face of the circular disk.

Periphery Milling Cutter:

When the cutting teeth are present on the periphery of the circular disk then it is known as periphery milling cutter.



Cutting tools used for Milling

Side Milling Cutter:

Side Mill cutter is a type of cutter in which the cutting teeth are present on the periphery and also at the face or end.

Face Milling Cutter:

Face mill Cutter consists of a large diameter cutter body with a number of mechanically fastened inserted tipped tools.

The diameter of the cutter body depends upon the length of the workpiece.



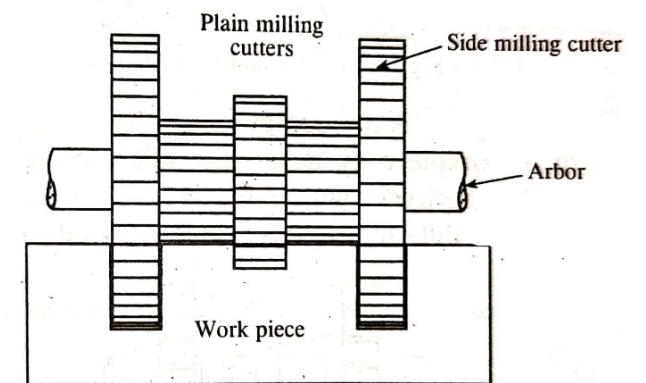
Cutting tools used for Milling

Staggered Mill Cutter:

Staggered Mill cutter has their teeth staggered at the periphery with alternate right-hand and left-hand helix angles and are made in relatively narrow width.

Gang Milling cutter:

It is a type of cutter in which the peripheral milling cutters of the different sizes are cut together to remove the material simultaneously from the workpiece.



Cutting tools used for Milling

Concave Milling Cutter:

The concave cutter is a type of formed type cutter. Concave Milling Cutter is a type of cutter which is shaped to mill a convex surface of circular contour equal to half of a circle or less.



Cylindrical Milling Cutter:

Cylindrical Mill Cutter is the type of cutter which has a cylindrical shape and has teeth on the circumferential surface only.



Cutting tools used for Milling

Woodruff cutter:

This tool used to cut the keyway for a woodruff key. It is slightly hollow ground on the sides for relief and the teeth are not side cutting. The teeth come in both straight and staggered varieties.



Hollow milling cutter:

It looks like a pipe having thicker walls. The cutting teeth of the hollow mills on the inside surfaces. This cutter used in the screw machines.



Cutting tools used for Milling

Thread mill cutter:

The thread is produced by doing a helical interpolation.



Ball cutter:

It is also called as ball nosed cutters. Ball cutters as their end are hemispherical in shape ; It is used to decrease stress concentration.



Cutting tools used for Milling

Hobbing cutter:

It is also is a cutting tool used to cut the teeth into the work piece. This is cylindrical in shape with helical cutting teeth.



Dovetail cutter:

The dovetail cutter is an end mill whose form leaves behind a dovetail slot.



From the above Topic we learnt about :

- The cutting tools used for milling operation.
- The types of milling cutter used in milling.

Check Your Understanding

1. Concave milling cutter is used to mill which type of shape?

- A. Straight
- B. Convex
- C. Concave
- D. None

2. Which cutter has alternate right-hand and left-hand teeth on its periphery ?

- A. Convex milling cutter
- B. Staggered milling cutter
- C. Concave milling cutter
- D. None of these

Check Your Understanding

3. Cylindrical Mill Cutter is the type of cutter which has a cylindrical shape and has teeth on the circumferential surface only.

A. True

B. False

4. The dovetail cutter is an end mill whose form leaves behind a dovetail slot.

A. True

B. False

Check Your Understanding

5. When the cutting teeth are present on the periphery of the circular disk then it is known as milling cutter?

- A. Straight
- B. Parallel
- C. Periphery
- D. None of these

6. Milling cutters have.....type of cutting edge?

- A. Single point
- B. Multi point
- C. Having no point
- D. Two point

Check Your Understanding

7. Hobbing cutter has?

- A. Cylindrical shape
- B. Helical teeth on periphery
- C. Both A and B
- D. None of them

8. Which of the following cutting tools is used for milling operations?

- A. Concave milling cutter
- B. Dove tail milling cutter
- C. End milling cutter
- D. All of These

Answer Key

1. B. Convex
2. B. Staggered milling cutter
3. A. True
4. A. True
5. C. Periphery
6. B. Multi point
7. C. Both A and B
8. D. All of These

Milling Machine

Side milling

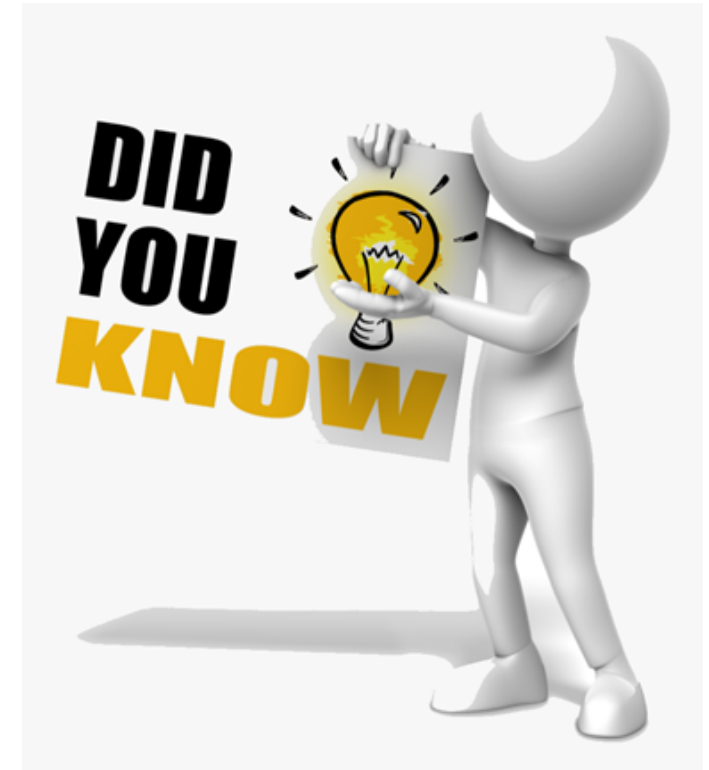
Objective

Upon completion of the course the student shall be able to:

- Understand the Facing operation .
- Know the usage of milling cutter..

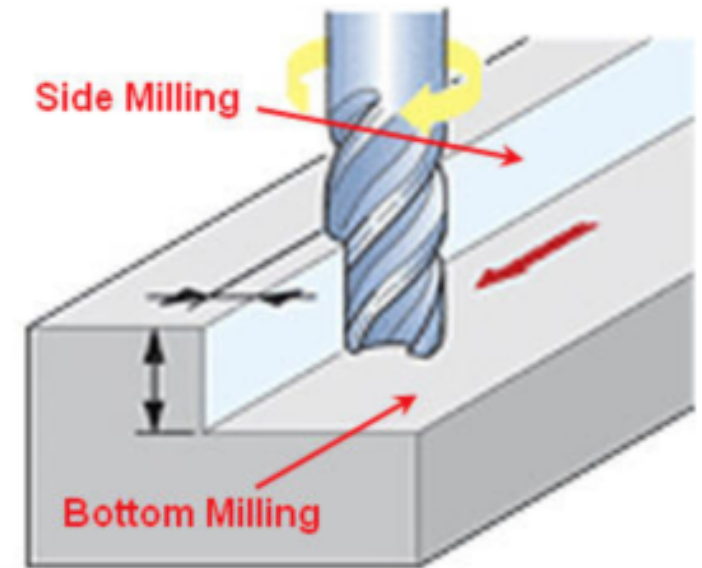
Did you Know?

- The side milling is the production of a flat vertical surface on the side of a work piece by using a side-milling cutter. The depth of cut is adjusted by rotating the vertical feed screw of the table.



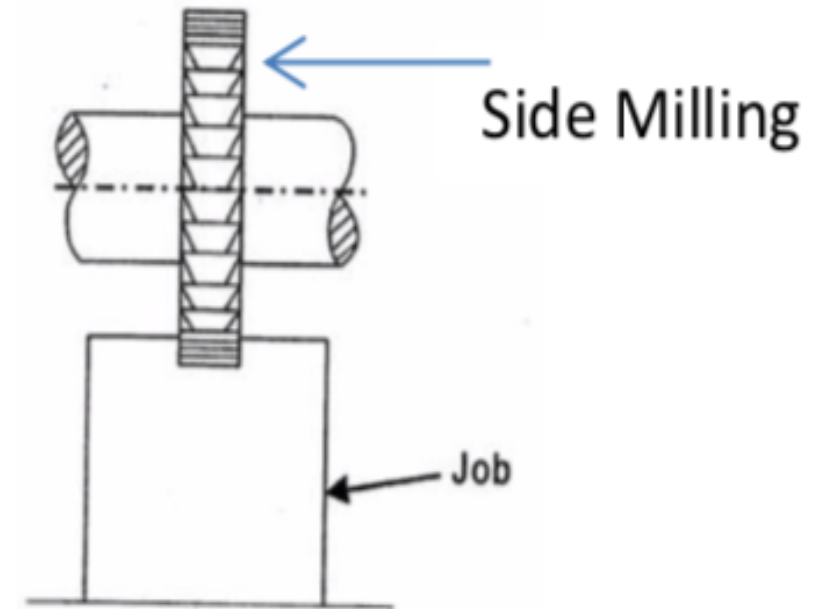
Introduction to Side Milling

- Side milling operation generally performed on horizontal milling machine.
- The cutting tool used for this operation is called as side milling cutter.
- The side milling cutter is connected to the arbor part of the machine.
- There are four types of side mill cutter available; They are : Plain side milling cutter, Half side milling cutter, Staggered teeth side milling cutter, Interlocking side milling cutter.



Needs and Applications of Side Milling

- Side milling is used for forming T-slots on workpieces.
- Also used for making key-ways on workpieces.



From the above Topic we learnt about :

- The execution of Side milling operation
- Usage of Side milling cutter

Check Your Understanding

1. Which type of side mill cutter is having alternate right and left-side teeth ?

- A. Half side mill cutter
- B. Plain side mill cutter
- C. Staggered side mill cutter
- D. None

2. Side mill cutter is attached to which part of the milling machine?

- A. Bed
- B. Arbor
- C. Table
- D. Vice

Check Your Understanding

3. Side milling operation generally performed on horizontal milling machine.

A. True

B. False

4. The cutting tool used for side milling operation is called as side milling cutter.

A. True

B. False

Check Your Understanding

5. Type of side mill cutter is available?

- A. 3
- B. 1
- C. 2
- D. 4

6. Half side mill cutter has teeth on part of its periphery?

- A. Half
- B. Full
- C. One-third
- D. Two-third

Check Your Understanding

7. Side milling is used for which application?

- A. T-Slot
- B. Key-way
- C. Both A and B
- D. None of them

8. Which is wrong about Side milling operation?

- A. Side mill cutter used
- B. Generally performed on horizontal machine
- C. Cutter attached with arbor
- D. All of These

Answer Key

1. C. Staggered side mill cutter
2. B. Arbor
3. A. True
4. A. True
5. D. 4
6. A. Half
7. C. Both A and B
8. D. All of These

Milling Machine

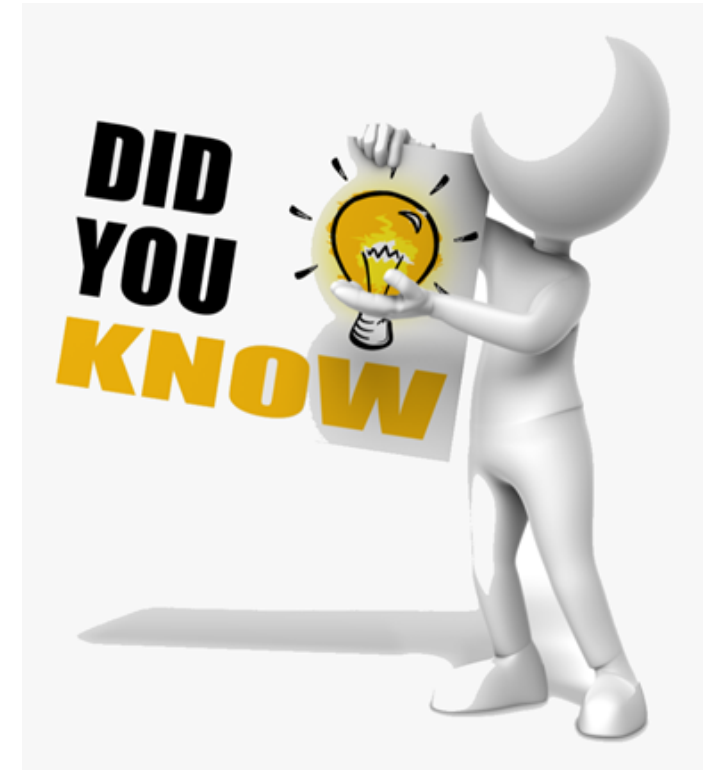
Profile Milling

Upon completion of the course the student shall be able to:

- Understand the Profile milling operation .
- Know the usage of milling cutter..

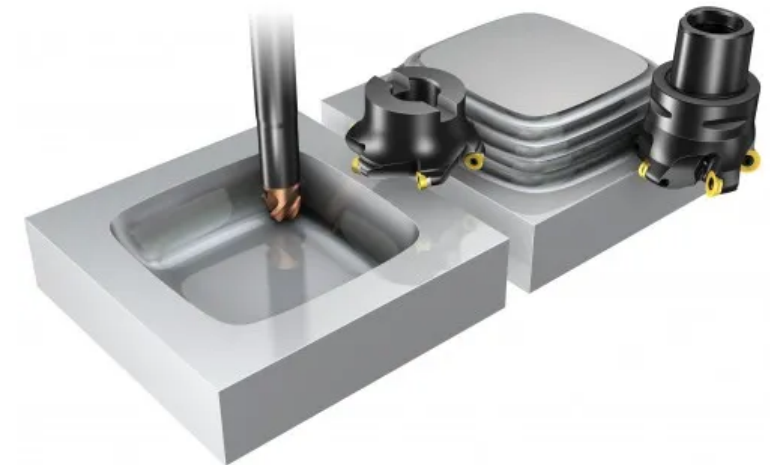
Did you Know?

- Profile milling is a type of milling process, usually used to semi-finish or finish the vertical or slanted surfaces, including multi-axis milling of convex and concave shapes in two or three dimensions.



Introduction to Profile Milling

- Profile milling covers multi-axis milling of convex and concave shapes in two and three dimensions.
- A larger component which have more complicated configuration can be done by profile milling process.
- The machining process should be divided into at least three operation types:
 1. Roughing/semi-roughing
 2. Semi-finishing
 3. Finishing



Needs & Applications of Profile Milling

- Profile Milling is generally used for forming cavity on workpieces.
- Also used for making complex shapes on workpieces.

From the above Topic we learnt about :

- The execution of Profile Milling operation
- Usage of Milling cutter

Check Your Understanding

1. Profile Milling is generally used for what purpose?
 - A. Create inclined surface
 - B. Forming chucks
 - C. Forming cavity
 - D. None
2. Profile milling is done on which machine?
 - A. Milling
 - B. Lathe
 - C. Drilling
 - D. None of these

Check Your Understanding

3. Profile milling covers multi-axis milling of convex and concave shapes in two and three dimensions.

A. True

B. False

4. A larger component which have more complicated configuration can't be done by profile milling process.

A. True

B. False

Check Your Understanding

5. The tool used for profile milling..... ?

- A. Face milling cutter
- B. Side milling cutter
- C. Profile milling cutter
- D. None of these

6. Profile milling is also called..... ?

- A. Single -axis milling
- B. Multi-axis milling
- C. Dual milling
- D. None

Check Your Understanding

7. Profile milling can be done in which dimension ?

- A. Two
- B. Three
- C. Both A and B
- D. None of them

8. Profile milling cutter is made up of?

- A. High speed steel
- B. Cemented carbide
- C. Aluminium
- D. Both A and B

Answer Key

1. C. Forming cavity
2. A. Milling
3. A. True
4. B. False
5. C. Profile milling cutter
6. B. Multi-axis milling
7. C. Both A and B
8. D. Both A and B

Milling Machine

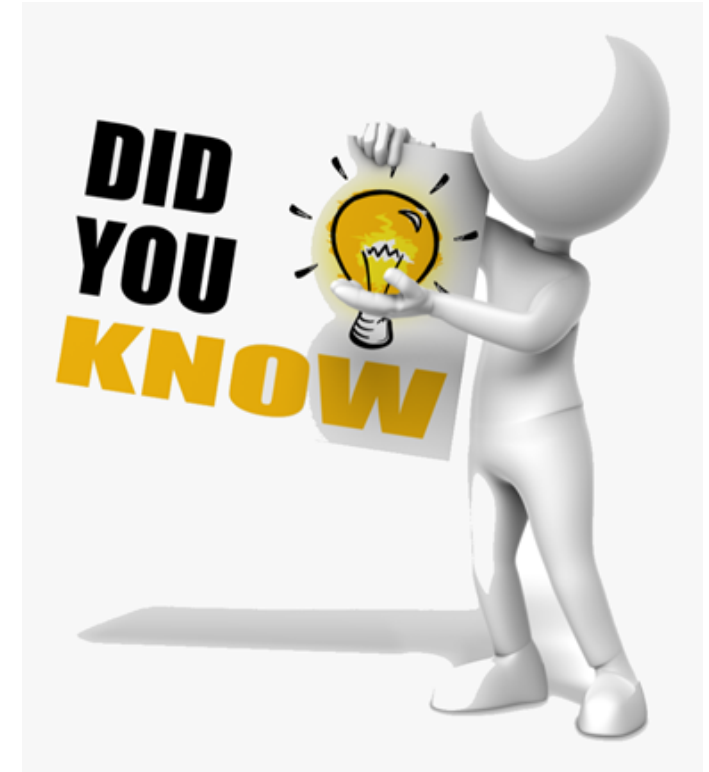
Face Milling

Upon completion of the course the student shall be able to:

- Understand the Face milling operation .
- Know the usage of face milling cutter.

Did you Know?

- Face milling is the most common milling operation and can be performed using a wide range of different tools.
- Cutters with a 45° entering angle are most frequently used but round insert cutters, square shoulder cutters and face mills are also used for certain conditions.



Introduction to Face Milling

- Face milling is a machining process in which the milling cutter is placed perpendicular to the workpiece.
- The milling cutting is essentially positioned “face down” towards the top of the workpiece.
- When engaged, the top of the milling cutting grinds away at the top of the workpiece to remove some of the material.
- Milling cutters are made from High Speed Steel (HSS) and some are carbide tipped.



Needs and Applications of Face Milling

- Face milling is generally used for producing wide flat surfaces.
- Also used for removing more materials from rectangular workpieces.

From the above Topic we learnt about :

- The execution of Face milling operation
- Usage of face milling cutter

Check Your Understanding

1. Which tool is used for face milling?

- A. Side Milling Cutter
- B. Face Milling Cutter
- C. End Milling Cutter
- D. None

2. In Face milling ; the cutting tool is placed?

- A. Parallel to work
- B. Perpendicular to work
- C. Inclined to work
- D. None

Check Your Understanding

3. Face milling is a machining process in which the milling cutter is placed Parallel to the workpiece.

A. True

B. False

4. Face milling is generally used for producing wide flat surfaces.

A. True

B. False

Check Your Understanding

5. Face milling cutter is made up of..... ?

- A. Plastic
- B. Aluminium
- C. HSS
- D. None of these

6. The speed at which the piece advances through the cutter is called ?

- A. Cutting speed
- B. Feed rate
- C. Depth of cut
- D. None

Check Your Understanding

7. Which of the following is a type of milling operation?

- A. Face milling
- B. End milling
- C. Both A and B
- D. None of them

8. Which is wrong about Face milling?

- A. End milling cutter used
- B. It is a non-conventional machining process
- C. It is a joining process
- D. All of These

Answer Key

1. B. Face Milling Cutter
2. B. Perpendicular to work
3. B. False
4. A. True
5. C. HSS
6. B. Feed rate
7. C. Both A and B
8. D. All of These