Skill India
कौशल भारत-कुशल भारत

सत्यमेव जयते
GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
& ENTREPRENEURSHIP

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National
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Participant Handbook

Sector
Iron & Steel

Sub-Sector
Steel, Sponge Iron

Occupation
Mechanical Maintenance

Reference ID: **ISC/Q0909, Version 1.0**
NSQF Level 3

Machinist

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Disclaimer

"Skilling is building a better India. If we have to move India towards development then Skill Development should be our mission."

Shri Narendra Modi
Prime Minister of India

Certificate

COMPLIANCE TO
QUALIFICATION PACK – NATIONAL OCCUPATIONAL STANDARDS

is hereby issued by the

Indian Iron & Steel Sector Skill Council

for

SKILLING CONTENT : PARTICIPANT HANDBOOK

Complying to National Occupational Standards of
Job Role/ Qualification Pack: ' **Machinist** ' QP No. ' **ISC/Q0909 NSQF Level 3** '

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Indian Iron & Steel Sector Skill Council

About this book

This Participant Handbook is designed to enable training for the specific Qualification Pack(QP). Each National Occupational (NOS) is covered across Unit/s.

This job is all about identifying the sequence of machining operations required to fabricate product components by studying their designs/ sample parts and fabricating the components using the appropriate tools and dies. This job requires the individual to work independently as well in teams. He should be result oriented and positive in attitude.

Key Learning Objectives for the specific NOS mark the beginning of the Unit/s for that NOS. The symbols used in this book are described below.

Symbols Used


Key Learning Outcomes


Steps


Exercise


Tips


Notes


Unit Objectives

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1. Introduction

Unit 1.1 - Understanding of Iron & steel industry

Unit 1.2 - Understanding various types of Iron & Steel Industry

Unit 1.3 - Creation of products in Iron & Steel industry

Key Learning Outcomes

At the end of this module, you will be able to:

1. Discuss about Iron & Steel industry
2. Discuss about development activities in Iron & Steel industry
3. Discuss about employment opportunities in India
4. Know about industry structure
5. Know about Iron & Steel plants in India
6. Know about steel making procedure
7. Know about processes involved in steel making

UNIT 1.1: Understanding of Iron & Steel Industry

Unit Objectives

At the end of this unit, you will be able to:

1. Understand about Iron & Steel industry
2. Understanding of development activities in the industry
3. Understanding of opportunities in Iron & Steel Industry in India

1.1.1 Introduction

India comes under the list of world's largest crude steel producer countries. The growth of steel sector in India has been motivated by availability of raw materials like iron ore and cheap labour. Thus, the steel sector is giving an important contribution to India's manufacturing industry.

Now crude steel capacity of India reached 109.85 Million tonnes (MT), with a growth of 7.4 per cent. Production of crude steel grew by 8.9 per cent to 88. 98 MT. Total finished steel production for sale increased by 5.1 per cent to 92.16 MT. Consumption of total finished steel increased 3.9 per cent to 76.99 MT.

India is now producing 7.34 MT of steel. The steel sector in India contributes nearly two per cent of the country's gross domestic product (GDP) and employs over 600,000 people.

1.1.2 Conditions for the growth of Iron and Steel Industries

The favorable conditions for the growth of Iron and Steel sector are:

1. Requirement of large amount of iron ore and coal for production of steel. Therefore establishment of industry is required near iron-ore producing areas or coal producing areas.

2. The factories are generally located near rivers or lakes also because large quantity of water is required to cool the smelt iron.

Other factors affecting the location of the steel plants are:

- availability of cheap labor near the steel plant,
- nearby market, ports, etc.

Huge amount of investment is requisite for setting up of Iron and Steel plants. Though India has enough volume of coal, iron-ore and cheap labor, but requirement of large investment makes it difficult to set up many steel plants.

1.1.3 Development activities in Iron & Steel industry

Investments

In India, Steel industry has seen a number of major investments and developments in past few years.

According to the data, the Indian metallurgical industries attracted Foreign Direct Investments (FDI) of around US$ 8.7 billion.

Some of the major investments in the Indian steel industry are as follows:

- National Mineral Development Corporation (NMDC) invested Rs 40,000 crore to attain mining capacity of 75 million tonnes per annum (MTPA) by FY2018-19 and 100 MTPA by FY2021-22.
- Posco Korea, a multinational Korean steel company, has signed an agreement with Shree Uttam Steel and Power to set up a steel plant in Maharashtra.
- Arcelor-Mittal, made a joint venture with Steel Authority of India Ltd (SAIL) for setting up an automotive steel manufacturing facility in India.
- NMDC made an investment of Rs 18,000 crore for setting up a greenfield 3-million tonne per annum steel mill in Karnataka jointly with the state government.
- JSW Steel planned to make its Karnataka steel plant, largest in India with the capacity of 20 MT by 2022.

Government Initiatives

Indian government is aiming to increase steel production to 300 MT by 2025 in the country.

The Ministry of Steel has announced to invest in expansion of steel plants of SAIL and Rashtriya Ispat Nigam Limited (RINL) in various states to enhance the crude steel production capacity.

The Minister of Steel & Mines has restated assurance of Central Government to support the steel industry for reaching production target of 300 MTPA in 2025.

The Minister of Steel & Mines, Mr Narendra Singh Tomar, has reiterated commitment of Central Government to support the steel industry to reach a production target of 300 Million Tonne Per Annum (MTPA) in 2025.

The Ministry of Steel is facilitating setting up of an industry driven Steel Research and Technology Mission of India (SRTMI) in association with the public and private sector steel companies to spearhead research and development activities in the iron and steel industry at an initial corpus of Rs 200 crore (US$ 31.67 million).

Some of the other recent government initiatives in this sector are as follows:

- Government has planned Special Purpose Vehicles (SPVs) with four iron ore rich states i.e., Karnataka, Jharkhand, Orissa, and Chhattisgarh to set up plants having capacity between 3 to 6 MTPA.
- SAIL plans to invest US$ 23.8 billion for increasing its production to 50 MTPA by 2025. SAIL is currently expanding its capacity from 13 MTPA to 23 MTPA, at an investment of US$ 9.6 billion.
- To increase domestic value addition and improve iron ore availability for domestic steel industry, duty on export of iron ore has been increased to 30 per cent.

6.7.1.1 Milling machines

Milling machine are most flexible conventional machines have metal cutting ability. Many complicated operations like indexing, gang milling and straddle milling etc. can be performed on a milling machine.

Mostly milling machines are constructed with a column and knee structure. Milling machines are categorized into two main types i.e. Horizontal Milling Machine and Vertical Milling Machine. The name Horizontal or Vertical is given to the machine by virtue of its spindle axis. Horizontal machines are further categorized into Plain Horizontal and Universal Milling Machine. The main difference between the two is that the table of a Universal Milling Machine can be set at an angle for helical milling while the table of a Plain Horizontal Milling Machine is not.

Horizontal Milling Machine

The main parts of a Plain Horizontal Milling Machine are:

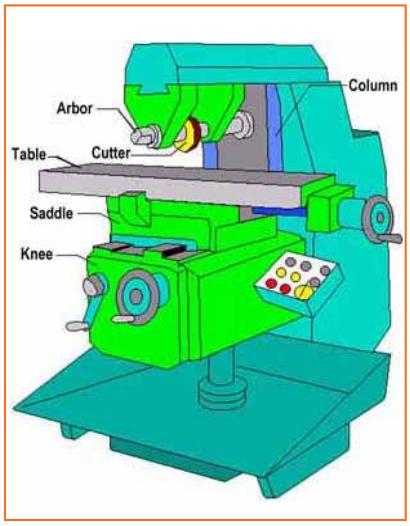
a) **Column:** The column gives the housing to machine parts like spindle, shafts, gear box, bearings, clutches, pumps and shifting mechanisms for power transmission from electric motor to spindle at chosen speed.

b) **Knee:** Knee supports the table and gives an up or down motion along the Z axis. It is mounted on the column.

c) **Saddle**: The saddle carries two slideways, in which one on saddle top and other at the saddle bottom at 90º to each other. They utilize lead screws for giving motion in X or Y axes.

d) **Table**: Table is mounted on saddle top. Table carries some T-slots on its top for supporting the workpiece or clamping fixtures.

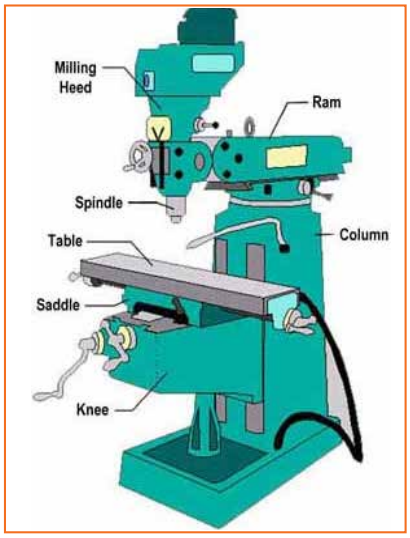
e) **Arbor**: Arbor is expansion of spindle, utilized for mounting of cutters.



6.7.3 Horizontal milling machine

Vertical Milling Machine

Vertical milling machine construction is nearly similar to horizontal milling machine apart from that spindle is mounted in vertical position. Some extra parts in vertical milling machine are:



6.7.4 Vertical milling machine

a) **Milling head**: It carries the spindle, motor and feed control unit. It is mounted on a swivel base so that it can adjust at any angle on table.

b) **Ram**: Milling head is attached with the ram. Ram can move frontward and rearward along the slideway on column top.

6.7.1.2 Milling cutters

Milling process requires sharp cutting tool that which is rotated by the spindle. The cutter is cylindrical in shape and has sharp teeth on its outer surface. The spaces between the teeth are called flutes; they remove the material chips away from workpiece. Cutter teeth's are straight, but set in a helix pattern. For good surface finish, larger number of teeth is required. For milling operations, cutters utilized are highly diverse, so they can form parts with variety of features.

A cutter utilized in horizontal milling machine has extended length of teeth along the complete length of tool. The tool is hollow from inside, so its mounting on arbor becomes easy. There are variety of cutters utilized in milling operations for different purpose.

Cutting Tools for Horizontal Milling

a) **Slab Mills**: Used for heavy cutting of large and flat surfaces.

b) **Side and Face Cutters**: These cutters have cutting edges and teeth on the sides for cutting shoulders and slots.

c) Slitting Saws: Used for cutting deep slots.

6.7.5 Milling cutters

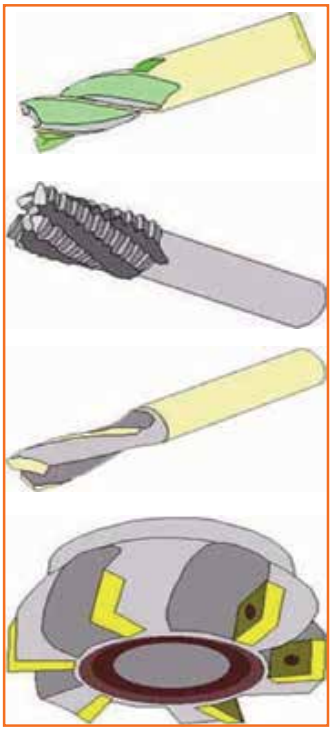
Cutting tools for Vertical Milling

a) **End Mills:** These are utilized for facing, slotting and profile milling.

b) **Rough Cut End Mills**: Utilized for quick removal of metal.

c) **Slot Drills:** Used for making pockets without drilling a hole.

d) **Face Milling Cutters**: Used for heavy cutting.



6.7.6 Vertical milling cutting tools

Every single cutting tool that are utilized as a part of milling machine are made with a variety of materials and they decide the property of tools and the work piece types for which they can be used. The tools are generally hard, strong and immune to wear because of above properties. The most common tool materials utilized are:

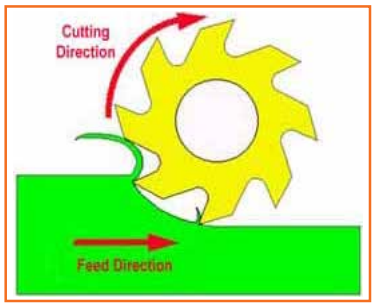
- High-speed steel (HSS)
- Carbide
- Carbon steel
- Cobalt high speed steel

Workpiece material, cost and life of tool are the few factors which have to be consider during the selection of tool material.

6.7.1.3 Milling process

Milling process removes metal by utilizing a revolving cutter having cutting teeth.

Workpiece is feed against the rotating cutter for cutting process. Thus, spindle speed, cut depth, table feed and direction of cutter rotation becomes key parameters of process. Balanced settings of these parameters give the good results.

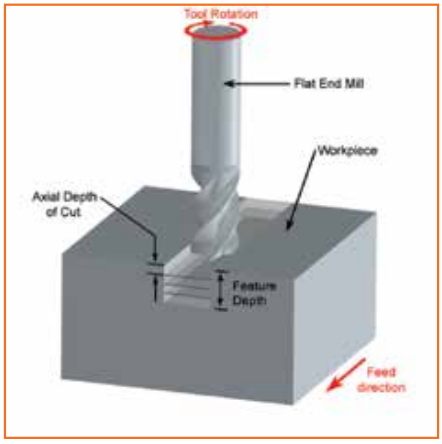


6.7.7 Milling process

6.7.1.4 Milling cutting parameters

In milling, the speed and motion of the cutting tool is specified through several parameters:

- **Cutting feed -** Cutting feed is the distance moved by cutting tool or work piece during the single machine rotation. Its unit is inches per revolution (IPR). Sometime the tool moves on the work piece and in others the work piece rotates and tool is fixed.
- **Cutting speed -** The Unit is surface feet per minute (SFM) and it is described as for any duration of a cut, the speed of the material surface with respect to the cutting tool edge.
- **Spindle speed -** It is the speed of the spindle rotations per minute (RPM). The cutting speed divided by the circumference of the work piece gives spindle speed. Depends on the diameter spindle speed should be adjusted to make steady cutting speed.
- **Feed rate -** The cutting tool's velocity with respect to the material as the tool makes a cut. Unit is inches per minute (IPM). Cutting feed (IPR) and the spindle speed (RPM) results in feed rate.
- **Depth of cut**: Effectiveness of cutting process directly relates with the cut depth. The produtib rate is fast if cut is deeper. However, cut fineness is connected with tool life and enhanced finish of surface.

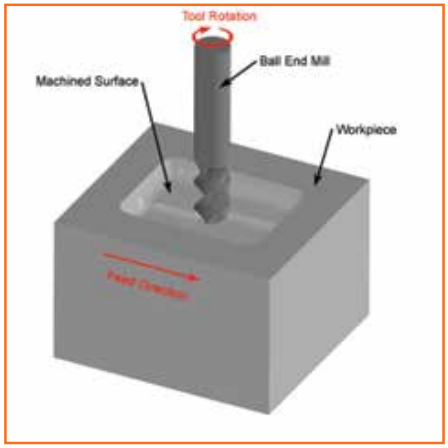


6.7.8 Milling cutting parameters

6.7.1.5 Milling operations

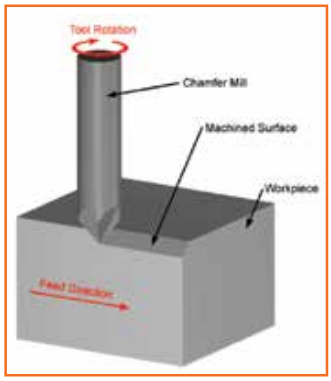
Different operations performed on the workpiece for getting the shape of part during the complete process. The following operations depend on the cutter type and path utilized for removing the unwanted material from the workpiece.

- **End milling** - An end mill make specified features like profile, slot, pocket etc. across the workpiece. Required cut depth can be attained in a single pass or multiple passes at smaller axial depth of cut during machining.



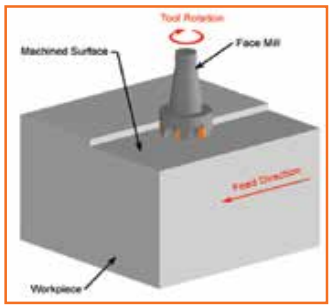
6.7.9 End milling

- **Chamfer milling** - A chamfer end mill makes an angled surface, known as a chamfer and cut along the edge of workpiece. Usually chamfer of an angle 45o is made on any of the exterior or interior of the part.



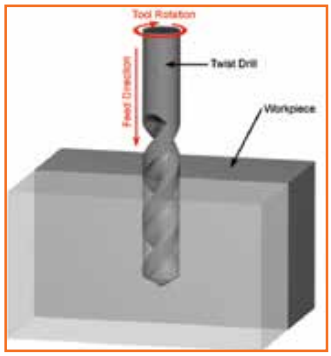
6.7.10 Chamfer milling

- **Face milling** - A face mill makes flat surface for giving smooth surface finish on the workpiece. Required cut depth can be attained in a single pass or multiple passes at smaller axial depth of cut during machining.



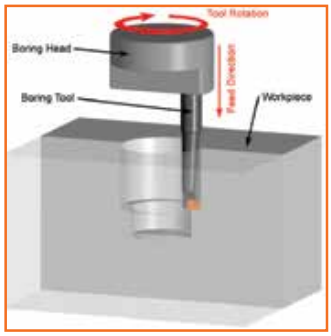
6.7.11 Face milling

- **Drilling** - This process makes hole of size same as that of a drill bit by removing material in its way. Work piece is drilled axially.



6.7.12 Drilling

- **Boring** - Boring shapes the inner surface of work piece by forming steps, tapers, chamfers, and contours by removing material by using boring tool. Boring head can be changed to produce different diameter bores. A drilling is done before boring to insert boring tool.



6.7.13 Boring

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