Machining

Level-II

Based on March 2022, Curriculum Version 1

Module Title: - Performing Machining Operations using Horizontal and Vertical boring

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Nominal duration: 60Hours

Prepared by: Ministry of Labor and Skill

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Acknowledgment

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Acronyms

C.S : Cutting Speed

D.C : Depth Of cut

H.B.M.: Horizontal Boring Machine

V.B.M : Vertical Boring Machine

ISO International standard

Introduction of the Module

A boring machine is a machine which is used for boring large holes on the articles or work items which are not possible to move or rotate on the machine. It is one of the most useful machines which is used on heavy articles like engines, frames, cylinders, land etc. on which the operation of lathe and drilling machine is not possible.

This Modules deals the knowledge, skills and attitudes required to effectively perform machining operations using horizontal and/or vertical boring machine as applies to individuals working in the metal engineering and maintenance industry. It is designed to meet the industry requirement under the machining occupational standard, particularly for the unit of competency **Performing Machining Operations Using Horizontal And Vertical Boring machines**

Module units

- Job Requirements
- Set Up Work.
- Boring Operations.
- Check Component For Conformance To Specification.
- Identify Inserts From Standards
- Adjust And Maintain Machine

Learning objectives of the Module Or LEARNING OUTCOMES

At the end of the module the trainee will be able to:

- Determine job requirements
- Set up work.
- Perform boring operations.
- Check component for conformance to specification.
- Identify inserts from standards
- Adjust and maintain machine

Module Learning Instructions:

- Read the specific objectives of this Learning Guide.
- Follow the instructions described below.
- Read the information written in the information Sheets
- Accomplish the Self-checks
- Perform Operation Sheets
- Do the “LAP test”

Unit one: Job requirements

This learning unit is developed to provide the trainees the necessary information regarding the following content coverage and topics:

1. Interpret Drawings.
2. Sequence of Operations and Cutting Tools.
3. Cutting Parameters.

This unit will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

4. Interpret drawings
5. Determine Sequence of operations and Cutting tools used .
6. Apply cutting parameters

1. Job requirements

1.1. Interpret Drawings.

Drawings are important because they are used to communicate the technical details of a project in a common format. The drawings also become the foundation for future projects and cost savings for customers.

The main purpose of technical drawings is to communicate specific information to other technical people (i.e. engineers, machinists, etc. Technical drawings give all of the information needed to make the product and being accurate in that information is the main goal.

Machine drawing may be defined as the representation of a machine. component or machine by lines according to certain set rules. *A machine drawing generally gives all the external and internal. details of the machine component from which it can be manufactured.

Typically, the purpose of an engineering drawing is to clearly and accurately capture all geometric features of a product or component so that a manufacturer or engineer can produce the required item.

Interpretation of drawings: Fabrication drawings (also called detail or part drawings) are used to communicate the design intent to the "fabricator". To avoid ambiguities in interpretation, these drawings are prepared according to specific "rules".

Scales -It can be shown as 1:1 or 1=1. The first number represents the actual size of the part and the second number represents the print. In other words, 1:2 means the the print is double the actual size. Whereas 3:1 indicates the actual size is three times what is shown on the print

Read and interpret the location where can be drill or bore from the following drawing

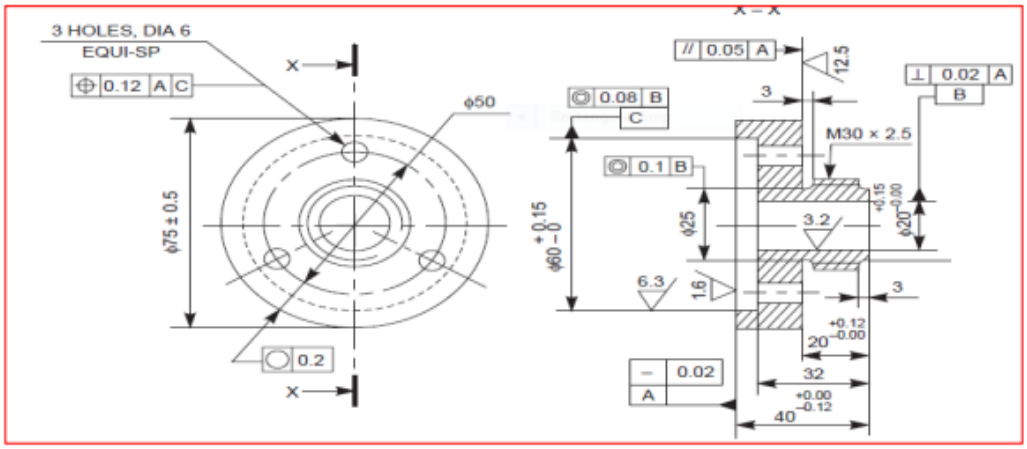


Figure 1.1 Interprating Detail Drawing

Views - Multi-view representation

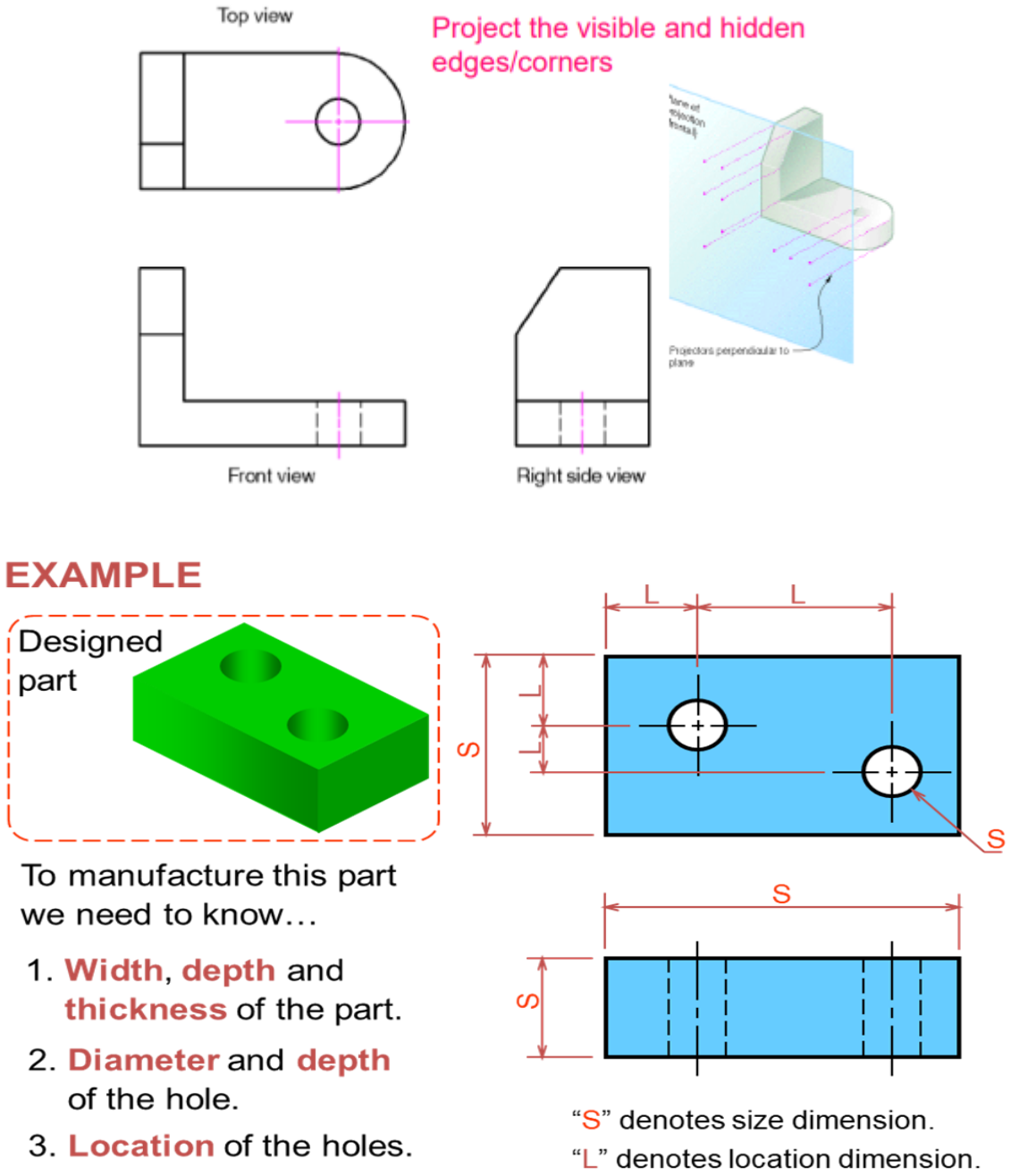


Fig.1.1 Interpreting Multiview Drawing

1.2. Boring Machines and Cutting Tools materials .

1.2.1 Boring Machines

The boring machine is one of the most versatile machine tools is using to bore holes in large and heavy parts such as engine frames, steam engine cylinders, machine housing, etc.

Which are practically impossible to hold and rotate in an engine lathe or in a drill machine. The boring machine has, therefore, been developing primarily to do this. So in this article, we will discuss all the information about the horizontal boring machine. In addition to its

primary purpose of boring, the range of speeds and feeds providing to the various traversing parts allow drilling, milling and facing to perform with equal facility.

By the fitting of simple attachments, the use of the machine can extend still further to include screw cutting, turning, planetary grinding, or gear cutting.

Function and Sizes Of Boring Machine:

Several machines have been developed that are specially adapted to boring work. The function of boring machine is to enlarge a hole that has already been drilled or cored.

Machine Size.

- The sizes of boring machines are varies according to their construction which may be vertical or horizontal.

For vertical

- The size is indicated by the diameter of its table or chuck expressed in mm.
- It can also be specified by the swing diameter of the largest work which can be accommodated in the machine.
- The size of a vertical turret lathe shifts from 600 to 2000 mm.
- The sizes of a standard vertical boring machine is pretty much as high as 6000 mm.

For horizontal

- The size is indicated by the diameter of its spindle in mm.
- The breadth of the spindle varies from 75 to 355 mm.
- To specify a boring machine fully other important dimensions for example spindle motor horse power, column heights, size of the table or size of the floor plate, spindle speeds, feeds and length of feeds, floor space required, weight of the machine, and so on likewise be expressed.

Major parts of Boring Machines.

The Important features of the boring machines are described in the following heads:

a) Headstock. This is most important unit of the machine. The entire machine is built around it. It supports, drives and feeds the tool. It may contain one or two spindles. One spindle is heavy and slow moving for the heavier operations of boring, or drilling. The other spindle is lighter and faster for drilling and tapping small holes and end mill work. Spindle rotation is reversible in either case for backing out tools and for right and left hand cutters.

b) Column. The column provides support for the headstock and guides it up and down accurately by means of ways. It is heavily constructed and is hollow to house the counterweights which balance the headstock and make it easier to move. Columns are

keyed, dowelled, and bolted to bases. Some columns are stationary whereas others move with their bases.

c) The column base. The base supports and secures the column. it houses the various sears and driving mechanisms. On floor type machines the column base is mounted so that the spindle is at right angle to the ways of the run way. On planer type machines, the SpIndle is parallel to the ways of the run way.

d) End support column. For operations involving the use of long Doting bars and heavy tools, an out board bearing is utilized to support the end of the bar. There is an open and a closed type of end support. On table and planer type machines, the bearing block travels in synchronism with the headstock of the machine. When such an end support is used with floor type machines, it is adjusted separately from the headstock and aligned by means of an accurate scale and venire.

e) Run ways. These arc used on floor or planer type machine to carry the main column, end-support column, and in some cases, a rotary table. When the column base, column and headstock are traversed as a complete unit, the member upon which it travels is called a run way and not a bed.

f) Table and saddle. The chief function cf the table is to provide a support for holding the work piece. It also provides a means of locking and clamping the work. It is equipped with suitable ranges of feeds as well as rapid traverse. The table usually traverses at right angles to the axis of the spindles unless provided with saddle. The function of the saddle is to provide a compound movement of the table, so that it can move axially as well as transversely to the spindle.

g) Bed. It may be cast in one or several pieces. It serves to support the column and headstock, the end supports, the table, the saddle and the various feed and cont-ol shafts. It contains alt the necessary feeding mechanisms for the table as well as a coolant tank.

h) Floor plate. Floor-plates are made up of several sections keyed and dowelled together to form a continuous surface for fastening work. The floor plates are mounted on a foundation and arc not adjustable after leveling into position. T-slots are provided for work-clamping,

i) Cross rail. It is used only on the multiple-head machine,

- Boring Machine Mechanism

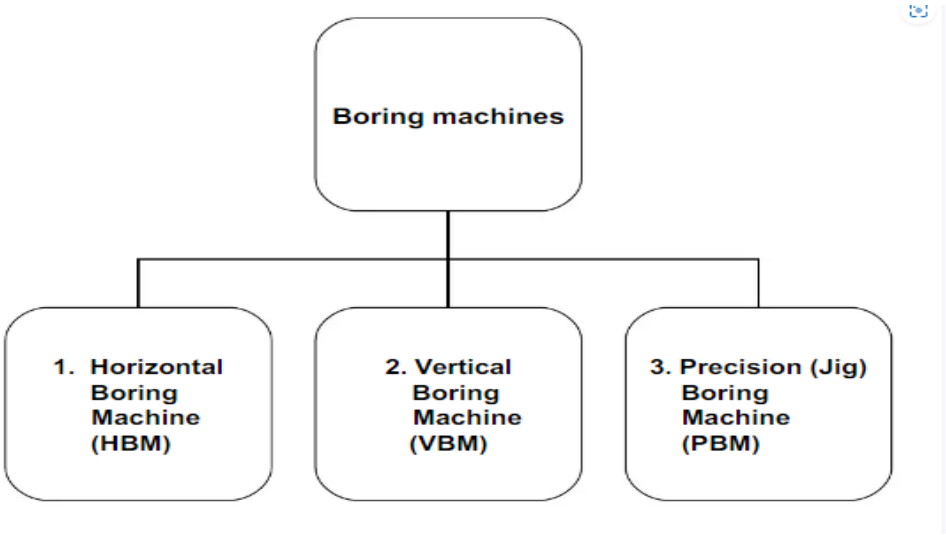
The machine contains different controls for movements of the different parts of the machine. A table type machine has the following movements:

- ✓ The headstock and the end supporting block may be moved up and down.
- ✓ The spindle may be rotating. The spindle has different speeds.
- ✓ A spindle may move in or out by hand or power for feeding.
- ✓ The saddle and the table may move by hand or power.
- ✓ The columns may move by hand or power.

All these movements may be given independently or in combination with two or more movements.

As all the controls are housed in a particular position of the machine the operator may give close attention to the work while controlling the machine.

- **Kinds of Boring machine**



The boring machines may be classified under the four headings:

1) Horizontal boring machine
   - A) Table type
   - B) Floor type
   - C) Planer type
   - D) Multiple head type
2) Vertical boring machine
   - A) Vertical turret lathe
   - B) Standard vertical boring machine
3) Precision boring machine
4) Jig boring machine
   - C) Vertical milling machine type
   - D) Planer type

A) Horizontal Boring Machine

The horizontal boring mill is also known as horizontal boring drilling and milling machine, and is intended to perform operations on relatively large pieces which cannot be rotated easily, are irregular and unsymmetrical, and require operations on many surfaces.

- In horizontal boring machine the work is supported on a table which is stationary and the tool revolves in a horizontal axis.
- A horizontal boring machine can perform operation like boring, reaming, turning, threading, facing, and grooving etc. with suitable tools. Workpiece which are heavy, irre gular, unsymmetrical can be conveniently held and machined easily.
- ·Table type is the most common of all horizontal boring machines. In this boring machine work is mounted on the table.
- Table may be adjusted by hand or power in lengthwise or crosswise.
- The headstock may be adjusted vertically on the column.
- The machine essentially consists of a bed, headstock, supporting column, end supporting column, headstock, saddle and table, and boring bar.
- This machine is suitable for general purpose work where other operation, in addition to boring are required to be performed

Fig 1.1. shows the main features of a horizontal bori1 machine. It also indicates the relative movements of its sliding and rotating elements. It may be noted that the main spindle c be rotated in either direction. It is possible to feed the main spindle axially. The work table can be traversed along and across machine bed. It is possible to machine a flat surface square with bored hole in one setting of work piece by mounting facing head over the spindle.

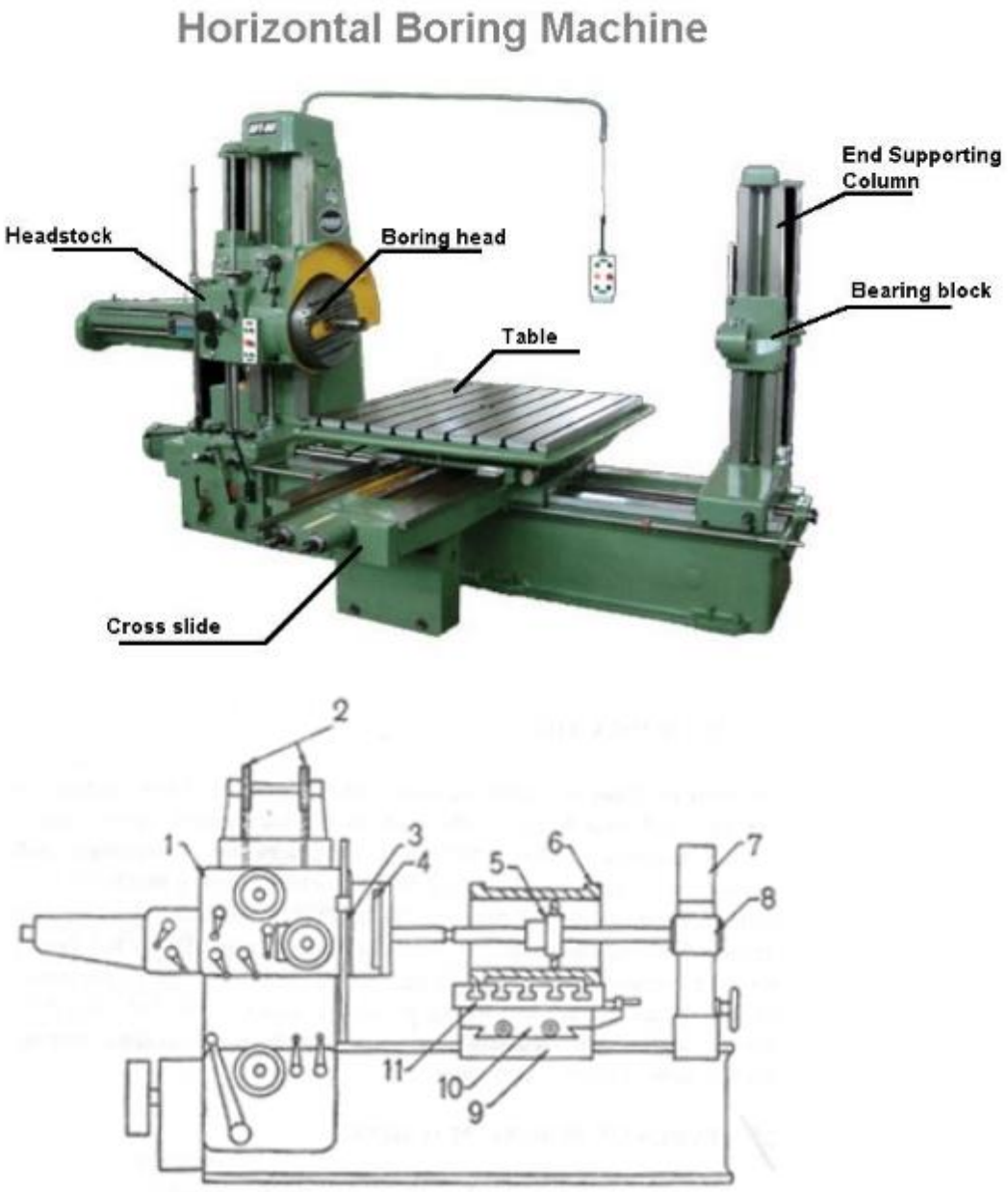


Figure :- 1.1 horizontal boring machine

- Horizontal Boring Machine Parts

In a horizontal boring machine, the work is supporting on a table which is constant and the tool turns into a horizontal axis. A horizontal boring machine can perform boring, reaming, turning, threading, facing, milling, grooving, recessing and many other operations with suitable tools.

Workpieces which are heavy, irregular and off-balance can conveniently hold and easy to machining. Different types of horizontal boring machines design to suit different purposes.

Following are the main parts of horizontal boring machine:

1 – Headstock, 2 – Pulley for counter balancing weight of headstock, 3 – Headstock elevating screw, 4 – Boring head, 5 – Boring cutter on boring bar, 6 – Work, 7– End supporting column, 8 – Bearing block, 9 – Saddle, 10 – Cross slide, 11 – Table

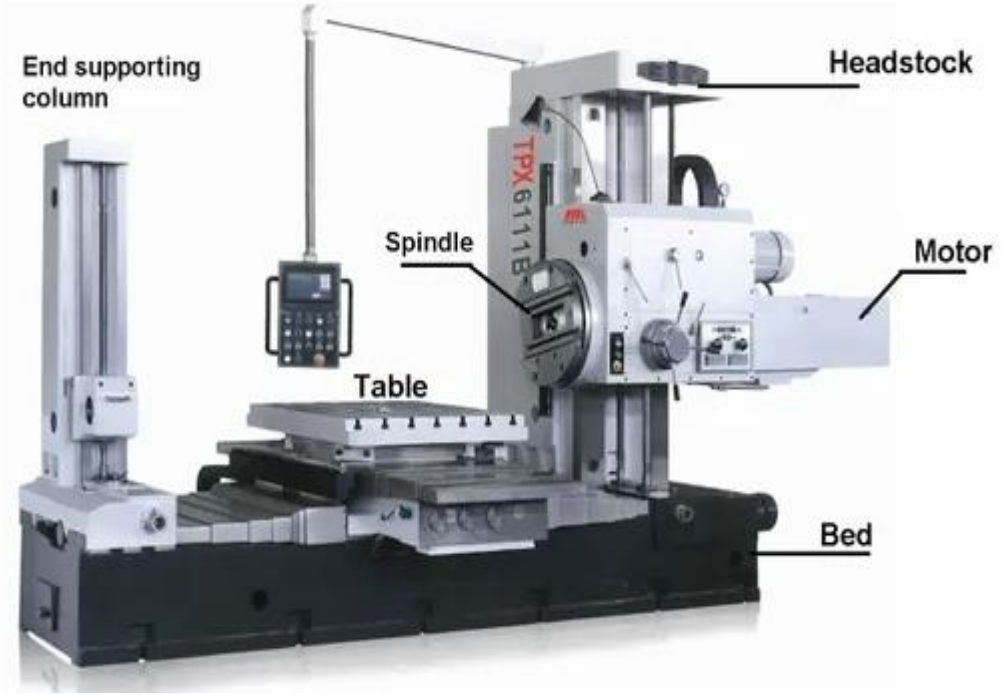
1) Bed
   - The bed is that part of the machine which is fitting on the floor of the shop and has a box-like casting. The bed supports the column, tables and other parts of the machine.
2) Headstock Supporting Column
   - The column provides support to the headstock and guides it up and down accurately by the guideways. The column which has hollow houses and is heavily ribbed to add rigidity. Some columns are stationary, others may be made to slide along the bed.
3) End Supporting Column
   - The end supporting column situated at the other end of the bed houses. Bearing block is provided for supporting a long boring bar.
   - The column may be adjusted on the slide ways of the bed towards or away from the spindle for supporting the different length of boring bars. It may be moved at right angles to the spindle as in the case of a floor type machine.
4) Headstock
   - The headstock mounting on the column supports, drives, and feeds the tool. A spindle provides rotary movement to the tool and the quill may be moved longitudinally to provide feeding movement of the boring cutter.
   - The spindle nose is provided with a tapered hole for receiving taper shanks of the boring bar or any other tool. A headstock may move up and down on the column for setting the tool for different heights of the work.
5) Saddle and Table
   - The tables support the work and is, therefore, provides T-slots for holding various devices. The saddle allows the work to be moved longitudinally on the bed. The table may be moved crosswise on the saddle.
   - These movements may be slow or rapid and are performed by hand or power.
6) Boring Bars
   - The boring bar supports the cutter for holding operations on jobs having large bore diameters. For short holes, the bar may support on the headstock spindle end only.
   - For long work, the bar is supported on the spindle end and on the column bearing block.

Types of Horizontal Boring Machine

The following are the four types of horizontal boring machine.

1) Table Type Horizontal Boring Machine

The table types are the most common of all horizontal boring machines. The name horizontal boring machine is given because the work is mounting on the table which is adjustable and feeds is giving by hand or power, lengthwise or crosswise with respect to the bed of the machine.



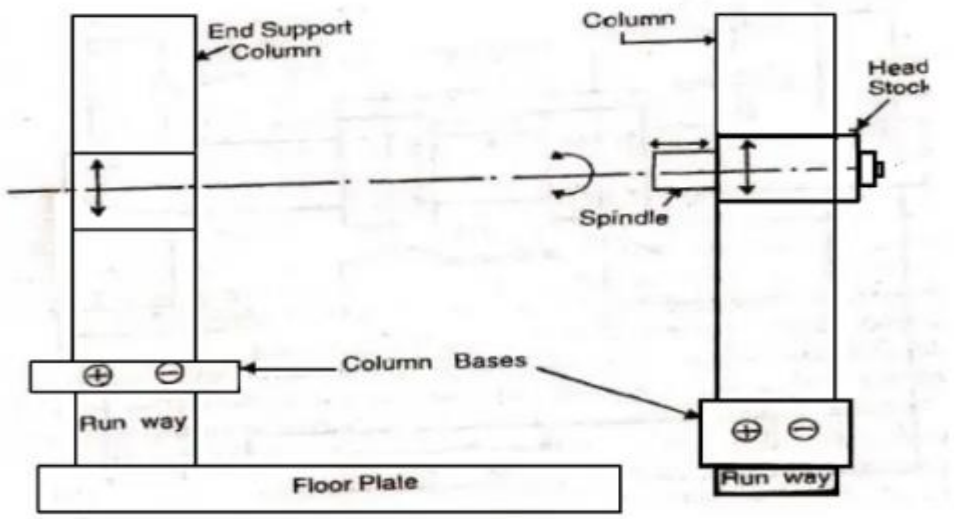


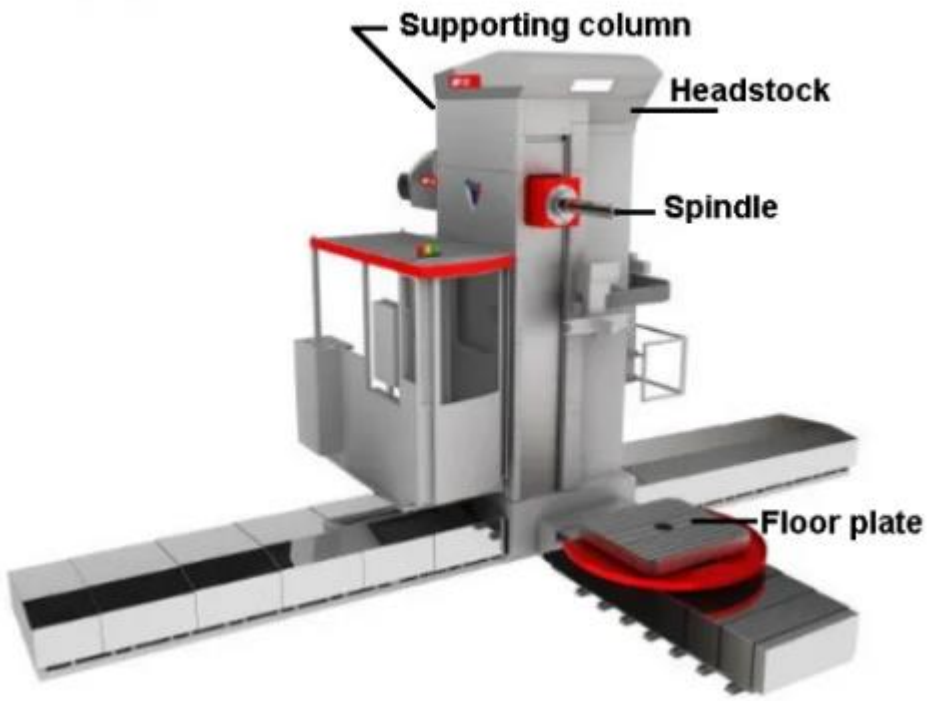
Figure : 1.2 Table Type Horizontal Boring Machine

The machine essentially consists of a bed, headstock supporting column, end supporting column, headstock, saddle and table, and boring bar. The table, saddle and headstock may adjust by leadscrews using micro-metre dials.

This type of machine is suitable for general purpose work where other operations, in addition to boring, is required to be performed.

2) Floor Type Horizontal Boring Machine

- The floor type horizontal boring machine having notable uses a constant floor-plate on which T-slots is providing to hold the work.
- Thus any crosswise adjustment or cross-feed movement is providing by the spindle itself and not by the work.
- This is so designed for holding very large and heavy workpieces which are difficult to be mounted and adjusted on a table.
- The headstock supporting column and the end supporting column is mounting on the runways which are placed at right angles to the spindle axis.



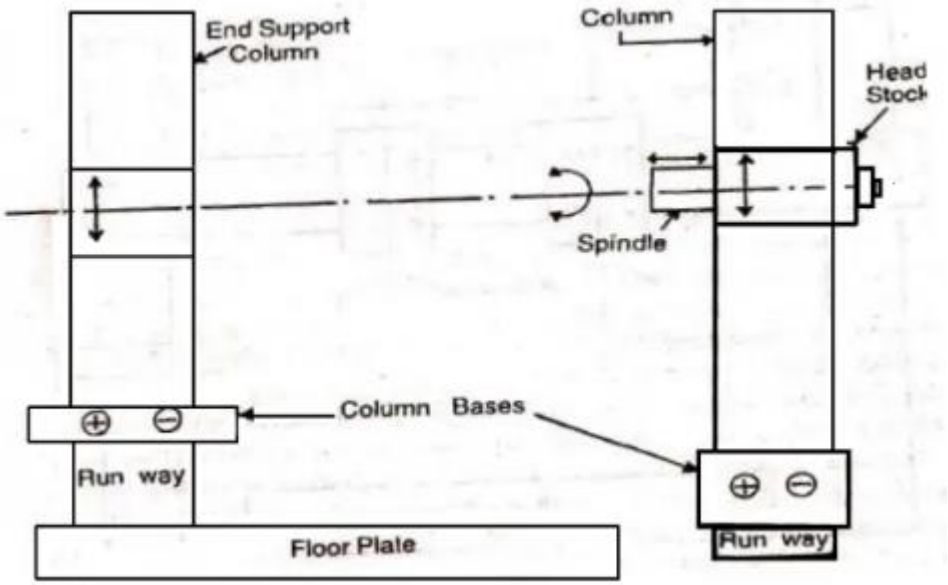
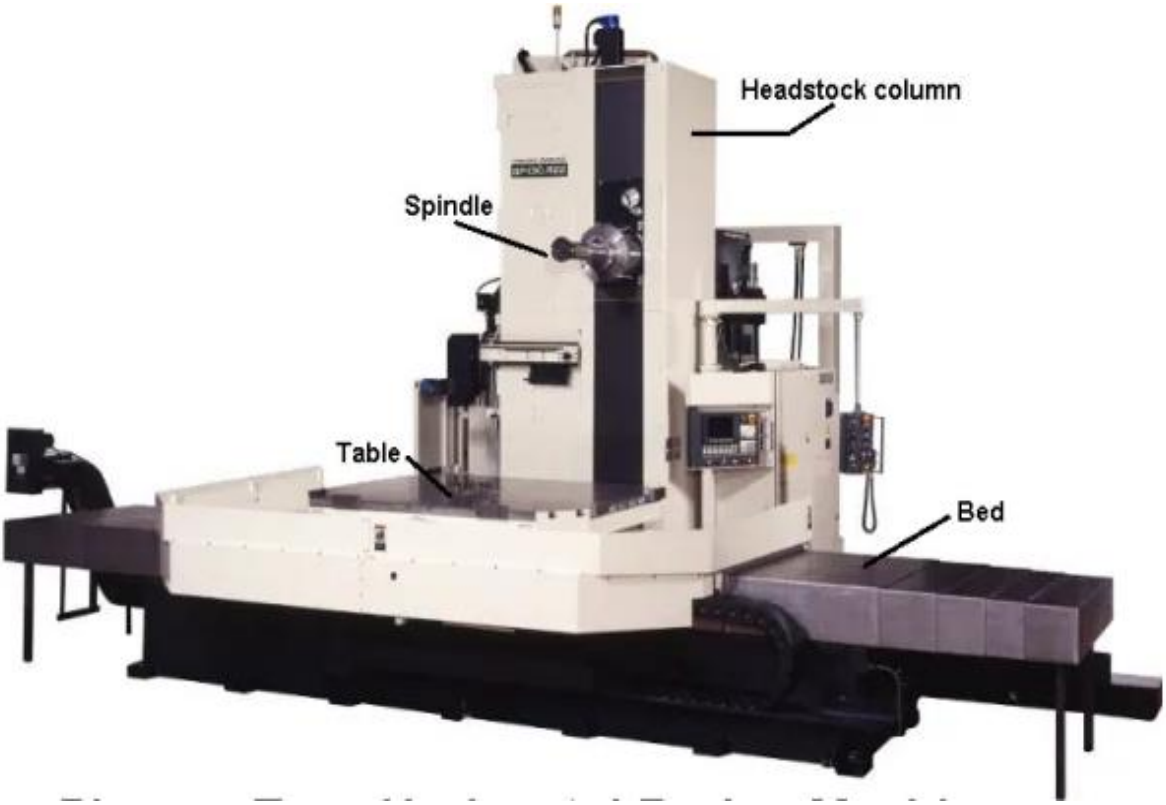


Figure : 1.3 Table Type Horizontal Boring Machine

3) Planer Type Horizontal Boring Machine

The planer type horizontal boring machine resembles the table type but the table slides direct on the bed instead of on a saddle angles to the spindle similar to a planer. The end of the supporting column and headstock supporting column may adjust towards or away from the table for accommodating different widths of works



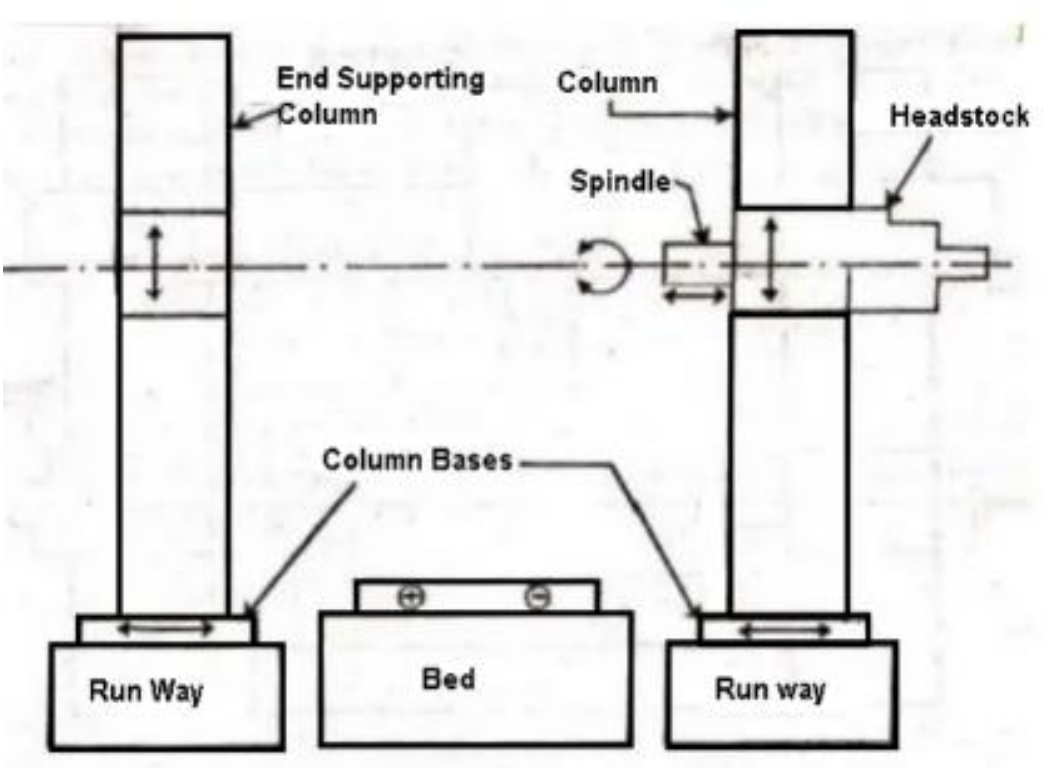


Figure:

1.4 Planer Type Horizontal Boring Machine

4) Multiple Head Type Horizontal Boring Machine

The machine resembles a double housing planer or a Plano-miller. The table is supporting on a long bed on which it reciprocates.

There are two vertical columns at two sides of the bed, nearly at the middle of the bed. The two columns are bridged by a cross rail.

The machine may have two, three or four headstocks. This type of machine may use as a horizontal and vertical machine. The machining operations can perform simultaneously at different work surfaces.

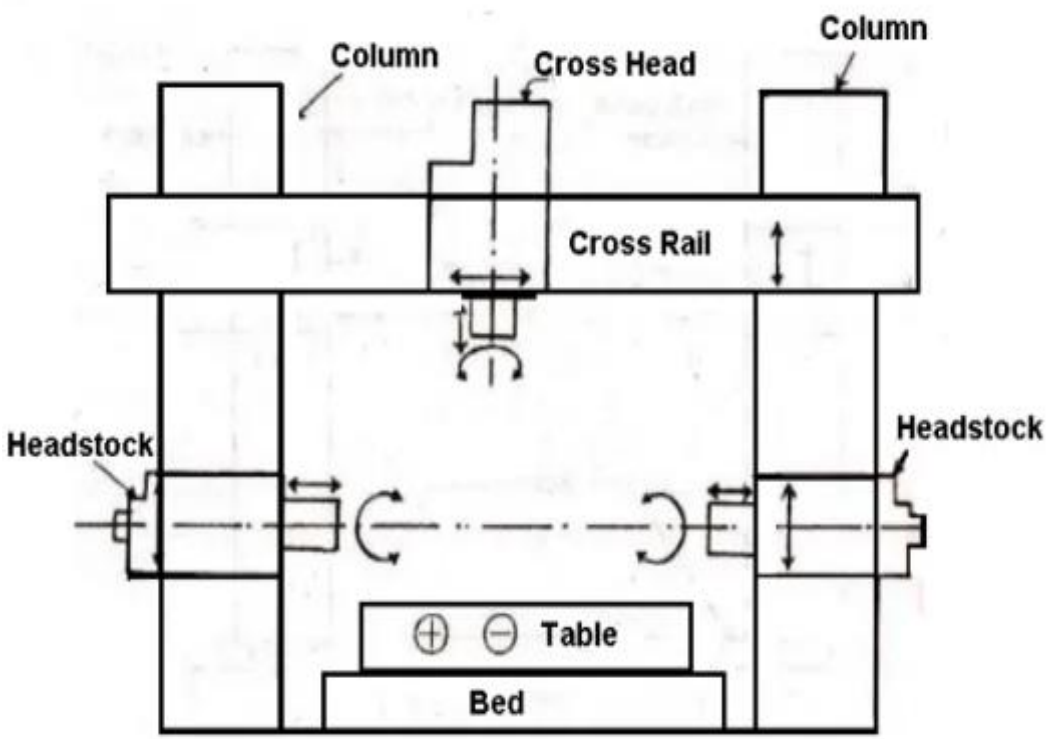


Figure1.4. Multiple Head Type Horizontal Boring Machine

B) Vertical Boring Machine (VBM)

Vertical boring is a type of machining that creates an accurate hole in a piece of metal or an existing workpiece. They use a machine called a vertical boring machine to carry out the tasks. This heavy-duty machine is usually very large with a borer that is able to travel up and down.

The schemating diagram of **vertical boring machine** is shown in figure. **1.6 .VBM** will be used in case of length of the workpiece is less then the diameter. Block diagram of vertical boring machine Here the cutting tool is stationary and mounted in the tool head.

In this boring machine work piece rotate on a horizontal table and tool remains stationary except for the feed

- This specific design of the machine provides certain distinct advantages over a lathe for a particular class of work. The advantages are:
- Large diameter and heavy workpieces, similar to chucking jobs on a lathe, may be set up more coveniently and quickly than on a lathe. It is easier to lay a workpiece down on the table rather than to hang it up.
- The table and the work it carries rotate in a horizontal plane, and there is no overhang as in the case of a lathe spindle, and consequently any chance of bending the spindle which supports the heavy workpiece is eliminated.
- The table being horizontal, the diameter of the table may be designed as large as possible to support large workpieces.
- Multiple tooling may be adapted in the case a vertical boring machine with its turret type tool post increasing the rate of production.
- Vertical turret lathe combines the advantages of the vertical boring mill and the turret lathe. A vertical boring machine of smaller size is called a vertical turret lathe.
- It has an indexable turret mounted upon the cross rail above the table for multiple tooling.

The head can be swiveled to produce conical (tapered) holes. Cutting speeds and feeds for boring are similar to those for turning. (For capabilities of boring operations, see Table 23.8.) Boring machines are available with a variety of features. Machine capacities range up to 150 kW (200 hp) and are available with computer numerical controls, allowing all movements of the machine to be programmed. Little operator involvement is required, and consistency and productivity are improved.

Parts of the Vertical Boring .Machine

Feed adjusting levers, 2 – Tool box, 3 – Tool head assembly, 4 – Ram, 5 – Housing, 6 – Handwheel for ram adjustment, 7 – Crossrail, 8 – Fine hand adjustmetn for ram, 9 – Crossrail elevating screw, 10 – Table, 11 – Bed

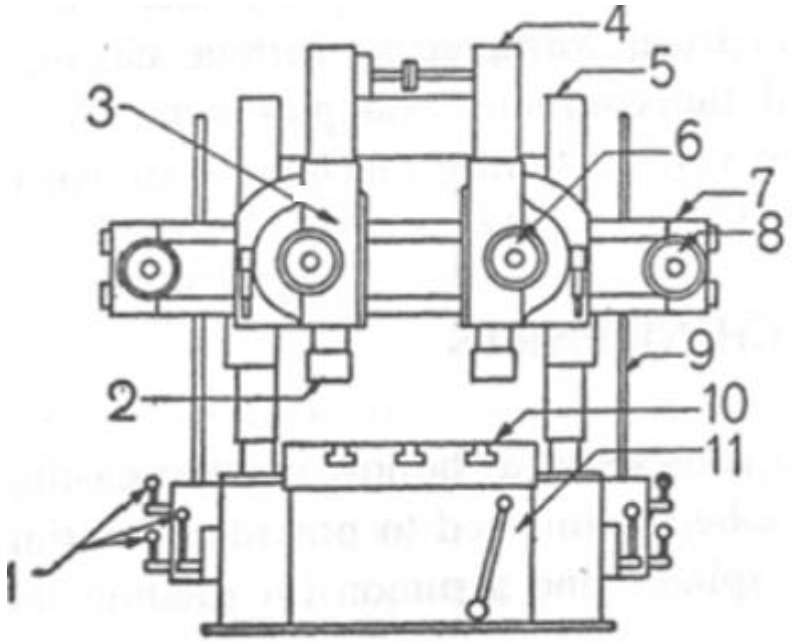


Figure: 1.6. Schematic illustration of a vertical boring Machine

C)Precision boring machine:-

- The precision boring machine uses single point tools to machine surfaces rapidly and accurately.

- Cemented carbide and diamond tipped single point tools are operated at a very high cutting speed to produce accurately sized holes with a fine surface finish.
- The feeding movement may be provided by the tool or by the work.
- The machine may be horizontal or vertical type.

D) Jig boring machine:-

- The jig boring machine is the most accurate of all machine tools. This was developed in the year 1910 in Switzerland and used as a locating machine. The real jig borer was first built in the year 1917 by Pratt and Whitney.
- The jig boring machines are now used for production of jigs, fixtures, tools and other precision parts which require high degree of accuracy.
- They characterized by provisions of highest accuracy through rigidity, low thermal expansion and precise spacing holes.
- The machining accuracy is very high, within range of 0.0025 mm.
- A jig boring machine resembles in appearance to a vertical milling machine, but so far its operation and accuracy are concerned there cannot be any comparison the two.

Parts of Jig Boring machine

1 – Spindle head, 2 – Quill, 3 – Column, 4 – Spindle housing, 5 – Spindle, 6 – Table, 7 – Saddle, 8 – Bed

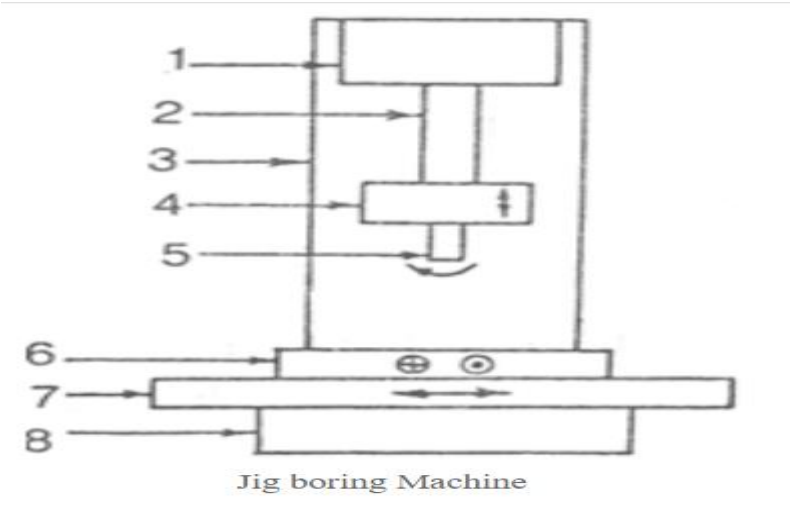


Figure Jig Boring machine

- The spindle and other parts of the machine are extremely rigid to resist deflection and the vibration is minimum.

- The spindle runs in preloaded antifriction bearing. The spindle housings are made of invar having a very low coefficient of linear expansion.
- The jig boring machine requires to be operated in temperature can be maintained constant. This is essential to prevent inaccuracy in the machine in the work being manufactured due to thermal expansion of the metal.

i. Vertical milling machine Jig Boring machine

- Vertical milling machine type resembles in construction to a vertical milling machine.
- The spindle rotates on a vertical column and the horizontal table rests on the bed in front of the column.
- The positioning of the work mounted on the table may be obtained by compound movements of the table, perpendicular and parallel to the column face.

ii. Planer type Jig Boring machine

- Planer type consists of two vertical columns at the two sided of the table and is mounted on the base.
- The table has reciprocating movement for adjustment of the work. The spindle is mounted on the cross rail bridging the two vertical columns.
- top 500 Mechanical Engineering books
- In a planer type jig borer, two co - ordinate movements for hole locations are provided by the longitudinal movement of the table and the cross movement of the spindl e along the cross rail.

1.2.2 Boring Machine Cutting tools

Ordinary boring operations are carried out with tools mounted on a bar held in spindle having morse taper hole. The maximum diameter of the bar employed is ordinarily not larger than the spindle diameter, and the length is such that it can reach the end column support.

The different types of equipment for mounting cutters in a horizontal boring machine are:

1) Boring bar
2) Boring head or cutter head
3) Facing head

1) Boring bar: **A boring bar** should be of the maximum diameter and minimum length to reduce bending or vibration and it may support in various ways to suit to different types of workpieces.

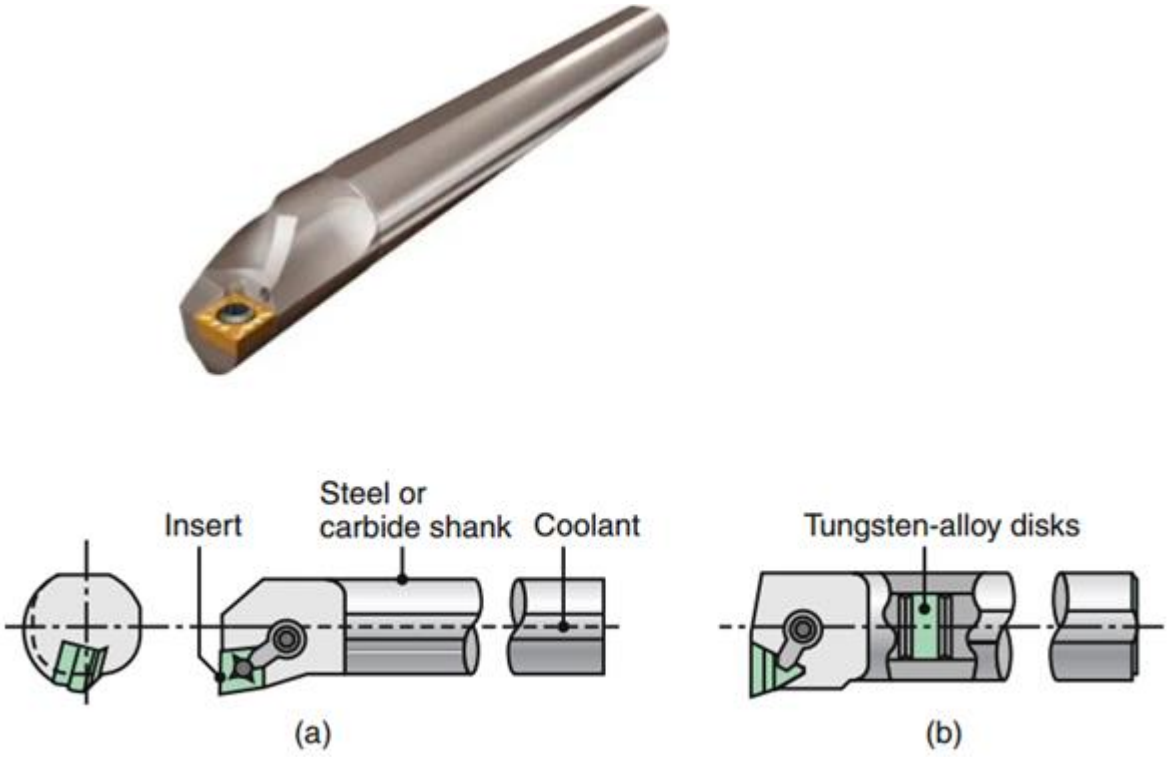


Figure 1.6 Schematic illustration of a steel boring bar with a carbide insert Boring tools

- **Methods of Supporting Boring Bars.:**

Supporting by Spindle: For boring blind holes, bars are using to support at the spindle end only. This type of bar is known as a stud bar.

Supported by the spindle and end column

- While boring long open holes, boring bars are supported at the spindle end and by a bearing block at the other end mounted on the end supporting column.This type of bar is called a line bar. It illustrates a line bar.

Supported by the workpiece

- In some types of work, the bar may be supported in the bored holes of the work by bushings.This type of support takes much of setting time and is using in stray jobs where only one or two similar articles are machined that do not call for a special jig to be manufactured.

Supported by boring fixture

- boring jigs are mainly using in mass production work. They locate, guide and support the bars at intermediate points. It illustrates a boring bar which is supported by a boring fixture.
- The facing head is mounting on the end of the spindle. It comprises a flange provides with a diameter slide-way on which the tool carrying a bracket may be adjusted. The

bracket may be fed radially or located and clamped at the centre for supporting a long boring bar.

1)Boring Head or Cutter Head

- The boring head is using for mounting cutters while machining large diameter holes where a standard boring bar is unsuitable due to the smaller diameter or excessive overhang of the cutter.

Figure 1.7 Boring Head or Cutter Head Boring tools

- Boring heads having the maximum permissible diameter. This device amply supports the tool and reduces machining time due to the larger number of cutting edges. The cutters may adjust by micrometre dials. it illustrates in the boring head.

1) Facing head

Figure: 1.8 Facing Head

- The facing head is mounting on the end of the spindle. It comprises a flange provides with a diameter slide-way on which the tool carrying a bracket may be adjusted.
- The bracket may be fed radially or located and clamped at the centre for supporting a long boring bar.
- A facing head enables enlarging of large diameter holes, facing an external turning operation. it is illustrating in the facing head.

1.3. Cutting Parameters.

In machining, three process parameters are (i) cutting speed or cutting velocity, (ii) feed rate and (iii) depth of cut.

a) Cutting Speed :- The speed at which a drill, boring tool, or reamer should be run depends upon the same considerations as for other tools. In general , the proper peripheral cutting speed of a drill is about the same as for a single point tool under comparable circumstances.

❖ It means the number of meters measured on the circumference of a job that passes the cutting edge of the tool in one minute.

❖ mathematically,

Cutting speed, (v) = $\frac{\prod DN}{1000}$ in m/min. Or $N=\frac{VX1000}{\Pi D}$

where, D= is diameter of a boring tool materials in mm

N= is spindle or job speed in rpm

b) Feed:- The feed of a drill is the distance it advances in one revolution. Cutting speeds and feeds for boring are same as for turning.

c) Depth Of Cut

It is the advancement of the tool in the job in a direction perpendicular to the surface being machined. Depth of cut depends up on cutting speed, rigidity of machine and tool material.

$$\text{Depth of cut } (t) = \frac{D-d}{2}$$

Where, D = is diameter of the work piece

D = is diameter of the work required

Machining Time : Machining time in boring operation is calculated by the same. formula as for calculating the machining time in turning operation,

Time required = $\frac{\text{Length of cut}}{}$ minutes.

r.p.m. X Feed/rev ‘

The length of cut in this case is the depth of hole to be bored.

Example .

1. A 10 mm (trilled hole in a casting of 10 mm thickness is to be brought in alignment by boring. Calculate (lie time taken in boring operation, assuming cutting speed 30 meters/minute and feed 0.13 nun/rev.

Solution. R.P.M.(N) = $\frac{1000 \times \text{Cutting speed}}{\pi \times \text{Diameter}}$ = $\frac{1000 \times 30}{\pi \times 10}$ = 955r.p.m.

Time taken in boring = $\frac{\text{Length of cut}}{\text{R.p.m} \times \text{Feed/rev.}}$ = $\frac{10}{255 \times 0.13}$

$\frac{10 \times 60}{955 \times 0.13}$ = 4.83seconds

Self-Check:1

Directions: Answer all the questions listed below. :

I. True or False Item

1. There is no difference between boring and drilling
2. For HBM. the size is indicated by the diameter of its table or chuck expressed in mm.
3. For VBM The size is indicated by the diameter of its spindle in mm

II. Chose The Best Answer For The Following Question

4. Among the different types of equipment for mounting cutters in a horizontal boring machine are:

   A) Boring bar C. Boring head or cutter head

   B) Facing head D. All

5. _____. It is universally standardized

   A) Orthographic C. Picture

   B) Technical drawing D. Flower drawing

6. _____. All are included in Title block except

   A) DR.BY (Name of Designer) D. Projection

   B) Title of drawing E. Drawing Number

   C) Amount of thickness to be removed

7. Which one is a parts of boring machine?

   A) Headstock. B) Column. C) Run ways. D) Bed E) All

III. **Answer the following question** .

8. List the three cutting parameter used in boring machine
9. List those two major categories of boring machines
10. What are those main parts of horizontal boring machine

Unit Two : Set up work of the Boring Machine.

This learning unit is developed to provide the trainees the necessary information regarding the following content coverage and topics:

1. Setting up work.
2. Holding of the part to be bored using standards machine.

This unit will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

3. Setting up work.
4. Hold of the part to be bored using standards machine.

2. Set up work of the Machine.

2.1. Safety Rules and Work Procedures

Unguarded moving parts of machines/equipment and the sudden or uncontrolled release of their power systems can result in serious injuries. Personnel working with machines must be aware of the risks involved and follow safe work practice

Causes of accidents while working with machinery

- Loose clothing, hair, jewelry being caught in moving parts.
- Materials ejected from the machine when it is operational.
- Inadvertent starting of the machine.
- Slipping and falling into an unguarded nip.
- Contact with sharp edges, e.g., cutting blade.
- Making adjustments while the machine is operational.
- Unauthorized operation of machines.
- Lack of preventive maintenance

Hazards

- Rotating machine parts give rise to nip points. Examples are
  - ✓ Rotating gears
  - ✓ Belt and its pulley
  - ✓ Chain and sprocket
  - ✓ Between grinding wheel and tool rest
  - ✓ Between rotating and fixed parts
- Rotating parts operating alone
  - ✓ Shafts
  - ✓ Couplings
- Reciprocating and sliding motions

1) PERSONAL SAFETY:

- Always wear approved type eye protection
- Do not attempt to use unless all guards and safety devices are in place and securely attached.
- Stop machine before making measurements or work adjustment.
- Remove your watch, rings etc before using the machine.

2) MACHINE SAFETY:

- ✓ Never attempt to operate a machine until you have been instructed properly.
- ✓ Never place a tool on a boring machine before checking it for soundness.
- ✓ adjust the cutter and work piece properly before any operation
- ✓ start the machine and feed the cutter into the work
- ✓ the machine should not be operated at speed higher than specified.
- ✓ clean the machine after operation.

3) WORK P LACE SAFETY

- ✓ keep all tools clear of a work table .
- ✓ change coolant fluid before it become contaminated.
- ✓ Wipe up all spilled coolants from the floor around the machine right away.
- ✓ Put tools and equipment in their proper position.

2.2. Machine Setting up.

- What is a machine setup in manufacturing?

A setup is the activity or event related to changing a production process from making one product to another. The time it takes to complete a setup is relevant in manufacturing because it determines how flexible a production process is

It is the preparation of the system (machine/workstation/operator) for the completion of work. In the case of press work, set up can be taken as the time for the preparation of the press from the completion of the last part of the last batch to the preparation of the first part of the next new batch on the press

- Machine setup time

Machine setup time refers to the period of time that is required to prepare a machine for its next run after it has completed producing the last part of the previous run. So why should you focus on reducing machine setup of your manufacturing process instead of focusing on reducing the overall run time.

The time for the removal and replacement of the tooling is dependent on

- ✓ Type of tool
- ✓ Form, weight and size of tool
- ✓ Skill of the fitter
- ✓ **Safety must be no. 1.**
- ✓ Must also ensure that tooling and machine are not damaged.
- ✓ Economics must also be accounted for

Machine setup include

A. Internal B. External

- **External Set Up** involves

Preparation

1) Getting information about the next batch which is to be run.
2) What kind of tools and gauges are needed
3) Arrange for Special Handling Equipment
4) Find and Fetch Tooling
5) Loosen any nuts and bolts on the new tooling
6) Perform any adjustments if possible at this stage
7) Ensure that boxes/cartons/trolleys are available for the material to be produced.
8) External set up also involves checking the tool that comes off the machine for any damage and repairing it before storing it.

- Internal Set Up

1) Machine has to be stopped.
2) Loosening of the press tool from the press machine
3) Removal of tool using special handling equipment already obtained during external set up.
4) Set up of the height of the press to take tool
5) Mounting bottom half of press tool on the bed of the press machine.
6) Mounting of the top half of the press tool.
7) Final Adjustment
8) Test and further adjustment

2.3. Hold of the part to be bored using standards machine.

2.3.1. Workpiece Material to be bored

According to the project material given all types of metal can be bored using boring machine. These work piece martial include all but not limited to :-

a. Ferrous Metals

✓ **Iron** (Fe) – atomic number 26. Most widely used of all metals as base metal in steel and cast iron.

✓ **Pig iron** - the intermediate product of smelting iron ore with a high-carbon fuel such as coke, usually with limestonee as a flux. Cast iron

✓ **Cast iron** – is derived from pig iron

- ✓ **White cast iron** is named after its white surface when fractured, due to its carbide impurities which allow cracks to pass straight through.
- ✓ **Grey cast iron** is named after its grey fractured surface, which occurs because the graphitic flakes deflect a passing crack and initiate countless new cracks as the material breaks.
- ✓ **Wrought iron** - iron alloy with a very low carbon content, in comparison to steel, and has fibrous inclusions (slag) tough, malleable, ductile and easily welded
- ✓ **Steel** is an alloy that consists mostly of iron and has a carbon content between 0.2% and 2.1% by mass
- ✓ Carbon is the most common alloying material for iron, but various other alloying elements are used, such as **manganese, chromium, vanadium, molybdenum, tungsten, etc.**
- ✓ **Stainless steel** (**inox steel**) is a steel alloy with a minimum of 10.5 or 11% chromium content by mass.It does not corrode, rust, or stain with water as ordinary steel does.
- ✓ **High speed steel** is commonly used in tool bits and cutting tools. It can withstand higher temperatures without losing its hardness. This property allows HSS to cut faster than high carbon steel, hence the name high speed steel.

b. Non-Ferrous Metals

- ✓ **Copper Latin *cuprum*(Cu)**– ranks next to iron in importance and wide range of application, good heat and electrical conductivity, resistance to corrosion
- ✓ **Alloys**: brass, bronze, cupro- nickel (copper nickel) alloys **Aluminum (BrE**) or **aluminum** (**AmE**) – Al, atomic number 13. the third most abundant element (after oxygen and silicon), and the most abundant metal in the Earth's crust. Low density and ability to resist corrosion; good conductivity Structural components made from aluminum and its alloys are vital to the aerospace industry and are important in other areas of transportation and structural materials
- ✓ **Zinc (Zn)**, atomic number 3. Corrosion resistant in air due to a thin oxide film forming on its surface. Used as a coating for protecting steel - **galvanization** is the process of applying a protective zinc coating to steel or iron, in order to prevent rusting.
- ✓ **TinLatin stannum (Sn)**, - atomic number 50, white, lustrous, soft, malleable, ductile, resistant to corrosion. Used as coating for steel and sheet iron.
- ✓ **Lead Latin plumbum (Pb)**- atomic number 82, mmetallic lead has a bluish-white color after being freshly cut, but it soon tarnishes to a dull grayish color when exposed to air. Has a shiny chrome-silver luster when it is melted into a liquid.

- **Property:**soft, malleable, has little ductility
- **usage:** plates for storage batteries, covering for electrical cables

2.3.2. Work Holding Devices For Boring.

The work may be supported on the table by the conventional work holding devices or by special fixtures.

Conventional work holding devices comprise T-bolts and clamps, angle plates, step blocks, etc. Special jigs are used in mass production work. The jigs are locating the work and support and guide the boring bar.

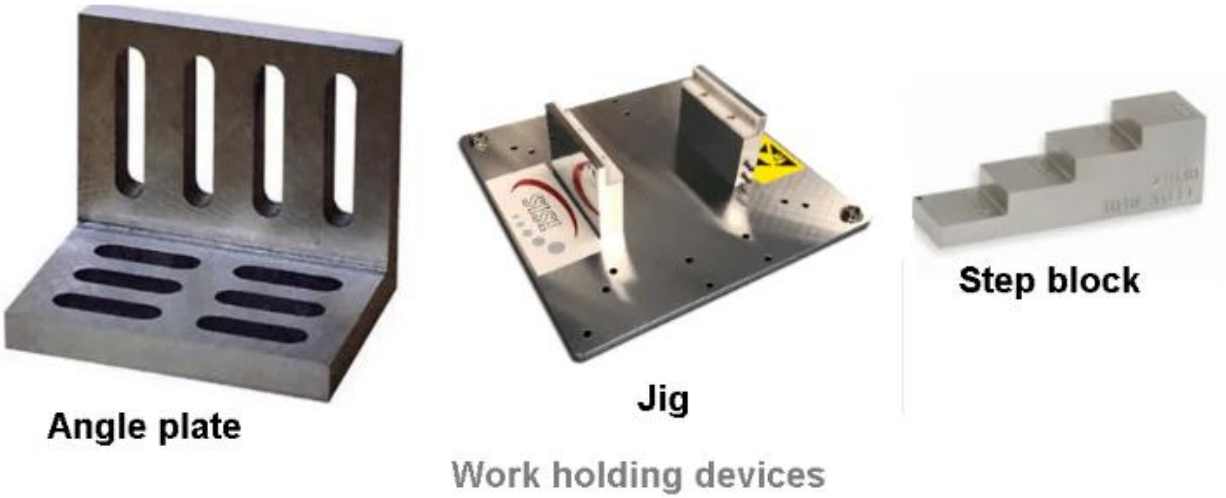


Figure: 2.1 Work Holding Device

Self-Check:2

Directions:1 Answer all the questions listed below.

I. True Or False Item

1. External set up involves checking the tool that comes off the machine for any damage and repairing it before storing it.
2. **Steel** is an alloy that consists mostly of carbon and has a carbon content between 0.2% and 2.1% by mass
3. Machine setup time refers to the period of time that is required to prepare a machine for its next run.
4. Do not attempt to use unless all guards and safety devices are in place and securely attached

II. Multiple choice Item

5. The time for the removal and replacement of the tooling is dependent on
   a. Type of tool
   b. Form, weight and size of tool
   c. Skill of the fitter
   d. All of the above
6. Conventional work holding devices comprise all except one .
   a. T-bolts
   b. Clamps
   c. Step Block
   d. Angle plates
7. **Ferrous Metals include one except :**
   a. **Iron** (Fe)
   b. **Zinc (Zn)**,
   c. **Pig iron**
   d. **Cast iron**
8. Which one can be the Causes of accidents while working with machinery?
   a. Slipping and falling into an unguarded nip.
   b. Unauthorized operation of machines.
   c. Lack of preventive maintenance
   d. All of the above

III. Short Answer Item

9. List those most important work holding device used for boring machine operation.
10. Mention those things which can be hazard during Machine boring operation.

Operation Sheet 2.1

1. Operation Title: Techniques of Setting up Boring Machine
2. Instruction: applying and Following the require safety rule ,using the right hand tool and the given boring machine try to set up and make it ready for operation
3. Purpose: to Set up machine , work and tool and ready for operation.
4. Required tools and equipment:
    - Boring Machine
    - Chuck key
    - Adjustable or Open wrench
    - Boring tool
    - Work piece material
    - Measuring tool
    - Wood hammer or mallet
    - Screw driver flat and or Philips
5. Precautions: Apply PPE
6. Procedures:
    - Steps 1- Apply safety precaution.
    - Steps 2- Prepare tool materials .
    - Steps 3- Mount the cutting tool on the tool post.
    - Steps 4- Check the spindle speed .
    - Steps 5- Adjust the tool to the work to be bore
7. Quality criteria: The exact bore size according to the drawing specification.

LAP Test: Practical Demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within 2 hour.

Task1. Set up Your Boring machine in the work shop and make it ready for further operation.

Unit Three: Perform boring operations

This learning unit is developed to provide the trainees the necessary information regarding the following content coverage and topics:

- Carrying out horizontal and vertical boring operation.
- Measuring size of the holes of the bored materials.
- Carrying out taper boring.

This unit will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Carrying out horizontal and vertical boring operation.
- Measure size of the holes of the bored materials.
- Carrying out taper boring.

3. Perform boring operations.

3.1. Carrying out horizontal and vertical boring operation.

There are so many operation performed by boring machine

1. Boring operation

- **In this operation** holes are bored by using boring bars.
- Multiple holes may be bored one after another by changing the position of the workpiece and aligning it each time with the boring bar.
- To bore a hole, the boring bar is fitted to the spindle and the cutter is adjusted in the boring bar to the required dimension and a light cut is then taken.
- The bore is measured, required speed and feed adjusted and the cut is then completed.

2. **Forming operation**

- This operation is performed by cross feed movement of the saddle.

3. **Machining flat surface**

- For performing this operation, the cross rail and the ram is locked at the desired position.
- Then, the saddle is fed cross wise while the work revolves on the table.
- The depth of cut is given by the ram.

4. **Taper boring operation**

- The taper and conical surfaces are turned by swiveling the tool head to the required angle. When a conical surface having a large included angle which is beyond the range of the swiveling arrangement of the tool head is turned, a combined cross and down feed is applied simultaneously on the tool to cut the required taper.

5. **Turning cylindrical surface**

- In this activity, the saddle is clamped to prevent any horizontal movement of the ram, and the ram is fed downwards.
- The larger diameter holes are bored by feeding the tool head directly within the work and the smaller diameter holes are bored by using a boring bar attached to the tool head.

6. **Cutting off and necking operation**

- This operation is similar to the forming operation and it is also performed by cross feed movement of the saddle.

- Horizontal Boring Machine Operations

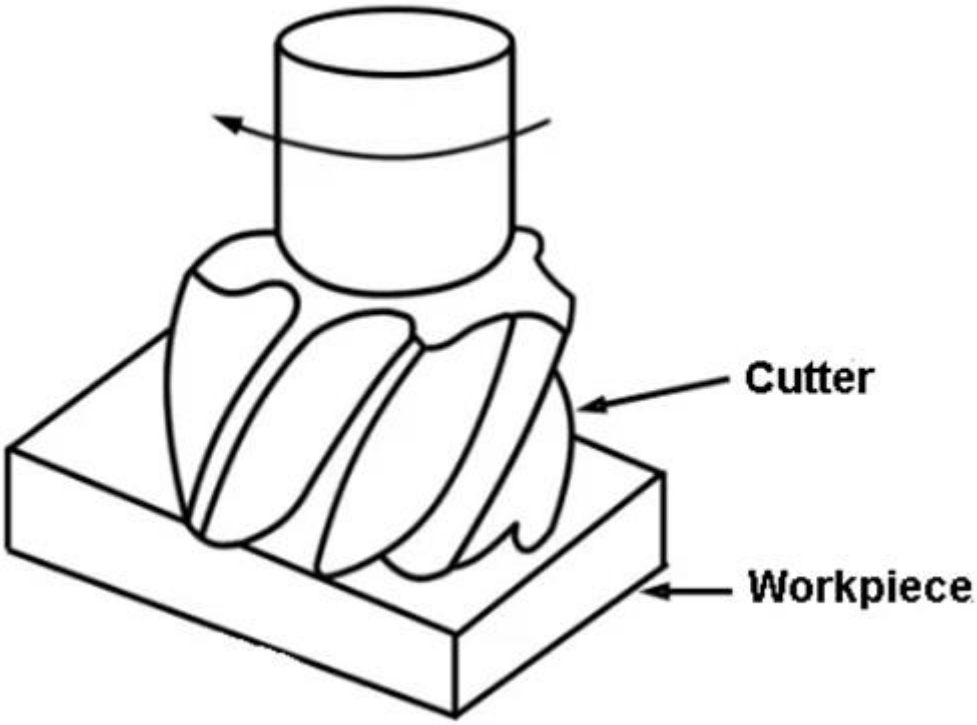


Figure 3.1 Face Milling operation

- In boring, the work remains stationary and the tool is rotated. Holes are bored by using boring bars.
- Multiple holes are bored one after another by changing the position of the workpiece aligning it each time with the boring bar.
- To bore a hole, the boring bar is fitted to the spindle and the cutter is adjusting in the boring bar to the required dimension and a light cut is then taken.
- The bore is measured, required speed and feeds adjusting and the cut is then completed.
- In a boring machine, for milling operation, any type of milling cutter may fit the spindle. Facing cutter is using for machining flat vertical surfaces.
- For face milling operation, the tool or work may be fed to complete the cut. The end mill is using to produce grooves and slots. Is illustrates in face milling operation.
- All other operations such as drilling reaming, counterboring, tapping and spotfacing operations may perform similarly to boring operations. Is illustrating in the drilling operation.

7. Twist Drill Operation

- The most common cutting tools for hole-making Usually made of high speed steel
- Rotation and feeding result in relative motion between cutting edges and workpiece
  - ✓ Cutting speed varies along cutting edges as a function of distance from axis of rotation
  - ✓ Zero Relative velocity at drill point (no cutting)
  - ✓ A large thrust force to drive the drill forward
- Chip removal – Flutes allow chips to be extracted
- Friction makes matters worse
  - ✓ Rubbing between outside diameter and wall
  - ✓ Delivery of cutting fluid to drill point

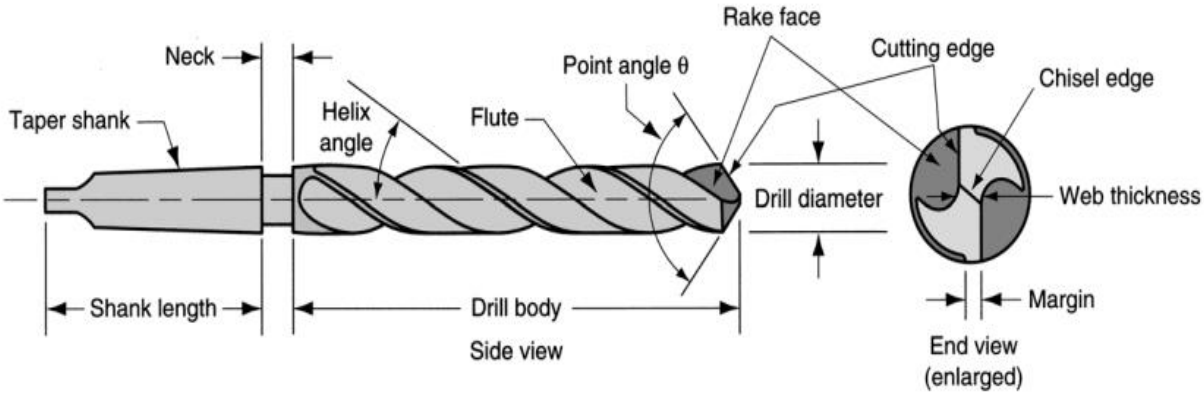


Figure 3.2 Twist drill used for boring operation

3.2. Measuring size of the holes of the bored materials.

Measure the large end to the taper bore - forward I.D. **Measure the keyway width and height.** Measure the overhang distance at the nut end (draw) with the propeller tightened on the taper properly. Check if old prop fits the taper without rocking and check the amount of draw or overhang is enough.

3.3. Carrying out taper boring.

- Bearings with a tapered bore are often used to facilitate mounting and dismounting and in some cases this type of bearing may be considered essential to the application. They can be mounted either directly on to a tapered shaft, or by means of an externally tapered sleeve on to a cylindrical shaft.

- The process of taper measurement involves measurement of taper angle of the given drafted surface. Since, there is no direct method available for measuring this angle, we use the ratio of two different lengths concerning the taper angle and then with the use of trigonometry, the required angle can be obtained.

3.4. Checking work for accuracy against pre-determined parameters

Self-Check:3

Directions: 1 Answer all the questions listed below.

I. True Or False Item

1. Multiple holes may be bored one after another by changing the position of the workpiece and aligning it each time with the boring bar.
2. Forming operation is performed by cross feed movement of the saddle.
3. Boring operation holes are bored by using boring bars.
4. The process of taper measurement involves measurement of straight angle of the given drafted surface>

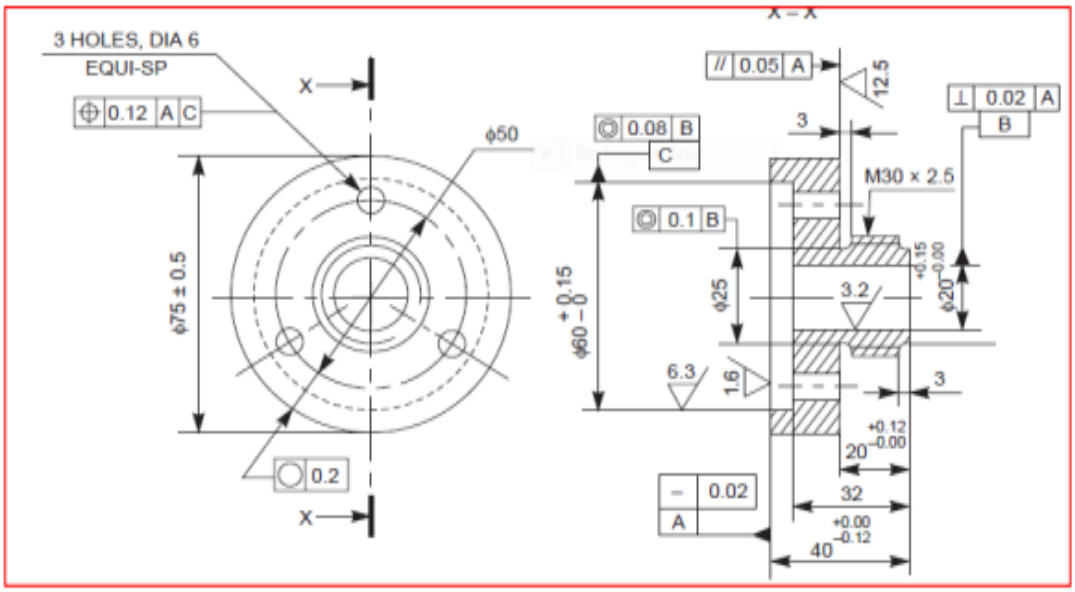
II. Short answer Item

5. List the most operation that has been done on boring machine
6. How can Carrying out a taper boring on Boring machine .

.

Operation Sheet 3

1. Operation Title: Perform boring operations.
2. Instruction: Applying and Following the require safety rule ,using the right hand tool and the given boring machine try to Bore the given work piece
3. Purpose: to bore a specified hole on the according to the specified drawing .
4. Required tools and equipment:
    - Boring Machine
    - Chuck key , Boring tool , Measuring tool
    - Adjustable or Open wrench
    - Work piece material
    - Wood hammer or mallet
    - Screw driver flat and or Philips
5. Precautions: Applay PPE
6. Procedures:
    - Steps 1- Apply safety precaution.
    - Steps 2- Prepare tool materials .
    - Steps 3- Mount the cutting tool on the tool post.
    - Steps 4- Check the spindle speed .
    - Steps 5- Adjust the tool to the work to be bore
7. Quality criteria: Perform the accurate bore size according to the drawing specification.



LAP Test: Practical Demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within 2 hour.

Task 1. Adjust H.B.M table and cutting tool material to Bore a hole with a 30mm diameter .

Unit Four: Component for conformance

This learning unit is developed to provide the trainees the necessary information regarding the following content coverage and topics:

- Components for conformance.
- Components for accuracy.
- Make djustments to ensure accuracy and quality of outcome

This unit will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Check components for conformance.
- Check components for accuracy.
- Make adjustments to ensure accuracy and quality of outcome

4. Component For Conformance.

4.1. Checking components for conformance.

- Conformance is how well something, such as a product, service or a system, meets a specified standard and may refer more specifically to: Conformance testing, testing to determine whether a product or system meets some specified standard.. For this reason, check the operation of the drill after starting the machine.
- Quality of conformance refers to the capability of a product, service, or process to meet certain design standards set by the producer. It measures how close a product, service, or process is to meeting design specifications.

4.2. Checking components for accuracy.

- Check the accuracy of the machined part with the required measuring tool, such as a micrometer or vernier caliper

Accuracy

- Accuracy is how close or far off a given set of measurements (observations or readings) are to their true value, while precision is how close or dispersed the measurements are to each other. In other words, precision is a description of random errors, a measure of statistical variability.
- Accuracy refers to the closeness of the measurements related to a specific value. Furthermore, accuracy is the description of the systematic error. Moreover, accuracy gives us the measure of the statistical bias.
- There are two common definitions of *accuracy*. In math, science, and engineering, accuracy refers to how close a measurement is to the true value.
- The ISO (International Organization for Standardization) applies a more rigid definition, where accuracy refers to a measurement with both true and consistent results. The ISO definition means an accurate measurement has no systematic error and no random error. Essentially, the ISO advises that *accurate* be used when a measurement is both accurate and precise.

Precision

- *Precision is the amount of information whose conveyance takes place by a number in terms of its digits. Precision shows the closeness of two or more measurements that they have to each other. It is certainly different from accuracy.*

- *Precision* is how consistent results are when measurements are repeated. Precise values differ from each other because of random error, which is a form of observational error.

Accuracy Versus Precision

- Accuracy is how close a value is to its true value. An example is how close an arrow gets to the bull's-eye center.
- Precision is how repeatable a measurement is. An example is how close a second arrow is to the first one (regardless of whether either is near the mark).
- Percent error is used to assess whether a measurement is sufficiently accurate and precise.

4.3. Making adjustments to ensure accuracy and quality of outcomes.

- It means Make changes to ensure the accuracy and quality of the results
- Accuracy is to be ensuring that the information is correct and without any mistake. Information accuracy is important because may the life of people depend in it like the medical information at the hospitals, so the information must be accurate.
- The condition or quality of being true, correct, or exact; freedom from error or defect; precision or exactness; correctness.

How to Improve Accuracy in the Workplace

- ✓ Provide a Clear Explanation of the Goal. ...
- ✓ Train Employees on the Correct Process and Procedure. ...
- ✓ Provide Enough Time to Employees for Their Tasks. ...
- ✓ Brainstorm the Issue if Accuracy Problems Persist. ...
- ✓ Increase Process Automation. ...
- ✓ Include Checks and Balances in the Process.

Self-Check:4

Directions:1 Answer all the questions listed below.

I. True Or False Item

1. To improve accuracy, it is important to train employees in the correct process and procedure.
2. Quality of conformance refers measures how close a product, service, or process is to meeting design specifications.
3. Accuracy is to be ensuring that the information is correct and without any mistake.
4. There is no any difference between precision and accuracy.

II. Choose the best answer

5. _____ is how close a value is to its true value.
   A. Accuracy C. Both A and B.
   B. Precision D. None
6. How to Improve Accuracy in the Workplace?
   C. Provide a Clear Explanation of the Goal. ...
   D. Train Employees on the Correct Process and Procedure. ...
   E. Provide Enough Time to Employees for Their Tasks. ...
   F. Increase Process Automation. E All of the above

III. Short answer Item

7. List the most operation that has been done on boring machine
8. How can Carrying out a taper boring on Boring machine .

Unit Five : Identify Inserts From Standards

This learning unit is developed to provide the trainees the necessary information regarding the following content coverage and topics:

- Select correct tool using International Standard.

This unit will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Select correct tool using International Standard

5. Identify inserts from standards

5.1. International standard (I.S.O)cutting tools.

It is important to select the correct cutting tool using the international standard for boring machine operation.

The selection of the right cutting tool is based on the material to machine, power available on machine, fixture stability, machine dynamics which leads to the right selection of cutting tool material, grades, geometries, depth of cuts and the feeds.

Metal cutting equipment is used in a wide variety of industries and enables the use of various types of cutting tools. Due to the large number of tool types, it is possible to choose the cutting tool that will be the best to perform corresponding operations.

The main criteria for the tool classification are:

- Design of the cutting tool;
- Type of surface (processed surface);
- Principle of interchangeability with the material;
- Method of connection with the machine;
- Method of application.

To reduce and ensure uniformity and quality, all production elements are standardized in enterprises, and cutting tools are no exception. The requirements of the standards form the quality and competitiveness of engineering products . The main principles in standardization at present are achieving mutual understanding of all interested parties, realizing the possibility of monitoring compliance with the requirements of the standard, compliance of the provisions of the standards with international treaties and the modern level of development of science, and technology, as well as consistency of standards with each other. One of the important tasks of modern standardization is to understand and explain how different standards interact .

This division of ISO 13399 standard complex is explained by the fact that the first group contains general information on the cutting tool, and the second group includes reference dictionaries for:

- ✓ cutting tools;
- ✓ cutter elements;
- ✓ adaptive elements;
- ✓ prefabricated elements;
- ✓ reference systems and general concepts;

- ✓ connection systems.

The second group also includes the ISO 13399-100 standard, which provides definitions, principles and methods for reference dictionaries.

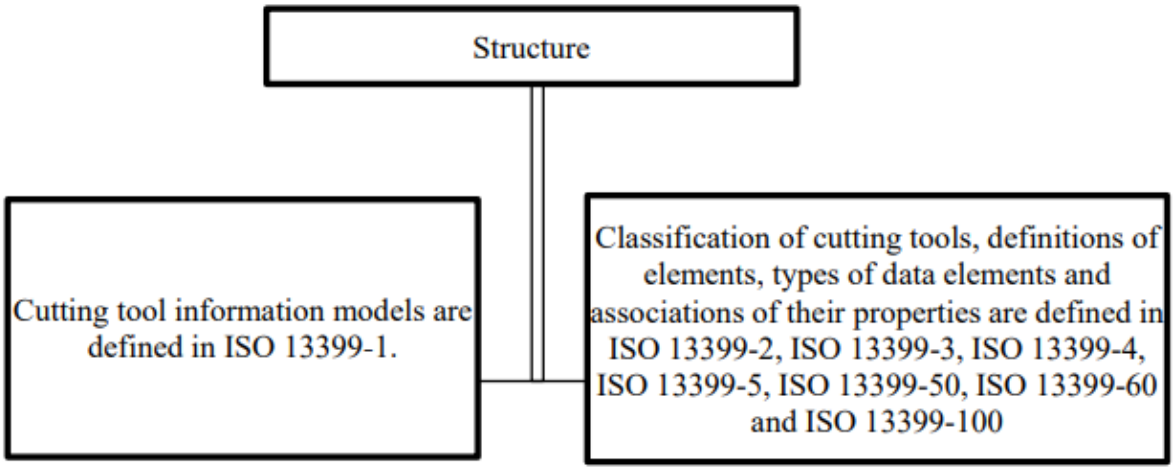


Figure: 5.1 ISO 13399 standard groups

Standard Tool Materials

- Important properties
  - ✓ Toughness – avoid fracture
  - ✓ Hot hardness – resist abrasion
  - ✓ Wear resistance- solubility
- Cutting tool materials
  - ✓ Plain carbon and low alloy steels
  - ✓ High-speed steels
  - ✓ Cemented carbides, cermets and coated carbides
  - ✓ Ceramics
  - ✓ Synthetic diamond and CBN
- HSSs
  - ✓ Still used extensively for complex geometry such as drills
  - ✓ Heat treated to R c=65
  - ✓ Re-grinded for reuse
  - ✓ Thin coating
- Cast Cobalt Alloys
  - ✓ 40-50% Co, 25-35% W, 15-20% others

- ✓ Casting in a graphite mold and grind
- ✓ Toughness is not as good as HSS but hot hardness is better.
- ✓ Not so important

- Cemented Carbides
- Advantages (Cemented Carbide, Cermets & Coated Carbides)
  - ✓ High compressive strength and modulus
  - ✓ High room and hot hardness
  - ✓ Good wear resistance
  - ✓ High thermal conductivity
  - ✓ Lower in toughness that HSSs
- Grades
  - ✓ Nonsteels grade – WC-Co
  - ✓ Steel grades – add TiC and TaC due to the high solubility of WC into steels resulting in extensive crater wear
- Cemented Carbides – Mainly WC-Co
  - ✓ As grain size is increased, hardness decreases but TRS increases.
  - ✓ As the content of cobalt increase, TRS increases but hardness decreases.
  - ✓ For roughing or milling, high cobalt is desirable – For finishing, low cobalt is desirable. 13 Classification of

Therefore, the cutting tool material should have the following basic properties:

1) (Hardness and wear resistance.
2) (Strength and toughness.
3) Heat resistance.
4) (Process performance and economy.

Type of diamond cutter.

1) Diamond cutting tool performance characteristics.
2) Diamond tool application.

Self-Check:5

Directions:1 Answer all the questions listed below.

I. True or False Item

1. It is not important to select the correct cutting tool using the international standard for boring machine operation.
2. Steel l used extensively for complex geometry such as drills

II. Choose The Best Answer

3. Which one is the characteristics of HSS?
   a) Heat treated to R c=65
   b) Re-grinded for reuse
   c) Non- coating
   d) All
4. Which one is the Important properties of standard cutting tool?
   a) Toughness – avoid fracture
   b) Hot hardness – resist abrasion
   c) Wear resistance- solubility
   d) All of the above
5. Which one is not the main criteria for the tool classification ?
   a) Design of the cutting tool;
   b) Type of surface (processed surface;
   c) Method of connection with the machine;
   d) Method of application. E. None of the above

III. Give short Answer

6. List four basic properties of Cutting tool material.

Unit Six: Adjust and maintain machine

This learning unit is developed to provide the trainees the necessary information regarding the following content coverage and topics:

- **Carrying out routine maintenance and adjustments.**
- **Checking machines.**

This unit will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- **Carry routine maintenance and adjustments.**
- **Check machines.**

6. Adjust and maintain machine

6.1. Routine Maintenance and Adjustments.

Routine maintenance are preventative or cyclical maintenance activities such as regular inspections or machine servicing. Routine maintenance is done on a regular basis, whether that be daily, weekly, monthly, or yearly. Routine maintenance is an important part of keeping systems up to date and functional.

Routine maintenance in a factory setting involves lubricating, cleaning, and adjusting machines, replacing equipment parts on a schedule, inspecting certain components, or performing conditioned monitoring exercises.

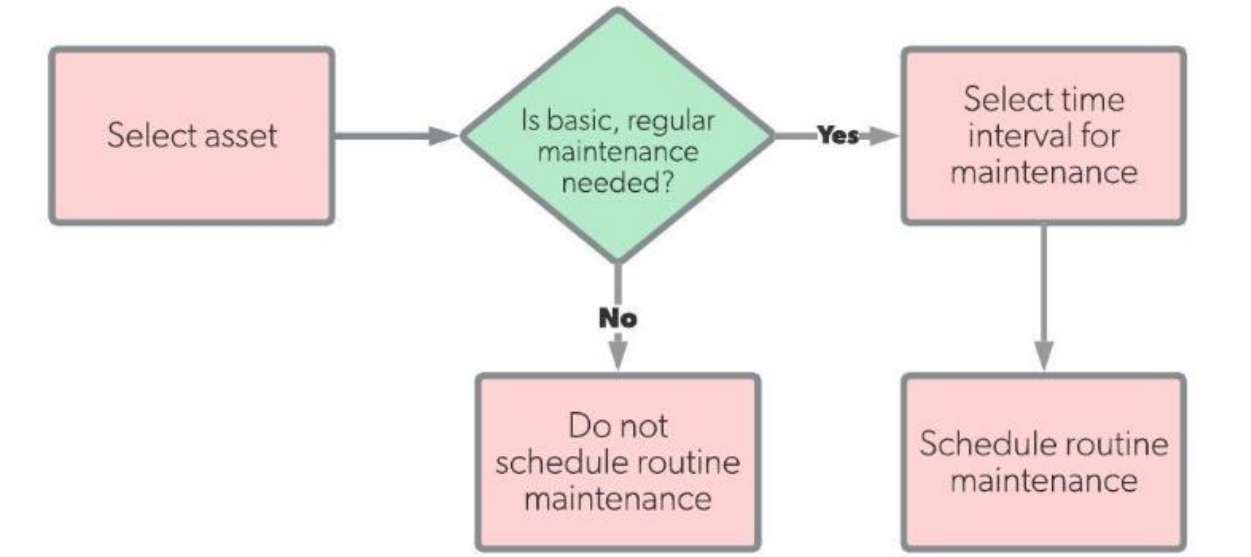


Figure: 6.1 Routine maintenance workflow

1) How routine maintenance decreases downtime

Routine maintenance is designed to help keep equipment, machines, and buildings operating optimally. If a particular piece of equipment needs lubrication, it may work at a slower rate and reduce the efficiency of an entire line. If dirt interferes with a certain component, an entire production line can be shut down until the problem is identified. Lubricating and cleaning equipment on a regular schedule prevents such problems.

In addition, routine maintenance can be scheduled on a daily basis, allowing a company to maximize the use of its maintenance resources. For example, if maintenance technicians move from one emergency work order to another, they may have to travel between locations, gather different tools and equipment, or simply switch mental gears from one problem to the next. A maintenance worker performing routine maintenance can clean, inspect, and adjust many items on a single piece of equipment much more quickly.

2) Examples of routine maintenance

Workers who perform routine maintenance for an apartment complex or other residential building are responsible for cleaning shared areas, inspecting and cleaning units when residents move in or out, or changing filters or other components in the HVAC system.

Routine maintenance in a factory setting involves lubricating, cleaning, and adjusting machines, replacing equipment parts on a schedule, inspecting certain components, or performing conditioned monitoring exercises.

Maintenance technicians who work for a municipality perform routine maintenance throughout a city. This includes trash removal, landscaping, and building walkthroughs to check for busted ballasts and burnt bulbs.

3) Benefits of routine maintenance

Routine maintenance prevents larger problems from occurring. Taking good care of equipment, machines, and facilities extends their overall life as well as keep them performing at their best. Routine maintenance gives technicians an opportunity to regularly “lay their eyes on” important components of a production line or specific system as well as a chance to catch any other potential problems that are lurking.

In addition, most maintenance technicians assigned to perform routine inspections, cleaning, or adjustments are entry-level or relatively new to a particular maintenance department. Routine maintenance is typically simple and straightforward and is an excellent training ground for a new technician to learn about a particular facility, business, or complex.

4) How to maximize routine maintenance

Routine maintenance provides an excellent return on investment considering the reduction of emergency work orders, increased efficiency of equipment, and fewer equipment replacement needs.

In order to maximize the benefits of routine maintenance, provide training and education to maintenance technicians about how to clean, inspect, lubricate, service, and adjust equipment, components or systems. Create a comprehensive maintenance checklist for each piece of equipment or machinery that requires routine maintenance, and research the industry standard for lubricating, replacing, or cleaning to ensure the routine maintenance is appropriate.

Guided Boring Machine Maintenance Before the Job

Before the beginning of each job, it is essential to perform routine maintenance checks to ensure that your machinery is ready to hit the ground running upon arrival at the job site.

A) Perform a Basic Visual Inspection

Before drilling begins, a simple visual inspection of the GBM can help spot issues that can manifest into bigger problems during drilling operations. When performing visual inspections, take note of any worn or damaged parts.

GBMs consist of numerous moving parts that are subject to wear and tear. As such, it is best to keep a list of spare parts that require frequent replacement. O-rings and filters are just some of the items that should be kept in ample supply in your inventory.

Should any faults turn up during visual inspections, they can be easily replaced with the inventory supply. Your accountant or purchasing manager should be able to inform you of which GBM parts are ordered most often.

B) Set Regular Times for Maintenance

Guided boring is a demanding job for even the toughest equipment. (Read also: An Unboring Yet Basic Guide to Boring.) As such, be sure to perform routine maintenance on each major assembly at regular intervals (daily, weekly and monthly). Daily maintenance should involve checking the quality and level of the engine oil, inspecting the cleanliness of the oil tank, and cleaning the suction strainer. At the end of each job, be sure to drain and clean the suction lines.

C) Check the Fluids

GBMs, like any machinery with moving parts, need to be well lubricated to perform at maximum efficiency. Therefore, before each boring project, apply fresh lubrication to all grease points, including the drive adapter swivel.

For hydraulic-powered GBMs, hydraulic fluids serve to transmit pressure, lubricate components, and keep the system cool. Poor quality or low levels of hydraulic fluid can affect the efficiency ofthe guided boring process. So, in addition, make sure that the hydraulic fluid is clean and filled to the required level.

Guided Boring Machine Maintenance After the Job

Once the job is complete, and the GBM returns to the office, preventative maintenance measures are needed to ensure that the equipment is ready to go for the next project.

1) Inspect the Pilot Tube

The pilot tube is the most fundamental component of any guided boring system, so it must be subjected to thorough maintenance. One of the most obvious, yet often overlooked, maintenance practices is to wash the pilot tube after each use. Wash drilling fluids and other debris from the pilot tube before they have a chance to harden. This can be done by using high-pressure water to clean the interior and exterior of the tube.

Once cleaned, thoroughly dry the pilot tube to ensure that rusting does not occur, particularly in storage. Also, inspect the pilot tube's threads and treat them with an anti-seize lubricant and replace O-rings as needed.

If wear is visible on the pilot tube's threads, the tube can either be rotated or removed from inventory. You can maintain the integrity of the tube threads for your next drive by using pilot tube caps and plugs. These simple devices protect the threads from potential damage during transportation and storage. Tubes and caps also maintain lubrication of the threaded joint and protect the O-ring sealer.

Figure 6.2: Pilot tube caps and plugs cover and protect the threads during storage and transport

2) Maintain the Paint

Carbon steel is susceptible to corrosion, particularly in soils with a high concentration of salts. Paint not only keeps the machines looking good, but also helps to protect the metal components from rusting. Protective paints act as a barrier that prevents the metal substrate from coming into direct contact with the surrounding soil. Frequent repainting of components can help to ensure the longevity of the GBMs metal components.

3) Check the Theodolite

Guided boring is renowned for its accuracy; therefore, instrumentation must be inspected after each use. The guidance system, which consists of sensitive components like the camera and theodolite, must be cleaned and thoroughly dried after each use before being returned to their protective cases.

Furthermore, the theodolite should also be checked for accuracy. It is recommended to have the theodolite calibrated annually to ensure accurate and repeatable results.

4) Prepare the Other Components for Storage

As mentioned before, carbon steel components, such as the casing, cutting head, and augers, can be vulnerable to soil-induced corrosion. The rate of corrosion attack on these components depends on several factors, including the properties of the soil, and the amount of available moisture and oxygen. However, it is well known that soils, with high conductivity, acidity, and dissolved salts content, will be the most corrosive.

Therefore, be sure to clean all soil and debris from the casings, augers, and cutting tools with high-pressure water before returning them storage. All components should also be dried and greased as required to prevent rust build-up.

Figure 6. 3: Casing and auger assembly

5) Final Thoughts

Like any mechanical machinery, guided boring machines must be properly maintained to perform at maximum efficiency. By implementing a thorough and regular maintenance routine, you can not only increase the longevity of your equipment, but you can also benefit from more efficient drives, which can translate to lower operation costs and increased profit.

6.2. Checking machines for specification

Equipment specifications are written documents or manuals that stipulate the method of production capacity, power requirement, fabrication methods and other finer details of the equipment that makes it apt for use. An engineer must have a clear understanding of equipment specifications to avoid equipment breakages.

Here are five reasons that assert why an adept understanding of equipment specifications is important for an engineer.

1) Enables the electrical engineer to forecast power & processing demands

Each equipment has its power demand and processing capacity. Equipment specifications enable an engineer to forecast the power requirements of the equipment for a specific period accurately.

The production budget and related forecasts can also be aligned to the production capacity of the equipment effortlessly. The engineer who has qualified a PE Exam will be capable of understanding the work flow of the equipment to devise the right operational flow that will achieve optimum results.

2) Helps order the right equipment

Different processes require different equipment with varying processing capabilities. In some cases, the equipment might look identical but might have unique and different features that make them suitable for exclusive functions.

Equipment specifications allows an engineer to implement better electrical engineering project construction process. It helps an engineer to make the right choice of an equipment that will serve the purpose without any hassles. Operational delays due to wrong equipment purchase can be avoided if equipment specifications are referred to prior to placing the order. Further the right devise with operational procedures will help achieve desired results.

3) Facilitates selecting the right service conditions

Equipment specifications provide a detailed overview of the service conditions and processes to be followed for equipment maintenance. It helps the engineer in establishing routine equipment conditions like power supply, use of materials, usage frequency, etc. to keep the equipment in prime condition. Equipment specifications also provide insights on the indoor and outdoor conditions in which the equipment may or may not be used.

4) Enables adherence to accurate specification standards

Misinterpretation of equipment specifications can cause severe fluctuations in the testing results. Before writing off the equipment as defective, it is necessary to check whether the right specification standards are used to determine its efficiency.

The use of applicable testing standards as laid down in the equipment specifications will help in an accurate evaluation of the equipment functioning without any deviation. It is the engineer's responsibility to ensure that the right testing standards as per the equipment specifications are used to derive an actual appraisal of the equipment's efficiency.

5) Bringing it all together

Equipment specifications enable an engineer to make the right logical decisions in circumstances where huge investments are involved. It helps to avoid costly mistakes that can disrupt production or cause material and human loss. An engineer will be able to sustain a steady level of activity with the help of equipment specifications used in day to day routine process.

Boring machine must be checked before any operation performed for its specification and maintenance. To check the machine performance it is advisable to use and follow the instruction manual of the machine properly.

6.3. Safety in maintenance (OHS)

6) Some maintenance safety-related facts and figures are as follows:

- ✓ In 1998, approximately 3.8 million workers in the United States suffered from disabling injuries on the job.4
- ✓ In 1998, the total cost of work injuries in the United States was in the order of $125.1 billion.4
- ✓ In 1993, there were approximately 10,000 work deaths in the United States.5
- ✓ In 1994, 13.6% of the accidents in the United States mining industry occurred during maintenance.
- ✓ In 1991, an explosion at an oil refining company in Louisiana that killed four workers occurred as three gasoline synthesizing units were being
- ✓ brought back to their active state after some maintenance actions.16
- ✓ In 1990, a steam leak occurred in the fire room on board the U.S.S. Iwo Jima
- ✓ (LPH 2) naval ship, resulting in ten fatalities. Subsequently, an investigation revealed that
- ✓ a valve had just been repaired and bonnet fasteners were
- ✓ replaced with mismatched and wrong material.6
- ✓ Each year around 35 million hours are lost because of accidents in United States industries.

Accidents occurring during maintenance account for a significant proportion of the overall accidents. There are various reasons for safety related problems in maintenance. Some of the important reasons are shown in Fig. 6.2.

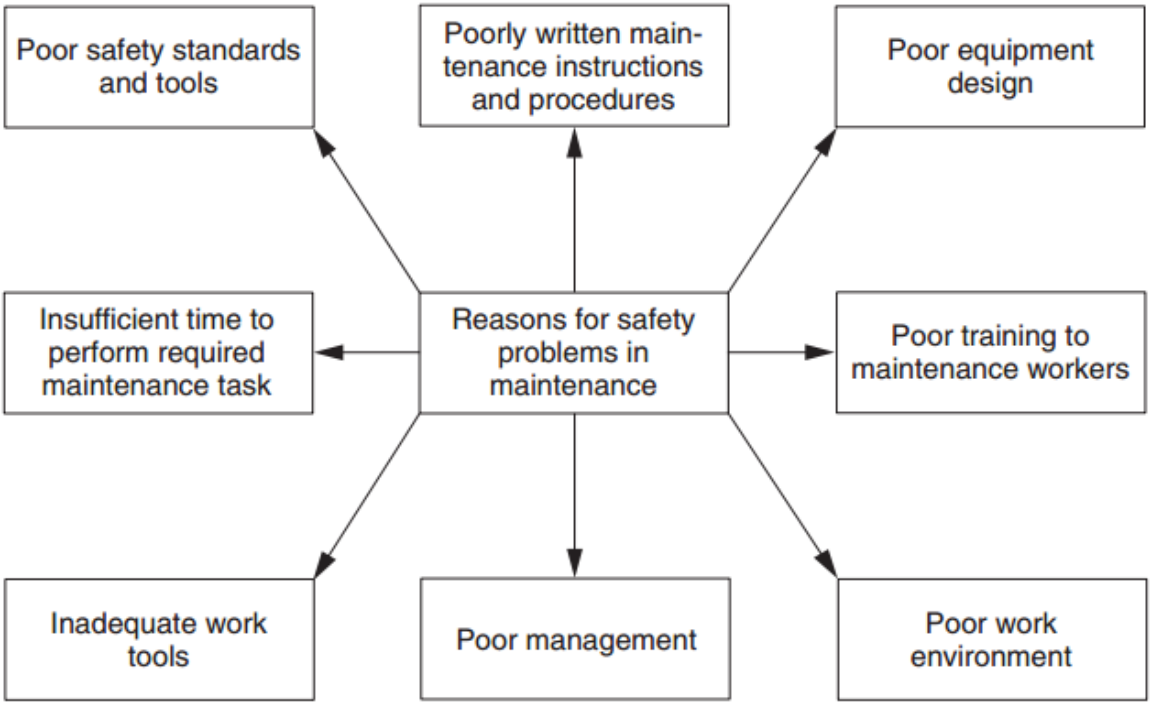


FIGURE 6.4 Some important reasons for safety problems in maintenance.

7) SAFETY AND MAINTENANCE TASKS

In addition to the general safety considerations, other factors that influence the safety dimensions of maintenance tasks include:

- Numerous maintenance tasks or jobs are in direct response to the needs of working safely. Consequently, safety needs augment maintenance tasks or jobs.
- Numerous maintenance tasks or jobs are hazardous and lead to hazardous solutions. Thus, maintenance work is a cause of safety-related problems.

The first item may be interpreted as one result of an effective safety management system. However, the second item requires further review. Some aspects of maintenance work that give it this dubious safety reputation are as follows:9

- Numerous maintenance tasks occur infrequently, e.g., machinery failures,

thus fewer opportunities to discern safety-related problems and to introduce remedial measures.

- Maintenance work performed in unfamiliar surroundings means that hazards such as rusted handrails, broken light fittings, and missing gratings may pass unnoticed..
- Difficulty in maintaining regular communication with workers in some maintenance tasks.

- Some maintenance work may require performing tasks such as disassembly of corroded parts, or manhandling cumbersome heavy parts in poorly lit areas and confined spaces.
- Disassembling previously working machinery, thus working under the risk of releasing stored energy.
- Sudden need for maintenance work, allowing limited time to prepare.
- Performance of maintenance work inside or underneath machines such as air ducts, pressure vessels, and large rotating machines.
- Performance of maintenance work at odd hours, in remote locations, and in small numbers.
- •Need to transfer heavy and bulky materials from a warehouse to the maintenance workplace, sometimes using lifting and transport equipment well outside a strict maintenance regime.

Self-Check:6

- **Directions:1** Answer all the questions listed below.

I. True Or False Item

1. Some maintenance safety-related facts and figures are very important concept for those who do not take care about safety rule .
2. Poor management style can be one of the Reason for safety problem.

II. Choose the best answer

3. Which one can be the reason of safety problem in maintenance
   A. Poor equipment design
   B. Poor management
   C. Poor Safety standards and tools
   D. Poor work environment
   E. D. All of the above

III. Short answer Item

4. Is the need for special tools for repairing safety-critical items minimized?
5. Do the repair instructions warn when protective gear must be worn because of pending hazards?
6. Is it possible to repair the item under consideration by people other than the specially-trained and -equipped personnel?
7. Is the repair process hazardous to involved repair workers?
8. Are there effective warnings against working on systems that can shock people?

Operation Sheet 6

1. Operation Title: Perform Routine maintenance of a boring machine
2. Instruction: Applying and Following the require safety rule ,using the right hand tool and the given boring machine try to make routine maintenance according to the maintenance schedule
3. Purpose: To keep of the machine from emergency break down .
4. Required tools and equipment:
    - Boring Machine
    - Chuck key ,
    - Adjustable or Open wrench
    - Wood hammer or mallet
    - Screw driver flat and or Philips
    - Lubricant oil
    - Rug
5. Precautions: Apply PPE take care for the machine spare part .
6. Procedures:
    - Steps 1- Apply safety precaution.
    - Steps 2- Prepare maintenance materials .
    - Steps 3- dismantle those movable part of the machine
    - Steps 4-clean dusts and other unnecessary particles with rug
    - Steps 5- Cleaning using Lubricant oil
    - Steps 6- maintain and /or change those parts
    - Step 7 –Apply grease when needed
    - Steps 8- Adjust the tool to the work to be bore
    - Steps 8 Assemble each parts on their normal place
7. Quality criteria: Assemble the right part on the right place .

LAP Test: Practical Demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within -1 hour.

Task 1. Make Routine maintenance for a boring machine in your work shop

Unit Seven : Clean up

This learning unit is developed to provide the trainees the necessary information regarding the following content coverage and topics:

- **Stacking /storing materials.**
- **Clearing work area.**
- **Cleaning, maintaining and storing tools and equipment.**

This unit will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- **Stacking /storing materials.**
- **Clearing work area.**
- **Cleaning, maintaining and storing tools and equipment.**

7. Clean up work Area

7.1. Stacking /storing materials.

- Store materials
  - ✓ Store materials and supplies in an organized manner to ensure easy access for retrieval and transportation. Place heavier loads on lower or middle shelves. Store long, tall or top heavy items on their side or secure them to prevent tip over.
  - ✓ Good storage place like shelves and racks are properly aligned and goods don't overhang shelves. Correct maximum loads for racking are displayed.
  - ✓ personal protective equipment is used where necessary. items are stacked correctly - put the heaviest at the bottom where possible.
  - ✓ Proper storing of materials is very important to prevent losses from damage, pilferage and deterioration in quality of materials. The stores must, therefore, be properly organised and equipped for the handling of raw materials.

Stored materials shall be separately stored under following classifications, with appropriate care necessary precautions to each Classification:

a. Climatically Sensitive Materials
b. Durable Materials
c. Materials Vulnerable to Rough Handling
d. Inflammable and/or Fire Sensitive Materials
e. Hazardous Materials

Under each classification a list of commonly used materials are listed below. Other materials used but not mentioned here shall be treated under one or more of the above listed classifications which most closely match the unlisted materials.

a. Climatically Sensitive Materials

Such material shall be stored in properly constructed sheds which must be stored in cool dry and well ventilated and confines, ensuring its storage without deterioration and without contact to ground and structural members, without exposure to moisture and heat, and away from direct sun. Materials requiring breathing, such as timber and other natural products, shall be allowed ample air flow between successive layers of stacking. Materials subject to deformation under stress shall be supported uniformly so as not to subject it to bending load or excessive vertical load. Materials subject to loss of quality through moisture shall be kept within impermeable wrapping, if not used within a reasonable period.

b. Durable Materials : Steel Bars and Sections

Steel reinforcement bars and structural steel shall be stored in a way to prevent distortion, corrosion, scaling and rusting. Reinforcement bars and structural steel sections shall be coated with cement wash before stacking, especially in humid areas. In case of long time storage or storage in coastal areas, reinforcement bars and steel sections shall be stacked at least 200 mm above ground level. Steel sections shall be stacked upon platforms, skids or any other suitable supports. Bars of different types, sizes and lengths and structural steel sections shall be stored separately to facilitate issues in required sizes and lengths without cutting from standard lengths. Ends of bars and sections of each type shall be painted with separate designated colors.

c. **Materials Vulnerable to Rough Handling : Aluminum Sections** :

Aluminum sections of different classification, sizes and lengths shall be stored separately, on a level platform under cover. The aluminum sections shall not be pulled or pushed from the stack nor shall be slided over each other, to protect the anodizing layer.

d. Inflammable and/or Fire Sensitive Materials : Plastic and Rubber sheets

Materials under this classification shall be stored within fire-preventive confines, furnished with fire fighting provisions. Buckets containing sand shall be kept ready for use. A 5 kg dry powder fire extinguisher conforming to accepted standards shall be kept at an easily accessible position. Besides the areas shall be close to fire hydrants'.

Plastic and rubber sheets shall be stored within fire proof confines according to manufacturer's instructions. Sheets shall be stored in the coolest of the store rooms available. The room shall be well ventilated and kept dark; direct sun light shall not be allowed to fall on the stored sheets. The sheets shall be stored away from electric generators, electric motors, switchgears and other such electrical equipment.

e. Hazardous Materials : Asbestos-based Materials

Materials under this category are (a) those posing health hazard through breathing, such as asbestos, glass fibre, etc. or injurious and/or intoxicating fluids of various kinds, (b) materials corrosive to living bodies and (c) materials likely to explode under heat or pressure. These should be stored in a manner specific to its properties, so as to prevent hazards of all kinds. Asbestos-based Materials: Whenever possible, materials which do not contain asbestos shall be used. Special precautions as specified by the following sub-sections shall be taken while handling asbestos containing materials to minimize the risk of inhaling asbestos. Handling shall be limited to as few workers as possible

- Stacking and storage regulations.

- Stacking and storage procedure:

Table 7.1 Safe working procedure stacking and storage

	SAFE WORKING PROCEDURE STACKING AND STORAGE	Form: SWP 002
1.	**THE TASK:**	
	Stacking and Storage of material	
2.	**THE HAZARDS:**	
	Sharp edges, Fall down / over, Slipping, Heavy materials, Communication, Poorly loaded vehicle	
	Bad stacking, Dust, Weather and Co-workers.	
3.	**PERSONAL PROTECTIVE CLOTHING:**	
	Hard hat, Overall, Safety boots, Gloves, Eye protection and Reflecting vest in some cases.	
4.	**TOOLS:**	
	Spade if sand or stone.(Other materials by hand.)	
5.	**SAFETY PRESCRIPTIONS: (General Safety Precautions)**	
a.	Be sober at all times.	
b.	Do not smoke dagga or use drugs during working hours.	
c.	Do not perform any task unless you have received specific training for the task.	
d.	Always wear the prescribed Personal Protective Equipment.	
e.	Do not wear loose clothing when working near moving machinery.	
6.	**Specific Safety Precautions: (All types of material)**	
a.	More than one person to lift up heavy material.	
b.	Beware of hitting face, hands, legs, and feet when moving material.	
C.	Use the correct lifting methods (Lift up with your legs and not your back)	

d.	Watch where you walk, be observant of co-workers.	
e.	Beware of sharp edges, and hazardous materials.	
f.	Maintain a safe working distance between co-workers.	
g.	Use the correct tools for the task to perform.	
h.	Do not confront Snakes and wild animals (report to your supervisor and warn co-workers)	
i.	Do not horseplay on the job. (It can be dangerous)	
j.	Beware of falling material. (Poles, stays, y standards)	
k.	Comply with all company and other signage.	
l.	Comply with all company safety rules.	
m.	Report any unsafe act, Situation or condition to your supervisor.	
n.	Carry out any reasonable instruction given to you by your supervisor.	
o.	Smoking to be carried out in manner and area as per company policy.	
p.	To conserve the environment in all possible ways.	
Employee Name:	Employee Signature	

- Follow Storage Inspection Checklist

Table 7.1 Follow Storage Inspection Checklist

MECHANICAL STORE						
No.	**Item description**	**Yes**	**No**	**Y/N**	**Observation & recommendation**	**Remark**
1.	Is base uneven and unable to sustain weight exerted by stack ?					
2.	Are stacking neat and arranged ?					

3.	Are stacking free from hazardous materials?					
4.	Are articles consistently of the same size, shape and mass ?					
5.	Are storage areas demarcated ?					
6.	Are pallets and containers in good condition ?					
7.	Is support structure properly installed ?					
8.	Are staking over cabinets and windows sills?					
9.	Are stacks in danger of collapsing					
10	Are Stored items clearly identified and labelled ?					
11	Is staking height as per standard (3 times basewidth) ?					
12	Is stack heights displayed ?					
13	Is safe access and egress provided?					
14	Is appropriate ladder or lift provided to gainaccess to stacks ?					
15	Stack does not obstruct power source, fire fighting equipment, lighting ventilation, sprinkler or detectors (minimum 1m clearance).					
	CHEMICAL & FLAMMABLE MATERIALS STORE					
1.	Are all chemical stored according to SDS And compatibility table ?					
2.	Are stores equipped with proper ventilation And lighting systems ?					
3.	Is clear indication provided outside or entrance door of the chemical store?					
4. 5.	Are all chemical & flammable liquids stored in a metal cupboard ? Are the store is equipped with doors and gauzed ventilation holes ?					
6.	Are all flammable items clearly labelled?					
7.	Are all flammable liquid stored separately					

	without Combustible packing materials like wood, rags, carton boxes, etc. ?					
8.	Are appropriate sign ages posted like "No open flames" and "No smoking" in the chemical store ?					
9.	Are Sufficient numbers of the correct fire-fighting equipment (fire extinguisher, smoke detectors, etc.) available in the chemical store ?					
10.	Are all MSDS, emergency and first aid instructions available at store ?					
	COMPRESSED GAS CYLINDER STORE					
14	Is clear indication provided outside or entrance					

7.2. Clear work area.

- Clear work area means make free the working area of the shop from any
  - ✓ Metal scrap material
  - ✓ Wood scrape
  - ✓ Unused Cutting tool material
  - ✓ Oil container
  - ✓ Rug material etc

7.3. Cleaning, maintaining and storing tools and equipment.

- What equipment is used in industrial cleaning?

There is a range of equipment for professional cleaning suited for cleaning factories, workshops, warehouses, medium-sized stores and large surfaces...: industrial vacuum cleaners, auto scrubber driers, sweepers, high pressure cleaners, all kinds of consumables: wipers, sponges, etc **The machine help for all types of cleaning operations:**

- ✓ To sweep and/or dust surfaces.
- ✓ To wash
- ✓ To strip or sand

1. **Overall, cleaning equipment can be categorised into two types:**
   - ✓ Manual Equipment.

- ✓ Mechanical Equipment.

2. Ways to storing tools and equipment
   - ✓ Tools should never be stored on the ground. **Invest in some shelving for smaller tools, or hang pegboard along your workbench or on a wall in your garage**.
   - ✓ You'll be able to hang things like wrenches, hammers, box cutters, garden equipment and many other tools so they'll be easy to access at any time.
3. 10 ways to make equipment last longer in the work shop
   - ✓ Read the User Guide.
   - ✓ Use the Correct Equipment For The Job. .
   - ✓ Know Your Machinery. .
   - ✓ Inspect Regularly. .
   - ✓ Carry Out Regular Maintenance, Using a Schedule. ...
   - ✓ Replace Parts When Needed. ...
   - ✓ Clean After Use. .
   - ✓ Repair and Refurbish, Rather Than Replace.

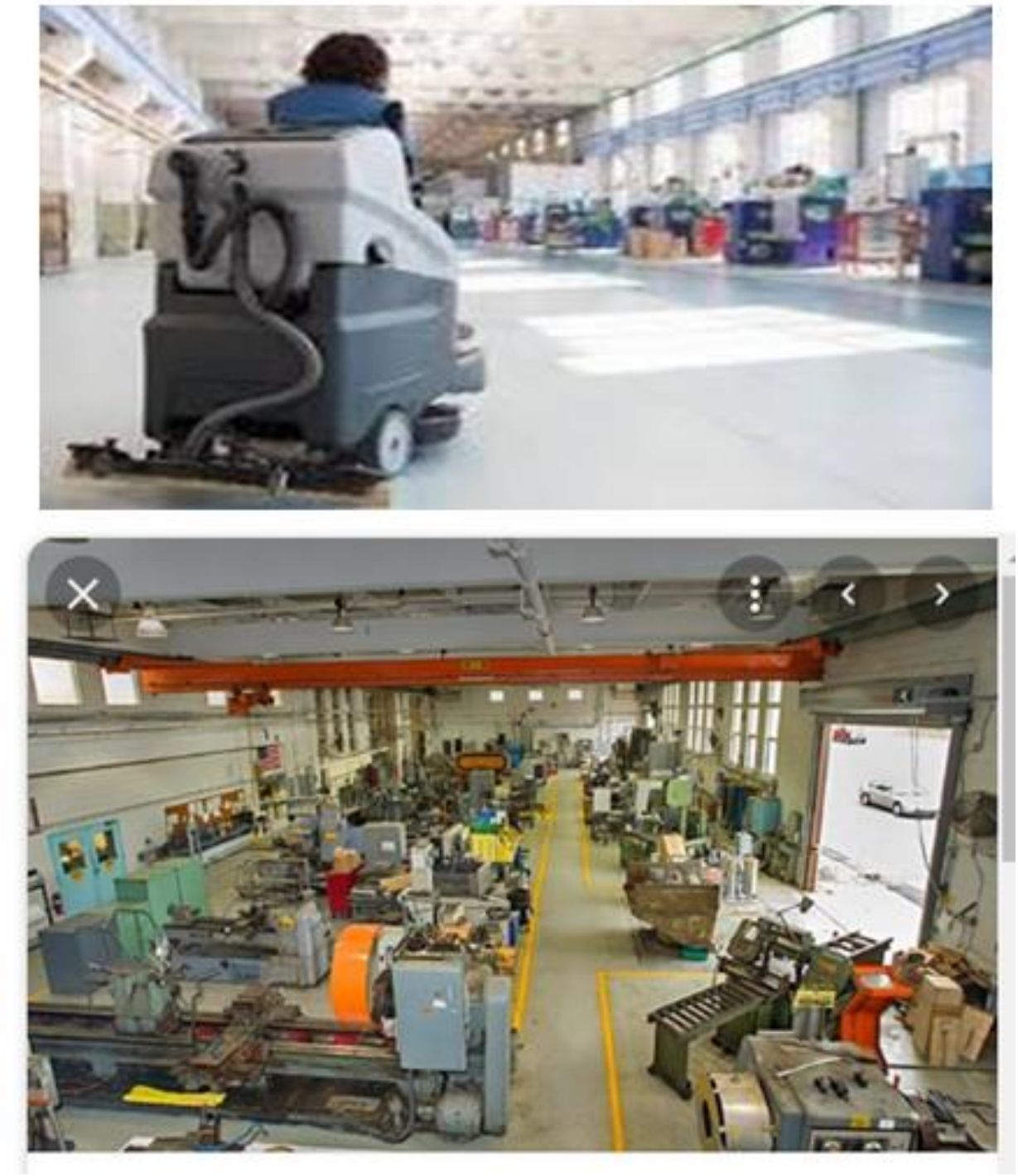


Figure 7.1 Shows clean and clear machine shop area

Self-Check:6

Directions:1 Answer all the questions listed below.

I. True Or false Item

1. Improper storing of materials is very important to prevent losses from damage.
2. All flammable liquid stored separately without Combustible packing materials.

II. Chose the best answer

3. Which ways best to make equipment last longer in the work shop
   A) Read the User Guide.
   B) Inspect Regularly. .
   C) Replace Parts When Needed.
   D) Clean After Use. E. All of the above
4. Stored materials shall be separately stored under following sensitivity except .
   A) Durable Materials
   B) Materials Vulnerable to Rough Handling
   C) Inflammable and/or Fire Sensitive Materials
   D) Hazardous Materials E. None of the above

III. Give short Answer

5. List at list five Specific Safety Precautions

Operation Sheet 7:

1. Operation Title: Cleaning up work Area
2. Instruction: Applying and Following the require safety rule ,using the right cleaning material clean the working area of the work shop
3. Purpose: To keep the machine and the work area free from dust particles , any unnecessary materials .
4. Required tools and equipment:
    - Cleaning machine
    - Cleaning brush
    - Lubricant oil
    - Rug, etc.
5. Precautions: Apply PPE take care for the machine.
6. Procedures:
    - Steps 1- Apply safety precaution.
    - Steps 2- Prepare cleaning materials .
    - Steps 3- clear those heavy duty or metal parts
    - Steps 4-clean dusts ,metal scraps and other unnecessary particles with rug
    - Steps 5- Cleaning the machine using Lubricant oil
    - Steps 6- Return the machine parts removed for cleaning to their original positions
7. Quality criteria: Make clean area. .

LAP Test 7: Practical Demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within 2 hour.

Task 1. Select your machine shop and **clean** up the work **area**

8. REFERENCE MATERIALS

- Manufacturing Engineering and Technology SIXTH EDITION Serope Kalpakjian Illinois Institute of Technology Steven R. Schmid The University of Notre Dame
- S. K. Ghosh, *Manufacturing engineering and technology*, vol. 25, no. 1. 1991.
- Boring Machine || Definition, Types, Parts, Operation & Size (mechanicalnotes.com)
- https://www.theengineerspost.com/horizontal-boring-machine/
- https://www.mie.utoronto.ca/wp-content/uploads/2016/10/MODULE-6-Interpreation-of-Drawings.pdf
- https://en.wikipedia.org/wiki/Technical_drawing#Sketching
- Bhatt, N.D., Machine Drawing, Charotar Publishing House, 48th Edition, 2013. 4.
- Brian Griffiths, “Engineering Drawing for Manufacture”, Kogan Page Science, 2003.

Profile of Participants on TTLM Development

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