MACHAKOS UNIVERSITY

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL & MANUFACTURING ENGINEERING

FIRST YEAR SECOND SEMESTER EXAMINATION FOR DIPLOMA IN BUILDING & CIVIL ENGINEERING

WORKSHOP TECHNOLOGY-MECHANICAL

INSTRUCTIONS **TIME:**

This paper consists of five questions, attempt ALL .

1 (a). Describe the procedure of marking out a work piece (7Marks)

(b). Using neat sketches illustrate the following measuring instruments giving their use;

I. Vernier calliper
II. Micrometer
III. steel rule
IV. Divider (8Marks)

(c).Mention six classifications of hand tools giving examples of each. (5Marks)

2(a).Using neat diagram show parts of lathe machine giving function of each part. (10Marks)

(b).Describe Five lathe operations with aid of neat sketches (10marks)

3 (a) . Describe the parts and principle of operation of the following pumps;

i. Centrifugal (7Marks)
ii. Reciprocating (8 Marks)

(b) Explain why centrifugal pumps are widely used in most typical applications (5Marks)

4 . (a) .Name Six ways of classifying internal combustion engines (6marks)

(b)Differentiate between a four stroke and two stroke engines . (8marks)

(c)Mention Six common maintenance checks when serving engines. (6Marks)

5 (a). Explain how quick return mechanism is achieved in a shaper machine. (10Marks)

(b).With aid of neat sketches describe Five drilling operations. (10marks)

WORKSHOP TECHNOLOGY BCEMarking scheme

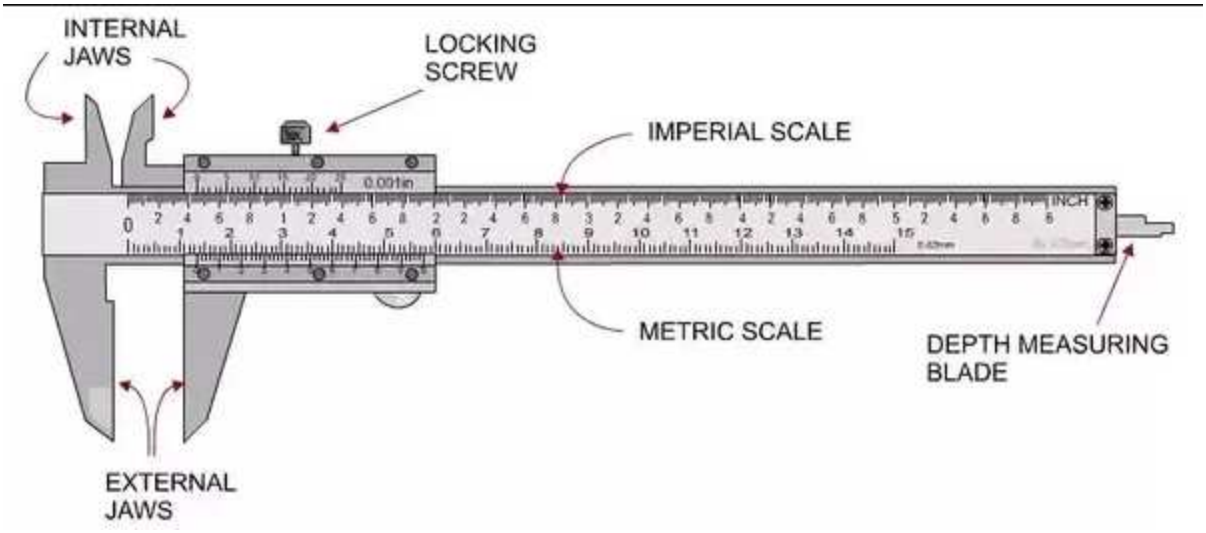
1(a) Marking out or layout means the **process** of transferring a design or pattern to a workpiece, as the first step in the manufacturing **process**.

Steps.

- Choose marking out tool
- Prepare the work piece
- Establish the datum
- Using marking out tools transfer the design to the workpiece

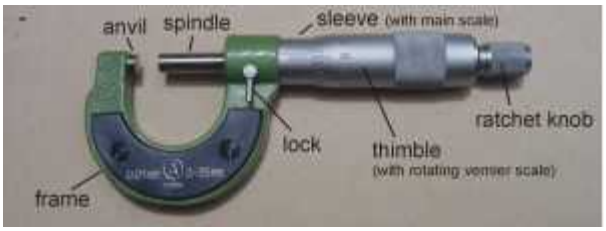
(b). **Measuring instruments**

Vernier Caliper is a precision instrument that can be used to measure internal and external distances extremely accurately.



Micrometer

Micrometer screw gauge is used for measuring extremely small dimensions.



Steel Rule

Is a device used in geometry and technical drawing, as well as the engineering and construction industries, to measure or draw straight lines

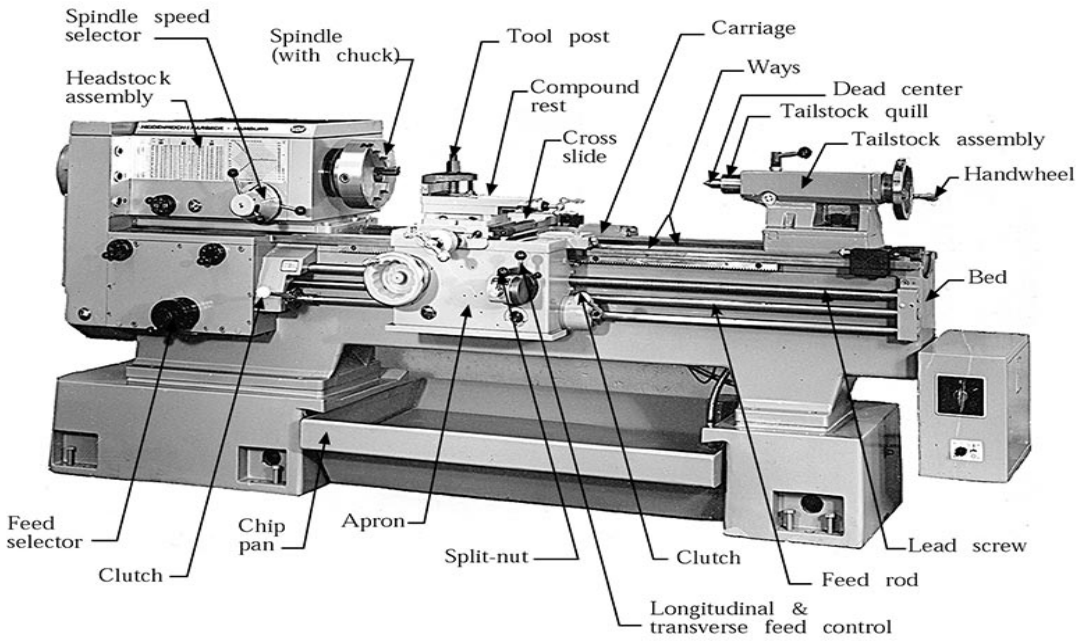
Divider

Divider, instrument for measuring, transferring, or marking off distances, consisting of two straight adjustable legs hinged together and ending in sharp points.

b. Classification of fitting tools.

- ✓ Holding tools-bench vice, pipe, hand
- ✓ Striking tools—Hammers
- ✓ Scraping tools- scapers
- ✓ Drilling tools –
- ✓ Measuring, marking and testing tools

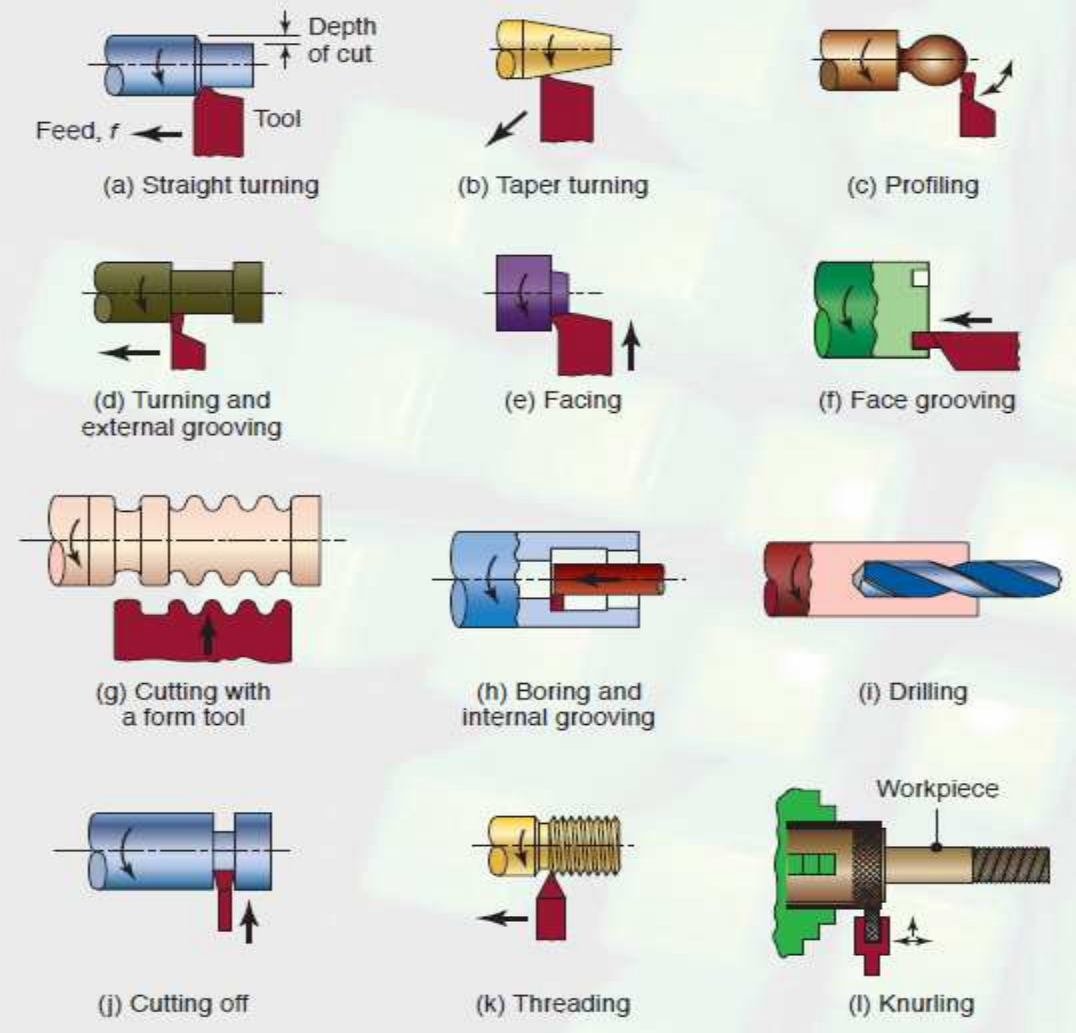
2(a). Lathe



Different parts of Lathe:

1. **Headstock**: Headstock supports the central spindle in the bearings and aligns it correctly. It also houses necessary transmission mechanism for different speeds. It supports the main spindle in the bearings and aligns it properly. It has a mechanism for getting different speeds. Accessories mounted to headstock spindle are 3/4 jaw chuck, lathe center, and lathe dog, collect chuck, face plate, and magnetic chuck.
2. **Split nut**: When closed around the lead screw, the carriage is driven along by direct drive without using a clutch.
3. **Carriage**: Carriage moves on the outer ways. Used for mounting and moving most of the cutting tools.
4. **Compound rest**: Mounted to the cross slide, it pivots around the tool post.
5. **Tailstock**: Fits on the inner ways of the bed and can slide towards any position the headstock to fit the length of the workpiece. An optional taper turning attachment would be mounted to it.
6. Apron
7. Main Spindle
8. Tool post
9. Cross slide
10. Dead center
11. Hand wheel

2(b).Lathe operations



- **Turning:** [Fig. 3. (a-d)] to produce straight, conical, curved, or grooved workpieces, such as shafts, spindles, and pins.
- **Facing:** [Fig. 3 (f)] to produce a flat surface at the end of the part and perpendicular to its axis [Fig. 3 (e)], useful for parts that are assembled with other components. Face grooving produces grooves for applications such as O-ring seats.
- **Cutting with form tools:** [Fig. 3 (g)] to produce various axisymmetric shapes for functional or aesthetic purposes.
- **Boring:** [Fig. 3 (h)] to enlarge a hole or cylindrical cavity made by a previous process or to produce circular internal grooves.
- **Drilling:** [Fig. 3 (i)] to produce a hole, which may be followed by boring to improve its dimensional accuracy and surface finish.
- **Parting:** [Fig. 3 (j)] also called cutting off, to cut a piece from the end of a part, as is done in the production of slugs or blanks for additional processing into discrete products.
- **Threading:** [Fig. 3 (k)] to produce external or internal threads.
- **Knurling:** [Fig. 3 (l)] to provide a regularly shaped roughness on cylindrical surfaces, as in making knobs and handles.

3(a**) parts and principle of operation of the following pumps;**

A **centrifugal pump** is a mechanical device designed to move a fluid by means of the transfer of rotational energy from one or more driven rotors, called impellers. Fluid enters the rapidly rotating impeller along its axis and is cast out by **centrifugal** for

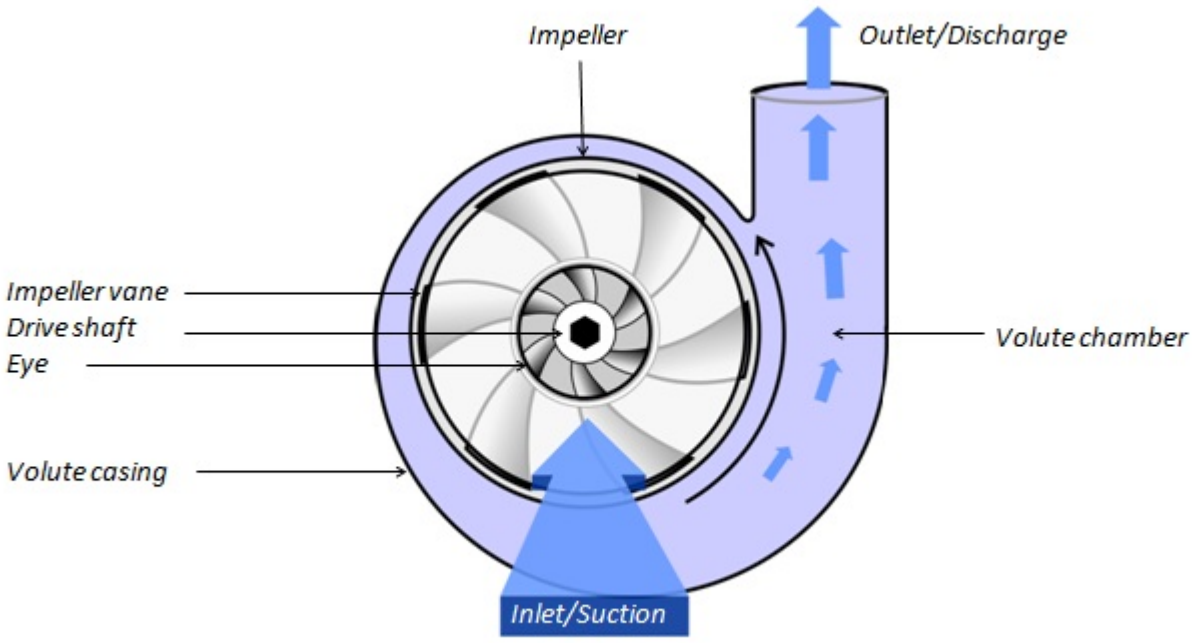
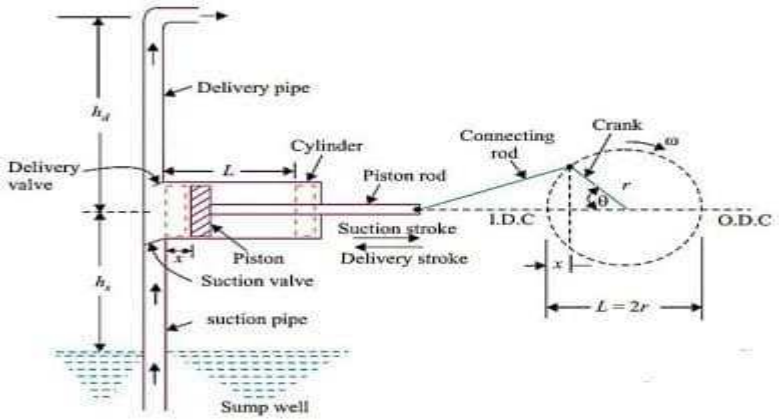


Figure 2. Volute case design

Applications. Most of the industrial processes include the conduction of fluids or energy transfer. ... These **pumps** are used for different **applications** including pressure boosting, wastewater, water supply, heating and cooling distribution and other industrial applications.

Reciprocating pumps work on the principle of pushing of liquid by a piston that executes a **reciprocating** motion in a cylinder of closed fitting. **Working** of**reciprocating** motion is done by the electric motor or engine.



CONTRUCTION DETAILS OF A RECIPROCATIN PUMP:

Components of reciprocating pumps:-

a) Piston or plunger: – a piston or plunger that reciprocates in a closely fitted cylinder.

b) Crank and Connecting rod: – crank and connecting rod mechanism operated by a power source. Power source gives rotary motion to crank. With the help of connecting rod we translate reciprocating motion to piston in the cylinder.

c) Suction pipe: – one end of suction pipe remains dip in the liquid and other end attached to the inlet of the cylinder.

d) Delivery pipe: – one end of delivery pipe attached with delivery part and other end at discharge point.

e) Suction and Delivery value: – suction and delivery values are provided at the suction end and delivery end respectively. These values are non-return values.

WORKING OF RECIPROCATING PUMP

Operation of reciprocating motion is done by the power source (i.e. electric motor or i.c engine, etc). Power source gives rotary motion to crank; with the help of connecting rod we translate reciprocating motion to piston in the cylinder (i.e. intermediate link between connecting rod and piston). When crank moves from inner dead centre to outer dead centre vacuum will create in the cylinder. When piston moves outer dead centre to inner dead centre and piston force the water at outlet or delivery value.

3(b). **Why centrifugal pumps are widely used ?**

- ✓ It uses kinetic energy of its impeller such that it continuously supplies fluid
- ✓ It can be **used** to **pump** fluids with high viscosity.
- ✓ Efficiency of a **centrifugal pump** is higher than a reciprocating **pump**.
- ✓ Simple construction
- ✓ Easy to maintain
- ✓ Cheap in cost

Q4a. Classification of Internal Combustion Engines:

Today's IC engines can be classified in several ways. Some of the ways of classification of Internal Combustion (IC) engines is listed below:

1. Based on application

- Automobile Engine
- Aircraft Engine
- Locomotive Engine
- Marine Engine
- Stationary Engine

2. Based on basic engine design

- Reciprocating: Single cylinder, Multi-cylinder In-line, V, radial, opposed cylinder, Opposed Piston.
- Rotatory: Single motor, Multi motor

3. Based on operating cycle

- Atkinson (For complete expansion SI Engine)
- Diesel (For the Ideal Diesel Engine)
- Dual (For the Actual Diesel Engine)
- Miller (For Early/Late Inlet valve closing type SI Engine)
- Otto (For the Convectional SI Engine)

4. Based on working cycle

- Four stroke cycle
- Two stroke cycle
    - Scavenging ; direct/crankcase/cross flow; back flow/loop; Uni flow
    - Naturally aspirated or turbocharged

5. Based on Valve/port design and location

- Design of valve/port
    - Poppet valve
    - Rotatory valve
- Location of valve/port
    - T-head
    - L-head
    - F-head
    - L-head

6.Based on Fuel

- Convectional
    - Crude oil derivatives; Petrol, diesel
    - Other sources; coal, bio-mass, tar stands, shale
- Alternative
    - Petroleum derived: CNG, LPG
    - Bio-mass derived: alcohols, vegetable oils, producer gas, biogas and hydrogen
- Blending
- Bi-fuel and dual fuel

7. Based on mixture preparation

- Carburetion
- Fuel injection

8. Based on ignition

- Spark ignition
- Compression Ignition

9. Based on stratification of charge

- Homogeneous Charge
- Stratified charge
    - With carburetion
    - With fuel injection

10. Based on combustion chamber design

- Open chamber: Disc, wedge, hemispherical, bowl-in-piston, bath tub.
- Divided chamber:
    - (For CI) 1. Swirl chamber, 2. Pre-chamber
    - (for SI) 1. CVCC, 2. Other designs

11. Based on cooling system

- Air-cooling system
- Water-cooling system

Q4b.Difference Between a Two Stroke and Four Stroke Engine

The biggest difference between a two stroke and four stroke engine has to do with firing timing, which can often be noticed in terms of sound: the two engine often has a high-pitched, very loud rumble, whereas the four engine tends to have a quieter purr. In most cases this is a facet of basic operation and efficiency. Two stroke engines fire once per revolution, which gives them twice the power of a four stroke that generally fires only every *other* revolution. Four strokes are more efficient, but they're heavier and more expensive, too. They're more commonly found in cars and industrial machinery, whereas things like lawnmowers, jet skis, and most lightweight motorboats rely on the smaller two stroke model. The basic fuel burning and combustion properties of these engines are generally the same, but the differences come with respect to *how* they convert energy and how efficiently that conversion happens.

Understanding the Strokes

Both types of engines burn fuel through four distinct processes, known as "strokes." How quickly they complete these strokes is one of the biggest differences, but they both will perform all four at some point.

Q4C. Common maintenance of engines

Maintenance tasks commonly carried out during a motor vehicle service include:

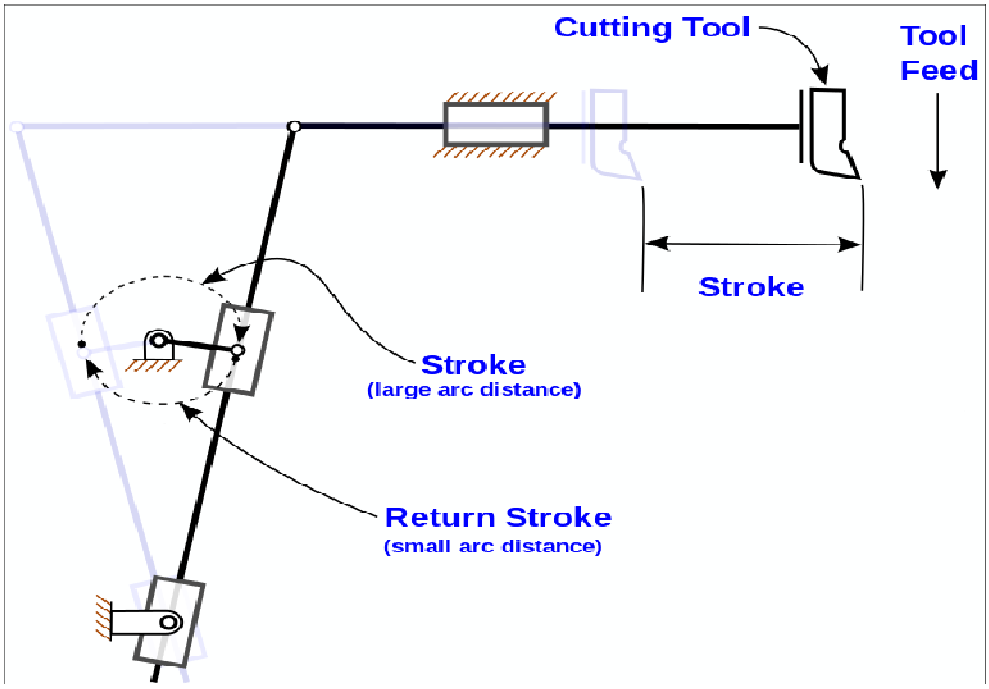
- Change the engine oil
- Replace the oil filter
- Replace the air filter
- Replace the fuel filter
- Replace the cabin filter
- Replace the spark plugs
- Tune the engine
- Check level and refill brake fluid/clutch fluid
- Check Brake Pads/Liners, Brake Discs/Drums, and replace if worn out.
- Check level and refill power steering fluid
- Check level and refill Automatic/Manual Transmission Fluid

- Grease and lubricate components
- Inspect and replace the timing belt or timing chain if needed
- Check condition of the tires
- Check for proper operation of all lights, wipers etc.
- Check for any Error codes in the ECU and take corrective action.
- Wash the vehicle and clean the interiors.
- Use scan tool read trouble code.

5(a) Quick return mechanism in a shaper

A **quick return mechanism** is an apparatus to produce a reciprocating motion in which the time taken for travel in one direction is less than in the other. It is driven by a circular motion source (typically a motor of some sort) and uses a system of links and sliding joints.

Quick return is a common feature of tools in which the action is performed in only one direction of the stroke, such as shapers and powered saws, because it allows less time to be spent on returning the tool to its initial position.



5(b) Drilling operations

Counterboring

This process creates a stepped hole in which a larger diameter follows a smaller diameter partially into a hole.

Countersinking

This process is similar to counterboring but the step in the hole is cone-shaped.

Boring

Boring precisely enlarges an already existing hole using a single point cutter.

Friction drilling

Reaming

Reaming is designed to enlarge the size of a hole to leave smooth sides.

Spot Facing • It is a finishing operation to produce flat round surface usually around a drilled hole, for proper seating of bolt head or nut. • It is done by using a special Spot Facing Tool.

Tapping • It is a process of cutting internal threads with a thread tool called as Tap. • Tap is fluted threaded tool used for cutting internal thread.

Drilling Machine Operations

- Drilling
- Reaming
- Boring
- Counter Boring
- Counter Sinking
- Tapping
- Spot Facing