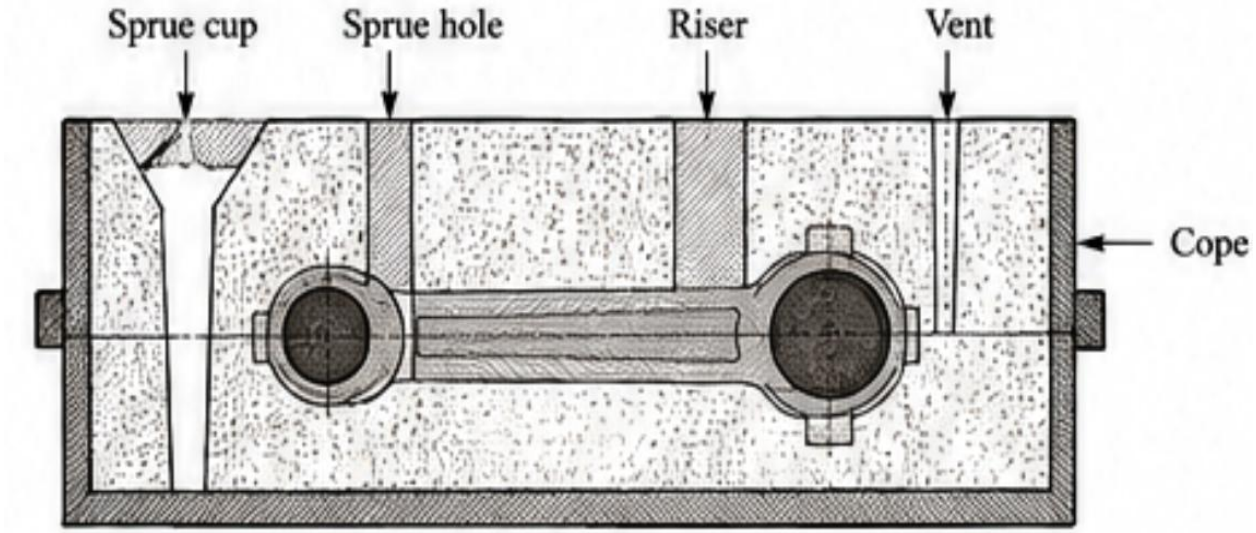
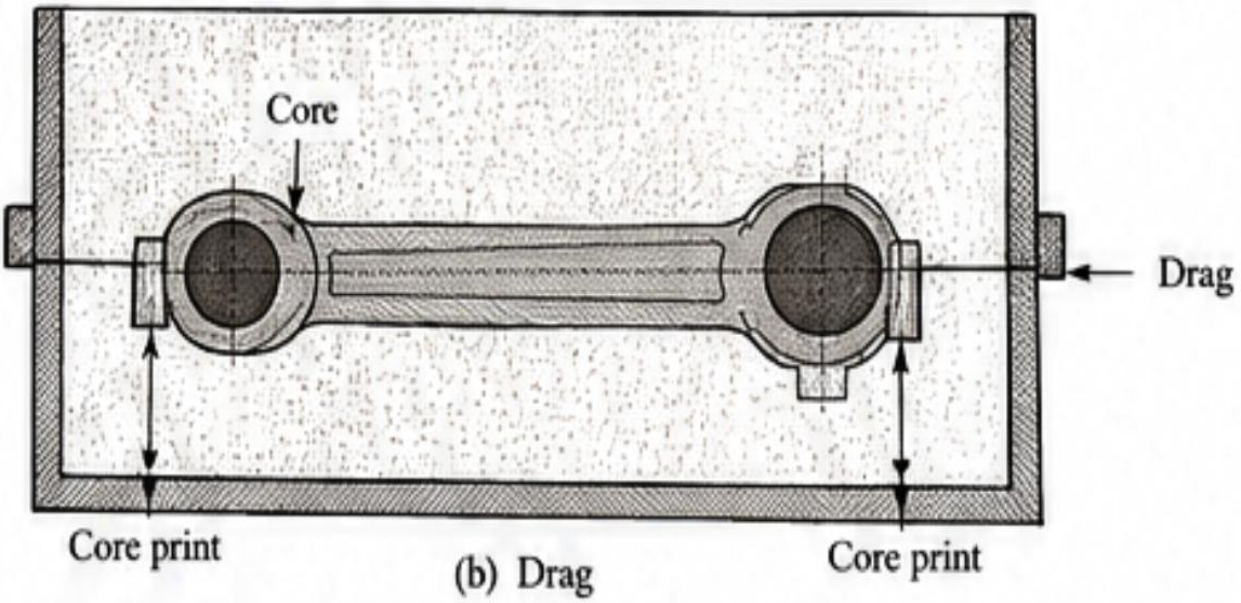
MOULDING DIAGRAM



(a) Cope



(b) Drag

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MOULDING & CASTING OF CONNECTING ROD

AIM: To make a mould and cast a connecting rod using sand casting process.

THEORY

A connecting rod is used to transmit the force from piston to the crank in I.C. engines. It has two ends-small end (for gudgeon pin) and big end (for crank pin). Casting is the most suitable method for producing connecting rods. In sand casting, a pattern of the component is used to make a cavity in the sand. Molten metal is poured into the cavity and after solidification and solidification and cooling, the casting is removed by breaking the mould.

PATTERN

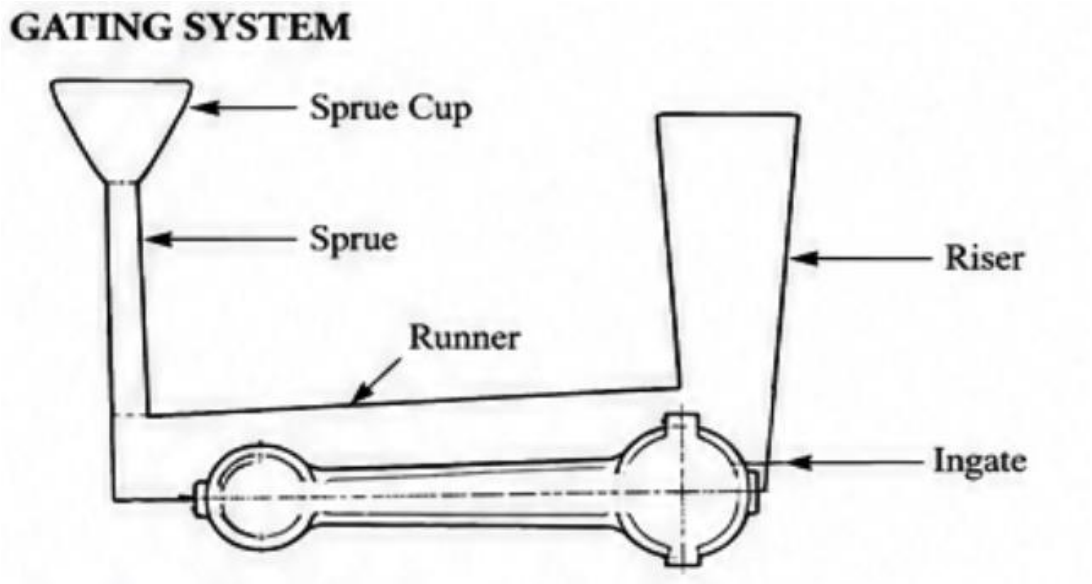
Split pattern is used. The parting line passes through the center of the connecting rod. Core prints are provided at the big end and small end to support the cores.

MATERIALS & EQUIPMENTS

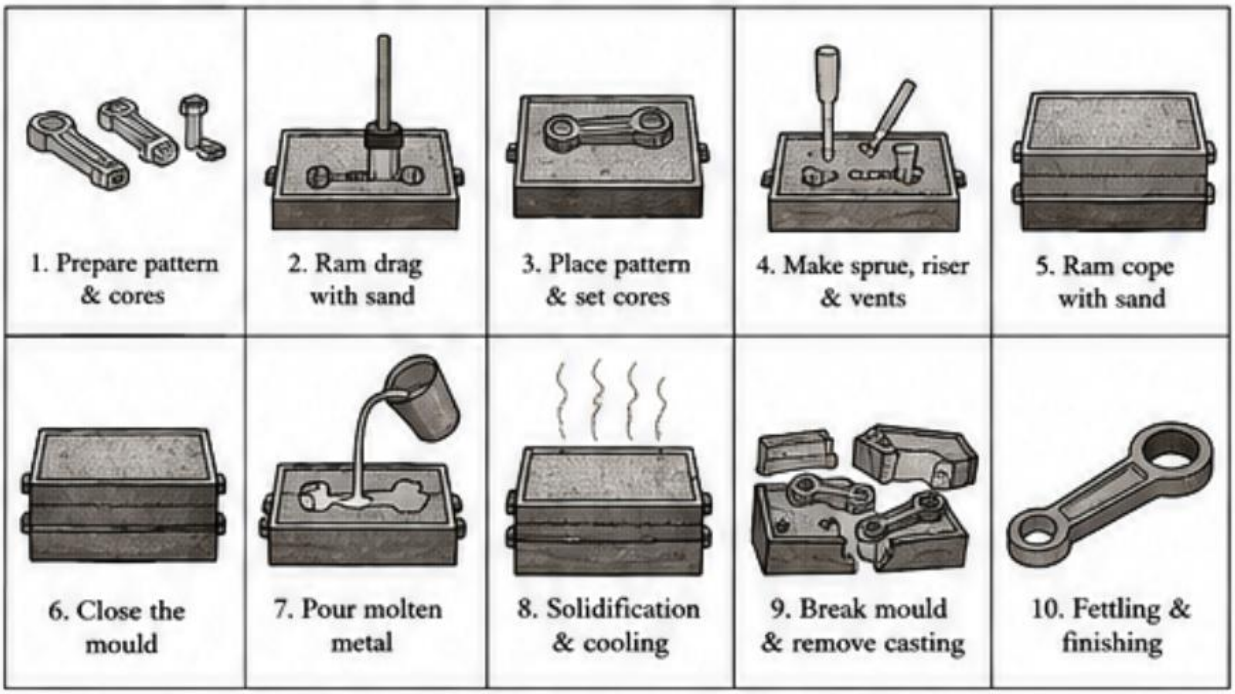
Pattern of connecting rod (split pattern)
Moulding sand, facing sand, parting sand
Cores (big end core & small end core)
Moulding box, riddle, trowel, rammer, vent rod
Sprue pin, riser pin, strike off bar
Melting furnace, crucible, ladle
Molten metal (Cast Iron/Aluminum alloy)
Fettling tools, hacksaw, file, emery paper

MOULDING PROCEDURE

1. The Moulding box is placed on a level floor. Drag is filled with sand, rammed and faced.
2. The pattern is placed with parting line horizontal. Core prints are kept in position and cores are placed.
3. Sprue and riser pins are set; vents are made with vent rod.
4. Cope is placed, sand is filled, rammed and faced.
5. The pattern is removed carefully (drawn), leaving the mould cavity.
6. Sprue hole and riser hole are made.
7. Mould is closed and ready for pouring.



STEPS IN SAND CASTING SEQUENCE



POURING OF METAL

1. Metal is melted in the furnace and temperature is maintained.
2. Slag is removed and molten metal is poured through the ladle into the sprue cup in a steady stream.
3. Metal fills the cavity and riser gradually.
4. After solidification and cooling, the mould is broken and casting is taken out.

FETTLING AND FINISHING

The casting is fettled to remove sand, gates, risers and projections using chipping hammer. Then filing and emery paper are used to obtain smooth surface.

RESULT

A sound casting of connecting rod was obtained by sand casting process.

PRECAUTIONS

Sand should be properly mixed and rammed uniformly.

Cores must be properly dried and placed correctly.

Metal should be poured at correct temperature.

Pouring should be steady to avoid turbulence.

Safety precautions must be followed while handling molten metal.

APPLICATION

Connecting rod is used in I.C. engines to connect piston and crank shaft and transmit motion.

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ARC WELDING (I) LAP JOINT (II) BUTT JOINT (III) T- JOINT

AIM: To prepare and weld the following joints using the Shielded Metal Arc Welding (SMAW) process: Lap Joint, Butt Joint, T-Joint

THEORY

Arc welding is a fusion welding process in which heat is generated by an electric arc formed between a consumable electrode and the work piece. The intense heat melts the edges of the base metal and the electrode, producing a strong welded joint after solidification. Shielded Metal Arc Welding (SMAW) is one of the most commonly used welding processes because it is simple, economical, and suitable for welding steels in various positions.

Apparatus Required

Arc welding machine (AC/DC)
Mild Steel (MS) plates
Earth clamp
Chipping hammer
Steel rule
Bench vice
Leather gloves
Safety shoes
Welding electrodes (E6013 or equivalent)
Electrode holder
Welding table
Wire brush
Try square
Welding helmet
Safety apron

Types of Joints

1. Lap Joint

A lap joint is formed by overlapping two metal plates and welding along the overlapping edges. It is commonly used for joining thin plates.

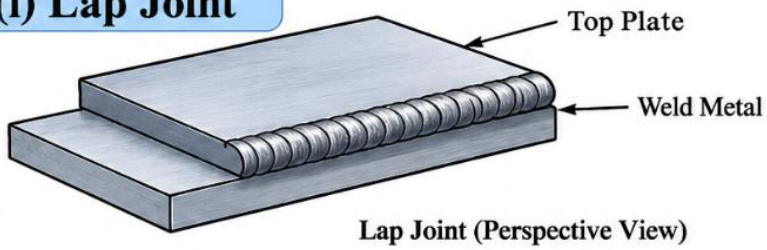
2. Butt Joint

A butt joint is formed by placing two plates in the same plane with their edges touching each other and welding along the joint line.

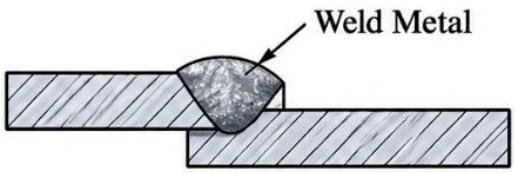
3. T-Joint

A T-joint is formed when one plate is placed perpendicular to another, forming the shape of the letter "T." Fillet welds are generally used in this joint.

(i) Lap Joint

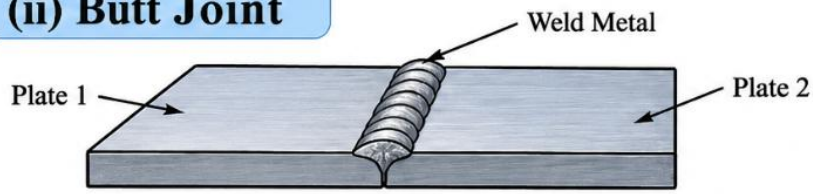


Lap Joint (Perspective View)

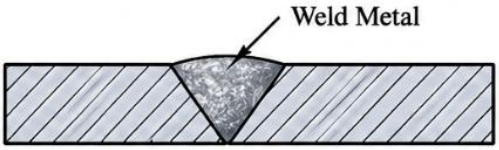


Cross-section View

(ii) Butt Joint

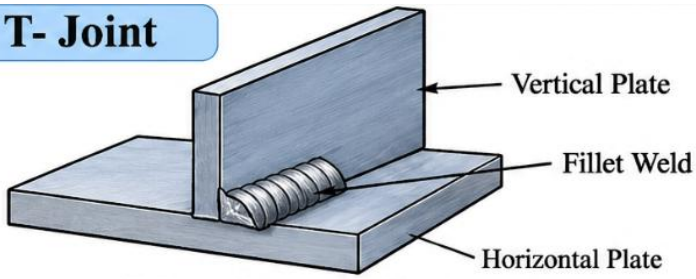


Butt Joint (Top View)

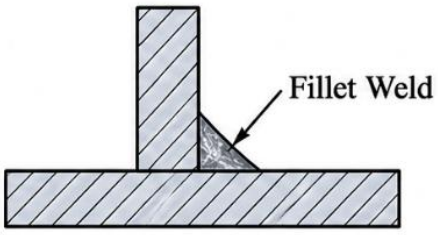


Cross-section View

(iii) T- Joint



T-Joint (Perspective View)



Cross-section View

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Procedure

A. Preparation

Clean the surfaces of the MS plates to remove rust, oil, and dirt.
Select the appropriate electrode and welding current.

Connect the workpiece to the earth clamp.

Wear all required personal protective equipment (PPE).

B. Lap Joint Welding

Overlap the two MS plates by the required distance.
Clamp the plates securely.

Strike the arc and maintain the correct arc length.

Deposit the weld bead uniformly along the overlap.

Allow the weld to cool.

Remove slag using a chipping hammer and wire brush.

Inspect the weld visually.

C. Butt Joint Welding

Align the edges of the two plates in the same plane.
Tack weld at both ends to maintain alignment.

Weld along the joint with a uniform travel speed.

Allow the weld to cool.

Remove slag and clean the weld.

Inspect for uniformity and defects.

D. T-Joint Welding

Position one plate at right angles to the other.
Tack weld the plates.

Deposit fillet welds on one or both sides of the joint.

Allow cooling.

Remove slag.

Clean and inspect the weld.

Welding Parameters (Typical)

Parameter	Value
Electrode Type	E6013
Electrode Diameter	2.5–3.15 mm
Welding Current	70–120 A
Arc Length	2–4 mm
Base Material	Mild Steel

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Result

The Lap Joint, Butt Joint, and T-Joint were successfully prepared using the Shielded Metal Arc Welding (SMAW) process. The welds were inspected visually and found to be satisfactory.

Precautions

Wear a welding helmet with the proper shade.
Use leather gloves, apron, and safety shoes.
Ensure proper earthing of the welding machine.
Maintain the correct arc length throughout welding.
Select the proper welding current according to the electrode size.
Keep the electrode dry before use.
Remove slag after each weld pass.
Avoid looking directly at the welding arc without eye protection.
Keep combustible materials away from the welding area.
Switch off the welding machine after completing the work.

Safety Measures

Wear appropriate PPE at all times.
Ensure proper ventilation in the welding area.
Never touch live electrical parts.
Use insulated electrode holders and cables.
Keep the work area dry and free from flammable materials.
Handle hot workpieces with tongs or pliers.
Follow all laboratory safety instructions.

Conclusion

The experiment demonstrated the preparation of Lap Joint, Butt Joint, and T-Joint using the Shielded Metal Arc Welding (SMAW) process. Proper welding parameters, electrode handling, and safety precautions resulted in sound welds with good appearance and strength.

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Aim: To perform the following machining operations on a Centre Lathe using a Mild Steel (MS) work piece:

Facing, Step Turning & Chamfering
Step Turning & Taper Turning
Step Turning & Groove Cutting
Step Turning & Knurling
Step Turning & Thread Cutting
Turning and Drilling

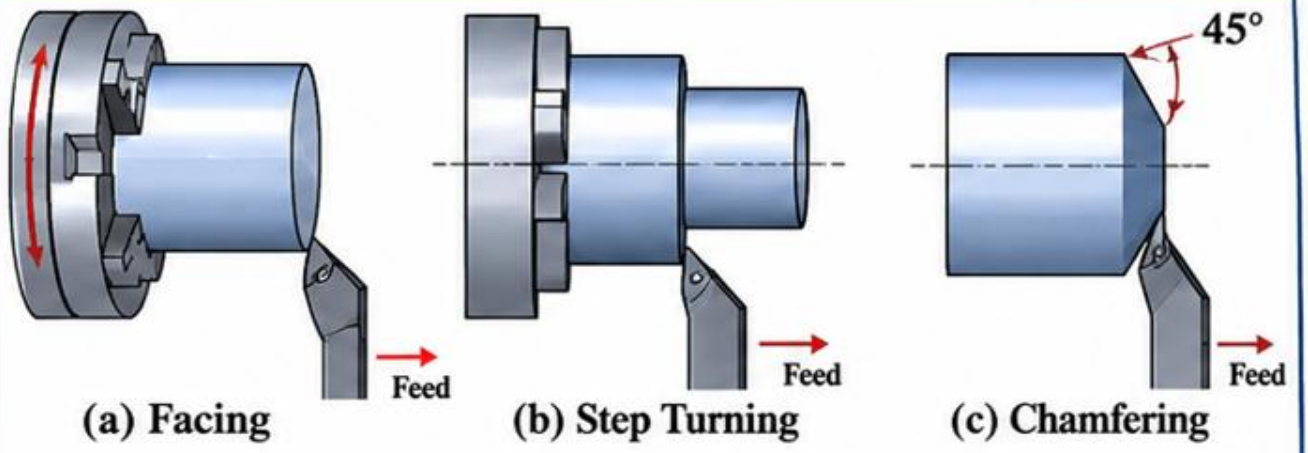
Apparatus Required

Centre Lathe Machine
Mild Steel (MS) Round Bar
Three-jaw Chuck
Single Point Turning Tool
Facing Tool
Parting/Grooving Tool
Knurling Tool
Thread Cutting Tool
Centre Drill
Twist Drill
Tailstock Drill Chuck
Vernier Caliper
Steel Rule
Outside Micrometer
Cutting Fluid
Safety Goggles and PPE

Theory

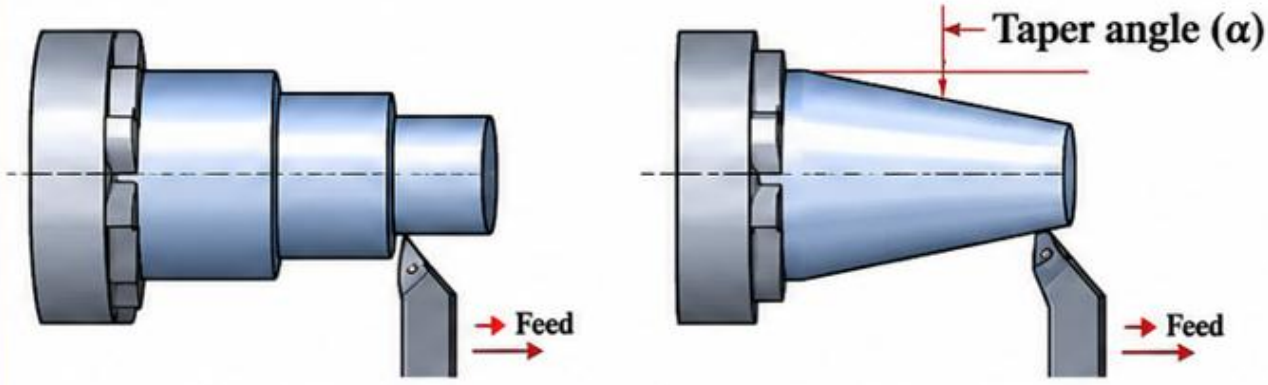
A lathe is a machine tool used for removing material from a rotating workpiece by means of a cutting tool. Different operations such as facing, turning, taper turning, grooving, knurling, thread cutting, and drilling are carried out to produce components of the required dimensions and surface finish.

1. Facing, Step Turning & Chamfering



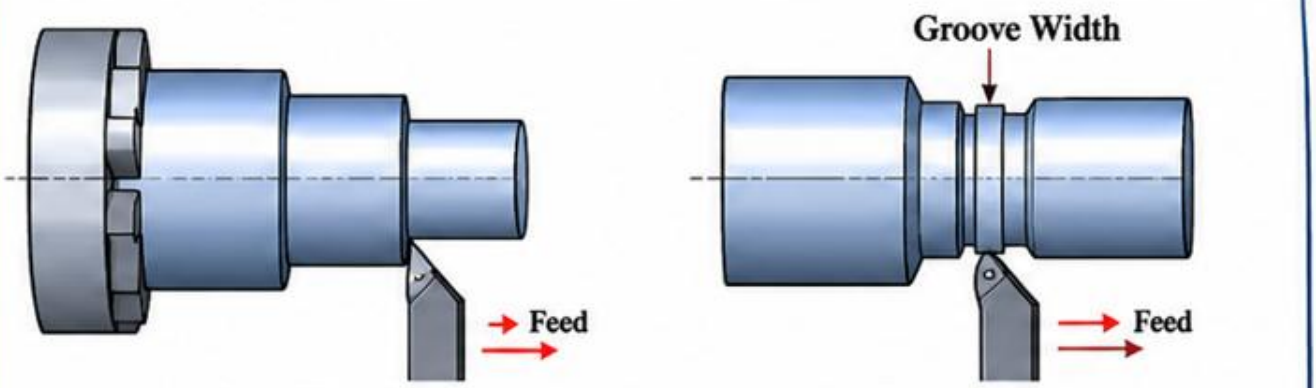
(a) Facing (b) Step Turning (c) Chamfering

2. Step Turning & Taper Turning



(a) Step Turning (b) Taper Turning

3. Step Turning & Groove Cutting



(a) Step Turning (b) Groove Cutting

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(i) Facing, Step Turning & Chamfering Aim

To perform facing, step turning, and chamfering on an MS rod.

Procedure

Mount the work piece securely in the chuck.
Perform facing to obtain a flat end surface.
Mark the required step dimensions.
Carry out step turning to the specified diameters.
Produce chamfers at the edges using a chamfering tool.
Measure all dimensions using a Vernier Caliper.

Result

Facing, step turning, and chamfering were completed successfully according to the specified dimensions.

ii) Step Turning & Taper Turning Aim

To prepare a stepped shaft with a taper.

Procedure

Face the work piece.
Perform step turning as per the drawing.
Set the compound rest to the required taper angle (or offset the tailstock if required).
Machine the taper uniformly.
Measure the diameters and taper length.

Result

The stepped shaft with the required taper was successfully produced.

(iii) Step Turning & Groove Cutting

Aim

To machine steps and cut grooves on the work piece.

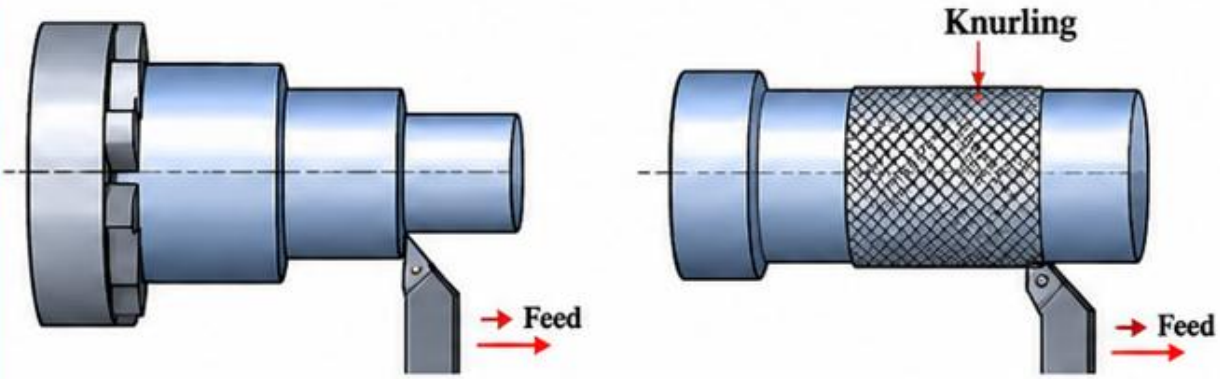
Procedure

Perform facing.
Produce the required steps.
Mark the groove locations.
Use the grooving tool to cut grooves to the required width and depth.
Inspect the finished workpiece.

Result

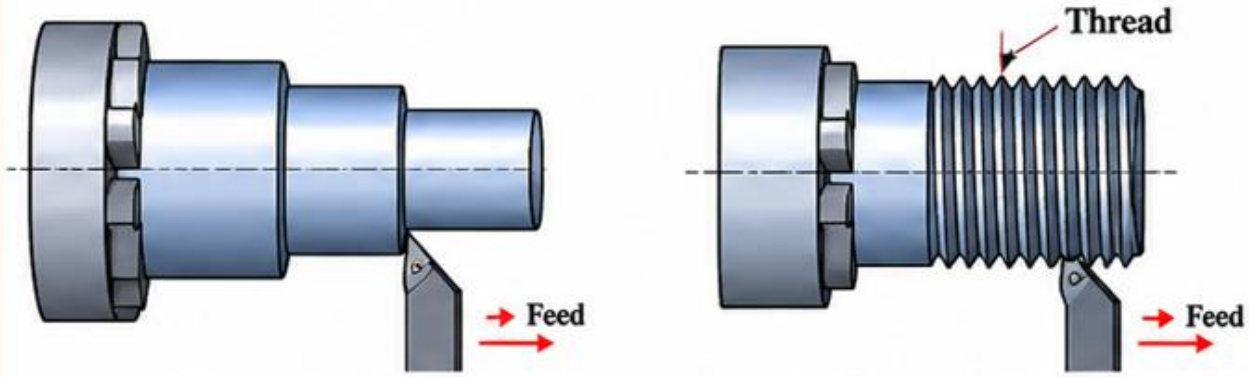
Step turning and groove cutting were completed successfully.

4. Step Turning & Knurling



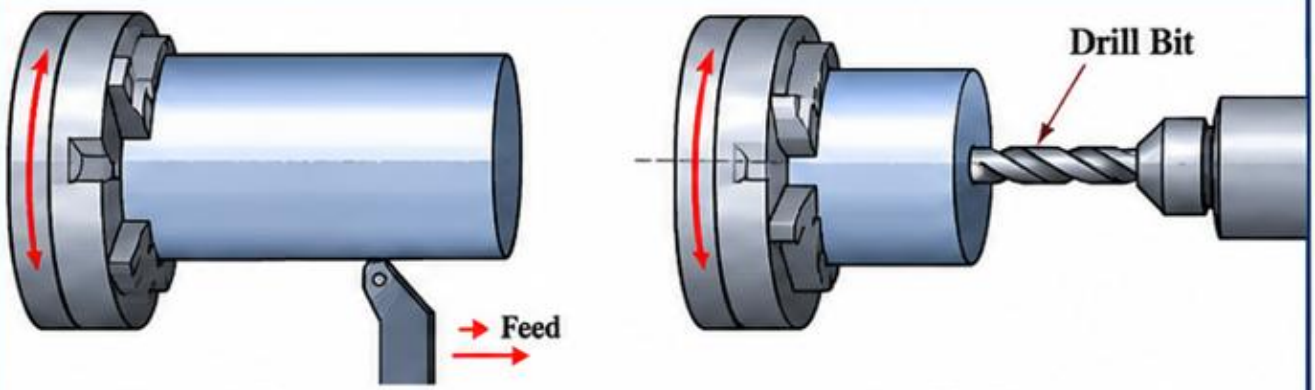
(a) Step Turning (b) Knurling

5. Step Turning & Thread Cutting



(a) Step Turning (b) Thread Cutting

6. Turning and Drilling



(a) Turning (b) Drilling

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(iv) Step Turning & Knurling

Aim

To perform step turning followed by knurling.

Procedure

Prepare the stepped shaft.

Mount the knurling tool.

Apply cutting fluid.

Press the knurling tool firmly against the rotating work piece.

Feed the tool uniformly until the required knurl pattern is obtained.

Result

A uniform knurled surface was successfully produced on the stepped shaft.

(v) Step Turning & Thread Cutting

Aim

To perform external thread cutting after step turning.

Procedure

Perform step turning to the required diameter.

Set the change gears for the desired thread pitch.

Grind and set the threading tool correctly.

Engage the half-nut and cut threads in successive passes.

Check the thread using a thread gauge or mating nut.

Result

External threads of the required pitch and dimensions were successfully produced.

(vi) Turning and Drilling Aim

To perform turning followed by drilling on the work piece.

Procedure

Face the work piece.

Turn the work piece to the required diameter.

Centre drill the work piece.

Mount the twist drill in the tailstock.

Drill the hole to the required depth using cutting fluid.

Measure the hole diameter and depth.

Result

Turning and drilling operations were completed successfully.

Conclusion

The various lathe operations—facing, step turning, chamfering, taper turning, groove cutting, knurling, thread cutting, and drilling—were successfully performed on a mild steel work piece using a centre lathe. The machined dimensions were checked and found to be within acceptable limits, demonstrating the proper use of the lathe and its accessories.

Student's Signature **Lecturer's Signature**

Aim: To grind a single-point lathe cutting tool to the required tool angles using a bench grinder and inspect the tool geometry.

Apparatus Required

- Bench Grinder
- High Speed Steel (HSS) Tool Blank
- Tool Angle Gauge (Centre Gauge/Tool Gauge)
- Steel Rule
- Vernier Caliper (if required)
- Coolant/Water Container
- Bench Vice (if required)
- Safety Goggles
- Face Shield
- Gloves and Apron

Theory

A single-point cutting tool is used on a lathe for machining operations such as turning, facing, grooving, and thread cutting. The performance of the tool depends on its geometry, including rake angles, clearance angles, and cutting edge angles. Proper grinding ensures efficient cutting, better surface finish, reduced cutting forces, and longer tool life. The tool is generally made of High Speed Steel (HSS) and is ground on a bench grinder to obtain the required shape and angles.

Tool Angles (Typical Values)

Tool Angle	**Typical Range**
Back Rake Angle	8°–12°
Side Rake Angle	8°–15°
End Relief (Clearance) Angle	6°–8°
Side Relief (Clearance) Angle	6°–8°
End Cutting Edge Angle	10°–15°
Side Cutting Edge Angle	10°–15°
Nose Radius	0.4–1.2 mm

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Date:
Sheet No.

Expt. No.:04

Procedure

1. Wear safety goggles, face shield, and other personal protective equipment (PPE).
2. Inspect the bench grinder and ensure the grinding wheel is in good condition.
3. Hold the HSS tool blank firmly with both hands.
4. Grind the side relief angle by maintaining the required inclination against the grinding wheel.
5. Grind the end relief angle.
6. Grind the side rake angle.
7. Grind the back rake angle.
8. Form the side and end cutting edges.
9. Round the nose to obtain the required nose radius.
10. Frequently dip the tool in water to avoid overheating and loss of hardness.
11. Check the tool angles using a tool angle gauge.
12. Remove burrs and inspect the finished cutting tool.

Observation Table

Tool Feature	Specified Angle	Obtained Angle	Remarks
Back Rake			
Side Rake			
End Relief			
Side Relief			
End Cutting Edge			
Side Cutting Edge			
Nose Radius			

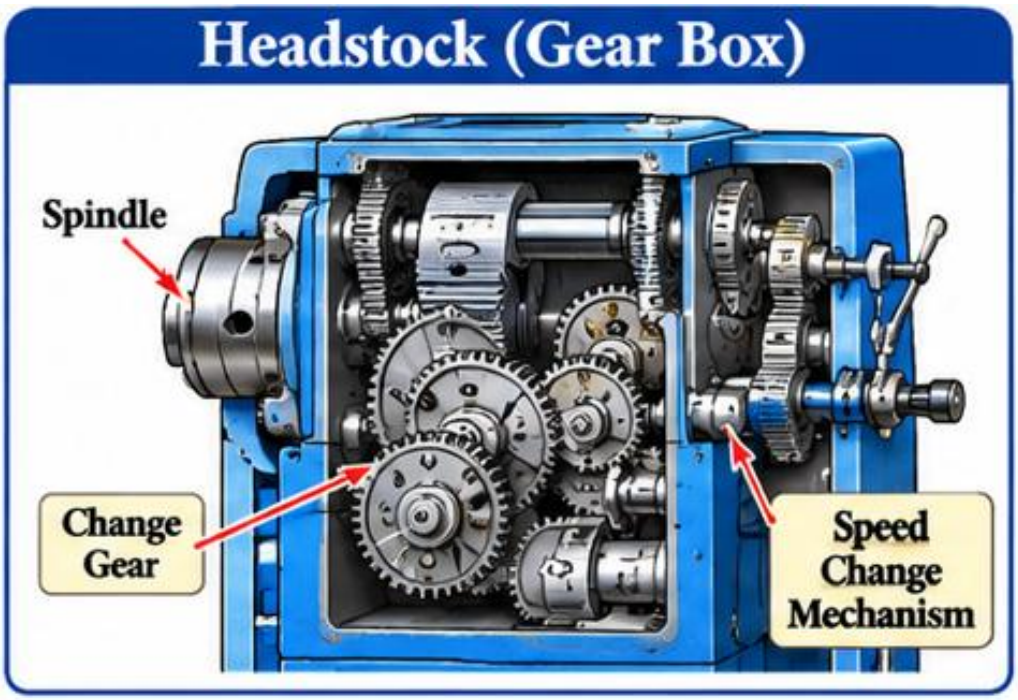
Result

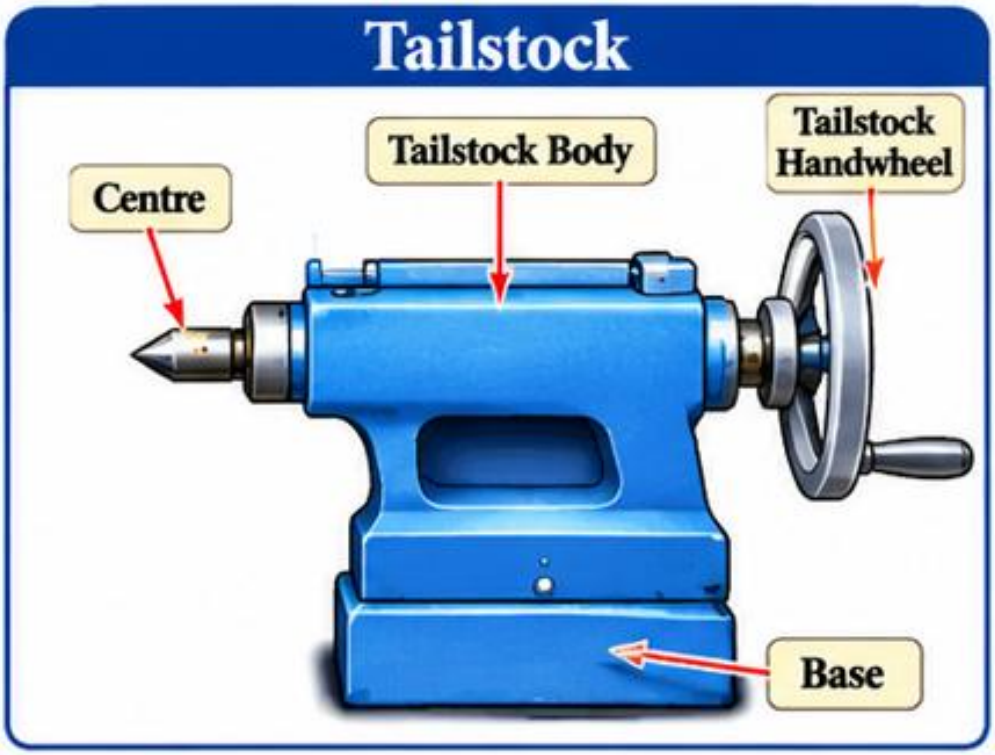
The single-point HSS lathe cutting tool was successfully ground to the required geometry. The tool angles were checked using a tool angle gauge and found to be satisfactory for machining operations.

Conclusion

The experiment demonstrated the correct method of grinding a single-point HSS lathe cutting tool using a bench grinder. The required rake, relief, and cutting edge angles were obtained, making the tool suitable for efficient machining operations while ensuring good surface finish and longer tool life.

Student's Signature **Lecturer's Signature**





Student's Signature

Lecturer's Signature

Aim:

To study the construction of a centre lathe by dismantling selected components, inspecting them, and reassembling them correctly.

Apparatus Required

- Centre Lathe
- Set of Spanners
- Allen Keys
- Screwdrivers
- Adjustable Wrench
- Soft Mallet
- Cleaning Cloth
- Lubricating Oil/Grease
- Parts Tray
- Personal Protective Equipment (Safety Goggles, Gloves, Safety Shoes)

Theory

A centre lathe is one of the most important machine tools used for machining cylindrical components. It consists of several assemblies such as the chuck, tool post, tailstock, carriage, and compound rest. Dismantling and assembling these components helps in understanding their construction, working mechanism, maintenance requirements, and proper handling. Correct assembly ensures smooth operation, dimensional accuracy, and longer machine life.

Components Studied

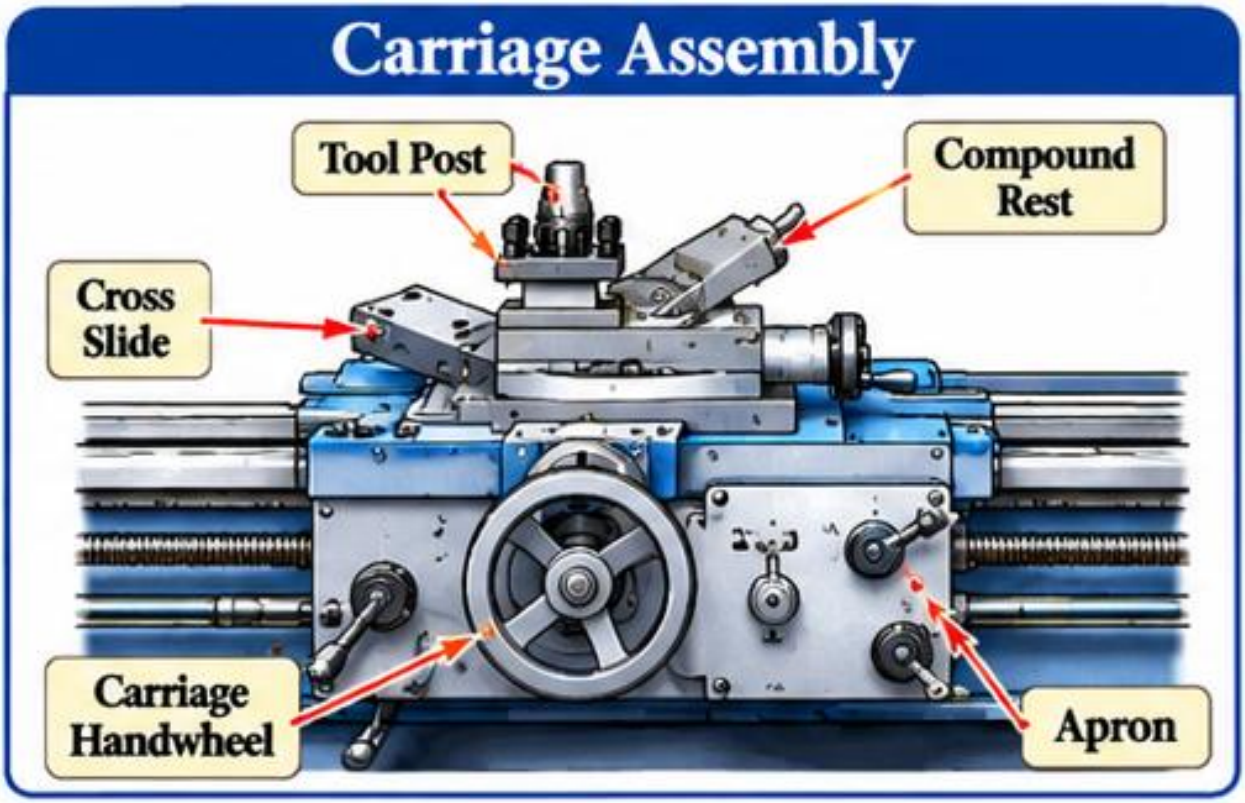
The following components may be dismantled and assembled as instructed by the laboratory supervisor:

1. Three-Jaw Chuck
2. Tool Post
3. Compound Rest
4. Tailstock
5. Carriage Assembly (where permitted)
6. Cross Slide (where permitted)

Procedure

A. Preparation

1. Switch off the lathe and disconnect the power supply.
2. Clean the machine and surrounding work area.
3. Collect the required tools and place a tray for small parts.
4. Wear the required personal protective equipment (PPE).



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B. Dismantling

1. Remove the cutting tool from the tool post.
2. Dismantle the tool post carefully and keep all parts in order.
3. Remove the tailstock from the lathe bed, if instructed.
4. Remove the three-jaw chuck using the correct procedure.
5. Dismantle the compound rest or cross slide as directed.
6. Clean all dismantled parts using a cloth and inspect them for wear, damage, or corrosion.

C. Inspection

1. Check bolts, nuts, and screws for damage.
2. Inspect sliding surfaces for wear.
3. Examine threads, bearings, and keys.
4. Verify proper lubrication of moving parts.
5. Report any defects to the instructor.

D. Assembly

1. Reassemble each component in the reverse order of dismantling.
2. Tighten all fasteners securely without over-tightening.
3. Apply lubricant where necessary.
4. Ensure correct alignment of all components.
5. Check the smooth movement of the assembled parts.
6. Clean the machine after completion.

Result

The selected components of the centre lathe were successfully dismantled, inspected, and reassembled. The assembled components operated smoothly and were found to be correctly fitted.

Conclusion

The experiment successfully demonstrated the dismantling, inspection, and reassembly of selected components of a centre lathe. It provided practical knowledge of machine construction, component identification, maintenance procedures, and correct assembly techniques, which are essential for efficient operation and maintenance of machine tools.

Student's Signature **Lecturer's Signature**

Aim: To study the routine and preventive maintenance procedures of a centre lathe machine to ensure proper functioning, accuracy, safety, and longer service life.

Apparatus Required

- Centre Lathe Machine
- Maintenance Tool Kit
- Lubricating Oil and Grease
- Cleaning Brush
- Cotton Waste/Cleaning Cloth
- Oil Can
- Spanners and Screwdrivers
- Grease Gun
- Personal Protective Equipment (PPE)

Theory

A lathe is a machine tool used for performing operations such as turning, facing, drilling, threading, and knurling. Continuous operation of a lathe causes wear and tear of machine components due to friction, cutting forces, dust, and improper handling.

Maintenance of a lathe is necessary to maintain machining accuracy, prevent unexpected breakdowns, reduce downtime, and increase machine life.

Maintenance is mainly classified into:

1. Routine Maintenance
2. Preventive Maintenance

1. Routine Maintenance of Lathe

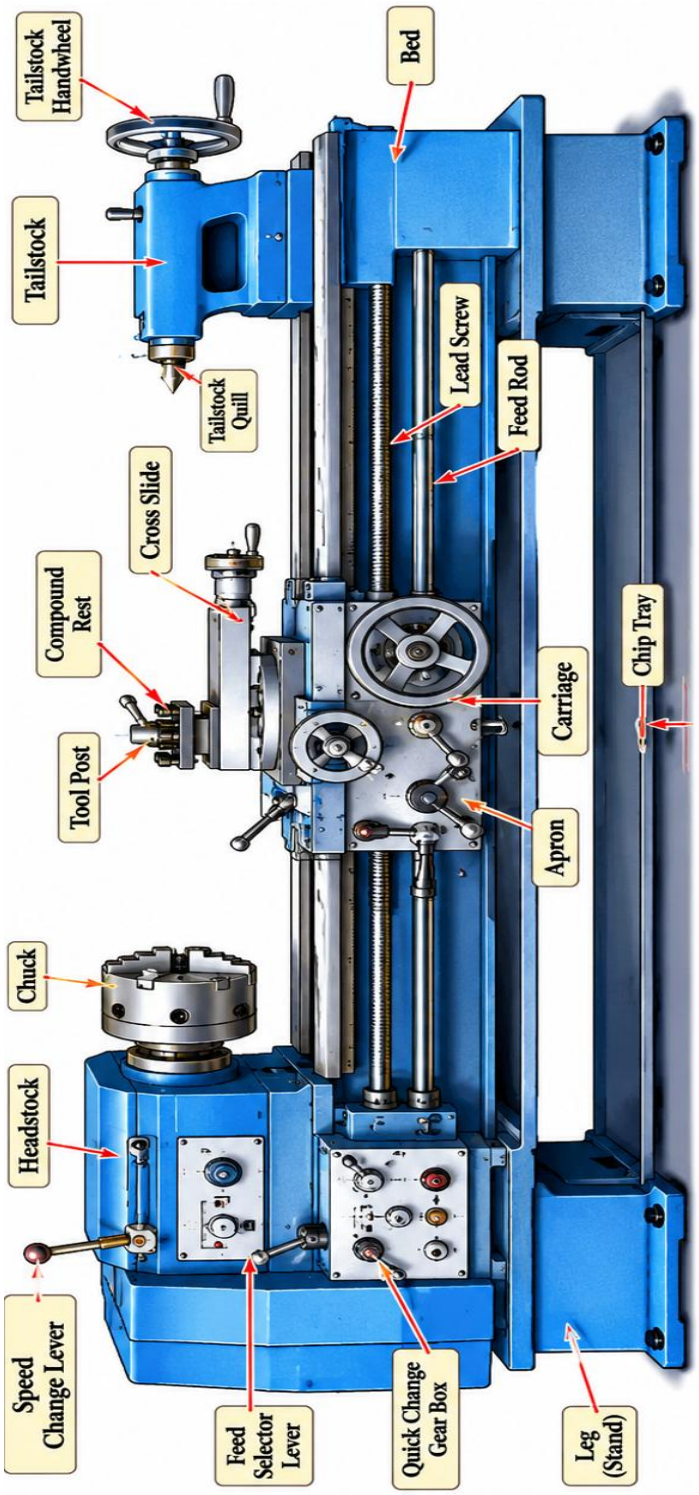
Routine maintenance consists of regular activities performed before, during, and after machine operation.

Daily Maintenance Procedure

1. Clean the machine bed and guideways after use.
2. Remove chips and dirt using a brush.
3. Check lubrication levels of moving parts.
4. Apply oil to guideways, lead screw, and feed mechanisms.
5. Check coolant level and condition.
6. Inspect cutting tools for wear or damage.
7. Ensure proper functioning of chuck, carriage, and tailstock.
8. Clean the work area after completion of work.

2. Preventive Maintenance of Lathe

Preventive maintenance is performed at scheduled intervals to avoid machine failure and maintain performance.



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Weekly Maintenance

1. Check the tightness of bolts, nuts, and fasteners.
2. Inspect belts for wear and proper tension.
3. Check chuck operation and jaw condition.
4. Clean and lubricate slides and screws.
5. Inspect electrical connections.
6. Check the condition of cutting tools and tool holders.

Monthly Maintenance

1. Check alignment of headstock and tailstock.
2. Inspect spindle bearings for abnormal noise or heating.
3. Check backlash in feed screws.
4. Inspect gears and gear train for wear.
5. Check the accuracy of machine movements.
6. Clean and lubricate internal machine parts.

Periodic Maintenance

1. Check the level and condition of lubricating oil.
2. Replace damaged or worn components.
3. Check machine geometry and alignment.
4. Inspect electrical motor and control systems.
5. Calibrate measuring and indicating instruments.
6. Replace belts, bearings, and seals if required.

Maintenance Schedule Table

Frequency	Maintenance Activity
Before Operation	Check lubrication, cleanliness, and safety devices
Daily	Clean machine, remove chips, lubricate moving parts
Weekly	Check belts, fasteners, chuck, and electrical connections
Monthly	Check alignment, bearings, gears, and accuracy
Periodically	Replace worn parts and perform complete inspection

Procedure

1. Observe the different parts of the centre lathe.
2. Identify the components requiring regular maintenance.
3. Check lubrication points and cleaning requirements.
4. Study the maintenance schedule followed for the machine.
5. Perform cleaning and lubrication procedures under supervision.
6. Record the maintenance activities and observations.

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Result

The routine and preventive maintenance procedures of a centre lathe were studied successfully. The importance of regular cleaning, lubrication, inspection, and timely replacement of worn parts was understood.

Conclusion

The routine and preventive maintenance procedures of a centre lathe were studied. Proper cleaning, lubrication, inspection, and timely servicing help maintain machine accuracy, improve efficiency, reduce breakdowns, and increase the service life of the lathe.