



CODE-436

Trade - Fitter

Unit VII: Basic Maintenance, Erection and Testing of Machineries

CLASS-1



1. Total Productive Maintenance (TPM):

- **Definition:** TPM is a holistic approach to equipment maintenance that aims to maximize productivity by ensuring machines are always in the best possible condition.
- **Goal:** Zero breakdowns, zero defects, and zero accidents.

Key Features:

- **Involves all employees, from operators to managers.**
- **Focuses on preventive and proactive maintenance.**
- **Encourages autonomous maintenance – operators take basic care of their own machines.**

2. Routine Maintenance:

- **Definition:** Maintenance activities that are performed regularly (daily, weekly, monthly) to keep machines running smoothly.

Examples:

- **Cleaning machines**
- **Lubricating moving parts**
- **Checking fluid levels**

Purpose: To reduce wear and tear and prevent bigger issues.

3. Breakdown Maintenance (Corrective Maintenance):

Definition: Maintenance that is performed after a machine breaks down or fails.

Action: Repair or replace the faulty part to restore the equipment.

Disadvantages:

Causes production downtime

May lead to higher repair costs

Used When: The equipment is not critical or when failure is unexpected.

4. Preventive Maintenance:

- **Definition:** Maintenance done before a failure occurs, based on a schedule or usage hours.
- **Goal:** To prevent breakdowns and extend machine life.

Examples:

- **Replacing belts or filters at set intervals**
- **Inspecting parts before they fail**

Benefits:

- **Reduces downtime**
- **Improves safety and efficiency**

Comparison Summary:

Type	Timing	Purpose	Who Involves
TPM	Ongoing	Maximize productivity & efficiency	All employees
Routine Maintenance	Regular (daily/weekly)	Avoid small wear issues	Maintenance staff/operators
Breakdown Maintenance	After failure	Repair damaged parts	Maintenance technicians
Preventive Maintenance	Before failure	Prevent breakdowns	Maintenance staff

1. Installation of Machinery

Installation of machinery is the process of setting up new machines at their designated locations in an industry or workshop, ensuring correct alignment, stability, and operational readiness.

Key Steps in Machine Installation:

- Site selection and preparation**
- Foundation construction**
- Laying of base plates or foundation bolts**
- Positioning the machine**
- Leveling and aligning**
- Connecting power supply, lubrication, and other utilities**
- Trial run and final inspection**

2. Foundation Bolts and Their Types

Foundation bolts are used to anchor machinery to concrete foundations. They help in absorbing vibrations and keeping the machine stable.

◆ **Common Types of Foundation Bolts:**

Type	Description
L-type bolt	Bent like "L", embedded in concrete for strong grip
J-type bolt	Bent like "J", similar to L-type, used in heavier foundations
Sleeve bolt	Comes with a sleeve to allow adjustments and repositioning
Rag bolt	Square or twisted shank for better grip in concrete
Anchor bolt	Straight bolt with threading on both ends, used with nuts and washers
Expansion bolt	Expands in the hole, used in retrofitting situations

3. Sling Load for Shifting

Sling loading refers to lifting and shifting of heavy machinery using slings (chains, ropes, or belts) and cranes.

◆ Types of Slings:

- Wire rope slings – High strength, used for heavy machinery**
- Chain slings – Durable, used for high-temperature environments**
- Nylon/web slings – Lightweight, used for delicate equipment**

◆ Safety Guidelines:

- Use proper load rating slings**
- Check for wear, cuts, or damages**
- Use lifting hooks, shackles, and spreader bars as needed**
- Use taglines to control swing**

Erection refers to assembling and setting up a machine or structure at its operational location.

♦ Common Erection Tools:

- **Hydraulic jacks – For lifting and adjusting position**
- **Spirit level / Plumb bob – For leveling and vertical alignment**
- **Wrenches, spanners, hammers – For fastening and adjustments**
- **Torque wrench – For applying specific torque to bolts**
- **Chain pulley block / Hoist – For lifting and holding loads**
- **Crowbars, rollers, skids – For shifting on ground**

♦ Techniques:

- **Center of gravity calculation before lifting**
- **Use of guiding ropes to control movement**
- **Step-by-step bolting to avoid stress**
- **Use of temporary supports until final alignment**
- **Trial run after installation**

Summary Table:

Section	Key Points
Installation	Site prep, foundation, positioning, alignment, testing
Foundation Bolts	L-type, J-type, anchor, expansion types
Sling Load	Wire/chain/nylon slings, safety checks, correct angles
Erection Tools	Jacks, pulleys, torque wrench, leveling tools

1. Forklift and Pallet Truck

◆ Forklift:

A forklift is a powered industrial vehicle used to lift and move heavy materials over short distances, commonly used in warehouses, factories, and construction sites.

✓ Key Parts:

- **Mast – Vertical support that raises/lowers the load**
- **Forks (Blades) – Two prongs that slide under the load**
- **Counterweight – Balances the load at the back**
- **Hydraulic system – Used for lifting and tilting**
- **Controls – Levers for movement and lifting**

✓ Applications:

- **Loading/unloading trucks**
- **Stacking pallets**
- **Moving materials inside warehouses**

✓ **Safety Tips:**

- **Never overload beyond capacity**
- **Drive at safe speed**
- **Avoid sharp turns with load raised**
- **Use horn at intersections**
- **Only trained operators should use**

Pallet Truck (Pallet Jack):

A pallet truck is a manually or electrically operated trolley used to move palletized goods on a flat surface.

✓ **Types:**

- **Manual pallet truck – Operated by hand-pumping to raise the forks**
- **Electric pallet truck – Battery-powered, easier to move heavy loads**

Common Uses:

- Moving goods within warehouses
- Short-distance transport of materials
- Placing goods on storage racks

Difference from Forklift:



Feature	Forklift	Pallet Truck
Power source	Engine/Battery	Manual or Battery
Lifting height	High	Very low (just enough to lift pallets)
Capacity	Higher	Medium/Low

Lubricant

A lubricant is a substance (usually oil or grease) applied between moving parts to reduce friction, wear, and heat.

◆ Functions of a Lubricant:

- **Reduces friction between surfaces**
- **Prevents wear and tear**
- **Acts as a coolant by absorbing heat**
- **Protects metal surfaces from rust and corrosion**
- **Removes debris and cleans moving parts**

◆ Types of Lubricants:

- **Oil-based lubricants – Engine oil, hydraulic oil**
- **Grease – Thick, semi-solid for heavy-duty parts**
- **Solid lubricants – Graphite, used in extreme conditions**
- **Synthetic lubricants – Man-made, high-performance**

Properties of Good Lubricants:

Property	Description
Viscosity	Thickness or resistance to flow (important for load carrying)
Thermal stability	Ability to withstand high temperatures without breaking down
Oxidation resistance	Prevents oil from reacting with air and forming sludge
Anti-wear property	Protects surfaces from direct contact and damage
Rust and corrosion resistance	Prevents metal parts from corroding
Adhesiveness	Ability to stick to surfaces under pressure
Detergent action	Keeps the parts clean by suspending dirt and debris

Use of Lubricants in Forklifts & Pallet Trucks:

- **Hydraulic oil – for lift mechanism**
- **Grease – for wheel bearings and moving joints**
- **Gear oil – for gearbox in electric pallet trucks**
- **Engine oil – in diesel forklifts**





Types of Lubrication

Lubrication is the process of applying a lubricant between two surfaces to reduce friction, wear, and heat. Based on how the lubricant behaves between moving parts, lubrication is categorized into the following types:

1. Boundary Lubrication

- Occurs when the lubricant film is very thin and cannot completely separate the surfaces.**
- Friction is partially reduced.**
- Used when loads are high and speed is low.**

Example: Engine starting condition, door hinges.

2. Hydrodynamic Lubrication

- **A thick film of lubricant separates the two moving surfaces completely.**
- **Friction is very low, and wear is minimal.**
- **Requires proper speed and surface design.**

Example: Bearings in engines, crankshaft lubrication.

3. Elastohydrodynamic Lubrication

- **Similar to hydrodynamic, but occurs where elastic deformation of surfaces and high pressure exist.**
- **Common in rolling contact areas like gears and roller bearings.**

Example: Gear teeth, roller bearings.

4. Mixed Lubrication

- **A combination of boundary and hydrodynamic lubrication.**
- **Some parts of the surface are separated by the lubricant, others are in direct contact.**

Example: Piston rings in engine cylinder

5. Solid Lubrication

- **Uses solid materials (not liquid or grease) to reduce friction.**
- **Used in extreme temperatures or vacuum where liquid lubricants fail.**

Common materials: Graphite, Molybdenum Disulfide (MoS_2)

6. Fluid Film Lubrication

- **A continuous fluid layer supports the load and prevents surface contact.**
- **Similar to hydrodynamic but can include gases.**

Example: Air bearings.

Different Methods of Lubrication

Lubricants can be applied using various methods, depending on the machine design, application, and type of lubricant:

1. Manual Lubrication

- **Lubricant applied by hand using an oil can, brush, or grease gun.**
- **Used for simple machines or during maintenance.**

Example: Lubricating machine beds or door hinges.

2. Gravity Feed Lubrication

- **Lubricant flows by gravity from an overhead reservoir to the moving part.**
- **Flow can be controlled using valves or wicks.**

Example: Older lathe machines, small gearboxes.

3. Wick Feed Lubrication

- **A wick (cotton thread) carries oil from a reservoir to the bearing by capillary action.**
- **Simple and continuous system.**

Example: Watch mechanisms, small motors.

4. Splash Lubrication

- **Parts like gears or crankshafts splash oil from a sump/reservoir onto other components.**
- **Very common in enclosed gearboxes or engines.**

Example: Scooter engines, oil bath gearboxes.

5. Pressure Feed Lubrication

- **Lubricant is forced by a pump to different parts under pressure.**
- **Ensures proper lubrication even at high speeds or loads.**

Example: Automobile engines, hydraulic systems.

6. Mist Lubrication

- **Lubricant is mixed with air and sprayed as a fine mist to moving parts.**
- **Suitable for high-speed tools and spindles.**

Example: Pneumatic tools, CNC spindles.

7. Grease Lubrication

- **Grease is applied to parts manually or using a grease gun.**
- **Stays in place longer and is used where re-lubrication is difficult.**

Example: Bearings, universal joints, chain drives.

Summary Table

Lubrication Type	Key Feature	Example
Boundary	Thin film, partial contact	Hinges, engine start
Hydrodynamic	Full fluid film, low friction	Engine bearings
Solid	Dry lubrication using solids	Gears in space
Manual Method	Hand-applied lubricant	Oil can use
Splash	Oil splashed by moving parts	Gearbox
Pressure Feed	Lubricant pumped under pressure	Engine lubrication
Mist	Air + oil sprayed	Pneumatic drill

1. In TPM, who is primarily responsible for basic machine care like cleaning and lubrication?

- A) Engineers**
- B) Supervisors**
- C) Machine Operators**
- D) Quality Inspectors**



2. Which type of maintenance is done on a fixed schedule to prevent equipment failure?

- A) Breakdown maintenance**
- B) Routine maintenance**
- C) Preventive maintenance**
- D) Emergency maintenance**



3. Which of the following is NOT a pillar of TPM?

- A) Focused improvement**
- B) Autonomous maintenance**
- C) Corrective maintenance**
- D) Training and education**



4. What is the key disadvantage of breakdown maintenance?

- A) High production output**
- B) Involves all employees**
- C) Leads to unexpected downtime**
- D) Increases preventive actions**



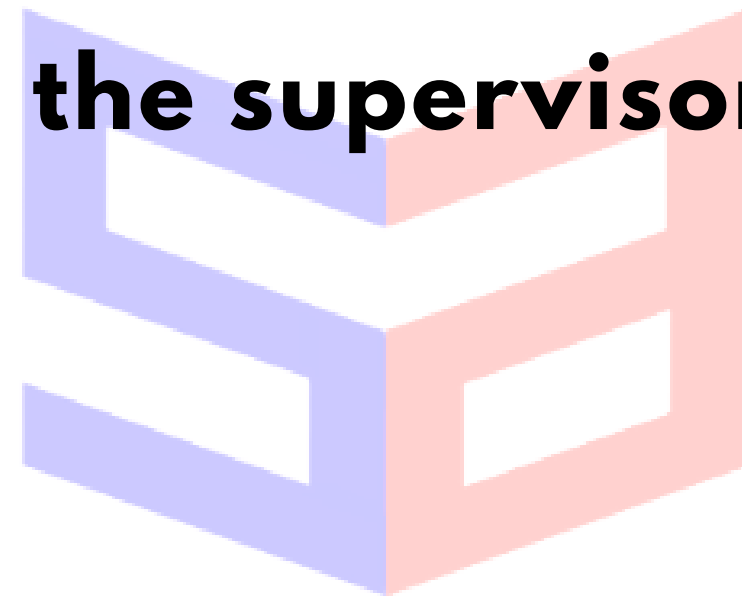
5. Routine maintenance is usually performed:

A) After the machine breaks

B) Once in a year

C) On a regular schedule (daily/weekly)

D) Only when the supervisor instructs



6. What is the first step before machine installation?

A) Painting the machine

B) Trial run

C) Site selection and preparation

D) Bolt tightening



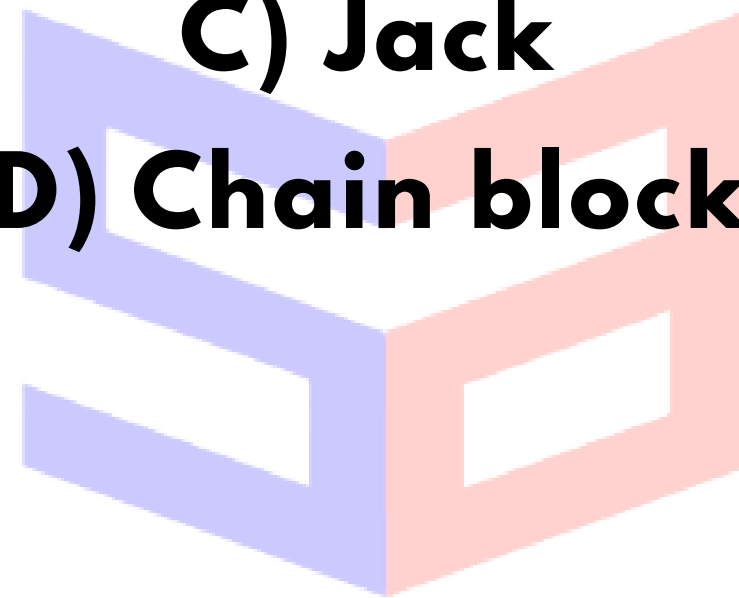
7.What is used to align a machine horizontally during installation?

A) Spirit level

B) Hammer

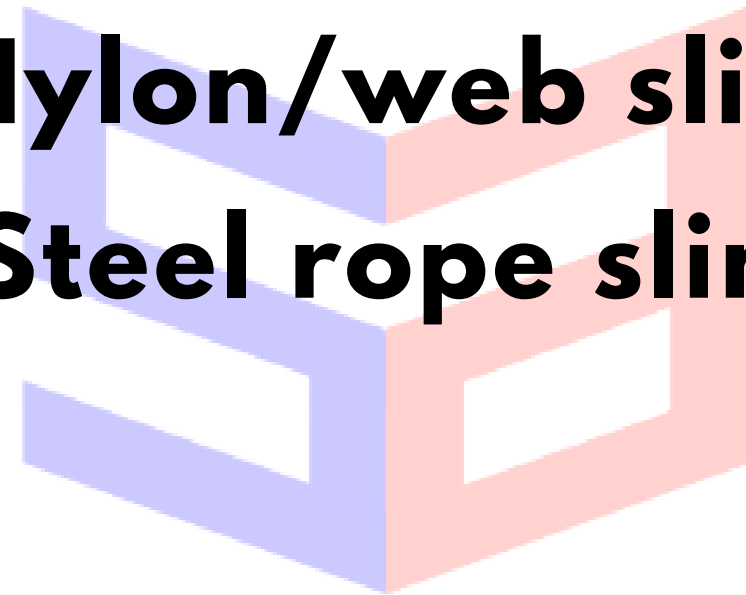
C) Jack

D) Chain block



8. Which sling is best suited for lifting delicate machinery?

- A) Wire rope sling**
- B) Chain sling**
- C) Nylon/web sling**
- D) Steel rope sling**



9. Expansion bolts are mainly used when:

- A) Concrete is still wet**
- B) Precise anchoring is not required**
- C) Retrofitting in existing concrete**
- D) Machines are placed on wooden floors**



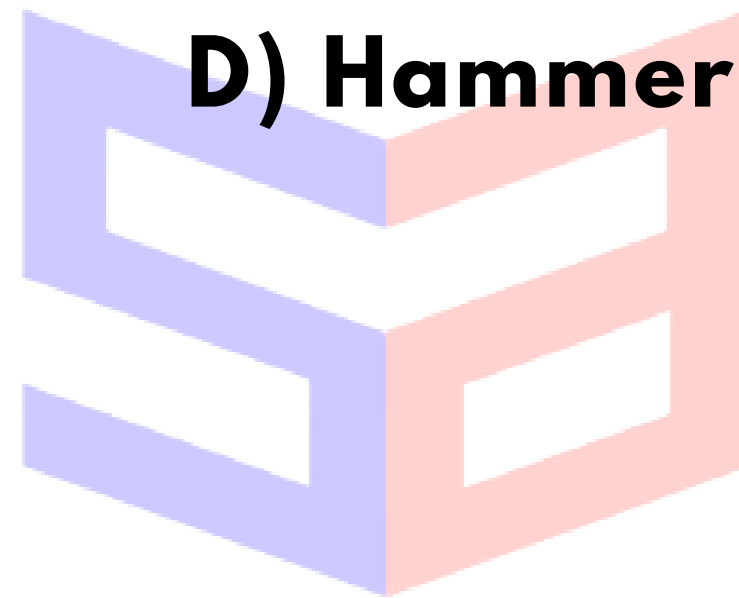
10.The tool used to apply a specific amount of tightening force to bolts is:

A) Wrench

B) Screwdriver

C) Torque wrench

D) Hammer



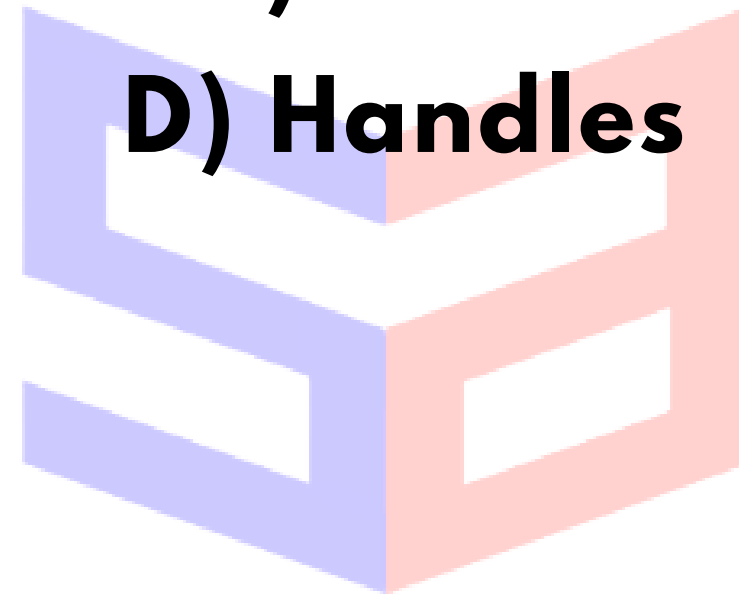
11.The two horizontal arms of a forklift used to lift pallets are called:

A) Clamps

B) Beams

C) Forks

D) Handles



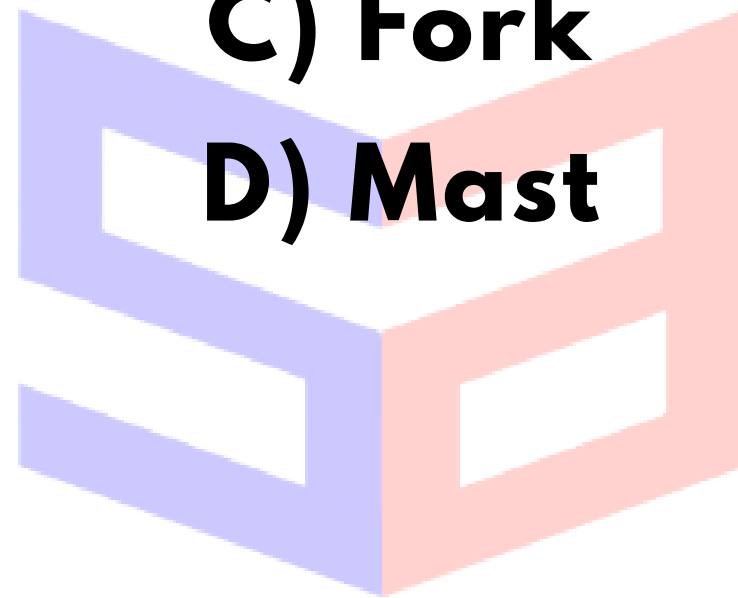
12. Which part of the forklift provides balance for heavy lifting?

A) Tyre

B) Counterweight

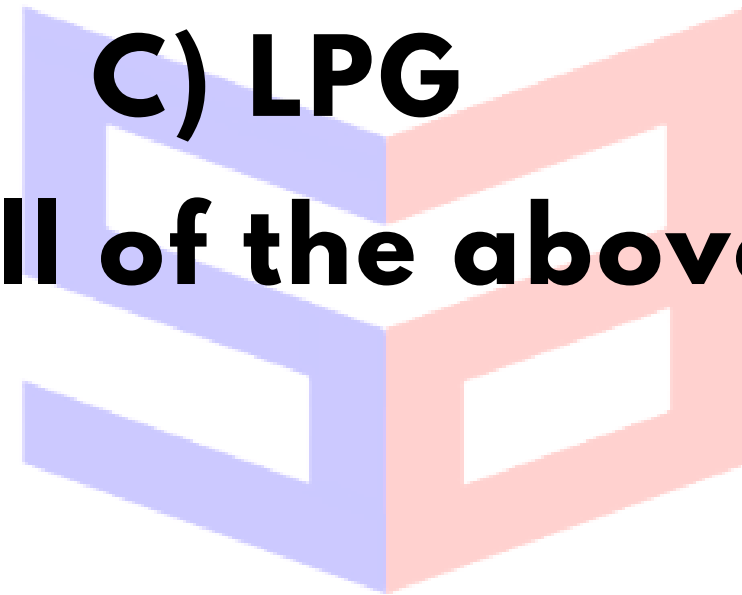
C) Fork

D) Mast



13. What type of power source can a forklift have?

- A) Diesel**
- B) Electricity**
- C) LPG**
- D) All of the above**



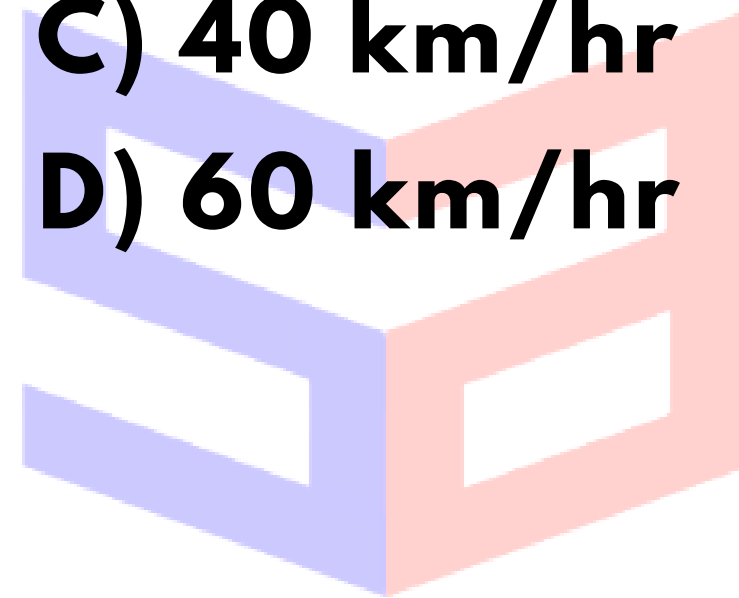
14. What is the maximum recommended speed of a forklift inside a warehouse?

A) 25 km/hr

B) 10 km/hr

C) 40 km/hr

D) 60 km/hr



15. A pallet truck is commonly used to:

A) Move pallets over short distances

B) Weld metal sheets

C) Paint forklifts

D) Repair engines



16. Solid lubricants are generally used when:

A) High-speed movement is required

B) Temperature is very high

C) Water is available

D) Low cost is a priority



17. Graphite and molybdenum disulfide are examples of:

- A) Liquid lubricants**
- B) Gas lubricants**
- C) Solid lubricants**
- D) Synthetic lubricants**



18. In which lubrication is the friction only partially reduced?

- A) Hydrodynamic**
- B) Boundary**
- C) Mixed**
- D) Elastohydrodynamic**



19. In which lubrication is the friction only partially reduced?

- A) Hydrodynamic**
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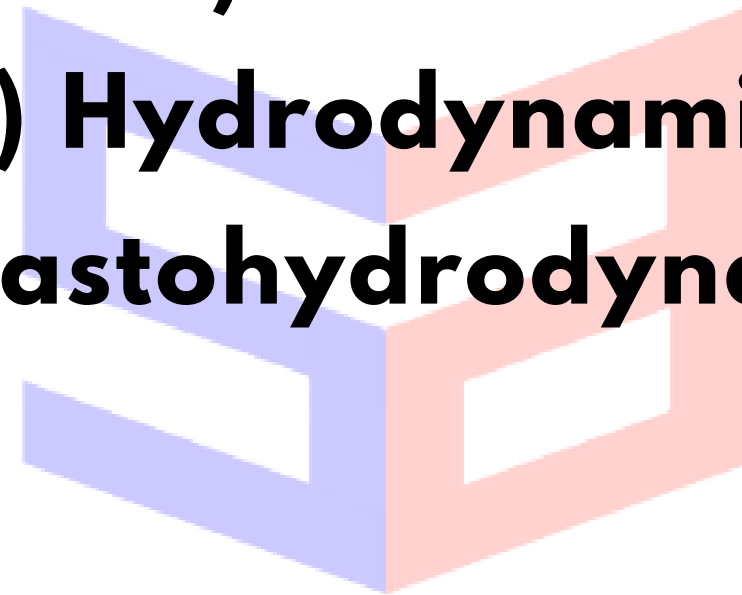
20. Which type of lubrication is most common in gears and roller bearings?

A) Solid

B) Mixed

C) Hydrodynamic

D) Elastohydrodynamic



Thank
*You*

