

The Mechanical Series consists of 14 core subject areas required to succeed in industry operations and maintenance from a technical perspective.

Industrial Hydraulic Fundamentals

Hydraulic Theory

- Development and Applications of Modern Hydraulics
- Pressure and Force
- Pascal's Law
- The Role of Pressure and Force in Hydraulic Systems
- Volume and Velocity of Flow

Hydraulic Components I

- Hydraulic Filters
- Hydraulic System Piping
- Hydraulic Seals
- Hydraulic System Pumps

Hydraulic Components II

- Reservoirs
- Accumulators
- Control Valves
- Relief Valves
- Cylinders and Actuators

Hydraulic Systems

- Basic Hydraulic Systems
- Hydraulic Fluid Properties
- Types of Hydraulic Fluids
- Hydraulic Schematic Symbols
- Hydraulic Circuit Operation

Industrial Pneumatic Fundamentals

Pneumatic Theory I

- Advantages of Fluid Power

- Differences between Liquids and Gases
- Formulas for Force and Pressure
- Changes in a Pneumatic System
- Fluid Flow in a Pneumatic System

Pneumatic Theory II

- Physical Factors that Act Upon a Fluid
- Advantages of Pneumatic Systems
- Common Pneumatic Applications
- Pneumatic Symbols on a Schematic

Pneumatic Components I

- Purification Equipment
- Pneumatic System Filters
- Moisture-Removing Equipment
- Compressed Air System Lubricating Devices
- Pneumatic Cylinders

Pneumatic Components II

- Pneumatic Control Valves
- Elements of Pneumatic Control Valves
- Air Receivers
- Pneumatic Motors
- Classifications of Pneumatic Tools

Pneumatic Systems

- Simple Pneumatic Systems
- Simple Pneumatic Circuits
- Complex Pneumatic Circuits

Precision Measurement Instruments

Precision Measuring Instruments

- Precision Measuring Tools
- Direct vs. Indirect Measurements

- Accuracy, Precision, and Error
- Precision Tools

Micrometers

- Parts of a Micrometer
- Reading a Micrometer
- Types a Micrometers
- Micrometer Maintenance

Vernier Calipers

- Parts of a Vernier Caliper
- Reading a Vernier Caliper
- Taking Measurements
- Vernier Caliper Maintenance

Dial Indicators

- Purpose of Dial Indicators
- Types of Dial Indicators
- Taking Measurements with Dial Indicators
- Dial Indicator Maintenance

Fixed Gauges

- Common Types of Fixed Gauges
- Limit Gauges for Length Dimensions
- Cylindrical Limit Gauges
- Fixed Gauges for Multiple Dimensions

Pumps

Pump Design

- Purpose of Pumps
- Pump Classification
- Pump Terminology

Centrifugal Pumps

- Centrifugal Pump Operation
- Major Components

- Common Design Aspects
- Centrifugal Pump Laws

Positive Displacement Pumps

- Positive Displacement Pump Operation
- Reciprocating Pumps
- Rotary Pumps

Special-Purpose Pumps

- Metering Pumps
- Screw Pumps
- Peristaltic Pumps

Pump Maintenance

- Common Pump Failures
- Pump Failure Causes
- Preventive Maintenance
- Predictive Maintenance

Mechanical Seals

- Mechanical Seals
- Mechanical Seal Properties and Component Functionality
- Mechanical Seal Types and Arrangements

Static and Dynamic Sealing

Packing

- Compression Packing
- Packing Construction
- Packing Renewal Techniques

Gaskets

- Gasket Fundamentals
- Gasket Installation and Replacement
- Gasket Cutting

Bolted Joints I

- Proper Fastener Torque
- Stresses on Fasteners
- Types of Bolted Joints
- Joint Integrity
- Effects of Vibration

Bolted Joints II

- Maintaining Tightened Joints
- Bolt Joint Relaxation
- Flange Surface Finish
- Flange Face Designs
- Stud Bolts

Threaded Fasteners

- Terminology for Screw Threads
- Classes of Fit
- Thread Specifications
- Mechanical Properties
- Fastener Materials

Torque and Tension

- Torque and Tension
- Controlling Torque
- Measuring Torque
- Torque Calculations

Valve Fundamentals

Basic Types and Operations I

- Purpose of Valves
- Valve Components
- Valve Mounting Methods

Basic Types and Operations II

- Gate Valves
- Globe Valves
- Needle Valves
- Butterfly Valves

Basic Types and Operations III

- Ball Valves
- Plug Valves
- Check Valves
- Regulating Valves

Relief and Safety Valves I

- Purposes of Relief and Safety Valves
- Safety and Relief Valve Terminology
- Safety vs. Relief Valves

Relief and Safety Valves II

- Direct-Acting Relief Valves
- Pilot-Actuated Relief Valves
- Safety Relief Valves

Actuators

- Purpose of a Valve Actuator
- Types of Actuators
- Pneumatic Actuator Principles of Operation
- Electric Actuator Principles of Operation
- Hydraulic Actuator Principles of Operation

Pipes and Pipefitting

Piping and Tubing

- Piping and Tubing
- Piping Schedule Numbers
- Classification of Tubing
- Major Advantages of Tubing
- Flared and Flareless Tubing Joints

Piping Materials and Manufacturing Methods

- Selecting Piping Materials
- Mechanical and Physical Properties of Metal
- Physical Composition and Heat Treating Practices of Steel
- Pipe Manufacturing Methods

Pipe Insulation

- Insulation and Thermal Conductivity
- Types of Piping Insulation
- Insulation Safety Precautions
- Installation and Removal

Pipe Hangers and Supports

- Pipe Hangers, Supports, and Symbols
- Pipe Clamps
- Pipe Hanger Connecting Units and Supports
- Use of Pipe Anchors

Piping Codes and Standards

- Purpose of Piping Codes and Standards
- Codes, Standards, Practices, and Guidelines
- Regulatory Authorities
- Quality Assurance

Lubrication Concepts

Principles of Lubrication

- Lubrication
- Modes of Lubrication
- Viscosity
- Common Lubrication Methods

Preventing Wear and Erosion

- Effects of Lubrication
- Types of Wear
- Maintaining Proper Lubrication

Bearing System Lubrication

- Common Lubrication Methods
- Drip-Fed Lubrication
- Splash Feed Lubrication
- Force Feed Lubrication
- Grease Lubricant Applications

Lubricant Properties

- Lubricant Types
- Lubricating Oil Properties
- Properties of Grease
- Oil and Grease Selection Criteria
- Lubricant Additive Uses

Machinery Lubrication

- Lubricant Types and Functions
- Selecting the Proper Lubricant
- Improper Lubricant Effects
- Obtaining Proper Oil Samples

Bearing Maintenance

Bearing Fundamentals

- Bearing Functions
- Bearing Categories
- Bearing Lubrication
- Types of Bearing Failure

Rolling Contact Bearings I

- Function and Design
- Common Types of Rolling Contact Bearings

- Bearing Lubrication

Rolling Contact Bearings II

- Rolling Contact Bearing Failures
- Installing Rolling Contact Bearings
- Removing Rolling Contact Bearings

Sliding Surface Bearings I

- Common Sliding Surface Bearings
- Journal Bearings
- Thrust Bearings
- Sliding Surface Bearing Lubrication

Mechanical Transmission Systems

Gear Drives

- Purpose of Gear Drives
- Types of Gears
- Gear Drive Terminology
- Characteristics of Gearboxes and Gearsets
- Lubrication and Gear Erosion

Gearbox Maintenance

- Gearbox Disassembly
- Gearbox Reassembly Precautions
- Gearbox Inspections
- Worn Gear Actuators

Belt Drives I

- Belt Drive Purpose
- Belt Selection
- Advantages and Disadvantages of Belt Drives
- Belt Tensioning

Belt Drives II

- V-Belt Components
- Types of V-Belts
- Poly V-Belts

Belt Drives III

- Variable Speed Belts
- Variable Speed Drives
- Flat Belts

Belt Drives IV

- Positive Belt Drives
- Linked V-Belts
- Flat Belt Fastening Methods

Belt Drive Maintenance

- Checking Belt Alignment
- Taper Lock Bushings
- Belt Life

Chain Drives I

- Purpose of Chain Drives
- Construction of Roller Chains
- Variables of Roller Chains
- Applications of Leaf Chains
- Hardened Sprockets

Chain Drives II

- Installation and Removal of Bushings and Sprockets
- Chain Tension and Alignment
- Conditions for Chain and Sprocket Inspection
- Methods of Lubrication
- Methods for Link Replacement

Rigging

Basic Rigging I

- Introduction to Rigging
- Block and Tackle
- Hoists, Jacks, and Winches
- Slings
- Rigging Safety

Basic Rigging II

- Derricks and Cranes
- Hand Signals
- Load Evaluation
- Rigging Inspections

Advanced Rigging I

- Rigging Hardware
- Bridge Cranes
- Boom Cranes
- Crane Inspections

Advanced Rigging II

- Capacity Charts
- Load Balancing
- Heavy Lifting Procedures

Shaft Alignment

Types and Effects of Shaft Misalignment

- Alignment Fundamentals
- Misalignment Causes
- Misalignment Indicators and Effects

Alignment Tools and Methods

- Alignment Fundamentals
- Pre-Alignment Checks

- Alignment Methods

Soft Foot and Bar Sag

- Soft Foot
- Detecting and Correcting
- Bar Sag

Moving the Machine

- Alignment Methods
- Vertical Moves
- Horizontal Moves

Rim and Face Alignment

- Rim and Face Alignment
- Advantages of Rim and Face Alignment
- How to Measure Angular Misalignment
- How to Measure Parallel Misalignment

Cross and Reverse Dial Alignment

- Cross and Reverse Dial Alignment Methods
- Use Graphs for Dial Alignments
- Calculating Misalignment

Laser Alignment

- Safety Precautions
- Shaft Misalignment
- Advantages of Laser Alignment
- Computer Interfaces with the Alignment Rig

Welding Fundamentals

Introduction to Welding

- Purpose of Welding
- Common Welding Terms
- Types of Welded Joints
- Filler Metal Selection
- Welding Procedure Symbols

General Welding Safety

- Hazards Associated with Welding
- Welding PPE
- Additional Protective Equipment
- Welding Ventilation

Shielded Metal Arc Welding

- Shielded Metal Arc Welding Theory
- Shielded Metal Arc Welding Advantages and Disadvantages
- Shielded Metal Arc Welding Equipment
- Shielded Metal Arc Welding Process

Gas Tungsten Arc Welding

- Gas Tungsten Arc Welding
- Advantages and Disadvantages of Gas Tungsten Arc Welding
- Gas Tungsten Arc Welding Equipment
- Gas Tungsten Arc Welding Process

Gas Metal Arc Welding

- Gas Metal Arc Welding
- Advantages and Disadvantages of Gas Metal Arc Welding
- Gas Metal Arc Welding Equipment
- Gas Metal Arc Welding Process

Oxyacetylene Welding and Cutting

- Oxyacetylene Welding and Cutting
- Advantages and Disadvantages of Oxyacetylene Welding and Cutting
- Oxyacetylene Welding and Cutting Equipment
- Oxyacetylene Welding and Cutting Process

Brazing

- Purpose of Brazing
- Uses and Advantages of Brazing
- Brazing Equipment

Weld Joint Inspections

- Quality Welded Joints
- Types of Weld Failure
- Weld Testing Methods