

HYDRAULIC / PNEUMATIC PRINCIPLES I

Course Introduction:

The goal of this training course is to provide you with a solid understanding of the general concepts associated with Hydraulic and Pneumatic equipment as found in industry today. It offers an introduction to the fundamentals of Hydraulic and Pneumatic principles, including a general understanding of the basic physics involved. The course describes the various types of Hydraulic / Pneumatic equipment as well as the different types of Seals used in such equipment and the materials they can be made of. It also provides a closer look at numerous industries and their specific applications for Hydraulic / Pneumatic equipment and Seals, as well as a thorough guide to troubleshoot both equipment and Seals.

Course Objective:

Upon completion of this course you will demonstrate an understanding of Hydraulic and Pneumatic principles, equipment, Seals and industries. You will be able to identify and describe the basic operation of Hydraulic / Pneumatic systems, the various equipment used in their operation, Hydraulic / Pneumatic terms as well as actuator Sealing Device design / material strengths and weaknesses. You will be able to troubleshoot Hydraulic / Pneumatic equipment and Seals.

Course Curriculum Length: 48 hours

Course Modules & Syllabus

- **Hydraulic / Pneumatic Fundamentals**
 - What is Hydraulic / Pneumatic?
 - Hydraulics
 - Pneumatics
 - Force, Pressure, Work and Power
 - Some Basic Physics
 - Physical Characteristics of Fluids
 - Transmission of Hydraulic / Pneumatic Force & Energy
 - Fluid Flow Characteristics
 - Pressure Drop
 - Mediums used to transmit Hydraulic / Pneumatic Force & Energy
 - Pneumatic Mediums
 - Pneumatic System Maintenance
 - Hydraulic Mediums
 - Important Characteristics of Hydraulic Mediums
 - Types of Hydraulic Mediums
 - Hydraulic System Maintenance
- **Hydraulic / Pneumatic Equipment**
 - Equipment used to create Hydraulic / Pneumatic Energy
 - Hydraulic Reservoirs / Coolers / Strainers & Filters / Pumps

- Hydraulic Reservoirs
 - Coolers
 - Strainers & Filters
 - Hydraulic Pumps
 - Pneumatic "Air Compressors"
- Equipment used to transmit & control Hydraulic / Pneumatic Energy
 - Transmission of Hydraulic / Pneumatic Energy
 - Control of Hydraulic / Pneumatic Energy
 - How Hydraulic/Pneumatic Energy (Flow) converts to Pressure Energy
 - Valves
 - Pressure Control Valves
 - Pressure Relief Valves
 - Pressure Reducing Valve
 - Unloading Valve
 - Counterbalance (Foot) Valve
 - Sequence Valves
 - Directional Control Valves
 - Check Valves
 - Flow Control Valves
 - Accumulators
 - Boosters
- Equipment used to convert Pressure Energy to Kinetic Energy
 - Rotary Actuators
 - Linear Actuators
 - Actuator Components and Construction
 - Barrel / Bore / Tube
 - End Caps / Barrel Flanges / Heads
 - Ports
 - Piston Rod or Ram
 - Bearings / Bushings
 - Sealing Devices
 - Wipers
 - Actuator Operation
 - Cylinders
 - Rams
 - Single Acting Cylinders or Rams
 - Double Acting Cylinders
- Specific Equipment
 - Tie-Rod Cylinders
 - Mill Cylinders & Mobile Equipment Cylinders
 - Disposable or Throw-Away Cylinders
 - Telescoping Cylinders
 - Double ended Cylinders
 - Rodless Cylinders

- Cylinder Manufacturers
 - Ram Actuators / Presses
 - Horizontal Rams
 - Vertical Rams
 - Press Manufacturers
- **Hydraulic / Pneumatic Seals**
 - Introduction to Hydraulic / Pneumatic Seals
 - Definition of "Elastomer Seals"
 - Fundamentals of "Elastomer Sealing"
 - Application Operating Parameters
 - Seal Containment Space
 - Surface Finish
 - Static Sealing
 - Surface Finish
 - Dynamic Sealing
 - The Importance of "Low Pressure" Sealing
 - Dynamic and Static Sealing with 1 Elastomer Sealing Device
 - The Rubber O-ring
 - The Single Lip Seal
 - Seal Shapes and Designs
 - OEM Designs
 - Symmetrical / Non-symmetrical
 - Unidirectional / Bi-directional
 - Squeeze Type / Lip Type Seals
 - Squeeze Type Seals
 - Lip Type Seals
 - Single / Combination / Multiple Lip Type Seals
 - Single Seals
 - Combination Seals
 - Multiple Lip Seals
 - Rod Seals and Piston Seals
 - Rod Mounted Seal Design
 - Piston Mounted Seal Design
 - Compression Type Seals
 - Automatic, Noncompression Type Seals
 - Piston Rings
 - Piston Rings
 - High Velocity Bypass
 - Scoring Damage
 - Cushion Seals
 - Wipers
 - Wipers
 - How a Wiper Functions
 - Foreign Contaminants in an Actuator
 - Scoring of Dynamic Surfaces

- Severity and Occurrence of Scoring Damage
 - Rod / Ram Scoring
 - Wiper Design and Material
 - Bearings and Bearing Bands
 - The Function of a Bearing
 - Tight Sliding Fit
 - Non-concentric, Sloppy Bearing Support
 - Bearing Materials
 - Metallic Bearings
 - Non Metallic Bearing Surfaces
 - Measurements and Tolerances
 - Measuring
 - Tolerances
 - Installation
 - Proper Seal Installation
 - **Hydraulic / Pneumatic Seal Materials**
 - Seal Material Considerations
 - Temperature Range
 - Compression Setting
 - Fluid Compatibility
 - Pressure Range and Extrusion Resistance
 - Pressure Range
 - Extrusion Resistance
 - Coefficient of Friction
 - The Effects of Friction
 - System Lubrication
 - Non Lubricated Material
 - Material "Surface" Lubrication
 - Material with "Built-In" Lubrication
 - Elastic Memory
 - Shelf Life
 - Surface Finish
 - Surface Profile
 - Surface Finish Measurements
 - Actuator Sealing Surface Finish Ranges
 - Durometer Hardness
 - Abrasion Resistance
 - The "Multi" Material Compromise
 - Leather
 - Rubbers
 - Buna-N
 - Always Ask
 - Parameters
 - Precautions
 - Summary
 - Carboxylated Nitrile

- Always Ask
 - Parameters
 - Precautions
 - Summary
 - Neoprene
 - Always Ask
 - Parameters
 - Precautions
 - Summary
 - Fluorocarbon
 - Always Ask
 - Parameters
 - Precautions
 - Summary
- Fabric Reinforced Rubber
- PTFE
 - Parameters
 - Precautions
 - Summary
- Thermoplastics
 - Thermoplastic Elastomers
 - Parameters
 - Precautions
 - Summary
- Thermoset Polymers
 - Parameters
 - Precautions
 - Summary
- **Types of Industries**
 - Fluid Power Industry
 - Injection Molding
 - Industry Overview
 - Actuator Applications
 - Power Plants
 - Industry Overview
 - Tire Manufacturing
 - Industry Overview
 - Tire Presses
 - Water Hydraulic Center Post Mechanism
 - Ram Cylinder with Bagwell
 - Oil Hydraulic with Mechanical Interface
 - Common Tire Press Manufacturers
 - Pulp & Paper
 - Industry Overview
 - Actuator Applications
 - Wood Yard

- Pulp
 - Paper Machine - Wet End
 - Paper Machine - Dry End
 - Converting
 - Power
 - Recovery
 - Waste Water Treatment
 - Hydroelectric
 - Industry Overview
 - Actuator Applications
 - Waste Water Treatment
 - Industry Overview
 - Sewerage Sludge Pumps
 - Sewerage Sludge Pumps Manufacturers
 - Automotive
 - Industry Overview
 - Parts Manufacturing
 - Automotive Assembly
 - Railroad Switch Yards
 - Industry Overview
 - Brake or Retarder Cylinders
 - Switch Cylinders
 - Mining
 - Industry Overview
 - Open Pit Mining
 - Open Pit Mining Equipment
 - Underground Mining
 - Long Wall Mining Applications
 - Industrial Presses
 - Overview
 - Metal Stamping Presses
 - Rubber Molding Presses
 - Chipboard / Plywood / Laminating Presses
 - Steel / Metal Mills
 - Industry Overview
 - Metal Extrusion
 - Foundries
 - Industry Overview
 - General Industries with Hydraulic / Pneumatic Systems
 - Other Industries
- **Troubleshooting Hydraulic / Pneumatic Equipment & Seals**
 - Service Problems
 - Understanding Failures - What is Acceptable Leakage?
 - Remember the term "Acceptable Leakage"?
 - So, what is "Acceptable Leakage"?
 - Hydraulic Applications

- Pneumatic applications
 - Troubleshooting
 - Scrapping and Replacing Cylinders
 - The four-step Process
- Leakage Pattern
 - Slight, Steady Leakage
 - Leakage Increases Gradually
 - Heavy, Sudden Leakage
 - Inconsistent, Erratic Leakage
- Actuator Performance
 - Chatter or Stick-Slip
 - Creep or Drift
 - Excessive Drag or Seizing
 - Increasing Actuator Temperature without External Heat Source
- Reasons for Cylinder Repair
 - Operating Conditions
 - Excessive Temperature
 - Fluid Type
 - Fluid Contamination
 - Excessive Speed
 - Shock Loading
 - Cylinder Condition
 - Rod Damage
 - Bore Damage
 - Side Load
 - Improper Seal Fit
 - Improper Surface Finish
 - Improper Gland and Piston Design
 - Seal Condition
 - Extrusion of Inside Diameter Heel
 - Excessive Abrasion or Grooving of Dynamic Sealing Lip
 - U-cup Split through center of its Cross Section
 - U-cup or Piston Cup is Separated from Heel
 - Crescent Shaped Section Missing from Dynamic Sealing Lip
 - Discoloration, Swelling, Softening or Hardening of Seal Compound
 - Excessive Wear, Misshaping, Darkening of V-ring Sets in Stacked Sets
 - Wear on Dynamic Heel 360; of Seal's Circumference
 - Excessive Wear on Dynamic Heel and Lip of 180; of Seal's circumference.

- Excessive Wear on Heel 360° of Circumference of Piston Cup
 - Black, Tar-like Deposits and/or Burned Spots between the Seal Lips
 - Rolled or Twisted Seal may have Permanent Creases from twisting in Seal Cavity.
 - No Visible Damage, but Leaking
 - Extrusion of Outside Diameter Heel
 - Seal lips are Crushed, Crimped or Creased
 - Seal is Dark or Black in color, has Lost Flair, or is Drastically Misshaped
 - Vertical / Axial Scratches on Static Lip may be associated with other Damage
- Friction, Wear & Drag Effects
 - Static Sealing Line
 - Dynamic Sealing Line
 - Conclusion
- Hydroplaning of Seals
 - Definition of Hydroplaning
 - Hydraulic Fluid and Hydroplaning
- Contaminant Entrapment & Exclusion
 - Introduction
 - Remedies