

PUMP PRINCIPLES I

Course Introduction:

Pumps are the second-most common machines in use today. They are exceeded in numbers only by the electric motor. Knowledge of Pumps and Pump Operation is often overlooked in today's colleges and universities. This course is designed to educate you with the appropriate knowledge of Pumping principles focusing mainly on the Centrifugal Pump.

A thorough comprehension of underlying Pump principles is often required for you to effectively carry out your day to day business. If you design, specify, repair, maintain, operate or work with Pumps in any way, this course will provide you with the information required to perform these tasks.

Course Objective:

Upon completion of this course you will be able to identify Pump classifications, describe the purpose of Pump parts, define various Pump terms, explain Pump Operation, describe the components of a Pump curve, describe the elements and effects of a simple Pumping system, and describe typical Pump failures and their causes.

Course Curriculum Length: 40 hours

Course Modules & Syllabus

- **Pumps**
 - Pump Definition
 - What is a Pump?
 - What is the purpose of a Pump?
 - Pump Classifications
 - How Pumps are Classified
 - Kinetic Pumps
 - Centrifugal Pumps
 - Positive Displacement Pumps
 - Rotary Pumps
 - Reciprocating Pumps
 - ANSI Pump Standard
 - What is the ANSI Pump Standard?
 - What is the purpose of the ANSI Pump Standard?
- **Pump Parts**
 - Overhung Impeller Centrifugal Pump Configuration
 - What are the four sections of an Overhung Impeller Centrifugal Pump Configuration?
 - Overhung Impeller Centrifugal Pump Wet-end; Parts & Function
 - What are the Parts in the Wet-end Section of an Overhung Impeller Centrifugal Pump?

- What is the function of the Volute?
- What is the function of the Impeller?
 - Radial Flow (Straight-vane) Impeller
 - Mixed Flow Impeller
 - Axial Flow Impeller
 - Completely Open Impeller
 - Semi-open Impeller
 - Closed Impeller
- What is the function of the Wear Ring?
- What is the function of the Stuffing Box?
- What is the function of the Sealing Device?
- What is the function of the Backcover?
- What is the function of the Pump Stuffing Box Jacket?
- What is the function of the Front Cover?
- What is the function of the Lantern Ring?
- Overhung Impeller Centrifugal Pump Power-end; Parts & Function
 - What are the Parts in the Power-end Section of an Overhung Impeller Centrifugal Pump?
 - What is the function of the Bearing Housing?
 - What is the function of the Frame Adapter?
 - What is the function of the Shaft?
 - What is the function of the Bearings?
 - What is the function of the Thrust Bearing Cartridge?
 - What is the function of the Snap Ring?
 - What is the function of the Bearing Protection?
 - What is the function of the Deflector?
 - What is the function of the Oil Sump Area?
 - What is the function of the Oil Sight Glass?
 - What is the function of the Breather?
 - What is the function of the Oil Flinger?
 - What is the function of the Power-end Cooling Jacket?
- Overhung Impeller Centrifugal Pump Driver; Parts & Function
 - What are the Parts in the Driver Section of an Overhung Impeller Centrifugal Pump?
 - What is the function of the Motor?
 - What is the function of the Coupling?
 - What is the function of the Motor Adapter?
 - What is the function of the Belts?
- Overhung Impeller Centrifugal Pump Support Structure; Parts & Function
 - What are the Parts in the Support Structure of an Overhung Impeller Centrifugal Pump?
 - What is the function of the Baseplate?

- What is the function of the Foundation?
 - What is the function of the Grouting?
 - What is the function of the Jack-bolts?
 - What is the function of the Shims?
 - Split-case Centrifugal Pump Part Differences
 - Overhung Impeller and Impeller between Bearings
 - Centrifugal Pump Differences
- **Pump Terms**
 - Pressure Terms
 - What is Pressure?
 - What is Atmospheric Pressure?
 - What is Gauge Pressure?
 - What is Absolute Pressure?
 - What is Vacuum?
 - What is Vapor Pressure?
 - Fluid Terms
 - What is Hydraulics?
 - What is Density?
 - What is Specific Gravity?
 - What is Viscosity?
 - What is Head?
 - What is Capacity?
 - Pressure / Head Conversions
 - How do you convert Pressure to Head?
 - How do you convert Head to Pressure?
 - Temperature Effects
 - How does temperature effect Specific Gravity?
 - How does temperature effect Viscosity?
 - How does temperature effect Vapor Pressure?
- **Pump Operation**
 - Fluid Flow
 - What is the Pump Suction?
 - What is Suction Pressure?
 - What is the Pump Discharge?
 - What is Discharge Pressure?
 - How does a Fluid pass through a Pump?
 - Fluid Energy Conversion
 - What is Pressure Energy?
 - What is Velocity Energy?
 - How does the Energy Conversion take place within a Pump?
- **Pump Curves**
 - Pump Performance Curve Definition
 - Single Pump Performance Curve
 - Composite Pump Performance Curve
 - Pump Performance Curve Elements

- Head
 - Total Dynamic Head
 - Capacity
 - Net Positive Suction Head Required (NPSHR)
 - Efficiency
 - Power Requirements
 - Impeller Diameter
 - Pump Speed
 - Pump Size
 - What is the relationship between Total Dynamic Head and Capacity?
- Element Effects; Various Operating Conditions
 - What effect does Viscosity have on a Pump Curve?
 - What effect does Specific Gravity and Viscosity have on the Power Requirement Curve?
 - What is the Best Efficiency Point of a Pump?
 - What effect does changing Capacity have on Net Positive Suction Head Required?
 - What effect on Efficiency does Pump Operation have when operating away from the Pump Best Efficiency Point?
 - What is a Shut-off or Dead-head Condition?
 - What is a Non-overloading or Run-out Condition?
 - What is the effect of operating at Shut-off on Power Consumption?
 - What is the effect of operating at Non-overloading on Power Consumption?
 - What are the effects and limitations of Impeller Trimming?
- **A Simple Pumping System**
 - Elements of a Pumping System
 - What are the elements of a Pumping System?
 - What is Static Head?
 - What is Velocity Head?
 - What is Friction Head?
 - What is Pressure Head?
 - What is Vapor Pressure?
 - Total Suction Head (System)
 - What is Suction Static Head?
 - What is Suction Velocity Head?
 - What is Suction Friction Head?
 - What is Suction Pressure Head?
 - What is Total Suction Head (System)?
 - Total Suction Head & Lift Applications (System)
 - What is Total System Head for a Suction Head Application?
 - What is Total System Head for a Suction Lift Application?
 - Total Discharge Head (System)

- What is Static Discharge Head?
- What is Discharge Velocity Head?
- What is Discharge Friction Head?
- What is Discharge Pressure Head?
- What is Total Discharge Head (System)?
- Total Head (System) Relationships
 - The relationship of Total Head (System) on Pump Operation when the Suction Tank level is raised
 - The relationship of Total Head (System) on Pump Operation when the Suction Tank level is lowered
 - The relationship of Total Head (System) on Pump Operation when the Discharge Tank level is raised
 - The relationship of Total Head (System) on Pump Operation when the Discharge Tank level is lowered
 - The relationship of Total Head (System) on Pump Operation when the Discharge Tank level is lowered and the Discharge pipe exits above the liquid surface
 - The relationship of Total Head (System) on Pump Operation with increased Friction Loss on the Pump Suction
 - The relationship of Total Head (System) on Pump Operation with increased Friction Loss on the Pump Discharge
 - The relationship of Total Head (System) on Pump Operation with decreased Friction Loss on the Pump Suction
 - The relationship of Total Head (System) on Pump Operation with decreased Friction Loss on the Pump Discharge
 - The relationship of Total Head (System) on Pump Operation with increased Pressure Head on the Pump Suction
 - The relationship of Total Head (System) on Pump Operation with increased Pressure Head on the Pump Discharge
 - The relationship of Total Head (System) on Pump Operation with decreased Pressure Head on the Pump Suction
 - The relationship of Total Head (System) on Pump Operation with decreased Pressure Head on the Pump Discharge
- Net Positive Suction Head
 - Net Positive Suction Head Required (NPSHR)
 - Net Positive Suction Head Available (NPSHA)
 - Pump System Factors effecting Net Positive Suction Head Available (NPSHA)

- The effect of changing Capacity on Net Positive Suction Head Required (NPSHR)
 - The relationship of NPSHA to NPSHR for proper Pump Operation
 - Pump's Operating Point
 - How do you convert Pressure to Head?
 - How to determine a Pump Operation Point from Suction and Discharge gauges
- **Typical Pump Failures**
 - Radial Loading; Shaft Deflection
 - Radial Loads
 - The relationship of Pump Operation away from the Best Efficiency Point on Radial Loads
 - The effects of running at Shut-off on Radial Loads
 - The effects of running at Non-overloading on Radial Loads
 - Shaft Deflection
 - Shaft Slenderness Ratio
 - The effect of Shaft Deflection on Sealing Device Failure
 - Bearing Failure
 - The function of Bearing Protection
 - Lip Seals
 - Labyrinth Seals
 - Gear Box Seals
 - The effect of Contamination on Bearing Life
 - The limitations of Lip Seals on Bearing Life
 - The limitations of Labyrinth Seals
 - The limitations of Gear Box Seals
 - The effect of Bearing Failure on Pump Operation
 - Classic Cavitation
 - Net Positive Suction Head Required (NPSHR)
 - Net Positive Suction Head Available (NPSHA)
 - Classic or Vaporization Cavitation
 - The relationship of NPSH to Classic or Vaporization Cavitation
 - The effect of Classic or Vaporization Cavitation on Pump Hydraulic Operation
 - The effect of Classic or Vaporization Cavitation on Pump Mechanical Operation