Pump ED 101

PumpTech Seminars & Training

Joe Evans, Ph.D http://www.pumped101.com

Title: AC Motors

Sponsor: PumpTech, Inc.

Level: Introductory or Advanced – This course will be tailored to the knowledge level of the audience.

Technique: Power Point presentation with animations and Excel examples. Live demonstrations by the instructor and audience interaction.

Duration: 1 hour

Topics Magnetism, Electromagnetism, Simple DC Motor, The AC Sine Wave, Single & Three Phase Rotating Fields, Synchronous Speed, Slip Speed, Work & Power, Torque, Load Types, Motor Enclosures, Service Factor

Result: Students will gain an understanding of the operation and application of single and three phase induction motors. They will become familiar with the relationship between frequency and poles and its effect on synchronous and slip speed. They will also gain an understanding of the different types of motor loads and the concept of work, power, and torque. This will allow them to do a better job of troubleshooting and maintaining pump motors.

Instructor: Joe Evans, Ph.D
PumpTech, Inc
2425 SE Ochoco Street
Portland, OR 97222

Joe Evans is responsible for customer and employee education at PumpTech Inc, a pumps & packaged systems manufacturer &

distributor with branches throughout the Pacific Northwest. He has a Ph.D in Physics and over twenty-five years experience in the design, installation, and maintenance of pumping systems and their controls. His seminar audiences include consulting engineers, municipal employees, the AWWA, NGWA, WEF, RWA, SWPA, and industrial & petrochemical plants. He is a contributing editor for Pumps & Systems magazine and writes a monthly article on hydraulics, pumps, motors, and controls. His resume is included in this package.

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Title: AC Power

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Level: Introductory or Advanced – This course will be tailored to the knowledge level of the audience.

Technique: Power Point presentation with animations and Excel examples. Live demonstrations by the instructor and audience interaction.

Duration: 1 hour

Topics: What is Electricity?, Common Electrical Terms, DC vs AC, Ohm's Law, DC Pros & Cons, AC Pros & Cons, Frequency, Single Phase Sine Wave, Three Phase Sine Wave, Why Three Phases?, Peak vs Effective Voltage, AC Generation & Transmission, Transformers, AC Loads, Power Factor, Single Phase Characteristics, Three Phase Characteristics

Result: This seminar will provide the student with a basic knowledge of single and three phase AC power. They will understand the relationship of voltage, current, power and frequency and how they apply to resistive and inductive loads. They will also gain an intuitive understanding of induction and the operation and application of transformers. Finally they will become familiar with power factor and its effect on power usage.

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Pump ED 101

PumpTech Seminars & Training

Joe Evans, Ph.D http://www.pumped101.com

Title: BEP, Current Unbalance, & Power Factor

Level: Introductory – A basic knowledge of pumps, electricity, and induction motors is required.

Technique: Power Point presentation with animations, Excel examples, and personal interaction with the audience.

Duration: 1 Hour

Topics: How the Overall System Effects Maintenance, BEP, Off BEP Operation, Radial Thrust Damage, Recirculation Cavitation Damage, The As Built Operating Point, As Built Fixes, Phase Voltage Unbalance, Current Unbalance, Effect of Unbalance, Measuring Unbalance, Rolling The Leads, Locating the Source of Unbalance, Fixing Unbalance, Power Factor

Result: Students will learn about the long and short term costs that occur when pumps operate off BEP and when motors operate with three phase current unbalance. They will learn how to diagnose these problems and what potential fixes can be used to correct them. They will also learn about power factor and how it can be corrected.

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Pump ED 101

PumpTech Seminars & Training

Joe Evans, Ph.D http://www.pumped101.com

Title: Constant & Variable Speed Pump Selection

Level: Introductory – A basic knowledge of pumps and pumping applications is required. A basic understanding of VFD operation is also required.

Technique: Power Point presentation with animations, Excel examples, and personal interaction with the audience.

Duration: 1 Hour

Topics: Generating the System Curve, Curve Shape, Efficiency and BEP, Constant Pressure – Variable Flow, Pressure Boosters, Variable Pressure – Variable Flow, Closed Loop Circulation, Friction Curve, Open Loop Circulation, Friction + Elevation Curve, Pump Selection

Result: This seminar will provide students with a basic understanding of the system conditions that are found in various constant and variable speed pumping applications. They will find that these conditions will often dictate different pump characteristics. They will also learn to plot the system curve for various conditions and then use an Excel program to evaluate potential pump selections.

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Pump ED 101

PumpTech Seminars & Training

Joe Evans, Ph.D http://www.pumped101.com

Title: Centrifugal Pump Hydraulics – Part 1

Sponsor: PumpTech, Inc.

Level: Introductory or Advanced – This seminar will be tailored to the knowledge level of the audience.

Technique: Power Point presentation with animations & Excel examples. Live demonstrations by the instructor and personal interaction with the audience.

Duration: 1 Hour

Topics: Pump Classification, Centrifugal Pump Dynamics, Bernoulli Effect, The Performance Curve, BEP Operation, The Affinity Laws, Series & Parallel Operation, The System Curve, Radial & Axial Forces

Result: This seminar will provide the student with a firm foundation in basic centrifugal pump operation and clarify the relationship of flow, pressure, and velocity. They will learn to interpret pump performance curves and how to apply the affinity laws to those curves when changes in pump speed and impeller diameter occur. They will gain an understanding of the problems that can occur from off BEP operation and how to avoid them. Upon completion, they will be better prepared to select, trouble shoot, and maintain pumps and pumping systems.

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Pump ED 101

PumpTech Seminars & Training

Joe Evans, Ph.D http://www.pumped101.com

Title: Centrifugal Pump Hydraulics – Part 2

Sponsor: PumpTech, Inc.

Level: Introductory or Advanced – This seminar will be tailored to the knowledge level of the audience.

Technique: Power Point presentation with animations & Excel examples. Live demonstrations by the instructor and personal interaction with the audience.

Duration: 1 Hour

Topics: Liquid Characteristics (Solid vs Liquid Static Pressure, The Pascal Effect, Specific Gravity, Solid vs Liquid Friction, Vapor Pressure), NPSH, Suction Specific Speed, Suction Conditions, Total Pump Head, Erosion, Cavitation, Waterhammer

Result: This seminar will advance the knowledge gained in Part 1 and provide the student with an even better knowledge of basic centrifugal operation. They will gain an understanding of some of the properties of water and their effect on the dynamics of pump operation. They will also learn about the effects of erosion, cavitation, and waterhammer. Upon completion, they will be better prepared to select, trouble shoot, and maintain pumps and pumping systems.

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Pump ED 101

PumpTech Seminars & Training

Joe Evans, Ph.D http://www.pumped101.com

Title: Positive Displacement Pump Hydraulics

Level: Introductory – A basic knowledge of pumps and pumping applications is useful but not required.

Technique: Power Point presentation with animations, Excel examples, and personal interaction with the audience.

Duration: 1 Hour

Topics: Reciprocating Pumps, Piston, Plunger, Rotary Pumps, Peristaltic, Gear, Lobe, Screw, Progressive Cavity, Diaphragm, Pumping Cycle, Displacement, Efficiency, Volumetric Efficiency, Pressure, Power, BHP, Capacity, Applications

Result: This seminar will provide students with an understanding of the operation of reciprocating and rotary displacement pumps. They will learn about pressure limitations, the pumping cycle, and how to calculate flow and power required. They will also learn which applications best fit a particular pump design. This will allow them to better apply these pumps in the field and troubleshoot existing problems.

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Pump ED 101

PumpTech Seminars & Training

Joe Evans, Ph.D http://www.pumped101.com

Title: P, PI, & PID Control

Level: Introductory

Technique: Power Point presentation with animations, Excel examples, and personal interaction with the audience.

Duration: 1 Hour

Topics: Pump Control, Process Control, On/Off Control, Open Loop Control, Boolean Logic, Feedback, Proportional Control, Closed Loop Control, Proportional/Integral Control, Proportional/Integral/Derivative Control, VFD/PID Control

Result: Students will gain a basic understanding of the various control techniques used in pumping applications. They will also learn which one(s) work best under varying circumstances. A knowledge of P, PI, and PID control is extremely valuable when troubleshooting pump control problems.

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Pump ED 101

PumpTech Seminars & Training

Joe Evans, Ph.D http://www.pumped101.com

Title: Pump Cavitation & NPSH

Level: Introductory – A basic knowledge of pumps and pumping systems is required. Elementary algebra is useful but not required.

Technique: Power Point presentation with animations, Excel examples, and personal interaction with the audience.

Duration: 1 Hour

Topics: Properties of Water, Boiling, Water Vapor vs Air Bubbles, NPSHa, NPSHr, Bubble Collapse, Microjets, Metal Erosion, Off BEP Operation, Conventional Cavitation, Suction Recirculation Cavitation, Discharge Recirculation Cavitation, Cavitation Prevention

Result: Students will learn about the various system conditions that lead to pump cavitation and how they can be rectified. Understanding the causes of cavitation and how to eliminate them will always lead to lower maintenance costs and much longer pump life.

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Pump ED 101

PumpTech Seminars & Training

Joe Evans, Ph.D http://www.pumped101.com

Title: Variable Frequency 101

Level: Introductory – A basic knowledge of electricity and induction motors is required. Elementary algebra and trigonometry is useful but not required.

Technique: Power Point presentation with animations, Excel examples, and personal interaction with the audience.

Duration: 1 Hour

Topics: Why Variable Speed?, Other Variable Speed Techniques, The AC Wave Form, RPM/Frequency/Motor Poles, VFD Components & Functions, Inverter Output, Effective Voltage & Its Control, Potential Problems and Fixes (bearing damage, harmonics, insulation stress, resonant frequency), Application Control Techniques (proportional, integral, derivative), Variable Speed Application Examples

Result: This seminar will provide students with a basic understanding of the inner workings of a VFD, its method of speed control, and the potential problems that might be encountered. They will also become knowledgeable of the various VFD application categories and when the VFD should and should not be used. This will allow them to better apply VFD's to various pumping applications and to troubleshoot problems with existing installations.

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