Technical Skills CD-ROM Catalog

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Table of Contents

ITC Learning Technical Skills CD-ROM Learning Library

Applied technical competency is the basis for increasing productivity and quality while minimizing downtime and rework. The courses comprising the ITC Learning Technical Skills CD-ROM Library are designed to improve technical competence. These courses use workplace situations and terminology, providing an atmosphere of practicality for the employee. Employees understand the course material faster and retain more, allowing them to apply more of their new skills. Since ITC Learning's Technical Skills CD-ROM Library allows employees to learn at a faster pace, organizations have the flexibility to schedule training to meet individual needs. Organizations benefit from the courseware's built-in ActivPro Administration – an automatic record-keeping system that keeps management up to date on every employee's progress. The ITC Learning Technical Skills CD-ROM Library offers a wide variety of courses including Electrical, Mechanical, and Instrumentation Training.

Electrical Skills Series

AC and DC Motors Library (4 CD's)

16-24 hours of training

This comprehensive interactive multimedia-training program consists of four individual lesson CD's that train participants to understand, maintain, and test AC and DC motors.

Audience: This program is excellent for the training of electricians and electronic technicians as well as for the multi-craft training needs of process and manufacturing facilities.

AC Motor Theory (A8011)

Prerequisites: This lesson is designed for participants familiar with AC/DC theory, electrical safety, electrical print reading, electrical connections, electrical control equipment, and the proper use of electrical test instruments.

Description: This lesson shows and explains how to measure winding insulation resistance and winding resistance. The lesson also describes the major components of AC motors and explains the theory behind permanent magnet motors, three-phase motors, and induction motors.

Objectives: Identify the components and principles of operation for the major types of AC motors ● Measure winding insulation resistance ● Measure winding resistance in AC Motors.

AC Motor Maintenance (A8012)

Prerequisites: This lesson is designed for participants familiar with AC/DC theory, electrical safety, electrical print reading, electrical connections, electrical control equipment, AC motor components, AC motor theory, and the proper use of electrical test instruments.

Description: This lesson shows and explains how to overhaul AC induction motors. Procedures for disassembling, inspecting, cleaning, and reassembling endbells, rotors, and bearings are presented in detail. The lesson also covers procedures for inspecting and cleaning the stator as well as windings and testing the motor once it has been reassembled.

Objectives: Remove endbells, rotor, and bearings from an AC motor ● Inspect and clean endbells and rotors ● Reinstall bearings ● Reassemble an AC motor as well as perform operational tests on it.

DC Motor Theory (A8013)

Prerequisites: This lesson is designed for participants familiar with basic electrical principles, electrical safety, electrical print reading, electrical control equipment, Ohm's Law and Three-Phase Motors.

Description: This lesson introduces participants to the application of direct current motors and their components. This lesson covers general characteristics of a DC motor, DC motor components, their functions and the design of the brush assembly. This lesson explains concepts such as flux interaction, commutation, the effect of multiple windings, armature' reaction, compensation and CEMF, and how each of these factors effects motor operation.

Objectives: Know the general requirements of a DC motor and what requirements they meet ● Be able to identify the basic components and explain the functions of a DC motor ● Identify the components of the brush assembly and explain its function ● Explain the effect of armature current on the main flux field and how this results in motor action ● Explain the process of commutation and how this maintains direct current in a DC motor ● Describe how the number of windings and commutator segments effects torque and mechanical power ● Explain how armature reaction shifts the neutral plane, how it affects motor operation, and what measures will correct the reaction ● Know the requirements for induced voltage in a motor, and explain Counter EMF ● Explain the designs of a series wound,

shunt wound, compound wound, and permanent magnet wound motor and how each of them work ● Learn about reduced voltage starters and what determines the direction of the rotation of a motor ● Learn how a reverse contractor works ● Know how a tapped resistor and field rheostat work ● Know how a drive control system works.

DC Motor Maintenance (A8014)
Prerequisites: This lesson is designed for participants familiar with basic electrical principles, electrical safety, electrical print reading, electrical control equipment, and preferably with AC and DC motor theory and AC motor maintenance.
Description: This lesson describes some of the basic concepts of DC motors; explains how DC motors differ from AC motors; describes the components of a DC motor and their functions. This lesson also covers DC motor maintenance, including commutator inspection and maintenance as well as brush maintenance; explains various types of commutator problems and how to remedy diem; describes how to select, install, and seat brushes.
Objectives: Maintain a DC Motor, including identifying components of a DC motor commutator and their functions ● Describe the color of the commutator and explain the function of the oxide film ● Identify wear patterns and the causes of arcing, high mica, uneven segments and thrown solder, and know how to correct them ● Explain how to prepare a commutator for reconditioning, how to undercut the mica of a commutator, and how to clean and check the commutator after maintenance ● Describe how to inspect, select, install and seat brushes ● Describe the procedures for cleaning and inspecting the brush holders ● Explain how to adjust spring pressure.

Conduit Installation Library (1 CD)

2-4 hours of training
This comprehensive interactive multimedia-training program consists of one lesson that train participants on identifying and applying the basic materials of a conduit system, as well as general practical methods of bending and installing conduit.
Audience: This program is excellent both for the training of electricians as well as for the multi-craft training needs of process and manufacturing facilities.

Conduit Bending and Installation (A8018)
Prerequisites: This lesson is designed so that no prior knowledge is required.
Description: This lesson provides instructions and interactions concerning general conduit bending and installation, in accordance with the National Electrical Code (NEC). This lesson defines a conduit system, lists general specifications for use of types of conduit, and introduces the major components or materials of a basic conduit system. This lesson also demonstrates and provides instruction on general methods and practices for cutting, cleaning, bending and installing conduit.
Objectives: Define conduit and the different types of conduit ● Read and use a conduit fill chart ● Determine the uses for types of conduit ● Identify boxes and fittings ● Plan a layout of and measure for a conduit installation ● Explain the methods for cleaning, cutting and threading a conduit ● Identify benders and their uses, and define common markings of a hand bender ● Measure for and make a 90 degree bend ● Identify an offset bend and its uses, and make an offset bend using an offset chart ● Make and use a three and four bend saddle ● Explain the methods for installing conduit and supporting a conduit system ● Explain the methods for installing conductors.

Digital Electronic Theory Library (4 CD's)

16-24 hours of training
This comprehensive award-winning interactive multimedia-training program consists of four individual lesson CD's that train participants to understand the operation of various types of digital circuits and to effectively troubleshoot these circuits.
Audience: This program is excellent both for the training of electricians and technicians in instrumentation and electronics as well as for the multi-craft training needs of process and manufacturing facilities.

Binary Logic Circuits (A9401)
Prerequisites: This lesson is designed for participants familiar with AC/DC theory, electrical safety, and electrical print reading. A basic understanding of logic gates is also required.

Description: This lesson explains and demonstrates binary logic signals and the use of logic gates in integrated circuits. The lesson also describes Boolean expressions, truth tables, and Karnaugh mapping in relation to the logic of complex circuits. These topics are directly applied to troubleshooting digital circuits.
Objectives: Identify voltages of digital components ● Identify leading and trailing edges of a digital signal ● Interpret pin connection diagrams and wiring diagrams ● State the function of a pin on an IC chip when provided with a pin connection diagram or a wiring diagram ● Properly use a logic probe, logic clip, logic monitor, and logic pulser to test the operation of an IC chip ● Test the operation of a circuit and determine if it is functioning properly ● Interpret and develop related Boolean expressions and truth tables ● Simplify a two-variable Boolean expression using Karnaugh mapping.

Codes, Encoders, Decoders, and Flip-Flops (A9402)
Prerequisites: This lesson is designed for participants familiar with AC/DC theory, logic gates, and binary numbering systems. A knowledge of pin connection diagrams and wiring diagrams is also required.
Description: This lesson discusses codes, encoders, and decoders and explains how to troubleshoot these circuits. In addition, the lesson addresses the operation and troubleshooting of flip-flops.
Objectives: Convert between BCD and decimal numbers ● Identify and describe the function of active low inputs and outputs ● Explain the functions of pins on an encoder and the operation of a seven segment LED display ● Determine whether encoder and decoder circuits are functioning properly ● State the difference between combinational and sequential logic circuits ● Describe the operation of R-S flip-flops, D flip-flops, and J-K flip-flops ● Describe the operation of an IC latch ● Interpret flip-flop truth tables ● Determine whether flip-flop circuits are functioning properly.

Counters and Shift Registers (A9403)
Prerequisites: This lesson is designed for participants familiar with AC/DC theory, binary numbering systems, logic gates, and flip-flops. A knowledge of pin connection diagrams and wiring diagrams is also required.
Description: This lesson discusses the principles of counters and their various applications. The lesson also explains the principles and features of shift registers, emphasizing serial load shift registers, parallel load shift registers, and universal shift registers. Troubleshooting counters and shift registers is also addressed.
Objectives: Determine binary outputs and the limits for counters ● Understand how input pulses affect the counter's output ● Identify synchronous and asynchronous counters ● Define ripple counters, up/down counters, self-stopping counters and frequency dividers ● Use count sequence tables in troubleshooting counters ● Understand the basic shifting concept ● State the difference between serial load shift registers and parallel load shift registers ● Identify universal shift registers ● Troubleshoot counters and shift registers.

Data Transmission, Conversion and Storage (A9404)
Prerequisites: This lesson is designed for participants familiar with AC/DC theory, binary numbering systems, and parallel and serial data. A basic understanding of logic gates and flip-flop circuits, and the use of pin connection and wiring diagrams is also required.
Description: This lesson demonstrates the use of data transmission circuits, including multiplexer and demultiplexer circuits. The lesson explains digital-to-analog and analog-to-digital converter circuits and teaches different types of memory. Troubleshooting of data transmission circuits is also performed.
Objectives: State the functions of a multiplexer ● Trace the logic in simplified and complex multiplexer and demultiplexer circuits ● Identify the pins used to input, output, and address data for multiplexer and demultiplexer chips ● Determine if a multiplexer or demultiplexer chip is functioning properly ● Understand the operation of a digital-to-analog and analog-to-digital converter circuit ● Understand the operation of a counter type analog-to-digital converter circuit ● Read and write data to a specific memory address ● Distinguish between rom and ram, and between prom, eprom and earom.

Electrical Control Equipment Library (6 CD's)

24-36 hours of training
This comprehensive award-winning interactive multimedia-training program consists of six individual lesson CD's that train participants to understand the operation and troubleshoot circuit breakers, limit switches, overload relays, motor starters, and electrical control circuits.
Audience: This program is excellent both for the training of electricians and technicians in instrumentation and electronics as well as for the multi-craft training needs of process and manufacturing facilities.

Fuses and Circuit Breakers (A8008)
Prerequisites: This lesson is designed for participants familiar with AC and DC theory, electrical safety, electrical schematics, and the proper use of hand tools and test instruments.
Description: This lesson describes fuses and circuit breakers, and how they work. This lesson shows and explains maintenance, testing, removing, and installing fuses and circuit breakers. This lesson discusses molded case, multiple, and ground fault circuit breakers.
Objectives: Describe the basic mode of operation of a fuse ● Identify the specification information ● Verify that a circuit is de-energized ● Select the proper replacement fuse and install it ● Describe the operation of a small, molded case circuit breaker ● Reset a tripped circuit breaker ● Explain circuit breaker sensing mechanisms and perform preventative maintenance on a circuit breaker panel ● Install a circuit breaker and identify one that is a multiple ● Use a characteristic trip curve to interpret test results ● Identify and test the operation of a ground fault circuit breaker and install it.

Limit Switches (A8007)
Prerequisites: This lesson is designed for participants familiar with AC and DC theory, electrical safety, electrical schematics, and the proper use of test instruments.
Description: This lesson describes limit switches, how they work, how to recognize them, and typical applications they are used in. This lesson discusses maintenance, troubleshooting, and adjustment requirements for the various limit switches.
Objectives: Use limit switches, including defining the purpose, function, and types of limit switches ● Explain and visually identify each of the limit switches ● Describe safety consideration and know how to ensure that a replacement switch will work correctly describe the internal function of a lever-actuated limit switch and its function in a control circuit ● Maintain, troubleshoot, repair, and adjust a lever-actuated limit switch ● Describe the internal functions of a photoelectric switch and a proximity switch, and explain how these switches are used in a control circuit ● Describe the possible malfunctions of these switches ● Troubleshoot, maintain and repair these switches ● Explain the internal function of a geared limit switch and torque switch in a control circuit ● Troubleshoot, maintain and repair these switches.

Switches, Coils and Overloads (A8006)
Prerequisites: This lesson is designed for participants familiar with AC and DC theory, electrical safety, electrical print reading, electrical connections, and the proper use of electrical test instruments. An understanding of the operation of control circuits and components, such as switches, relays, fuses, and circuit breakers is recommended.
Description: This lesson describes switches, coils and overloads. This lesson explains the type and operation of switches and overload relays. This lesson covers the testing of switches and coils. Participants will learn the proper way to verify that a circuit is de-energized, and how to determine component malfunctions by use of circuit diagrams, manufacturer's literature and continuity checks.
Objectives: Explain what types of switches are used in industry and know how to tell if they are functioning properly ● Know how to test coils and how to test and replace overload relays ● Explain the concept of poles and throws and describe the operation of momentary and maintained push-button switches ● Describe how selector switches work ● Describe rotary switches and explain how to read a switch connection diagram ● Perform a continuity check on a push-button switch and remove and replace a defective push-button contact block ● Learn how to check coils for overheating and breaks in the wire winding ● Explain how an overload relay protects a motor and describe how a bimetallic thermal overload relay works ● Describe how a melting-alloy thermal overload relay works and explain its heat storage characteristics ● Describe magnetic and electronic overload relays ● Describe the common problems of thermal overload relays ● Install a thermal overload relay in a starter.

Magnetic Starters (A8009)
Prerequisites: This lesson is designed for participants familiar with AC and DC theory, electrical safety, electrical print reading, electrical connections, and the proper use of electrical test instruments. An understanding of the operation of control circuits and components, such as switches, relays, fuses, and circuit breakers is recommended.
Description: This lesson describes Magnetic Starters. This lesson explains the parts of a magnetic motor starter and its operation. This lesson discusses the correct procedures for troubleshooting a magnetic motor starter. Participants will learn the proper way to determine the malfunction by use of schematic diagrams, manufacturer's literature, continuity checks, and voltage and resistance tests. This lesson also defines and demonstrates reversing magnetic motor starters.

Objectives: Explain the parts of a magnetic motor starter and its operation, including describing an electromagnet and explaining how the contactor works ● Identifying troubleshooting steps and performing sensory inspections ● Performing a test on the armature ● Executing the disassembly of the motor starter ● Explaining what an interlock is used for and how mechanical and electrical interlocks work.

Troubleshooting Electrical Control Circuits (A8010)
Prerequisites: This lesson is designed for participants familiar with AC and DC theory, electrical safety, electrical schematics, and the proper use of electrical test instruments. An understanding of the operation of control circuits and components, such as switches, relays, fuses, circuit breakers, motor starters, contactors, and control transformers is also recommended.
Description: This lesson presents a basic procedure for troubleshooting electrical control circuits. The lesson shows and explains how to gather information about the symptoms, how to verify the symptoms, and how to use the schematic diagram to locate the cause of the problem. The lesson also shows how to perform continuity checks on the circuit and replace any defective components.
Objectives: Develop a logical and systematic strategy for troubleshooting a circuit ● Obtain all necessary troubleshooting information ● Verify problem symptoms by performing electrical and/or mechanical operational checks ● Isolate the problem ● Replace all defective parts ● Check the operation of replacement parts.

Inverters – Operation and Maintenance (A8019)
Prerequisites: This lesson is designed for participants familiar with AC and DC theory, AC motor theory, electrical safety, electrical print reading, and the proper use of electrical test instruments.
Description: This lesson explains the design and operation of inverter drives, and describes control features provided by inverter drive systems. This lesson provides procedures for inspecting and maintaining inverter drives, and gives explanations of common error messages.
Objectives: State the function and parts of inverter drives ● Describe the principle of operation of pam and pwm inverters ● Review the operation of a typical induction motor and explain the formula for synchronous speed ● Explain how to calculate slip percentage and how inverters compensate for slip ● Describe the three types of inverter drives and describe open-loop and closed-loop control and how flux-vector control drives work ● Explain how an inverter in a variable-torque application can conserve energy, and how an inverter drive can be used for soft-starting ● Describe environmental conditions that adversely affect inverter drivers and describe safety precautions for working with drives ● Give examples of error messages associated with electrical or motor problems ● Describe a drive overtemperature fault.

Electrical Safety Library (2 CD's)

2-4 hours of training
This comprehensive interactive multimedia-training program consists of two individual lesson CD's that trains participants to understand the principles of basic electrical safety.
Audience: This program is excellent for training every employee in all disciplines in basic electrical safety awareness.

Electrical Safety (A9701)
Prerequisites: This lesson is designed so that no prior knowledge is required.
Description: This lesson covers basic electrical safety practices based on the OSHA standards stated in 29CFR 1910 requiring qualification for work on live circuits. The lesson provides an understanding of electricity focused on increased awareness and prevention of industrial accidents.
Objectives: Describe how voltage, current, and resistance are related and the effects various amounts of current have on the human body ● Identify the factors that influence body resistance to electric shock ● Describe how the amount of time spent in contact with an electrical circuit will affect the severity of shock ● List basic safety rules when working around electricity ● Describe the safe loading of circuits ● Identify safety considerations when using an extension cord and the proper procedure for inspecting portable electric hand tools ● Define the purpose of a ground fault interrupter (gfi) ● Identify the correct type of fire extinguisher to use on an electrical fire ● Identify requirements necessary to be a "qualified" person as defined by osha's 29cfr 1910 ● Describe the need to lock and tag a de-energized circuit before working on the circuit ● Describe the dangers of static electricity ● And describe the proper procedure for operating mobile equipment around energized circuits.

Electrical Personal Protective Equipment (A9702)
Prerequisites: No specific prerequisites are necessary for successful completion of this lesson.
Description: This lesson introduces several types of electrical personal protective equipment including hand and arm protection, eye and face protection, and head protection. Also this lesson reviews general protective equipment such as matting, line protectors, covers barriers, insulated tools, and fuse handling equipment.
Objectives: Identify safeguards for personal protection when working on or near electrical equipment ● Describe the hazards for which gloves should be worn and the factors to consider when selecting gloves ● Properly inspect gloves and sleeves prior to use ● Properly repair gloves and sleeves ● Properly wear gloves and sleeves ● Properly care for gloves and sleeves ● Identify approved protective eye wear and the types of hazards for which it offers protection ● Properly put on, take off, and care for protective eye wear ● Explain the protection provided by helmets and identify the level of protection offered by Class A and Class B helmets ● Properly inspect, wear, and maintain your protective helmet ● Follow safe work practices ● Identify safeguards other than PPE worn on the body ● Properly use rubber insulating equipment such as line protectors, covers and blankets ● Properly use matting ● Identify the safety features provided by insulating tools and how to use them properly ● Properly use fuse pullers ● Properly use barriers ● Properly use ropes and handlines ● Identify and use alerting techniques ● Identify the requirements for being "qualified."

Electrical Theory for Troubleshooters Library (7 CD's)

28-42 hours of training
This comprehensive interactive multimedia-training program consists of seven individual lesson CD's that train participants in the principles of AC/DC and solid-state theories. Digital electronic theory is also introduced.
Audience: This course is excellent for the training of electricians and electronic technicians as well as for the multi-craft training needs of process and manufacturing facilities.

Ohm's Law (A8201)
Prerequisites: This lesson is designed so that no prior knowledge is required.
Description: This lesson shows and explains how a basic DC electrical circuit operates and how voltage, current, and resistance behave in a series circuit, a parallel circuit, and a series parallel circuit. Procedures for using Ohm's Law to calculate voltage, current, and resistance in a circuit are also provided.
Objectives: Define electricity ● Describe how a simple electrical circuit operates ● Use Ohm's Law to calculate voltage, current, and resistance in any kind of circuit.

AC Characteristics (A8202)
Prerequisites: This lesson is designed for participants familiar with Ohm's Law.
Description: This lesson covers the basic characteristics of AC circuits including the relationship between voltage and current flow in an AC circuit, the way in which AC voltage is induced, and the cause and effect of inductance and capacitance in AC circuits. The lesson shows and explains how to use a sine wave to interpret changes in AC voltage over time, how to determine the frequency of AC voltage, and how to recognize the effects of inductance and capacitance in AC circuits.
Objectives: State the basic operating characteristics of AC voltage ● Use a sine wave to determine the frequency of AC voltage ● Define the principles of magnetic attraction and repulsion ● Define lines of flux and flux density ● Describe how AC voltage is induced ● Describe how a capacitor operates in an AC circuit ● Describe how capacitance affects the relationship between voltage and current in an AC circuit ● Interpret AC voltage over time.

Three-Phase AC Circuits (A8203)
Prerequisites: This lesson is designed for participants familiar with AC circuits and AC voltage. A basic understanding of how to interpret changes in AC voltage over time is also required.
Description: This lesson shows how three-phase AC voltage is generated and describes different characteristics of three-phase voltage. The lesson introduces two types of winding electrical connections with graphic demonstrations of their effect on voltage and current. Also presented are transformers and the way in which they affect voltage and current.
Objectives: Explain how voltage is induced in a three-phase system ● Use a sine wave to explain how three-phase voltage changes over time ● Describe the effect of three- and four-wire wye connections have on the relationships between phase and line voltage and current in a three-phase system ● Describe the effect of a delta connection on the relationship between phase and line voltage and current in a three-phase system ● Identify the basic parts of a

transformer and describe their functions ● Explain what determines how much voltage a transformer produces ● Describe how current changes from the primary winding to the secondary winding.

Semiconductors and Diodes (A8204)
Prerequisites: This lesson is designed for participants familiar with AC/DC theory, electrical safety, electrical print reading, electrical connections, and the proper use of electrical test instruments.
Description: This lesson presents the physical and electrical properties of different semiconductor material types and how current flows through each type. The lesson shows codes and symbols for diodes and how to interpret schematic drawings and manufacturer's markings on diodes. Operating characteristic curves and zener diodes are also explained.
Objectives: Describe the physical and electrical properties and current flow of N-type and P-type semiconductor material ● Understand the PN junction theory ● Describe the codes and symbols that are used to identify a diode ● Interpret schematic drawings and manufacturer's markings for diodes ● Test an unmarked diode to identify the anode and cathode ● Explain how the operating characteristic curve represents diode operation in terms of the relationship between current and voltage ● Explain how the operating characteristic curve indicates forward operating current in an AC circuit ● Describe how zener diodes operate and how they are used to regulate voltage in a circuit.

Rectifiers and Filters (A8205)
Prerequisites: This lesson is designed for participants familiar with AC/DC theory, electrical safety, electrical print reading, electrical connections, semiconductors and diodes. The ability to use electrical test instruments is also required.
Description: This lesson presents the basic operating theories of electronic power supplies, half-wave rectifiers, full-wave rectifiers, full-wave bridge rectifiers, capacitive input filters, and inductive input filters. The lesson shows how to calculate the expected DC output voltage for a half-wave rectifier, full-wave rectifier, and full-wave bridge rectifier.
Objectives: Identify and state the function of the major components in an electronic power supply ● Explain the operation of a half-wave rectifier circuit ● Calculate the expected DC output voltage and recognize the appropriate output waveform from a half-wave rectifier ● Explain the operation of a full-wave rectifier circuit ● Calculate the expected DC output voltage and recognize the output waveform from a full-wave bridge rectifier ● Explain the operation of capacitive and inductive input filters.

Power Devices (A8206)
Prerequisites: This lesson is designed for participants familiar with AC/DC theory, electrical safety, electrical print reading, electrical connections, semiconductors and diodes. The ability to use electrical test instruments is also required.
Description: This lesson describes the operating principles and function of transistors, SCR'S, and triacs and shows how current flows through each device. Schematic symbols for transistors, SCR'S, and triacs are also shown and explained.
Objectives: Describe the switching and amplification functions as well as the three regions of a transistor ● Identify the schematic symbols for PNP and NPN transistors and explain how current flows through each type ● Explain how transistors perform switching and amplification functions ● Use an ohmmeter to test a transistor ● Identify the schematic symbols for a SCR and a triac and explain how they operate.

Introduction to Digital Devices (A8207)
Prerequisites: This lesson is designed for participants familiar with basic electrical theory, electrical safety, electrical connections, electrical print reading, semiconductors, diodes, and the operating characteristics of transistors, resistors, and other basic circuit components. The ability to properly use electrical/electronic test instruments is also required.
Description: This lesson covers how digital electronic components process and transmit information, the principles of operation of basic logic gates, and how the binary number system can be used to represent information.
Objectives: Describe how digital electronic circuits process information ● Explain the logic functions that can be performed by digital electronic circuits ● Explain the truth tables associated with logic functions ● Determine the logic function that is performed by a circuit ● Explain an integrated circuit ● Explain how the binary number system is commonly used in digital electronic circuits.

Electrical/Electronic Test Equipment Library (3 CD's)

12-18 hours of training

This comprehensive interactive multimedia-training program consists of three individual lesson CD's that train participants how to properly use multimeters, megohmmeters, clamp-on ammeters, wheatstone bridges, and oscilloscopes.

Audience: This program is excellent for the training of electricians and electronic technicians as well as for the multi-craft training needs of process and manufacturing facilities.

Multimeters (A8002)

Prerequisites: Prerequisites: This lesson is designed so that no prior knowledge is required.

Description: This lesson demonstrates and explains how to use both a digital and an analog multimeter. During this lesson, voltage, resistance, current, capacitance, and frequency are measured. This lesson also describes some of the more common features of a digital multimeter.

Objectives: Identify and describe the display area, the function switch, and the leads/jacks on a digital multimeter ● Adjust the mechanical zero and interpret a reading on the voltage scale, and the resistance scale of an analog meter ● Given an expected measurement, set the function and range switches of an analog multimeter and adjust the zero on the ohms scale ● Know how to use a multimeter for a variety of purposes including checking for continuity across a circuit, measuring resistance, current, frequency, ac and dc voltage, and capacitance ● And use the hold button, relative button, range button, and min/max button on a DMM.

Oscilloscopes (A8001)

Prerequisites: This lesson is designed for participants familiar with AC and DC theory, electrical safety, and electrical print reading. A basic understanding of electronic devices and circuits is recommended.

Description: This lesson explains and demonstrates the use of both analog and digital oscilloscopes. Participants will learn the controls on each type of oscilloscope, how to use a probe with an oscilloscope, how to set up an oscilloscope, and how to determine various measurements taken with an oscilloscope.

Objectives: Describe what an oscilloscope is and how it works ● Explain the function of its display system, vertical system, horizontal system, trigger system and their controls ● Describe different probe types and their applications ● Adjust the display controls ● Set the trigger, vertical and horizontal controls to display a given waveform on an oscilloscope ● Identify sine, square, sawtooth, triangle, pulse, step, and complex waveforms ● Measure the voltage, period and frequency of a waveform ● Analyze its shape and perform waveform phase measurements.

Ammeters, Meggers, and Wheatstone Bridge (A8003)

Prerequisites: This lesson is designed for participants familiar with AC and DC theory, electrical safety, and electrical print reading. A basic understanding of electronic devices and circuits is recommended.

Description: This lesson describes Wheatstone bridges, megohmmeters, and clamp-on ammeters. This lesson provides examples of the use of these instruments, identifies their components, and defines their functions. This lesson also describes safety and selection considerations for their use, describes how to set up the instruments, how to connect them to the systems under test, and how to take and read measurements. This lesson describes how to take a resistance reading of a Three-phase AC motor with a megohmmeter, how to set mechanical and electrical zero on a Wheatstone bridge, and how to interpret a Wheatstone bridge reading. This lesson also defines the "record" and "lock" features of a clamp-on ammeter and describes how to modify the range of the meter for the best results.

Objectives: Explain the use of a megger, identify its basic components and define its function ● Describe the safety and selection considerations for using it, and describe the procedures for setting it up ● Know how to attach the leads to the system and take a reading of a three-phase ac motor ● Define a bridge circuit and identify the components and function of a Wheatstone bridge ● Describe how to take a reading with a Wheatstone bridge and interpret it ● Identify the components, range, function, and safety and selection consideration for a clamp-on ammeter ● Describe the procedures for setting up a clamp-on ammeter, know how to take a reading and modify the range.

Print Reading Library (2 CD's)

8-12 hours of training

This comprehensive interactive multimedia-training program consists of two individual lesson CD's that train participants to read and interpret wiring diagrams, single line diagrams, building electrical diagrams, and ladder diagrams.
Audience: This program is excellent for the training of electricians and electronic technicians as well as for the multi-craft training needs of process and manufacturing facilities.

Electrical Schematics (A8004)
Prerequisites: This lesson is designed so that no prior knowledge is required.
Description: This lesson shows and explains how to read and interpret the symbols on an electrical schematic the function of the input, logic, and output elements of a control circuit. This lesson identifies devices that are typically used as these elements, and presents their schematic symbols. This lesson also describes the steps for interpreting the relationships among the input, logic, and output components of an electrical schematic.
Objectives: Explain the function of the input, logic, and output element of a control circuit ● Identify the symbol for various manually operated input devices, and identify symbols for various process actuated input devices and state how they are used ● Identify the symbol for a relay and the associated contacts ● Identify various logic symbols, the symbol for a motor starter, and various output symbols and state how they are used ● Describe the layout of a typical electrical schematic and describe various conventions for labeling schematics ● Interpret an electrical schematic and know how to state the functions of its various devices.

Electrical Diagrams (A8005)
Prerequisites: This lesson is designed for participants familiar with schematic diagrams and basic electrical terminology.
Description: This lesson presents information about three types of electrical diagrams: building diagrams, single-line diagrams, and wiring diagrams. This lesson explains how to identify components, equipment, wire and cables on these diagrams how to relate the diagrams to the installed hardware and how to use diagrams for maintenance and troubleshooting problems.
Objectives: Explain the purpose of drawings and types of drawings ● Describe the layouts of the diagrams and know how to make drawing revisions, and describe the floor plan and elevation view diagrams ● Identify components, cables and conduits, and the cable chart in a building electrical diagram ● Identify voltage conventions, symbology, loads and isolation breakers in a single-line diagram ● Identify components, terminal conventions, wiring conventions, and bundles in a wiring diagram ● Relate a wiring diagram to actual hardware and actual wires, and troubleshoot a circuit using this type of diagram.

Programmable Controllers Library (3 CD's)
12-18 hours of training
This comprehensive interactive multimedia training program consists of three individual lesson CD's that train participants to understand programmable controller system operations; interpret power flow through ladder logic; and principles of operation, characteristics, and capabilities of analog control using programmable logic controllers.
Audience: This program is excellent for the training of electricians and instrument technicians as well as for the multi-craft training needs of process and manufacturing facilities.

Principles of Operation (A9601)
Prerequisites: This lesson is designed for participants familiar with AC/DC theory, electrical safety, basic electrical maintenance procedures, and electrical print reading.
Description: This lesson covers the basics of programmable controller systems. It describes what a programmable controller is, its hardware and software components, and how it functions in an industrial environment.
Objectives: Identify the major hardware components of a programmable controller system and how they work together ● Identify the various software components of a programmable controller system and their functions ● Identify I/O terminals through addresses and use I/O documentation to find the addresses of field devices as well as use I/O modules indicators and tables to determine status of input and output devices.

Interpreting Ladder Logic (A9602)
Prerequisites: This lesson is designed for participants familiar with the principles of programmable controller system operation, AC/DC theory, electrical safety, basic electrical maintenance procedures, and electrical print reading.

Description: This lesson teaches how to interpret programmable controller ladder logic. The lesson defines the program elements of ladder logic and the functions that they perform. This includes contacts, coils, and data functions as well as many of the common ladder logic arrangements.
Objectives: Interpret power flow in circuits containing many program elements ● Circuits designed to start equipment ● Start circuits with sealing (holding contacts) ● Stop circuits, and in circuits that contain the following: normally open contacts to represent normally closed field devices, timer functions, counter functions, math functions, data comparison functions and data transfer functions.

Programmable Controllers for Analog Control (APCAA)
Prerequisites: This lesson is designed for participants familiar with digital electronic theory, programmable logic controllers and digital instrumentation.
Description: This lesson teaches the difference between discrete and analog control and how PLC's implement PID control modes. It shows different hardware configurations and how process data is transmitted between components on a data highway. Programming languages including ladder logic and function block statements are presented. Additionally, the lesson shows how PLCs actually work in different process applications and some routine and preventative maintenance techniques.
Objectives: Describe the differences between discrete control and continuous process control ● Describe how PLCs implement proportional, integral, and derivative process control ● List and explain hardware for PID control ● Explain the purpose of a/d converters ● Describe typical field devices connected to PID modules ● Describe the types of input signals generated by analog field devices ● Explain the functions of a data highway ● Explain factors that could affect the speed of data transfer and communications between PID modules ● The PLC/PID systems to monitor a given process ● Explain the uses of single loop and group displays ● Identify typical programming languages for PID control ● Explain how PID algorithms are configured in PLC software ● Identify other configuration functions available for analog control ● Identify other configurations for advanced control strategies ● Describe the execution of a typical PID program ● Explain how scan times affect program execution ● Describe how to change from automatic to manual control modes ● Describe the application of PID control using a PLC in a blending process ● Describe the application of PID control using a PLC for water quality control ● And explain analog I/O verification.

Mechanical Skills Series

Air Compressor Repair Library (2 CD's)
4-8 hours of training
This comprehensive interactive multimedia-training program consists of two lessons individual lesson CD's that train participants to understand, disassemble, inspect, troubleshoot, and repair reciprocating air compressors.
Audience: This course is excellent for all levels of maintenance personnel as well as for the multi-craft training needs of process and manufacturing facilities.

Reciprocating Air Compressors: Principles and Troubleshooting (A9001)
Prerequisites: This lesson is designed for participants familiar with the basic operation of reciprocating air compressors.
Description: This lesson explains the normal operating conditions for a reciprocating air compressor. The lesson also focuses on how to troubleshoot typical compressor problems such as knocking, failure to unload, and excessive discharge temperature.
Objectives: Gather necessary information and perform operational checks to determine the cause of common reciprocating air compressor malfunctions.

Reciprocating Air Compressors: Disassembly, Inspection, and Reassembly (A9002)
Prerequisites: This lesson is designed for participants familiar with the basic principles of operation for reciprocating air compressors.
Description: This lesson demonstrates how to disassemble, inspect, and repair various components of a reciprocating compressor. Included in this lesson are the maintenance procedures for discharge valves, suction valves, unloaders, and cylinders and pistons. Additionally, the lesson covers disassembly, inspection, and repair as well as the reinstallation of the components.

Objectives: Remove, disassemble, clean, repair, and reassemble a discharge valve in a compressor ● Remove, disassemble, reassemble, and install a suction valve in a compressor ● Remove the compressor inspection covers, the cylinder head, and the piston; and inspect component parts and reinstall them properly.

Bearings – Reducing Failure Rate Library (2 CD's)

4-8 hours of training

This comprehensive interactive multimedia-training program consists of two individual lesson CD's that train participants remove, inspect, select, handle, install, and troubleshoot bearings according to manufacturers' instructions and best practices. Participants learn how to identify replacement bearings and install and maintain the bearings properly using the right tools.

Audience: This program is excellent for training mechanics and millwrights as well as for the multi-craft needs of process and manufacturing facilities.

Failure Analysis (A8101)

Prerequisites: This lesson is designed for participants familiar with safe shop practices and the use of hand tools and precision measuring instruments.

Description: This lesson explains the purpose of bearings and demonstrates how bearings reduce friction and maintain the alignment of operating equipment. The basic operation of anti-friction bearings and plain journal bearings is demonstrated as well as the importance of full fluid film lubrication and proper lubrication clearance. Additionally, indications of various premature bearing failures are discussed.

Objectives: Understand how bearings reduce friction ● Describe radial, axial (thrust), and angular load in terms of the pressure applied to the shaft and bearing ● Understand the operation of common types of plain bearings and their applications ● Understand the operation of common types of anti-friction bearings and their applications ● Understand the purpose of seals and shields and the conditions when each is used ● Relate the "interference fit" to bearing operation ● Recognize common indications of bearing failure ● Identify common types of premature bearing failure and some of the means used to prevent them.

Maintaining Bearings (A8102)

Prerequisites: This lesson is designed for participants familiar with safe shop practices, the use of hand tools and precision measuring devices, as well as bearings failure analysis.

Description: This lesson explains and demonstrates how to clean and disassemble bearing housings and how to dismount, inspect, and mount common types of bearings. The importance of cleanliness and following manufacturers' instructions are stressed throughout each demonstrated procedure.

Objectives: Dismount anti-friction bearings using a bearing press and/or a bearing puller ● Inspect the bearing for signs of failure ● Clean the shaft and check for taper and out-of-round using the proper measuring instruments ● Clean the housing and check for damage ● Select the proper bearing for replacement, if necessary ● Properly orient a bearing prior to installation ● Mount a bearing using an induction heater and/or an arbor press ● Measure the bearing's inner and outer clearances during installation ● Properly lubricate bearings per manufacturers' recommendations.

Centrifugal Pump Repair Library (2 CD's)

4-8 hours of training

This comprehensive interactive multimedia-training program consists of two individual lesson CD's that train participants to disassemble, inspect, troubleshoot, and repair centrifugal pumps.

Audience: This program is excellent for all levels of maintenance personnel as well as for the multi-craft training needs of process and manufacturing facilities.

Principles and Troubleshooting (A8901)

Prerequisites: This lesson is designed for participants familiar with the basic operation of centrifugal pumps. A familiarity with the relationship between flow rate and pressure is also required.

Description: This lesson introduces the components and operating principles of a typical centrifugal pump. Normal operating conditions for the pump are described and guidelines for troubleshooting excessive leakage, excessive temperature, and loss of capacity/loss of head are provided.

Objectives: Identify and describe the functions of a centrifugal pump in a system and its components ● Recognize causes and symptoms of excessive leakage, excessive temperature, and loss of capacity/loss of head ● Explain how pressure, flow rate, and temperature are affected by the system in which the pump operates.

Disassembly, Inspection, and Reassembly (A8902)
Prerequisites: This lesson is designed for participants familiar with the basic principles of operation for centrifugal pumps. A familiarity with troubleshooting procedures as well as the proper use of hand tools and precision measuring instruments is required. Additionally, a familiarity with mechanical seals is recommended.
Description: This lesson demonstrates how to disassemble, inspect, and reassemble a typical end-suction pump. The locations and functions of pump components are described as well as procedures for measuring and inspecting pump parts, and the steps for checking impeller clearance. General guidelines for installing a mechanical seal are also provided.
Objectives: Disassemble an end-suction pump; inspect the components of a centrifugal pump ● Measure the bearing seat on the shaft ● Measure shaft runout ● Reassemble an end-suction pump; check impeller clearance ● Calculate the thickness of shims needed to correct impeller clearance ● Determine the gasket size needed in the bearing end cap ● Install a mechanical seal.

Hand Tools and Measuring Instruments Library (2 CD's)

4-8 hours of training
This comprehensive award-winning interactive multimedia-training program consists of two individual lesson CD's that train participants to properly use a variety of hand tools and precision measuring instruments.
Audience: This program is excellent for employees in all disciplines as well as for the multi-craft training needs of process and manufacturing facilities.

Hand Tools (A8601)
Prerequisites: This lesson is designed so that no prior knowledge is required.
Description: This lesson introduces and demonstrates the proper use of hand tools for holding, turning, and striking. This lesson also describes situations that require the use of each type of tool.
Objectives: Improve their on-the-job performance through the proper use of vises, c-clamps, pliers, screwdrivers, non-adjustable wrenches, socket wrenches, torque wrenches, and hammers.

Precision Measuring Instruments (A8602)
Prerequisites: In order to successfully complete his lesson, participants should be familiar with whole number operations and decimals.
Description: This lesson describes the purpose and the basic components of dial calipers, outside micrometers, inside micrometers, depth micrometers, telescoping gauges, thickness gauges, and dial indicators. The lesson also provides procedures for properly using each of these instruments to measure the dimensions of an object.
Objectives: Better obtain inside and outside measurements using a dial caliper ● Measure outside dimension using an outside micrometer ● Measure inside dimension using an inside micrometer ● Measure depth by using a depth micrometer ● Measure the inside diameter by using a telescoping gauge in conjunction with an outside micrometer ● Measure a clearance with a thickness gauge ● And measure small changes in dimension by using a dial indicator.

Industrial Hydraulic Power Library (5 CD's)

10-20 hours of training
This comprehensive interactive multimedia-training program consists of five individual lesson CD's that train participants to identify system components, read schematics, and understand the conditions necessary for proper operation of a hydraulic system.
Audience: This program is excellent for the training of mechanics, electricians, and operators as well as for the multi-craft training needs of process and manufacturing facilities.

Hydraulic System Operation (A9501)
Prerequisites: This lesson is designed so that no prior knowledge is required. However, a knowledge of basic mathematical skills is recommended.

Description: This lesson covers the components of hydraulic systems and explains how the components function together to operate a hydraulic system. Interpretation of hydraulic schematics is also taught in this lesson.
Objectives: Visually identify and describe the function of each basic component in an industrial hydraulic system ● Use Pascal's Law ● Interpret hydraulic schematics ● Identify transmission of power and flow path through the system ● Understand the stages of power transmission through a hydraulic system ● Identify and describe the function(s) of hydraulic reservoirs and their components ● Identify common indications of malfunctions in hydraulic piping and connectors ● Identify safety considerations for working with system hydraulics.

Hydraulic Pumps, Pumping Principles, and Accumulators (A9502)
Prerequisites: This lesson is designed for participants who are familiar with the basic operating principles of hydraulic systems, the stages of power transfer through a hydraulic system, hydraulic schematics, and basic hydraulic safety considerations.
Description: This lesson covers hydraulic pumps and accumulators. The lesson shows and explains the functions of pumps in hydraulic systems and the operating principles of different types of pumps. Common maintenance procedures performed on pumps, procedures for inspecting and monitoring pump efficiency, operating principles of different types of accumulators, common maintenance procedures, and precharging accumulators are also covered.
Objectives: Describe the operation of positive and non-positive displacement pumps ● Calculate the actual flow rate and the volumetric efficiency ● Recognize symptoms of pump malfunction ● Identify the components and principles of operation for fixed and variable volume vane pumps as well as bent axis and axial piston pumps ● Describe the function of accumulators.

Pressure Controls (A9503)
Prerequisites: This lesson is designed for participants who are familiar with the basic operating principles of hydraulic systems, hydraulic schematics, hydraulic pumps, and basic hydraulic safety considerations.
Description: This lesson covers types of pressure control valves, their functions in hydraulic systems and some of their applications. The lesson discusses the principles of hydraulic pressure control with specific applications of check valves, pressure relief valves, direct-acting valves, pilot operated valves, normally-open valves, unloading valves, counterbalance valves, sequence valves, and pressure reducing valves.
Objectives: Explain the operation and applications of pilot-operated pressure control valves, normally-open pressure control valves, unloading pressure control valves, counterbalance valves, pressure control valves in sequencing operations as well as pressure control valves in pressure reducing circuits.

Directional and Flow Controls (A9504)
Prerequisites: This lesson is designed for participants who are familiar with the basic operating principles of hydraulic systems, the stages of power transfer through a hydraulic system, hydraulic schematics, hydraulic pumps, and basic hydraulic safety considerations.
Description: This lesson covers types of directional control valves and flow control valves, their functions in a hydraulic system, and some of their applications. This lesson shows four-way, three-position directional control valves and explains different ways they can be centered, actuated, piloted, and drained. This lesson also covers different flow control valve designs and explains how pressure differential affects flow.
Objectives: Identify functions of ports on a directional control valve ● Trace various flow paths through a directional control valve on a system schematic ● Describe the type of actuators used with directional control valves ● Explain how changing flow rate affects the performance of the actuator ● Identify functions of ports on a flow control valve ● Describe the operation of various valves, including a needle valve, pressure-compensated flow control valve, and a check valve ● Describe the operation of meter-in and meter-out circuits.

Hydraulic Actuators (A9505)
Prerequisites: This lesson is designed for participants who are familiar with the basic operating principles of hydraulic systems, hydraulic schematics, flow and pressure controls, and basic hydraulic safety considerations. An understanding of hydraulic pumps, pressure controls, and directional and flow controls is also necessary.
Description: This lesson discusses the designs, operating principles, and maintenance of hydraulic cylinders and hydraulic motors. The lesson shows and explains pressure and flow requirements for hydraulic cylinders and hydraulic motor performance. Test procedures for checking internal leakage in a cylinder are also demonstrated.
Objectives: Calculate electrical horsepower and piston speed ● Describe the operation of single-acting, double-acting, and non-differential cylinders as well as the operation of cylinders controlled by regulating flow or pressure

● Identify schematic symbols ● Describe the operation of unidirectional and bi-directional motors, hydraulic pumps, hydraulic gear motors, hydraulic piston motors, hydrostatic drive circuits, braking circuits, and meter-in circuits.

Industrial Lubrication Library (2 CD's)

4-8 hours of training

This comprehensive interactive multimedia-training program, consisting of two lessons, trains participants to recognize various types of lubrication systems and their maintenance requirements, including ring, bath, splash, constant level, and forced feed lubrication systems, as well as understand how they operate. Participants also learn the importance of following lubrication schedules, how to change common types of oil filters, and how to properly handle and store lubricants to prevent lubricant contamination.

Audience: This program is excellent for training oilers, mechanics, and millwrights as well as for the multi-craft needs of process and manufacturing facilities.

Fundamentals of Lubrication (A8401)

Prerequisites: This lesson is designed so that no prior knowledge is required. However, a know-ledge of applied mathematics is recommended.

Description: This lesson explains the concepts of lubrication, friction, and viscosity and demonstrates the benefits of a proper lubrication program. Additionally, the properties of common solid, semi-solid, and liquid lubricants are described as well as the benefits associated with synthetic lubricants and the functions of additives and inhibitors. Common types and causes of lubricant contamination are described and proper methods of lubricant storage are demonstrated.

Objectives: Define lubrication ● Explain the benefits of a proper lubrication program ● Define friction ● Identify factors that contribute to friction ● Identify the three basic types of friction ● Describe three types of lubrication applications used to reduce friction ● Define viscosity ● Describe three types of liquid lubricants and some typical applications ● Describe the properties of liquid lubricants ● Describe types of semi-solid lubricants and some typical applications ● Describe conditions or circumstances under which it would be preferable to use grease as a lubricant ● Describe the properties of semi-solid lubricants ● Describe types of solid lubricants and some typical applications ● Describe the properties of solid lubricants ● Identify some of the benefits of using synthetic lubricants ● Explain the function of additives and inhibitors ● Describe types of lubricant contamination ● Describe how to prevent lubricant contamination ● Describe proper methods of lubricant storage.

Lubrication Maintenance (A8402)

Prerequisites: This lesson is designed for participants familiar with the fundamentals of lubrication. A knowledge of applied mathematics is recommended.

Description: This lesson explains and demonstrates how various types of lubrication systems operate, including ring, bath, splash, constant level and forced feed lubrication systems. Participants learn pertinent maintenance checks to make for each type of system. Manual devices used to apply lubricant are covered as well as the purpose of filters and the importance of filter maintenance in lubrication systems. Additionally, the lesson indicates the benefits of oil sampling and analysis and identifies several factors that can cause lubrication failure.

Objectives: Explain how ring lubrication systems operate ● Explain how bath lubrication systems operate ● Explain how splash lubrication systems operate ● Explain how constant level lubrication systems operate ● Perform a check on a natural feed lubrication system and determine machine condition ● Describe how to add oil to a natural feed lubrication system ● Describe the operation of forced feed lubrication systems ● Explain the differences between natural feed and forced feed lubrication systems ● Perform a check on a forced feed lubrication system and determine machine condition ● Identify various devices used to apply lubrication manually ● Describe how to apply the proper amount of grease to a bearing ● Explain the purpose of filters in a lubrication system ● Explain the differences between surface filters and depth-type filters ● Explain why filter maintenance is important ● Recognize indications that a filter must be cleaned or replaced ● Describe how to clean a filter ● Explain the benefits of following a lubrication schedule ● Interpret information on a lubrication schedule ● Explain the benefits of oil sampling and analysis.

Mechanical Seals Library (1 CD)

2-4 hours of training

This comprehensive interactive multimedia-training program consists of one lesson that trains participants to work effectively with mechanical seals. The functions, operation, and repair of common mechanical seals are demonstrated.
Audience: This program is excellent for all levels of maintenance personnel as well as for the multi-craft training needs of process and manufacturing facilities.

Mechanical Seals (A9801)
Prerequisites: This lesson is designed for participants familiar with the basic operation and maintenance of pumps and other rotating equipment.
Description: This lesson covers the features, operation, and applications associated with three common types of mechanical seals: single, double, and cartridge. The lesson presents specific procedures for failure analysis and identification, seal removal, disassembly, reassembly, and installation.
Objectives: Identify the basic components of a mechanical seal ● Identify sealing points and applications in which packing is installed to control process leakage as well as the types of materials commonly used to make seal faces and elastomers ● Select the appropriate seal design for a specific type of application ● Verify the compatibility of seal materials with the process fluids for a particular application ● Perform a failure analysis to determine the cause of seal failure and to identify the means to correct the problem ● Remove and disassemble a failed mechanical seal ● Remove and replace the o-rings on a mechanical seal ● Perform the preliminary checks prior to seal installation ● Reassemble and install a new or repaired mechanical seal.

Pipefitting Library (4 CD's)
8-16 hours of training
This comprehensive interactive multimedia-training program consists of four lessons that train participants to select, measure, cut, and install piping properly. Blueprint reading is also included.
Audience: This program is excellent both for the training of maintenance personnel as well as for the multi-craft training needs of process and manufacturing facilities.

Pipefitting Materials and Layout (A8801)
Prerequisites: This lesson is designed so that no prior knowledge is required.
Description: This lesson explains the different characteristics of piping systems. The lesson also shows how to read blueprints, how to conduct a field check, and how to measure pipe for installation. Methods of cutting pipe are also included.
Objectives: Identify different types of pipes and explain how they are sized ● Explain why different pipes are used in different systems ● Read single-line and double-line blueprints ● Read isometric and orthographic projection blueprints ● Make a field check of the piping system ● Find the end-to-end measurement of a pipe ● Measure makeup and take-out ● Identify and describe the various tools used to cut pipe ● Choose the correct tool for cutting pipes of different materials and sizes ● Choose the correct tool for cutting different types of piping.

Tubing and Threaded Pipe (A8802)
Prerequisites: This lesson is designed for participants familiar with the proper use of hand tools and precision measuring instruments. A knowledge of pipefitting materials and layout is also required.
Description: This lesson shows how to cut and bend tubing, use tubing fittings, cut and thread pipe, and use pipefittings. Information on the sequence of steps involved in each procedure, as well as information on using the necessary tools, is also provided.
Objectives: Identify the correct size tubing for the job ● Cut tubing to the proper size for a job ● Use a mandrel bender to bend tubing ● Assemble a compression fitting ● Use a flaring tool to flare tubing ● Inspect a flared fitting for damage ● Use a tubing cutter to cut tubing ● Use a wheel and roller cutter to cut pipe ● Use a reamer to ream tubing and piping ● Cut threads on a pipe ● Assemble a union fitting on threaded pipe.

Preparing Piping for Installation (A8803)
Prerequisites: This lesson is designed for participants familiar with the proper use of hand tools and precision measuring instruments. A knowledge of pipefitting materials, layout, tubing, and threaded pipe is also required.
Description: This lesson shows how to set up and use an automatic cutting torch, hot to prepare a pipe end using an end preparation tool, and how to align components for a socket weld joint and butt weld joint. Information on the

sequence of the steps involved in each procedure, as well as information on using the necessary tools, is also provided.
Objectives: Set up an automatic cutting torch ● Adjust the flame on an automatic cutting torch ● Cut pipe using an automatic cutting torch ● Identify the components of an end preparation tool ● Install an end preparation tool on a pipe ● Use an end preparation tool to machine pipe ends ● Align a butt weld joint ● Align a socket weld joint.

Lagging and Insulation (A8804)
Prerequisites: This lesson is designed for participants familiar with the proper use of hand tools and precision measuring instruments. A familiarity with pipefitting materials, layout, tubing, threaded pipe and the preparation for piping installation is also required.
Description: This lesson shows and explains the procedures for measuring and cutting block insulation for piping elbows and flanges, for installing the insulation, and for covering the insulation. The lesson includes information on the sequence in which the steps should be performed, as well as the materials needed for each step.
Objectives: Calculate the size of each piece of insulation needed for a piping elbow ● Mark and cut block insulation for a piping elbow ● Install block insulation on a piping elbow ● Cement the piping elbow insulation ● Measure the amount of insulation needed for a flange ● Score flange insulation so it will fit snugly on the flange ● Install block insulation on a flange ● Cement the flange insulation ● Measure and cut the insulation cloth covering ● Install cloth covering on piping elbows and flanges.

Pneumatic Power Library (1 CD)
2-4 hours of training
This comprehensive interactive multimedia-training program consists of one lesson that trains participants to identify system components, read schematics, and understand the conditions necessary for the proper operation of a pneumatic system.
Audience: This program is excellent for training mechanics, electricians, and operators as well as for the multi-craft needs of process and manufacturing facilities.

Pneumatic Air Treatment (A7401)
Prerequisites: This lesson is designed so that no prior knowledge is required. However, a knowledge of basic mathematical operations is recommended.
Description: This lesson is designed to provide an overview of pneumatic systems and how pneumatic components relate to produce useful work output as well as explain how system components function and the conditions necessary for proper pneumatic system operation.
Objectives: Describe the purpose of pneumatic power ● Differentiate between pneumatic and hydraulic power ● Describe why pneumatic power is used for certain applications ● Define the laws that relate to pneumatic power ● Identify pneumatic schematic symbols ● Describe the effects of moisture on a pneumatic system ● Define dew point ● Describe how temperature and pressure affect dew point ● Describe the purpose of an aftercooler ● Describe how refrigeration, regenerative and deliquescent dryers remove moisture from compressed air ● Describe how system piping is designed to control moisture ● Describe the importance of filters in a pneumatic system ● Describe how filters are rated ● Describe the design and use of surface and depth filters ● Describe the purpose and operation of a filter-separator ● Discuss the purpose of manual and automatic drain valves ● Describe the purpose of a regulator ● Describe potential regulator problems ● Describe the purpose of a lubricator ● Describe the purpose and advantages of an FRL ● Describe the purpose of a compressor ● Describe the purpose of a receiver.

Rigging and Lifting Library (3 CD's)
6-12 hours of training
This comprehensive interactive multimedia-training program consists of three lessons that train participants to use rigging and lifting equipment safely. The proper use of forklifts and cranes is also covered.
Audience: This program is excellent for every employee in all disciplines.

Hand Operated Equipment (A8701)
Prerequisites: This lesson is designed so that no prior knowledge is required.

Description: This lesson shows how to prepare for and carry out a lift using a hand-operated hoist. The lesson describes different types of lifting equipment and when each type would be used. The lesson also focuses on procedures for planning a lift, inspecting equipment, and performing a lift.
Objectives: Identify and explain the operation of different types of hand-operated hoists ● Identify and explain the function of components on the different hoists, including hooks, shackles, slings and eyebolts ● Plan a lift using a hand-operated hoist ● Inspect hoists, wire rope slings, man-made fiber slings, trolley, shackles, eyebolts, and other related equipment ● Install necessary equipment ● Perform a lift ● Invert a load using two chain hoists.

Forklifts and Cranes (A8702)
Prerequisites: This lesson is designed so that no prior knowledge is required. However, a familiarity with the basic operation of forklifts and mobile cranes is recommended.
Description: This lesson provides procedures for the safe and efficient operation of forklifts and mobile cranes. The lesson covers specific aspects of operation such as inspections before use and communication during operation, as well as the actual steps involved in lifting and moving loads.
Objectives: Perform a visual inspection and an operational check of a forklift ● Safely maneuver a forklift indoors ● Properly unload, lift, stack, and unstack pallets ● Perform static and operational inspections of a mobile crane ● Properly use and interpret signals when operating a mobile crane ● Determine the load limit for a boom extension and angle by using load limit and angle charts ● Describe the procedures involved in performing a lifting operation with a mobile crane.

Ladders and Scaffolding (A8703)
Prerequisites: This lesson is designed so that no prior knowledge is required.
Description: This lesson explains how to select, inspect, and safely use both ladders and scaffolding. The lesson focuses on the application and safe use of single, extension, and stepladders in addition to the procedures for assembling tubular welded frame scaffolding.
Objectives: Identify the components of a single, extension, and stepladder ● Select the correct ladder taking length, weight, and type of material into account ● Inspect ladders ● Determine the correct angle to set the base ● Raise and lower ladders according to safety procedures ● Inspect and assemble tubular welded frame scaffolding.

Rotating Equipment Predictive Maintenance and Alignment Library (7 CD's)
14-28 hours of training
This comprehensive interactive multimedia-training program consists of seven individual lesson CD's that train participants to use predictive maintenance as a tool for prolonging equipment life and preventing major problems.
Audience: This program is excellent both for the training of maintenance personnel and equipment operators as well as for the multi-craft training needs of process and manufacturing facilities.

Principles and Practices of Predictive Maintenance (A8301)
Prerequisites: This lesson is designed so that no prior knowledge is required.
Description: This lesson focuses on the general purpose of an effective predictive maintenance program by showing how methods such as vibration analysis, and lubricant and trend analysis can be used to determine equipment condition and predict equipment life.
Objectives: Define predictive maintenance and differentiate it from other approaches such as run-to-failure and preventive maintenance ● Describe the benefits of predictive maintenance ● Describe how equipment vibration can provide an indication of equipment condition ● Describe how impurities in equipment lubricant can provide an indication of the condition of the components being lubricated ● Describe how trends reflected in equipment records can provide an indication of equipment condition ● Describe some basic guidelines for a successful predictive maintenance program.

Vibration Analysis (A8302)
Prerequisites: This lesson is designed for participants familiar with the basic principles and practices of predictive maintenance.
Description: This lesson teaches how to monitor vibration and perform a vibration analysis. The lesson also covers how to determine velocity and displacement as well as how to use a vibration analyzer and interpret various vibration patterns.

Objectives: Identify two measures of vibration amplitude and the units of measurements used ● Identify the points on a bearing where horizontal, vertical, and axial readings would be taken ● Use a severity chart to get an indication of machine condition ● Define amplitude and frequency ● Identify the function of three filter settings on a vibration analyzer ● Recognize the characteristics of vibration produced by conditions such as unbalance, misalignment, mechanical looseness, worn gears, and anti-friction bearings.

Lubricant and Trend Analysis (A8303)
Prerequisites: This lesson is designed for participants familiar with the basic principles and practices of predictive maintenance.
Description: This lesson introduces the principles of lubricant and trend analysis. The lesson shows how to take oil samples and read an oil analysis report as well as how to identify and interpret trends.
Objectives: Take an oil sample at a sampling valve and reservoir ● Determine where to take a sample to check the condition of a particular component ● Use operating data to establish trends in machine condition ● Identify increasing, decreasing and flat trends ● Compare trends using different data from the same machine.

Techniques for Extending Bearing Life (A8304)
Prerequisites: This lesson is designed for participants familiar with the components and functions of bearings in relation to rotating equipment as well as with the procedures for installing bearings. A basic understanding of the principles and practices of predictive maintenance is also required.
Description: This lesson presents guidelines for maximizing the operational life of bearings for rotating equipment. The lesson emphasizes the proper handling, storage, installation, and maintenance of bearings.
Objectives: Describe proper handling and storage procedures for bearings ● Obtain readings on the outside diameter of the shaft and inside diameter of the housing ● Determine proper fit ● Describe two types of bearing lubrication ● Identify three potential areas of lubrication contamination ● Identify symptoms and possible causes of bearing problems.

Principles of Reverse Double Dial Alignment (A8305)
Prerequisites: This lesson is designed for participants familiar with precision measuring instruments, specifically dial indicators. A basic understanding of the principles and practices of predictive maintenance is also required.
Description: This lesson describes the principles of the reverse double dial alignment method used to measure and correct misalignment. The lesson also explains the data needed to determine offset and angularity misalignment values by using a graph. Formulas used to calculate misalignment corrections and factors that may affect alignment are also presented.
Objectives: Identify three types of misalignment found in most rotating equipment ● Distinguish vertical plane from horizontal plane ● Identify the parts of the alignment rig and explain how they work ● Convert sweep reading to offset values ● Plot indicator offset values on a graph to find angular and offset misalignment values ● Read specifications correctly ● Perform calculations to determine how far and in which direction to move the machine.

Reverse Double Dial Alignment (A8306)
Prerequisites: This lesson is designed for participants familiar with precision measuring instruments, specifically dial indicators, and the principles of reverse double dial alignment. A basic understanding of the principles and practices of predictive maintenance is also required.
Description: This lesson shows how to use the reverse double dial alignment procedure to determine and correct misalignment as well as how to take dial indicator readings. The lesson also teaches how to calculate the necessary vertical and horizontal adjustments and how to verify the results. Emphasis is on good record keeping, the importance of accurately reading the dial indicators, and performing the calculations correctly to ensure that proper alignment is achieved.
Objectives: Measure bracket sag and other dimensions necessary to calculate misalignment v Mount an alignment rig correctly on two shafts ● Take a set of sweep readings ● Determine if misalignment exists between two rotating shafts joined by coupling ● Calculate the distance to move a machine to correct vertical misalignment ● Shim a machine to correct vertical misalignment ● Determine horizontal misalignment ● Calculate the distance to move a machine to correct horizontal misalignment ● Verify that equipment is aligned within specifications.

Computerized and Laser Alignment (A8307)
Prerequisites: This lesson is designed for participants familiar with the components and functions of bearings in relation to rotating equipment as well as with the procedures for installing bearings. A basic understanding of the principles and practices of predictive maintenance is also required.
Description: This lesson explains how to determine a computer's specifications and introduces proper steps to take in correcting misalignment with the use of a laser.
Objectives: Take and then enter alignment measurements required by a computer ● Use a computer to calculate offset and angular misalignment values in the horizontal and vertical planes to determine if a machine is within specification ● Determine the amount and direction to move the machine to correct misalignment ● Identify the components of a laser/detector system and properly set up the equipment ● Take measurements necessary for the laser alignment system ● Use the laser/detector system to calculate angular and offset misalignment in vertical and horizontal planes ● Position the machine properly by using the laser.

Statistical Process Control Library (7 CD's)

14-28 hours of training
This comprehensive interactive multimedia-training program consists of seven individual lesson CD's that train participants to use statistical process control as a means of improving a process. The use of several common types of control charts is included.
Audience: This program is excellent for every employee in all disciplines.

Introduction to Statistical Process Control (A8501)
Prerequisites: This lesson is designed so that no prior knowledge is required. However, a knowledge of basic mathematical skills is recommended.
Description: This lesson introduces statistical process control (SPC) as a prevention method used to reduce quality costs. The lesson explains variability and shows how to construct a histogram to represent it. The normal curve is described as well as its probability and relevance to the philosophy of never-ending improvement.
Objectives: Explain the difference between prevention and detection systems ● Define statistical process control and quality as it relates to SPC ● Describe the various classifications of quality costs and discuss their relevance to SPC ● Describe the concept of variation ● Generate frequency charts and histograms ● Apply basic SPC terminology such as variable, attribute, class width, and frequency ● Describe what is meant by probability ● Show how normal curves can represent measured quantities.

Introduction to Control Charts (A8502)
Prerequisites: This lesson is designed for participants familiar with the basics of statistical process control. A knowledge of basic mathematical skills is recommended.
Description: This lesson introduces control charts and shows how to plot specific values on the control chart. The lesson also demonstrates how to determine and plot the mean, median, and range on a control chart.
Objectives: Explain the use of common elements of a control chart ● Explain the two ways in which a process curve can change and describe the measures that are used to monitor those changes ● Calculate and plot the mean using values with decimal points, both positive and negative numbers, and a scale marked either with actual values or increments above and below zero ● Determine and plot the median ● Calculate and plot the range using values with decimal points, and positive and negative numbers ● Explain the difference between common and special causes of variations.

Control Charts for Variables (A8503)
Prerequisites: This lesson is designed for participants familiar with the principles of statistical process control, the basic components of control charts, and the characteristics of a normal curve. A knowledge of basic mathematical skills is recommended.
Description: This lesson explains how to interpret variable control charts in order to determine whether or not a process is in statistical control. The lesson introduces the concept of performance-based limits for process control and presents basic guidelines for proper sampling. In addition, the principles for interpreting control charts are presented.
Objectives: Identify variables ● Explain how the control limits for a process are related to a normal curve ● Explain how the central line may be identified for mean, median, and range charts ● Identify the criteria of good sampling

practice ● Identify a random pattern of values using the 2/3 rule ● Identify three different types of non-random patterns and interpret their meaning ● Explain when a non-random pattern may be a sign of process improvement.

Control Charts for Attributes (A8504)
Prerequisites: This lesson is designed for participants who are familiar with the basics of statistical process control, the basic components of control charts, the characteristics of a normal curve, and control charts for variables. A knowledge of basic mathematical skills is recommended.
Description: This lesson discusses principles of attribute control charts and shows how to plot and interpret various control charts for attributes, including p, np, u, c, and multiple characteristic charts.
Objectives: Identify nonconformities ● Recognize the different sections of an attribute control chart and explain their purpose ● Describe the information that is contained in each section of an attribute control chart ● Describe proper sampling procedures for attributes using assigned data ● Complete p, np, u, c, and characteristic charts ● Interpret an attribute control chart for statistical control ● Identify three different non-random patterns and interpret their meaning.

Advanced Control Charts (A8505)
Prerequisites: This lesson is designed for participants familiar with the principles of statistical process control as well as control charts for variables and attributes. A knowledge of basic mathematical skills is recommended.
Description: This lesson explains how to calculate the control limits for variable and attribute control charts. The lesson also shows how to construct and interpret cusum charts in order to improve process performance.
Objectives: Calculate the standard deviation and control limits for mean variable control charts including mean and median range charts, and p, np, u, and c charts ● Define local mean ● Interpret a cusum chart for statistical control.

Machine and Process Capability Studies (A8506)
Prerequisites: This lesson is designed for participants familiar with the principles of statistical process control, the function and components of a control chart, and procedures for collecting sample process data. An understanding of the concepts of control limits, specification limits, standard deviation, and the characteristics of a normal curve is also required. A knowledge of basic mathematical skills is recommended.
Description: This lesson explains the purpose and procedures for performing machine and process capability studies. The lesson shows how to complete and interpret machine capability charts and how to perform a process capability study as well as how to calculate a capability index for a machine and a process.
Objectives: Define capability for a machine and a process ● Explain the purpose of machine and process capability studies ● Perform a machine capability study using a capability chart ● Interpret a machine capability graph using the specification limits as guidelines ● Perform a process capability study ● Calculate two different process capability indices for machines and processes.

Problem Solving Techniques (A8507)
Prerequisites: This lesson is designed for participants familiar with the principles of statistical process control as well as the interpretation and extraction of data from tally charts, plant records, and control charts. Basic mathematical skills and graphing techniques are also required.
Description: This lesson covers several problem-solving techniques including brainstorming, Pareto diagrams, cause and effect diagrams, and scatter diagrams. The lesson focuses on how to collect data and display it graphically as well as how to apply graphic tools to problem solving.
Objectives: Construct a Pareto diagram from data provided by tally charts, plant records, and control charts ● Define the Pareto principle of 80/20 rule ● Calculate the cumulative frequencies and percentages of defect categories and plot them on a Pareto diagram ● Construct a cause and effect diagram ● Extend a fishbone diagram through logical backward analysis of a cause ● Distinguish between dependent and independent variables ● Construct a scatter diagram as well as interpret it for relationships between variables.

Troubleshooting Skills Library (1 CD)
This comprehensive interactive multimedia-program, consisting of one lesson, teaches strategic troubleshooting skills that can be applied to the analysis of problems in any type of industrial system.
Audience: This program is excellent for training instrument technicians, electricians and electronics technicians, mechanics and millwrights as well as for the multi-craft needs of process and manufacturing facilities.

Developing Troubleshooting Skills (A7501)
Prerequisites: This lesson is designed so that no prior knowledge is required.
Description: This lesson teaches participants how to develop logical thinking and create a personal troubleshooting outlook that will prove valuable under any troubleshooting situation.
Objectives: Define root cause problem solving ● Define trouble-shooting ● Describe the basic steps involved in a general troubleshooting procedure ● Describe how to obtain information about a malfunctioning system ● Explain the importance of comparing the symptoms of a problem to the characteristics for normal operation ● Describe sources of information concerning normal operations ● Describe sources of information concerning the background of a problem ● State the relationship between a symptom and a cause ● Describe how to develop a trouble-shooting plan ● Describe the importance of using schematics while troubleshooting ● Describe steps necessary to repair the problem ● Describe steps that can be taken to prevent future trouble ● Explain the importance of a troubleshooting outlook ● Describe how to troubleshoot under pressure ● Describe the importance of experience in troubleshooting.

Valve Repair Library (2 CD's)
4-8 hours of training
This comprehensive interactive multimedia-training program consists of two individual lesson CD's that train participants to disassemble, inspect, and repair gate, globe, and control valves.
Audience: This program is excellent both for the training of maintenance personnel and equipment operators as well as for the multi-craft training needs of process and manufacturing facilities.

Gate Valve Repair (A9101)
Prerequisites: This lesson is designed for participants familiar with the operation of gate valves and the proper use of hand tools and precision measuring instruments.
Description: This lesson addresses the procedures for disassembly, inspection, and reassembly of a typical gate valve. The lesson covers the locations and functions of valve components. Procedures for disassembling, inspecting, and measuring valve parts and procedures for lapping the disc and checking seat contact are also covered.
Objectives: Identify the parts of a gate valve and describe their functions ● Inspect a valve and make adjustments to stop leakage ● Position rising stem and non-rising stem valves to the half-open position ● Remove and disassemble the bonnet assembly of a gate valve ● Use a telescoping gauge to determine if a stuffing box is round ● Perform a runout to determine if a stem is bent ● Use an outside micrometer to determine if the stem has excessive wear ● Lap a disc and perform a contact check of disc mating surfaces ● Reassemble the bonnet assembly of a gate valve ● Perform a contact check to determine if there is a proper seal between the seat and disc of a gate valve.

Globe and Control Valve Repair (A9102)
Prerequisites: This lesson is designed for participants familiar with the basic operation of globe and control valves and the proper use of hand tools and precision measuring instruments.
Description: This lesson provides guidelines for repairing globe and control valves including procedures for disassembling, inspecting, and reassembling both globe and control valves.
Objectives: Identify the basic components of a typical globe valve ● Disassemble and inspect a globe valve for damage ● Describe what lapping is and explain when it is used ● Complete a dye check ● Reassemble a globe valve ● Identify the basic components of a typical control valve ● Disassemble and inspect a control valve for damage ● Reassemble a control valve.

Instrumentation Series

Analyzers Library (5 CD's)
20-30 hours of training
This comprehensive INVOLVE® multimedia-training program was produced in association with the Instrument Society of America USA. This five individual lesson CD's program trains participants in Me principles of process analysis and Me operation and applications associated with spectroscopic, electrochemical, and chromatographic analyzers.
Audience: This program is excellent for training instrument technicians as well as for the multi-craft training needs of process and manufacturing.

Principles of Process Analysis (AAS01)
Prerequisites: This lesson is designed for participants with an understanding of industrial process control. Participants should also have a basic understanding of chemistry and physics.
Description: This lesson introduces participants to the principles of process analysis. The advantages of process analysis for industry are discussed and the scientific principles of the various process analysis methods, such as spectrometry, chromatography, electrochemical and physical property analysis are described.
Objectives: Describe the concept of process analysis ● Distinguish between process and laboratory analysis ● Describe how process analysis aids in conforming to environmental and regulatory policy as well as safety and loss prevention standards ● Understand safe and effective process analyzer use ● Describe the principles of thermal conductivity analysis, combustible gas detection, electrical conductance analysis, electrochemical analysis, zirconium ● Oxide oxygen detection, ph analysis, opacity analysis, and spectrometric analysis ● Explain the beer-lambert law ● Identify the means of measuring density in fluids ● Identify the methods to measure moisture in fluids ● Describe how moisture is measured in gases and liquids using the electrolytic method, the piezoelectric method, and the aluminum gas method ● Describe the principles of gas chromatography and mass spectrometry ● Explain the methods.

Spectroscopic Analyzers (AAS02)
Prerequisites: This lesson is designed for participants familiar with industrial process control and process analysis. Participants should also have a basic understanding of chemistry and physics.
Description: This lesson introduces participants to spectroscopic analyzers and describes their principles of operation, components, and measurements. Various analyzer configurations are explained and the operation of mass spectrometers is described.
Objectives: Define the term electromagnetic spectrum ● Identify UV, visible, and infrared regions on electromagnetic spectrum diagrams ● Describe common types of molecular excitation ● Identify and describe typical spectroscopic analyzer components and explain their functions ● Explain the function of optical filters in limiting radiation to the wavelength of interest ● Explain the necessity of various analyzer configurations ● Describe the operation of split beam, single beam, and dual beam analyzers ● Describe the configuration and operation of a nondispersive analyzer ● Describe the configuration of multicomponent analyzers ● Explain the operation of a mass spectrometer ● Describe the functions of a mass spectrometer's control unit ● Discuss spectroscopic analyzer sampling considerations.

Gas Chromatographs (AAS03)
Prerequisites: This lesson is designed for participants with an understanding of industrial process control, process analysis, and spectroscopic analysis. Participants should also have a basic understanding of chemistry and physics.
Description: This lesson introduces participants to gas chromatography and describes gas chromatograph principles of operation, components, and Applications appropriate for gas chromatographs are identified and discussed.
Objectives: Identify gas chromatograph system components ● Identify the two most common types of columns: liquid on solid and active solid columns ● Identify the components of a column switching system ● Explain column efficiency- define resolution and peak interface ● Explain the effects of oven temperature, sample size, and carrier gas flow on chromatograms ● Explain the function of a programmer ● Define each component of a standard chromatogram ● Explain methods of determining column switching times for back-flushing ● Describe how to program and calibrate a gas chromatograph ● Be able to identify appropriate applications for using a gas chromatograph, such as butadine analysis and trace component analysis.

Air and Water Analysis (AAS04)
Prerequisites: This lesson is designed for participants with a basic understanding of industrial process emissions and effluents and the regulations governing them. Participants should also have a basic knowledge of the principles of process analysis, spectroscopic analysis, and gas chromatographs.
Description: This lesson trains participants to apply the concepts and terminology associated with the principles of process analysis to air and water analysis. The agencies and regulations governing air and water quality are described, and the ways in which various types of analyzers detect and measure the components in air and water are discussed.
Objectives: Explain the role and importance of analyzers and detectors for air and water monitoring ● Identify EPA and OSHA regulatory issues surrounding air and water monitoring ● Identify and describe the fundamental operating principles of paramagnetic, zirconium oxide, and low temperature instruments ● Identify air quality applications for spectroscopic instruments ● Identify the operating principles of opacity monitors and infrared and

ultraviolet stack analyzers ● Identify air quality applications for gas chromatography ● Identify water quality applications for electrochemical instruments ● Identify the operating principles of pH analyzers, ion-specific electrode analyzers, conductivity analyzers, and dissolved oxygen analyzers ● Identify water quality applications for spectroscopic instruments ● Identify water quality applications for flame ionization detection ● Identify the principles of operation for flame ionization detectors.

Process Sampling Systems (AAS05)
Prerequisites: This lesson is designed for participants with an understanding of industrial process control, process analysis, spectroscopic analysis, gas chromatographs, and air and waver analysis. Participants should also have a basic understanding of chemistry and physics.
Description: This lesson introduces participants to the tenets of sound simple handling system design for process analyzers and covers each of the major sections usually included process interface, sample transport, sample conditioning, and sample disposal. Multistream switching and contamination prevention strategies are also covered.
Objectives: Identify the reasons for using a sample handling system in process analysis ● Identify the importance and characteristics of a well-designed sample handling system ● Identify the reasons for using a sample handling system in process analysis ● Describe the operating principles of sample handling systems ● Recognize sample system components ● Identify the materials of construction in different sample handling systems that enable components to withstand any corrosive effects of the sample ● Identify the methods to ensure a safely maintained sample handling system ● Identify the importance and function of the sample handling transport system ● Identify the factors that determine lag time in a sample transport system ● Explain the importance of sample conditioning ● Describe and explain the different ways that samples can be conditioned ● Explain the importance of proper filter maintenance ● Explain how block-and-bleed and double, block sample switching systems operate.

Boiler Control Library (3 CD's)

12-18 hours of training
This comprehensive INVOLVE® multimedia-training program was produced in association with the Instrument Society of America USA). This program trains participants in the operation and maintenance of boilers and their associated safety systems.
Audience: This program is excellent for training instrument technicians as well as for the multi-craft training needs of process and manufacturing.

Boiler Systems (ABC01)
Prerequisites: This lesson is designed for participants familiar with process operations and industrial process control.
Description: This lesson focuses on the principles of operation of boiler systems and teaches the thermodynamic principles governing steam generation and heat transfer. Basic boiler components and operations will also be covered. The lesson provides a detailed overview of how steam is generated on the water side of the boiler as well as the fundamentals of combustion and how energy is converted in the boiler's furnace.
Objectives: Give a description of a typical boiler and related system ● Describe the function of a boiler ● Define the following terms: enthalpy, sensible heat, latent heat, latent heat of vaporization, saturation temperature, superheating, critical pressure, British Thermal Unit (BTU), and steam quality ● Describe the flow of water and energy when given a general description of a typical steam system ● Explain how each system contributes to the production of steam when given a block diagram of a typical boiler ● Show the flow paths for inputs and outputs through the system when given a block diagram of a basic boiler ● Identify the basic types of boilers when given descriptions of common features of the boilers ● Describe common applications for the different boiler types ● Explain the functions of the various components in a boiler when given their descriptions ● Explain how components such as economizers and preheaters conserve heat energy and maximize the efficiency of steam production while minimizing cost when given a description of the principles that govern efficient steam production and optimal use Of fuel ● Explain why feedwater must be treated before it enters the boiler when given a description of the effects of corrosion and scale on boiler components ● Describe the principles of combustion in a boiler furnace ● Explain the functions of the components in the fuel and air systems ● Identify the most common types of boiler fuels and describe their physical characteristics and heat values when given descriptions of the three major categories of boiler fuels ● Describe the various methods for preparing the fuel for use in a boiler ● Describe the principle by-products of combustion and how each is measured ● Explain the importance of monitoring emissions.

Boiler Controls (ABC02)
Prerequisites: This lesson is designed for participants familiar with process operations and industrial process control.
Description: This lesson focuses on the control systems of boilers and teaches the importance of proper drum level and basic methods for controlling that level. Shrink and swell will be explained. Furnace draft control and basic control strategies for liquid, gas and solid fuel boilers will also be covered as well as the fundamentals of combustion testing. The lesson also provides information about steam temperature control and unit management systems.
Objectives: Explain the relationship between steam demand, feedwater flow, and drum level ● Identify the problems caused by low drum water level ● Identify the problems caused by high drum water level ● Explain the terms "shrink" and "swell" and their associated control problems ● Identify the major components and functions in each of the following drum level control systems: single-element, two-element and three-element control systems ● Identify the various sensors used to measure steam drum level in a high pressure drum boiler ● Explain why steam drum level transmitters are density or temperature compensated and how this is accomplished ● Describe the function of the demand loop ● Describe the function of furnace draft control ● Describe the control systems used in gas and liquid fuel boilers ● Describe the control systems used in solid fuel boilers ● Describe the purpose of and basic steps for a combustion test ● Explain the purpose of controlling steam temperature ● Identify the instruments and interconnections used to control steam temperature ● Describe boiler-following unit control ● Describe turbine-following unit control, and describe the coordinated unit control system.

Troubleshooting Boiler Controls (ABC03)
Prerequisites: This lesson is designed for participants familiar with process operations and industrial process control.
Description: This lesson teaches how to troubleshoot various boiler control systems. Problems that might be encountered in each phase of boiler operation from startup to shut down will be discussed. The lesson also covers permissives, interlocks, shutdown systems and their associated logic.
Objectives: Identify the conditions that must be met prior to initiating boiler startup ● Explain the purpose of each step in a typical operation ● Troubleshoot cause of startup failure ● Troubleshoot the source of the problem ● Identify the safety concerns with improper furnace pressure and methods for detecting and correcting furnace pressure problems ● Troubleshoot the problem if given a problem with furnace pressure ● Troubleshoot the problem if given a problem with drum level ● Identify the safety concerns with high steam pressure and methods for relieving pressure ● Explain the purpose of each step in a typical shutdown operation, given a sequential description of the tasks involved in shutting down a boiler ● Identify parameters that could cause an emergency shutdown ● Describe methods of troubleshooting the cause of a shutdown. ● The effects of corrosion and scale on boiler components ● Describe the principles of combustion in a boiler furnace ● Explain the functions of the components in the fuel and air systems ● Identify the most common types of boiler fuels and describe their physical characteristics and heat values when given descriptions of the three major categories of boiler fuels ● Describe the various methods for preparing the fuel for use in a boiler ● Describe the principle by-products of combustion and how each is measured ● Explain the importance of monitoring emissions.

Control Valves Library (4 CD's)

16-24 hours of training
This comprehensive INVOLVE® multimedia-training program was produced in association with the Instrument Society of America USA). This four individual lesson program trains participants in the function, operation, maintenance, and troubleshooting of common types of control valves.
Audience: This program is excellent for training instrument technicians as well as for the multi-craft training needs of process and manufacturing.

Body Types and Trim (ACV01)
Prerequisites: This lesson is designed for participants familiar with industrial process control, specifically single loop control and multiple loop control. A working knowledge of fluid flow characteristics, fluid flow measurement, and typical elements in process loops is recommended.
Description: This lesson explains control valve selection factors and demonstrates typical linear and rotary control valve functions and applications. Control valve bodies for several types of valves including globe, butterfly, and ball

valves are described. The function and components of valve trim, including the relationship between flow characteristic and trim type is explained.
Objectives: Define control valve function in process systems ● Explain how control valves are used in process industries ● Describe how control valves can affect process efficiency, product quality, maintenance, safety, and the environment ● Describe the systems analysis approach to selecting a control valve ● List the types of data needed to choose a control ● Valve for a system ● Identify examples and applications of linear and rotary valves as well as the associated function and components of valve trim ● Describe how differential pressure and flow path affect fluid flow ● Describe how the ability of trim to withstand corrosion and erosion affects trim design ● List trim materials that can withstand corrosion and erosion ● Describe advantages and disadvantages of various packing materials ● Describe seal designs that are required where leakage is not acceptable.

Actuators and Positioners (ACV02)
Prerequisites: This lesson is designed for participants familiar with industrial process control, specifically single loop control and multiple loop control, as well as control valve body types and trim. A working knowledge of fluid flow characteristics, fluid flow measurement, and typical elements in process loops is recommended.
Description: This lesson trains participants to recognize, identify, and understand actuators and positioners as they relate to control valve trim. The parts and operation of diaphragm and piston actuators as well as pneumatic and electropneurnatic positioners are demonstrated.
Objectives: Describe the principles of pneumatic valve actuation ● Identify diaphragm actuator parts ● Describe actuator response ● Describe the operation of piston actuators ● Identify the advantages and limitations of pneumatic actuators ● Describe electric actuator operation ● Identify common actuator and positioner types ● Identify positioner function ● Describe principles of pneumatic positioner operation ● Identify positioner parts ● Describe how positioners can improve valve response time ● Describe how positioners can change valve flow characteristics ● Describe how positioners can change actuator response ● Describe the selection factors that indicate the appropriate actuator or positioner for system applications ● Match failsafe requirement with the appropriate actuator response ● Identify external fail-safe devices used with piston actuators.

Body and Trim Maintenance (ACV03)
Prerequisites: This lesson is designed for participants familiar with industrial process control, specifically single loop control and multiple loop control, as well as control valve body types and trim, and positioners and actuators. A working knowledge of fluid flow characteristics, fluid flow measurement, and typical elements in process loops is recommended.
Description: This lesson applies the concepts and terminology associated with control valve body types and trim, actuators and position to the disassembly, repair, parts replacement and reassembly of linear and rotary action control valves. Symptoms of valve malfunctions, lapping, and post-repair tests are also covered.
Objectives: Describe control valve malfunctions ● List causes and effects of control valve malfunctions ● Recognize the importance of following facility safety guidelines and manufacturer's recommendations for valve maintenance ● Describe linear valve disassembly steps ● Clean and inspect linear valve packing and trim ● Recommend replacement of linear valve trim parts ● Describe linear valve parts replacement ● Describe linear valve packing replacement ● List linear valve re-assembly steps ● Determine the outcome of linear valve stroking ● Describe linear valve leak testing ● Explain the necessity of linear valve lapping ● Describe the lapping process ● Describe rotary valve disassembly steps ● Clean and inspect rotary valve packing and trim ● Recommend replacement of rotary valve trim parts ● Describe replacement of other rotary valve parts ● Describe replacement of rotary valve packing replacement ● Describe rotary valve re-assembly ● Determine outcome of rotary valve stroking.

Actuator and Positioner Maintenance (ACV04)
Prerequisites: This lesson is designed for participants familiar with industrial process control, specifically single loop control and multiple loop control, as well as control valve body types and trim, and the operating characteristics of positioners and actuators. A working knowledge of fluid flow characteristics and the other elements in process loops is recommended.
Description: This lesson introduces participants to causes and symptoms of actuator and positioner malfunctions and applies the concepts and terminology of actuators and positioners to the disassembly, repair, parts replacement and re-assembly of diaphragm and piston actuators.
Objectives: List common symptoms of a failed diaphragm actuator ● List the causes of a diaphragm actuator failure ● List maintenance requirements for a diaphragm actuator ● Remove and inspect the stem and diaphragm assembly

and the range spring and seal bushing on a diaphragm actuator ● Replace the gasket and O-ring on a diaphragm actuator ● List common symptoms of a failed piston actuator ● List the causes of piston actuator failure ● List maintenance requirements for a piston actuator ● Remove and inspect the ring and the stem and piston assembly on a piston actuator ● List common failures of pneumatic and electro-pneumatic positioners and the causes of failure ● List maintenance requirements for a pneumatic positioner ● Inspect and clean the pilot relay assembly on a pneumatic positioner ● List the causes of i/p transducer failure on an electro-pneumatic positioner ● Adjust the zero and span on an electro-pneumatic positioner.

Controller Tuning Library (1 CD)

4-6 hours of training

This comprehensive INVOLVE® interactive multimedia training program was produced in association with the Instrument Society of America (ISA). This one lesson program trains participants in three methods of controller tuning and the various steps needed to be taken in each method.

Audience: This program is excellent for training technicians, operators, control practitioners and engineers as well as for the multi-craft training needs of process and manufacturing facilities.

Controller Tuning (ACTAV)

Prerequisites: This lesson is designed for participants familiar with the basics of instrument control including the proportional, integral, and derivative control modes.

Description: This lesson explains tuning methods and principles behind the three methods of tuning a controller: ultimate, reaction curve, and trial and error. The lesson presents the characteristics of a properly timed process response and relates these to proportional, integral, and derivative control actions. In addition, step-by-step procedures for tuning controllers using each method are demonstrated.

Objectives: Define controller tuning and its purpose as used in a process control system ● Define a process response ● Explain the significance of a 1/4 decay reaction curve ● Perform the preliminary steps for tuning a controller ● Stabilize a process on manual control before using the ultimate method ● Obtain the value of and calculate the proper setting for a proportional band or gain ● Find the value of the ultimate period ● Calculate the proper settings for PI, PD, and PID controllers ● Verify adjustments ● Obtain and interpret a process reaction curve ● Calculate the process gain, dead time, time constant, and controller settings using the reaction curve method ● Interpret a process response to determine the proper setting ● Using the trial and error method, tune the proportional mode.

Digital Instrumentation Library (2 CD's)

8-12 hours of training

This comprehensive INVOLVE® interactive multimedia training program was produced in association with the Instrument Society of America (ISA) This program consists of two individual lesson CD's that train participants in the principles of digital instrumentation and signal transmission.

Audience: This program is excellent for control practitioners, engineers, and technicians as well as for the multi-craft training needs of process and manufacturing facilities.

Smart Transmitters (ADI01)

Prerequisites: This lesson is designed for participants familiar with digital signal transmission, process control principles, and the function of transmitters in process loops.

Description: This lesson introduces digital electronics and teaches the principles of operation, the functions of the electronic components, and the signal characteristics. The lesson also demonstrates operation of the hand-held interface for system configuration.

Objectives: Describe the principles of analog and digital signal theory ● Describe the benefits of digital signal transmission ● Describe and identify the signal processing capabilities of smart transmitters ● Describe the major features and characteristics of smart transmitters ● Describe the characterization function, special installation requirements, and signal conditioning of a smart transmitter ● Describe the function of a hand-held interface device ● Describe configuration parameters and demonstrate configuration of a smart transmitter ● Describe the test functions of smart transmitters ● Demonstrate the procedure for doing a loop test with a hand-held interface ● Describe the use of a smart transmitter in a temperature, flow, or pressure measurement loop.

Single Loop Digital Controllers (ADI02)
Prerequisites: This lesson is designed for participants familiar with digital signal transmission, control principles, and the function of transmitters in process loops.
Description: This lesson introduces the principles of operation, characteristics, and capabilities of single loop digital controllers, including controller components and signal processing capabilities. In addition, the lesson demonstrates the configuration and tuning of single loop digital controllers.
Objectives: Describe digital controller principles and capabilities ● Recognize alarm conditions and solve self-diagnostic errors ● Identify and use the features on a display panel ● Identify and state the function of various controller boards ● Demonstrate how the controller processes analog and digital input signals ● State the purpose of function blocks ● Demonstrate the procedure for diagramming a controller configuration ● Read PID, feed forward, and cascade controller diagrams ● Identify different programming devices ● Label configuration keypad buttons and use them to enter configuration data ● State the purpose of the lockout function and locate the lockout switches ● Label and use the portable configurator to enter data ● State the purpose of tuning and list the different tuning methods ● Explain self-tuning principles ● Explain when an adaptive control is needed ● Explain automatic tuning principles.

Distributed Control Library (2 CD's)

8-12 hours of training
This comprehensive INVOLVE® interactive multimedia training program was produced in association with the Instrument Society of America (ISA). This program, consisting of two individual lesson CD's, trains participants in distributed contra techniques, architecture and hardware as well as in the methods used to maintain and troubleshoot distributed control systems.
Audience: This program is excellent for training technicians, operators, control practitioners and engineers as well as for the multi-craft training needs of process and manufacturing facilities.

Distributed Control Fundamentals (ADC01)
Prerequisites: This lesson is designed for participants familiar with process operations, digital electronic theory, and test instruments and devices.
Description: This lesson provides an understanding of the fundamentals of Distributed Control Systems (DCS). The evolution of computer control systems is discussed and the architecture of contemporary DCS is described in detail. The lesson covers hardware, configuration, data communications, user interface and 1/0 devices.
Objectives: Describe direct digital control ● Describe a supervisory control system ● Identify an advantage of supervisory control over direct digital control ● Describe a Distributed control system ● Identify the advantages of DCS ● Identify some of the control functions of a distributed control system ● Explain DCS terminology ● Explain hardware requirements for distributed control systems ● Describe how control loops are implemented in a DCS ● Explain communications between modules and external devices ● Describe two types of data transmission ● Explain how signal integrity is maintained ● Define system interfacing ● Define communication protocols and their function in data transmission ● Name two primary types of human interface ● Describe DCS input devices and describe types of available displays.

Maintaining Distributed Control Systems (ADC02)
Prerequisites: This lesson is designed for participants familiar with process operations, digital electronic theory, and test instruments and devices.
Description: This lesson introduces the general maintenance requirements of a distributed control system (I)CS). It covers troubleshooting techniques using DCS self-diagnosis and the various diagnostic displays available to the technician as well as safe and proper component replacement procedures for cards, modules and power supplies. The lesson also covers DCS peripheral equipment including disk and tape drives and uninterruptible power supplies (UPS).
Objectives: Identify proper tools and test equipment for troubleshooting ● Interpret diagnostic software from the operating console and the engineering workstation ● Demonstrate proper troubleshooting methods ● Identify typical communication malfunctions ● List symptoms of communication faults ● Identify a proper cable connection ● List indications of power supply failure ● Check power supply voltages ● List indications of workstation failure ● Identify 1/0 failures ● Demonstrate safe removal and replacement of cards ● Demonstrate proper replacement card set up ● Explain 1/0 module configuration ● Demonstrate safe power supply removal ● Set power supply voltages ● Explain how signal integrity is maintained ● Describe proper communication cable replacement ● Perform a

redundancy check ● Clean a disk drive ● Explain the importance of and general procedure for backing up data and list UPS preventive checks.

Electronic Maintenance Library (5 CD's)

20-30 hours of training

This comprehensive INVOLVE® multimedia-training program was produced in association with the Instrument Society of America (ISA). This five lesson program trains participants in Me maintenance of electronic instruments, including pressure, temperature, flow, level, and weight transmitters as well as transducers, recorders, annunciators, and analog electronic controllers.

Audience: This program is excellent for training for maintenance personnel and instrument technicians as well as for the multi-craft training needs of process and manufacturing facilities.

Pressure and Temperature Transmitters (AEM01)

Prerequisites: This program is designed for participants familiar with process and control principles as well as basics of digital electronic theory and test procedures.

Description: This lesson introduces electronic transmitter maintenance focusing on pressure and temperature transmitters. The lesson describes the components of a typical pressure or temperature transmitter, their functions, adjustments, inspections, and repairs. Procedures for isolating the faulty component in a transmitter are also demonstrated.

Objectives: Identify components in a disassembled electronic differential pressure or electronic temperature transmitter ● Test the power supply for the transmitter in an electronic pressure transmitter ● Adjust the sensor zero and replace the electronics module of the pressure transmitter ● Isolate malfunctions to either the sensor or circuitry portion of a differential pressure transmitter ● Verify that a sensor is properly grounded ● Swap circuit boards in a differential pressure transmitter ● Replace the sensor assembly of a DP transmitter ● Identify the faulty component in a thermocouple transmitter ● Test outputs and repair an RTD ● Swap a defective board to calibrate a malfunctioning RTD.

Flow Transmitters (AEM02)

Prerequisites: This lesson is designed for participants familiar with electronic test procedures. An understanding of process operation is also required.

Description: This lesson introduces the inspection and repair of electronic flowmeters by demonstrating maintenance procedures for vortex shedding, turbine, magnetic, and mass electronic flowmeters. The lesson describes typical flow transmitter components, their functions, common malfunctions, and procedures for isolating a faulty component.

Objectives: Test and replace the amplifier unit, sensor, and bluff body of a vortex shedding flowmeter ● Test and replace ● The preamplifier unit, coil and other necessary components of a turbine flowmeter ● Test and replace the coil, electrodes, and circuit board in a magnetic flowmeter ● Jumper the appropriate terminals to simulate zero output and check the flowmeter output in an installed mass flowmeter ● Test and replace the sensor and circuit boards in an installed mass flowmeter.

Level and Weight Transmitters (AEM03)

Prerequisites: This lesson is designed for participants familiar with basic mathematical operations including algebra.

Description: This lesson describes the operation, applications, and maintenance of ultrasonic, capacitance, conductivity, and radiation level detectors. The lesson also explains the functions and operation of weighing systems.

Objectives: Describe the applications and operation of ultrasonic level detectors and their use in both point and continuous measurement applications ● Troubleshoot and maintain ultrasonic level detection systems ● Describe the applications and operation of radiation level detectors and their use in both point and continuous measurement applications ● Explain the safety considerations when maintaining radiation level detectors ● Describe the applications and operation of capacitance and conductivity level detectors in both point and continuous measurement applications ● Recognize safety considerations for the use of level probes with flammable and/or explosive materials ● Identify the maintenance procedures for capacitance level detection systems ● Describe the applications and operation of a strain gage load cell as well as considerations for load cell calibration ● Describe the applications and operation of a belt conveyor scale as well as how to test and calibrate it.

Transducers, Annunciators, Recorders (AEM04)
Prerequisites: This lesson is designed for participants familiar with calibration principles, process control, and control loops.
Description: This lesson teaches routine maintenance requirements and calibration procedures for transducers, recorders, and annunciators. The lesson provides a basic understanding of the functions of I/P, P/I, and E/I transducers, multipen and multipoint recorders, and annunciators. The lesson also outlines how to identify and troubleshoot problems in these instruments.
Objectives: Identify and describe the function of electronic transducers ● Identify how I/P transducers work ● Identify troubleshooting steps for pneumatic and electronic function on I/P transducers ● Identify the steps for continuity tests on I/P transducers ● Identify coil replacement steps for I/P transducers ● Identify calibration steps for P/I and E/I transducers, identify motor replacement steps for the chart drive on a multipen recorder ● Identify the function of drive gears on a multipen recorder and how to clean them ● Identify installation steps for a new drive cable on a multipoint recorder and check for proper operation ● Identify the function of drive wire resistors on multipoint recorders and how to clean and inspect them ● Calibrate multipen and multipoint recorders ● Define the function of annunciators and troubleshoot them.

Electronic Controllers (AEM05)
Prerequisites: This lesson is designed for participants familiar with process control and control loops.
Description: This lesson presents routine maintenance requirements and calibration procedures for electronic controllers. The lesson shows how controller circuitry works and how to adjust and calibrate each of its component sections: the display, the alarm circuitry, and the control circuitry.
Objectives: Identify the features and functions of controllers ● Describe and compare pneumatic and electronic controllers ● Identify the signal path through a control circuit ● Describe the function of resistors, comparators, proportional band amplifiers, integral amplifiers, differentiating amplifiers, summing amplifiers, and the transducer ● Visually identify indicators on electronic controllers as well as set point, process, output, and alarms ● Visually identify controls on electronic controllers as well as set point control, auto-manual selector switch, and manual/valve control ● Identify appropriate equipment and demonstrate procedures for calibrating and troubleshooting display indicators ● Identify appropriate test points and demonstrate procedures for calibrating and troubleshooting alarm indicators ● Identify appropriate equipment for calibrating control circuits and calibrate proportional, integral, and derivative zero on the control circuit ● Identify appropriate equipment for troubleshooting control circuits.

Fundamentals of Industrial Measurement Library (4 CD's)
This comprehensive INVOLVE® interactive multimedia training program was produced in association with the Instrument Society of America (ISA). This four individual lesson program trains participants in the principles of process control and measurement.
Audience: This program is an excellent entry-level course for engineers, technicians, and operators as well as for the multicraft training needs of process and manufacturing facilities.

Pressure Measurement (AFM01)
Prerequisites: This lesson is designed for participants familiar with basic mathematical operations including algebra.
Description: This lesson presents the basic principles of pressure measurement and applications of direct and inferred pressure measurement methods. Various pressure instruments are presented including manometers, mechanical pressure sensors, and transducers.
Objectives: Recognize the importance of the measurement and control of pressure ● Define pressure and determine the pressure exerted by a liquid ● Recognize the importance of sensor location in pressure measurement, calculate the force exerted by liquids ● Identify the effects of temperature change on the force exerted by a liquid ● Identify the factors which determine the force exerted by a gas ● Convert various units of pressure measurement to psig, psia, InH2O, and InHg using a conversion table ● Calculate differential pressure ● Recognize the effect of atmospheric pressure on pressure measurement ● State the principle of operation of closed and open manometers ● Identify the types of manometers and the considerations for their safe and effective use ● Describe the principle of operation for elastic elements ● Explain how the movement of a sensing element can be used to produce a pneumatic and electrical signal ● Describe the operation of mechanical to electrical transducers.

Flow Measurement (AFM02)
Prerequisites: This lesson is designed for participants familiar with basic mathematical operations including algebra.
Description: This lesson describes the properties of fluids that are a factor in the measurement of their flow. In addition, the lesson explains how differential pressure measurements can be used to determine flow rate. Various types of flow measurement devices and their principles of operation are also discussed.
Objectives: Recognize the effect of temperature and pressure on the density and volume of a liquid and a gas ● Describe the effects of temperature on viscosity and how viscosity affects flow ● Describe laminar flow, turbulent flow, and transitional flow ● Describe the application of the Reynolds Number to flow measurement ● Identify variables that affect mass flow rate ● Describe how static pressure is converted to kinetic energy ● Explain Bernoulli's law as it applies to differential pressure flow measurements ● Explain the necessity of an expansion factor in differential pressure flow measurements of a gas ● Describe how an orifice-type differential pressure flow device measures flow ● Explain how a beta ratio is determined and its application to flow measurements ● Identify the location of high and low pressure taps in an orifice run ● Describe the design and operation of Venturi tube, flow nozzle, and Pitot tube differential pressure flow devices ● Explain the difference between closed and open systems ● Describe the design and operation of weir and flume head-type differential pressure flow devices ● Describe the design and operation of vortex shedding, magnetic, ultrasonic, rotary vane, turbine, and Coriolis mass flowmeters ● Describe the operational principles of positive displacement flowmeters ● Describe how an inferential mass flow measurement differs from a true mass flow measurement.

Temperature Measurement (AFM03)
Prerequisites: This lesson is designed for participants familiar with basic mathematical operations including algebra.
Description: This lesson presents the basic principles of temperature measurement and the application of temperature measuring instruments. Various temperature-measuring instruments are discussed including thermometers, pyrometers, thermocouples, resistance temperature detectors, and thermistors.
Objectives: Recognize the importance of temperature measurement and control ● Identify the principle of kinetic energy with a graph of molecular movement ● Identify four scales used to indicate temperature ● Define heat transfer in terms of conversion, conduction, and radiation ● Define response time, stem loss, and radiation error ● Identify the effect that inserting a sensor in a thermowell will have on the sensor's temperature measurement and its response time ● Identify the effect that thermal shunting will have on temperature measurement ● Describe the principles of operation for a liquid in glass thermometer ● Thermal bulb, and a bimetallic thermometer ● Describe the principle of operation for an optical and ratio pyrometer ● Identify the reference and measuring junctions in a drawing representing a thermocouple ● Identify the negative wire in a type J thermocouple ● Identify the components of a thermocouple assembly when a thermocouple is inserted in a thermowell ● Explain how a thermopile is used to produce greater output in response to smaller temperature change ● Identify the use and application of thermocouples joined in parallel ● State the principle of operation for a resistance temperature detector ● Identify the bridge circuit's operation in an RTD to measure temperature ● Identify the effect strain will have on a resistance temperature detector ● Identify the type, design considerations, and strain on various types of RTDs ● Identify a voltage divider circuit's operation in a thermistor circuit to measure temperature ● State the principle of operation for a thermistor.

Level Measurement (AFM04)
Prerequisites: This lesson is designed for participants familiar with basic mathematical operations including algebra.
Description: This lesson describes the fundamentals of level measurement and the sensors employed. Applications for both direct and indirect level measurement are covered including float-type devices, hydrostatic head and differential pressure measurements, as well as electrical, ultrasonic, and radiation instruments.
Objectives: Recognize the importance of measuring and controlling level ● Describe what an interface is and list some of the types of interfaces that may be measured for level indication ● List common measurement units of level ● Define direct and indirect level measurement and some types and applications of these methods ● Define continuous level and point level measurement ● Describe how sight glasses operate to measure liquid level ● Describe how dipsticks, weighted lines, and float-type instruments can be used to gage level ● Define hydrostatic head pressure and explain how it can be used to measure the height of liquid ● Calculate the height of the liquid in inches with a head pressure and specific gravity ● Describe configurations using hydrostatic head to measure level

in open tanks ● Describe how differential pressure can be used to measure level in closed-tank applications using a dry or wet leg ● Explain how level can be measured using electrical capacitance or resistance ● Describe two ways the level of granular solids and powders can be measured ● Describe some non-invasive level measurement methods that use ultrasonic and radiation detectors ● Describe the basic operation of one type of fiber optic level measurement instrument for point level measurement.

Industrial Process Control Library (2 CD's)

8-12 hours of training

This comprehensive INVOLVE® interactive multimedia training program was produced in association with the Instrument Society of America. (ISA). This two lesson program trains participants in the concepts and principles of process control modes.

Audience: This program is an excellent entry-level course for control practitioners as well as for the multi-craft training needs of process and manufacturing facilities.

Single Loop Control (AIP01)

Prerequisites: This lesson is designed for participants familiar with measurement fundamentals. An understanding of algebra is also recommended.

Description: This lesson presents the principles of single-loop control and the applications of feedback control in the industrial environment. Also introduced are various control modes including on/off, proportional, integral, and derivative control.

Objectives: Define and site industrial control ● Define process variable ● Compare manual and automatic process control ● Adjust the set point on a pictorial representation of an industrial controller ● Identify the controlled, measured, and manipulated variables of a heat exchanger system ● Define deviation ● Identify the system response for various control modes ● Define load change ● Identify the elements of process control ● Identify the action of the final control element of various control systems ● Identify the dead zone or dead band on an on/off control response curve ● Compare and contrast the action of a final control element in an on/off control ● System with a proportional control process ● Identify reverse- or direct-acting control with an example of measurement and subsequent output response ● Define proportional control in relation to response error ● Determine the setting of the controller's proportional band and gain on a pictorial representation of process control action ● Identify offset on an example of proportional only control ● Define integral control in relation to error signal ● Identify minutes per repeat and repeats per minute with an example of the units used in integral control ● Define reset wind-up on a process response curve for an integral controller ● Identify the effects of reset wind up on the elements of process control on a heat exchange system ● Define derivative process control in relation to error signal.

Multiple Loop Control (AIP02)

Prerequisites: This lesson is designed for participants familiar with single-loop control. An understanding of pressure, temperature, level, and flow measurement as well as basic algebra is also recommended.

Description: This lesson explains the application of multiple-loop control strategies to industrial process control systems. The lesson also explains the operation of several types of digital process control systems.

Objectives: Identify the benefits of advanced process control strategies ● Compare feedback and feedforward control ● Explain the principles and applications of a feedforward control system ● Explain the principles and identify the benefits of cascade control ● Discriminate between wild and controlled flows in a ratio control system ● Explain the principles and applications for ratio control ● Explain the principles and application of adaptive and selective control ● Identify the method of process control used in direct digital, supervisory, and distributed control systems.

Instrument Calibration Library (5 CD's)

20-30 hours of training

This comprehensive INVOLVE® interactive multimedia training program was produced in association with the Instrument Society of America. (ISA). This five lesson program trains participants to calibrate pressure, differential pressure, temperature, flow, and level instruments.

Audience: This program was designed for instrument technicians and electricians as well as for the multi-craft training needs of process and manufacturing facilities.

Calibration Principles (AIC01)
Prerequisites: This lesson is designed for participants familiar with instruments and their functions within a typical feedback/control loop. An understanding of algebra is also recommended.
Description: This lesson introduces basic concepts of instrument calibration. The lesson explains the characteristics of proper instrument performance as well as how to identify common instrument errors. In addition, the steps in a typical calibration procedure are demonstrated.
Objectives: Define calibration ● Recognize if an instrument is properly calibrated by examining the instrument input and output ● Explain how calibration affects quality, productivity, and safety ● Identify conditions when calibration is performed such as at an installation, periodic scheduled maintenance, in response to process deviation, and after repair or change in mounting position ● Recognize accuracy and precision ● Identify zero shift, span error, combined zero shift and span error, and non-linearity with a pattern of instrument readings on an input/output graph or calibration data sheet ● Identify the basic elements of a calibration set-up ● Identify the input values for a five point ● Calibration check as a percent of the instrument's range.

Calibrating Pressure and Differential Pressure Instruments (AIC02)
Prerequisites: This lesson is designed for participants familiar with the basic principles of calibration including the steps of a calibration procedure, common instrument errors, and the standards for instrument performance. An understanding of algebra is also recommended.
Description: This lesson demonstrates the necessary steps for calibrating pressure instruments. The lesson also identifies procedures and set-up equipment for pressure calibration. Emphasis is placed on selection of the appropriate test instruments and interpretation of readings.
Objectives: Set up a pressure transmitter, differential pressure transmitter, and a pressure gage for calibration with the appropriate input and output test equipment, proper connections, and mountings ● Perform a five-point calibration check on an analog electronic pressure transmitter, a differential pressure transmitter, and a pressure gage ● Identify zero shift, span error, combined error, and nonlinearity ● Properly adjust pressure instruments to eliminate errors ● Use a digital interface device to re-range a smart pressure transmitter.

Calibrating Temperature Instruments (AIC03)
Prerequisites: This lesson is designed for participants familiar with the basic principles of calibration including calibration procedures, common instrument errors, and the standards for instrument performance. An understanding of algebra is also recommended.
Description: This lesson teaches basic procedures for checking the calibration of thermocouples and RTDS, as well as for calibrating temperature instruments including thermocouple transmitters and RTD transmitters. Procedures using thermocouple and RTD tables are presented in addition to calibration steps using a digital temperature calibrator.
Objectives: Identify common test equipment used as measurement standards for calibration of temperature instruments ● Property set up and connect the measurement standards for calibration of temperature instruments ● Identify the proper thermocouple or RTD table for the sensor in the loop and use the tables in calibration ● Check the calibration of thermocouples and RTDs ● Calibrate an analog electronic temperature transmitter whose input is provided by a thermocouple or an RTD ● State safety precautions for calibrating temperature instruments in the field.

Calibrating Flow Instruments (AIC04)
Prerequisites: This lesson is designed for participants familiar with the basic principles of calibration including procedures, identifying instrument errors, and the standards for instrument performance. An understanding of algebra is also recommended.
Description: This lesson demonstrates procedures for calibration of flow instruments. The lesson specifically explains calibration of differential pressure transmitters, magnetic flowmeters, vortex shedding flowmeters, and mass flowmeters. Emphasis is placed on the proper set-up for calibration and the selection of the proper test equipment.
Objectives: Observe the correlation between differential pressure and flow rate ● Identify and set up the measurement standards for calibrating a differential pressure transmitter ● Perform a five point check on a differential pressure transmitter ● Interpret the results and correct instrument errors ● Set up a square root extractor for calibration and adjust its zero ● Observe how a magnetic flowmeter generates the output voltage as a result of the input voltage ● Calibrate a magnetic flowmeter ● Observe how a vortex shedding flowmeter generates output resulting from input ● Set the course span jumpers correctly and determine proper calibration of a vortex shedding

flowmeter ● Connect the interface device to the smart mass flowmeter ● Set the interface device to the smart mass flowmeter ● Modify the upper and lower range values ● Download the new information to the transmitter ● And test the mass flowmeter for autozero.

Calibrating Level Instruments (AIC05)
Prerequisites: This lesson is designed for participants familiar with the basic principles of calibration including procedures, common instrument errors, and the standards for instrument performance. An understanding of algebra is also recommended.
Description: This lesson demonstrates the steps for calibrating level instruments. Specifically, the lesson shows set-up procedures for differential pressure transmitters and electronic displacement level transmitters in a variety of applications.
Objectives: Identify the importance of properly calibrated level instruments ● Describe how hydrostatic pressure can be used to sense liquid level ● Determine the input range for calibrating a differential pressure transmitter for use in a specific level application ● Select the input and output measurement standards for calibrating hydrostatic level instruments ● Calibrate a differential pressure transmitter used in an open tank or dip pipe, a closed tank with dry leg, and closed tank with wet leg ● Define elevated or suppressed zero and determine the amount of zero suppression or elevation in a given hydrostatic pressure level gaging system ● Describe how an electronic displacement level transmitter uses buoyant force to sense liquid level ● Select the input standards for calibrating an electronic displacement level transmitter for liquid-vapor and liquid-liquid interface applications ● Select the output equipment for calibrating an electronic displacement transmitter ● Calibrate an electronic displacement level transmitter for liquid-vapor and liquid-liquid interface applications.

Instrumentation and Control Safety Library (3 CD's)

12-18 hours of training
This comprehensive INVOLVE® interactive multimedia training program was produced in association with the Instrument Society of America. (ISA). This three lesson program trains participants in personnel safety, safe practices for working with hazardous materials, and the safe use of instruments in hazardous environments.
Audience: This program is excellent for training instrument technicians as well as for the multi-craft training needs of process and manufacturing facilities.

Personnel Safety (AIS01)
Prerequisites: This lesson is designed for participants with an understanding of industrial process control and a working knowledge of the elements in single-loop and multiple-loop control.
Description: This lesson trains participants in precautions for ensuring their personal safety while working in four types of hazardous locations: high places, outdoors, confined spaces, and open trenches. It also covers types and applications of personal protective gear, including safety harnesses, atmospheric monitors, and breathing aids.
Objectives: Describe how attitude and awareness can affect personal safety ● Describe safety considerations for working in high places, open trenches, outdoors, and in confined spaces ● Explain when and how personal and portable oxygen monitors, combustible gas/vapor monitors, and portable radiation monitors are used ● Identify the correct personal protection gear to wear in different hazardous locations ● Describe the conditions under which air-purifying respirators are used ● Describe the two main types of air-supplying respirators and describe the conditions under which each is used ● Describe three types of regulators used in air-supplying respirators and their applications ● Describe the checks that need to be made to respirators to ensure their proper operation ● Describe proper checks to make on safety belts/harnesses.

Working with Hazardous Materials (AIS02)
Prerequisites: This lesson is designed for participants with an understanding of industrial process control and personnel safety, as well as a working knowledge of the elements in single-loop and multiple-loop control.
Description: This lesson trains participants to identify and properly handle hazardous materials in the workplace. Characteristics and warning labels for corrosives, oxidizers, flammables, and toxic materials are described.
Objectives: Define hazardous materials ● Identify the importance of safety in handling hazardous materials ● Describe toxic materials ● Describe flammable and combustible materials ● Describe oxidizers ● Describe explosive materials ● Describe compressed gases ● Explain the Right-to-Know concept ● Identify a safety warning label ● Interpret a material data safety sheet ● Demonstrate precautions to take when working with hazardous process lines ● Given a component, describe the necessary decontamination process ● Describe how poor

housekeeping can affect safety ● Describe proper collection and disposal methods for hazardous materials ● Describe proper re-use of hazardous materials ● Demonstrate the correct response to an inadvertent release of a hazardous material ● Demonstrate the correct response to exposure to hazardous materials.

Instruments in Hazardous Environments (AIS03)
Prerequisites: This lesson is designed for participants with an understanding of industrial process control, personnel safety and working with hazardous substances, as well as a working knowledge of the elements in single-loop and multiple-loop control.
Description: This lesson explains the characteristics and importance of intrinsically safe, explosion-proof, and purged and pressurized systems. Installation and maintenance considerations for safety systems are taught, including project planning, wire runs, terminations, and grounding.
Objectives: Identify the causes of explosions ● Identify the components of the combustion triangle ● Describe how protective measures can reduce the probability of explosion ● Describe nonincendive, encapsulation, and oil-filled safety methods ● List and define area classification descriptions ● Define intrinsic safety and identify intrinsically safe components and installations ● Identify the principles of intrinsic safety ● Define the function of a barrier ● Identify process components that require certification for intrinsic safety ● Demonstrate the ability to interpret documentation for proper intrinsic installation ● Identify intrinsically safe wire runs ● Explain the purpose of conduit seals ● Identify proper terminations for intrinsically safe connections ● Describe the installation and maintenance procedures associated with intrinsically safe systems ● List maintenance conditions for intrinsically safe installations ● Identify the correct tools and equipment to use on intrinsically safe installations ● Identify the proper classifications and ratings for explosion-proof materials ● Demonstrate the proper handling of explosion-proof covers, housings, and fittings, and the minimum precautions needed prior to the maintenance of explosion-proof equipment ● Describe purging and pressurization.

Interpreting Process Control Diagrams Library (1 CD)
4-6 hours of training
This comprehensive INVOLVE® interactive multimedia training program was produced in association with the Instrument Society of America. (ISA). This one lesson program trains participants how to interpret process and instrument diagrams.
Audience: This program is excellent for training instrument technicians and electricians as well as for the multi-craft training needs of process and manufacturing facilities.

Interpreting Process Control Diagrams (AIPCD)
Prerequisites: This lesson is designed for participants familiar with instruments and control functions.
Description: This lesson introduces the common instrument and line symbols and notations used on process control and loop diagrams. The interpretation of process control and loop diagrams is presented as well. Emphasis is placed on identifying the functions of components within the process control system.
Objectives: Identify the function, measured variable, location and accessibility, and loop identification of an instrument given its symbol and tag number ● Identify the type of connection between an instrument and the process to which it's connected when given a tag number ● Identify signal line types (pneumatic, electrical, capillary, or internal software link) ● Identify the type of valve actuator (diaphragm, motor, solenoid, or piston) when given a symbol ● Describe the information available in a typical process control diagram, title block, revision list, materials list, and notes block ● Describe the functional operation of the systems represented in typical process control diagrams ● Understand the function of loop diagrams and their relationship to process control diagrams ● Understand the purpose of each of the four areas of a typical loop diagram ● Identify the location and type of each instrument port connection, junction box, and power source as well as the controller action for the instruments in a loop diagram ● Describe the functional operation of the systems represented in a typical loop diagram.

Pneumatic Maintenance Library (3 CD's)
6-12 hours of training
This comprehensive INVOLVE® interactive multimedia training program was produced in association with the Instrument Society of America. (ISA). This three lesson program trains participants in the theory of pneumatic instrumentation and the principles of operation, characteristics, and capabilities of components typically found in pneumatic control loops.

Audience: This program is excellent for training technicians, operators, control practitioners and engineers as well as for the multi-craft training needs of process and manufacturing facilities.

Pneumatic Principles (APM01)
Prerequisites: This lesson is designed for participants familiar with test instruments and devices.
Description: This lesson introduces the principles of pneumatic instrument operation and the terms force, pressure and compressibility are defined. The operation of pneumatic air supply system components, including compressors, dryers, filters and regulators is explained. System maintenance and testing is also taught. Filter cartridge replacement and regulator maintenance is demonstrated.
Objectives: Define force as it applies to pneumatics ● Define pressure as it applies to pneumatics ● Define compressibility as it applies to pneumatics ● State Pascal's law as it relates to pneumatics ● State Boyle's law as it relates to pneumatics ● State Charles law as it relates to pneumatics ● State the ideal gas law as it relates to pneumatics ● Discuss how and why pneumatics are used in the industry ● Describe why pneumatic instruments have a limited transmission distance ● Describe the purpose and operation of a booster ● List the effects of contaminants on a pneumatic system ● Identify types of filters and how they aid in removing suspended material in an air supply system ● Prepare a filter for disassembly ● Dissemble a fitter ● Clean a filter ● Reassemble a filter ● Identify the basic operating theory of three types of dryers ● Check the operation of an air dryer ● Determine when and explain why dew point is measured ● Identify the parts of a regulator ● List the difference between a bleed-type and a nonbleed type regulator ● Adjust output pressure on a regulator ● Maintain a regulator.

Sensors and Transmitters (APM02)
Prerequisites: This lesson is designed for participants familiar with test instruments and devices.
Description: This lesson describes the features and operation of sensors used in pneumatic instruments, including Bourdon tubes, filled bulbs, diaphragm capsules and bellows. It teaches how both force and motion-balance pneumatic transmitters operate and how transmitter components, such as flapper/nozzles, relays and restrictors are cleaned and maintained.
Objectives: State four common sensing elements used in pneumatic instruments ● Describe how a diaphragm capsule operates ● List some types of damage that will affect the accuracy of a diaphragm capsule ● Describe how a Bourdon sensing element operates ● List three shapes a Bourdon sensing element can take ● List some types of damage that will affect the accuracy of a Bourdon tube ● Describe how a filled bulb sensor operates ● State some types of damage that will affect the sensing accuracy of filled bulb system ● Identify the nozzle/flapper, relay, feedback element, and restrictor in a pneumatic instrument ● Explain the operation of a basic pneumatic instrument ● Explain the operation of a pneumatic relay ● Describe how a force-balance pneumatic transmitter operates ● Interpret a manufacturer's schematic drawing of a pneumatic transmitter to describe its principle of operation and location of parts ● List possible causes for a pneumatic transmitter to erroneously produce full output ● List possible causes for a pneumatic transmitter to produce no output ● Given a pneumatic transmitter, clean the nozzle and flapper ● Given a pneumatic transmitter, clean the restrictor ● Given a pneumatic transmitter, disassemble and repair the relay ● Given a pneumatic transmitter, replace air supply filter screens ● Given a pneumatic transmitter, replace the diaphragm capsule.

Controllers and Recorders (APM03)
Prerequisites: This lesson is designed for participants familiar with test instruments and devices.
Description: This lesson focuses on operation and maintenance of pneumatic controllers and recorders. The lesson teaches how the bellows, relays, links, and levers within a controller are configured to provide proportional, integral, and derivative control modes, both in direct and reverse action. Common maintenance practices are covered, including relay and restrictor cleaning and replacement, along with controller and recorder calibration.
Objectives: Describe the function of a controller ● Identify common components found in a controller and state the function of each ● State the purpose of damping in pneumatic systems ● Review proportional, integral, and derivative control modes ● Describe the operating principle of the four bellows arrangement ● Review proportional band and gain ● Review offset and the difference between repeats per minute and minutes per repeat ● Describe an appropriate application for each of the control modes ● Define direct action and reverse action and give an example of where each would be used ● List possible malfunctions in a controller and the probable causes ● Check the operation of a controller ● Remove a controller from service ● Replace a relay in a proportionally-plus-reset controller ● Clean an adjustable restriction from a reset assembly ● Return a controller to service ● Align and calibrate a proportional-plus-reset controller ● Identify the components of a pneumatic recorder ● Disassemble and

clean a pneumatic recorder ● Clean a chart drive motor ● Replace a chart drive motor ● Calibrate a pneumatic recorder.

Process Operations Library (3 CD's)

12-18 hours of training

This comprehensive INVOLVE® interactive multimedia training program was produced in association with the Instrument Society of America. (ISA). This three lesson program trains participants how and why control strategies are applied according to process requirements.

Audience: This program is excellent for control personnel and instrument technicians as well as for the multi-craft training needs of process and manufacturing facilities.

Heating and Cooling Systems (APO01)

Prerequisites: This lesson is designed for participants familiar with process control. A knowledge of standard symbols used in process control diagrams, PID control systems, and various process control strategies is also recommended.

Description: This lesson describes the design and operation of various heating and cooling systems utilized in industrial processes. The lesson also presents the principles of heat transfer and its effect on heat exchanger design. In addition, typical control strategies for various heating and cooling systems are presented.

Objectives: Identify typical applications of heating and cooling systems in industrial processes ● Describe the process of heat transfer through convection, conduction, and radiation ● Describe factors that will affect the rate of heat transfer ● State factors associated with process material that affect heat exchanger design ● Describe the design and operation of a tube and shell heat exchanger ● Describe applications for heating systems ● Describe the design and operation of a fired reboiler ● Identify the control loops required of a fired reboiler, evaporator/vaporizer, chiller condenser, and a cooling tower in the proper process diagram and process control requirements.

Distillation Columns (APO02)

Prerequisites: This lesson is designed for participants familiar with process control. A knowledge of standard symbols used in process control diagrams, PID control systems, and various process control strategies is also recommended.

Description: This lesson introduces the concepts of distillation including the components, operation, and principles of distillation systems. The relationship of process variables such as temperature and pressure is described in relation to the proper operation of a distillation column. The lesson also presents basic and advanced distillation control strategies.

Objectives: Summarize the essential features of distillation ● Describe the function of the main components of distillation ● State the significance of vapor pressure, boiling point, temperature variables, pressure variables, and reflux in the distillation process ● Distinguish between binary and multi-product distillation columns ● State the importance of temperature, pressure, reflux, and feed control for a distillation process ● Identify a process analyzer and describe its role in a distillation process ● Describe the significance of material balance regulation to control product composition ● Describe how cascade control is applied ● Describe how feedforward control is applied.

Batch Process Systems (APO03)

Prerequisites: This lesson is designed for participants familiar with process control. A knowledge of standard symbols used in process control diagrams, PID control systems, and various process control strategies is also recommended.

Description: This lesson introduces industrial batch process systems. The lesson includes batch process steps, types, and operation as well as batch process control strategies.

Objectives: Describe the operational differences between batch and continuous processes ● Identify components, functions, and control requirements of a batch process ● Describe control variables and strategies for temperature control ● List batch process steps in correct operational sequence ● State the importance of sequential control for correct process operation ● Describe control variables and strategies involving mixing/blending ● Describe the purpose of polymerization ● Describe how the effects of disturbances and load changes can be minimized ● Describe how the control system would respond to an increase in reaction rate in an exothermic batch process ● Describe the heat transfer principles that contribute to batch process control ● State the advantages of using a closed system of heating and using a heating or cooling coil ● Describe the operation of a single feedback control loop and

a cascade control loop ● Describe the operation and control of a batch process using split range valves ● Describe how pressure can be controlled.

Test Instruments and Devices Library (4 CD's)

16-24 hours of training

This comprehensive INVOLVE® interactive multimedia training program was produced in association with the Instrument Society of America. (ISA). This four-lesson program trains participants on the principles and procedures of various test devices.

Audience: This program is excellent for control personnel and instrument technicians as well as for the multi-craft training needs of process and manufacturing facilities.

Pneumatic and Hydraulic Test Devices (ATI01)

Prerequisites: This lesson is designed for participants familiar with process control instruments. An understanding of basic algebra is also recommended.

Description: This lesson presents operating principles and procedures for using a variety of test devices including manometers, test gages, portable pneumatic and hydraulic calibrators, and pneumatic and hydraulic deadweight testers. Selection of the appropriate test device for a particular instrument calibration is also discussed.

Objectives: Identify the facility's primary and secondary standard pneumatic test equipment ● Identify the pressure reading of a liquid in a manometer and type manometer to use ● Recognize and identify the factors that affect accuracy of manometers ● Read the pressure on a u-tube manometer ● Determine the type of pressure being measured when given a u-tube connected to a vacuum source ● Adjust the manometer scale to zero ● Identify the point on the manometer that should be connected to a pressure source to measure positive pressure ● Determine which test gage should be used for an instrument having high and/or low pressure range ● Identify the required accuracy of the test gage when given the accuracy rating of both the instrument and test gage ● Identify the correct setting of the regulators and selector valve on a pneumatic calibrator to prepare for testing ● Identify the correct type of calibrator for testing high or low pressures ● Identify the means by which the balance point on the deadweight tester is achieved ● Identify the factors that can affect the accuracy of hydraulic and pneumatic deadweight testers.

Electronic Test Devices (ATI02)

Prerequisites: This lesson is designed for participants familiar with basic digital electronic theory. Knowledge of the functions of electronic instruments such as pressure, temperature, flow, level, and weight transmitters is recommended.

Description: This lesson describes the operation of electronic test devices as well as the measurement units used with typical test procedures. The lesson also presents the operation of multimeters and multifunction electronic calibrators in electronic test procedures.

Objectives: Identify the electronic instrument or device that utilizes an electronic value as part of its normal operating procedures ● Identify safety procedures associated with the operation of electronic test devices ● Describe the function of each user control of a multimeter ● Zero the meter display of an analog multimeter ● Measure an electronic input value of a multimeter ● Describe the function of each user control of a multi-function electronic calibrator ● Measure an electronic input value of a multi-function electronic calibrator ● Generate an electronic value to test an instrument using a multi-function electronic calibrator.

Temperature and Frequency Test Devices (ATI03)

Prerequisites: This lesson is designed for participants familiar with process control principles and instruments. An understanding of basic algebra is also recommended.

Description: This lesson presents the basic operating principles and procedures for using multi-function temperature calibrators and sweep/function generators. Emphasis is placed on equipment selection and set-up for various types of sensors.

Objectives: Describe the features of a temperature calibrator and how calibrator temperature and sensor type are configured ● Describe how calibrator output memories and ramp steps are configured ● Demonstrate taking a reading of a thermocouple input ● Demonstrate taking a reading of a 4-wire, 3-wire, and 2-wire RTD input ● Demonstrate connecting the calibrator to an instrument to simulate a thermocouple ● Demonstrate outputting a thermocouple value ● Demonstrate the connection of the calibrator to an instrument to simulate an RTD ● Demonstrate the production of an RTD value ● Define the sweep/function generator as an instrumentation test instrument ● Describe the switches, controls, displays, and indicators found on a sweep/function generator ●

Demonstrate a proper variable symmetry operation ● And demonstrate generation of frequency input for a controller.

Analog and Digital Oscilloscopes (ATI04)
Prerequisites: This lesson is designed for participants familiar with process control principles and instruments. An understanding of basic algebra is also recommended.
Description: This lesson presents the operating principles and procedures for using analog and digital oscilloscopes. The lesson also provides an understanding of how these test devices work, the functions performed, and how they are utilized. Procedures for using an oscilloscope to measure amplitude, period, and frequency are also demonstrated.
Objectives: Identify the major sections of an oscilloscope and their functions ● Describe the function of the vertical input connector and coupling switch ● Describe the functions of the vertical gain control and of the vertical position ● Describe the operation of the trigger and the function of a probe ● Describe the advanced features of a digital oscilloscope ● Set up an oscilloscope ● Identify and interpret typical examples of characteristic waveforms ● Describe the amplitude, frequency, and period of a waveform ● Measure amplitude, period, and frequency using analog and digital oscilloscopes.

Troubleshooting Library (3 CD's)

12-18 hours of training
This comprehensive INVOLVE® interactive multimedia training program was produced in association with the Instrument Society of America. (ISA). This three lesson program trains participants in efficient methods for finding the cause of a problem in a system and correcting it.
Audience: This program is excellent for instrument technicians as well as for the multi-craft training needs of process and manufacturing facilities.

Troubleshooting Single Loop Control Systems (ATS01)
Prerequisites: This lesson is designed for participants familiar with instruments and their functions within a control loop and fundamentals of process measurement. A knowledge of process control diagrams is also recommended.
Description: This lesson describes the systematic approach to troubleshooting and applies that approach to single loop control systems. The lesson explains and demonstrates troubleshooting steps such as verifying that a problem exists, identifying possible causes of the problem, dividing the system to isolate the cause, recommending corrective action, and following up to prevent future problems.
Objectives: Describe the purpose of troubleshooting process systems and identify the reasons a systematic troubleshooting approach is most effective ● Verify that a performance problem exists by gathering information from sources such as the operator, diagrams, trend graphs, historical data, and system performance ● Locate and identify the possible causes of a performance problem based on information gathered about the system in the quickest, most efficient way possible ● Divide the system to isolate possible causes ● Check each possible cause to determine if it is the source of the problem ● Identify and carry out or recommend appropriate corrective action once a performance problem has been located ● Verify that corrections have been made by consulting resources such as the operator and observation of system performance ● Take or recommend appropriate follow-up procedures to minimize the potential for recurrence ● Apply a systematic troubleshooting approach to its proper conclusion in single loop flow, temperature, level, and pressure control systems.

Troubleshooting Multi-Loop Control Systems (ATS02)
Prerequisites: This lesson is designed for participants familiar with instruments and their functions within a control loop and how they are represented on process control diagrams. An understanding of a systematic approach to troubleshooting single loop control systems is also required.
Description: This lesson discusses the application of the steps for applying the systematic approach to troubleshooting multi-loop control systems. Emphasis is placed on isolating possible causes to the appropriate loop of a multi-loop control system. The lesson applies the basic troubleshooting procedure to ratio, cascade, and feedforward systems.
Objectives: Apply the systematic approach to troubleshooting malfunctioning multi-loop control systems ● Read and interpret a control diagram of a multi-loop system, identifying the process variable controlled and the input and output devices for each loop ● Verify that a performance problem exists by gathering information as necessary from such sources as the operator, diagrams, trend graphs, historical data, and system performance ● Locate and identify

the possible causes of a performance problem in the quickest, most efficient way possible ● Divide a multi-loop system into logical divisions to isolate possible causes ● Once the problem has been located, identify and carry out or recommend appropriate corrective action ● Verify that corrective action has been taken by consulting resources and take or recommend appropriate follow-up to minimize the potential for recurrence ● Apply a systematic troubleshooting approach to its proper conclusion in ratio and cascade control as well as feedforward/feedback systems.

Troubleshooting Distributed Control Systems (ATS03)

Prerequisites: This lesson is designed for participants familiar with instruments and their functions within a control loop. An understanding of the steps involved in a systematic approach to troubleshooting single loop control systems is required.

Description: This lesson applies a systematic process for identifying, isolating, and correcting process system problems to distributed control systems (DCS). Emphasis is placed on the use of DCS displays as a troubleshooting tool. System graphics such as set point displays, alarm summaries, and trend graphics are included.

Objectives: List the five steps in a systematic approach to troubleshooting ● Identify the set points and process variables of the components, valve positions, and alarms represented in a graphic display ● Analyze the trend of a process variable over time in a trend graph ● Identify the time, tag name, type of an alarm, and current value or status of the process variable in an alarm summary- evaluate information supplied by the system operator to determine the current condition of the system ● Apply information gathered from displays and from the operator to verify that a problem exists ● Locate and identify the cause of a performance problem in the most efficient way possible ● Take or recommend appropriate corrective action ● Verify that the problem has been corrected ● Recommend follow-up procedures to minimize the potential for recurrence ● Apply the systematic troubleshooting approach to its proper conclusion in a distillation system, batch process, cascade control system, as well as separating feed stock, and batch blending processes.