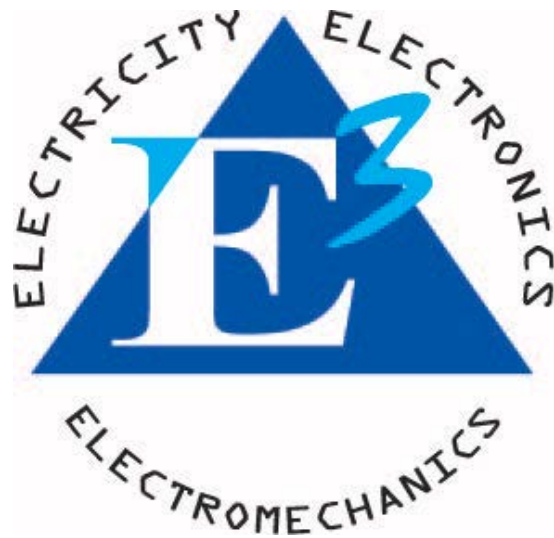


Nida Corporation

Electricity, Electronics, & Electromechanics Program

A Training Program for **All** Technicians



COMPUTER ASSISTED INSTRUCTION

LESSON AND OBJECTIVE LISTING

April 9, 2013

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Electricity, Electronics & Electromechanics (E3) Program

5013-1XX-XXX INTRODUCTION

5013-112-xxx Safety Concepts and Best Practices

5013-112-130 Personal and Workplace Safety

- Define a hazard.
- Identify a hazard as physical, chemical, ergonomic, radiation, psychological, or biological
- Perform a safety risk assessment
- Apply the hierarchy of risk controls
- Select the correct fire extinguisher to put out a class A, B, C, D, and combination fires
- Read emergency evacuation route diagrams
- Practice standard safety rules while working around and with electricity
- Correlate OSHA safety code colors used in manufacturing to situations and devices
- Read material safety data sheets (MSDS)
- Implement the 5-point eye safety checklist
- Recognize the hazards of confined spaces

5013-112-160 Electrical Shock and Safety

- Understand the nature of electric shock
- Understand the effects of electric shock
- Know how to work on an energized circuit
- Know how to prevent electrical hazards
- Know what to do in case of electric shock

5013-112-190 Tool Safety and Best Practices

- Understand basic tools used by systems technicians
- Recognize safe procedures concerning tool use
- Follow hand and power tool precautions

5013-112-220 Introduction to Systems

- Familiarization with system concepts (system thinking)
- Understand 360S system trainer configuration
- Understand 360S system trainer operation
- Experiment card familiarization
- Insertion and removal of experiment cards
- Perform system installation and configuration
- Observe and understand system faults as they affect functionality

5013-114-xxx Tools of the Trade

5013-114-130 Tools for Systems Maintenance

- Identify the basic hand tools used for systems installation, configuration, and support
- Describe the types of tasks performed with each tool
- Describe the safe and proper use of systems technician tools

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5013-114-160 Introduction to Multimeters

- Identify the quantities measured by multimeters
- Identify multimeter characteristics
- Describe the functional sections of a digital multimeter
- Describe the purpose of each functional section

5013-116-xxx Mathematical Basics (New Sub-block)

5013-116-130 Mathematic Skills

- Understand numbers and number format
- Understand basic arithmetic operations
- Understanding exponents
- Understanding fractions
- Understanding decimals
- Understanding percent
- Ratios and proportions
- Understand basic algebraic concepts

5013-116-160 Metric Notation

- Convert decimal numbers to powers of ten and vice versa
- Convert decimal numbers to metric prefixes and vice versa
- Add, subtract, multiply, and divide powers of ten
- Add, subtract, multiply, and divide metric prefixes

5013-2XX-XXX ELECTRICITY AND ELECTRONICS

5013-212-xxx Introduction to Electrical and Electronic Concepts

5013-212-130 Voltage, Current and Resistance

- Describe an atom and its structure
- Define electric charge as it relates to electrons and protons
- Define electrostatic charge
- Describe the law of electrostatic force
- Define voltage and the volt as a unit of voltage
- Define the relationship between voltage and potential difference
- Define current and the ampere as a unit of current
- Describe a conductor and the behavior of electrons within a conductor
- Describe an insulator and the behavior of the electrons within an insulator
- Define watt (power) as a unit of work in a circuit
- Define resistance and the ohm as a unit of measure
- Identify the three basic parts of an electrical circuit
- Describe an electrical circuit load and its relationship to the flow of current

5013-212-160 Basic Multimeter Measurements

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- Understand how to read a digital multimeter's display when measuring voltage, current, and resistance
- Describe the correct way to connect a multimeter for making voltage, current, and resistance measurements
- Describe how to set up a digital multimeter to measure voltage, current, and resistance
- Identify the precautions to observe when making multimeter measurements

5013-212-170 Digital Multimeter Use

- Perform DC voltage measurements using a digital multimeter
- Perform DC current measurements using a digital multimeter
- Perform resistance measurements using a digital multimeter

5013-212-190 Ohm's Law and Power

- Learn what Ohm's Law is and how voltage, current, and resistance are related
- Learn what power is and how voltage, current, and Ohm's Law are related to power
- Prove the Ohm's Law relationship of voltage, current, and resistance

5013-212-220 Introduction to Electronics Technology

- Identify the common force that is present in all electrical and electronic devices
- Define electronics
- Define direct current
- Define alternating current
- Define analog electronics
- Define digital electronics
- Define Active component
- Define semiconductor
- Define Integrated Circuit
- Define Passive component
- Understand the characteristics of a Printed circuit board
- Describe the characteristics of surface mount technology

5013-212-250 Wiring and Schematic Diagrams

- Understand the purpose of wiring and schematic diagrams
- Describe the basic characteristics of wiring and schematic diagrams
- Identify component symbols from wiring and schematic drawings
- Describe the basic signal path in electrical and electronic circuits using wiring and schematic drawings
- Use a wiring diagram to trace signal flow in a system

5013-212-280 Electrical Ground and Grounding Principles

- Understand general concepts of an electrical ground
- Understand the purpose for electrical grounding

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- Understand the various types of grounds used in electrical and electronic circuits
- Define ground loop
- Understand the purpose of circuit over-current protection devices
- Understand ground faults and their implications
- Define electrostatic discharge (ESD)
- Understand how to prevent damage from ESD

5013-214-xxx Basic DC

5013-214-130 Direct Current and DC Resistance

- Understand the definition of Direct Current (DC)
- Understand the physical application of Direct Current (DC)
- Understand batteries as a source of Direct Current (DC)
- Understand the concept of polarity
- Understand DC resistance concepts
- Understand conductivity and non-conductivity from atomic structural view
- Understand resistors as passive, semi-conductive components

5013-214-160 Series Circuits

- Define what a series circuit is
- Identify a series circuit
- Understand the concepts of current and resistance in a series circuit
- Calculate current and resistance in a series circuit
- Understand voltage drop concepts
- Calculate voltage drops across resistance
- Understand the concepts of voltage divider circuits
- Identify a voltage divider circuit
- Calculate and measure current values in a series circuit
- Calculate and measure voltage drops in a series circuit
- Calculate and measure resistance in a series circuit
- Calculate and measure voltage divider outputs

5013-214-190 Parallel Circuits

- Recognize and identify a parallel circuit
- Understand how Ohm's Law applies in a parallel circuit and the relationships of voltage, current, and resistance
- Understand how voltage, current, and resistance react to parallel circuit configurations
- Calculate total resistance in a parallel circuit
- Calculate current in each branch of a parallel circuit
- Measure the applied voltage across each branch in a parallel circuit
- Measure current across each branch in a parallel circuit
- Measure total resistance in a parallel circuit

5013-214-220 Series-Parallel (Combination) Circuits

- Identify a series-parallel circuit
- Understand how Ohm's Law concepts apply to combination series-parallel circuits
- Calculate resistance in a series-parallel circuit
- Calculate current in a series-parallel circuit
- Calculate voltage in a series-parallel circuit
- Measure resistance values in a series-parallel circuit
- Measure current values in a series-parallel circuit
- Measure voltage values in a series-parallel circuit

5013-216-xxx Introduction to AC

5013-216-130 Alternating Current (AC)

- Define alternating current
- Identify an AC sine wave
- Define frequency and cycle
- Describe Hertz
- Determine wavelength of a sine wave
- Determine the period of a sine wave

5013-216-160 Generating Alternating Current (AC)

- Define magnetism
- Identify characteristics of magnets
- Define the characteristics of induction
- Explain the operation of an AC generator
- Identify values of voltage and current at various electrical degrees
- Calculate peak, peak-to-peak, average, and RMS values
- Identify in and out of phase

5013-216-190 Non-Sinusoidal Waves

- Identify harmonic frequencies
- Identify harmonic frequencies used to produce non-sinusoidal waves
- Define square waves
- Identify square wave cycles
- Describe the difference between square and rectangle waves

5013-216-220 Resistance in AC Circuits

- Use Ohm's Law to determine resistance in an AC series circuit
- Identify the relationship between voltage, current, and resistance in an AC series circuit
- Use Ohm's Law to determine resistance in an AC parallel circuit
- Identify the relationship between voltage, current, and resistance in an AC parallel circuit
- Use Ohm's Law to determine resistance in an AC series-parallel circuit

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- Identify the relationship between voltage, current, and resistance in and AC series-parallel circuit

5013-216-250 Oscilloscope Familiarization

- Describe the purpose of an oscilloscope
- Identify the quantities measured by an oscilloscope.
- Identify different types of oscilloscopes.
- Identify the four major functional sections of an oscilloscope.
- Describe the purpose of menus and controls

5013-216-280 Oscilloscope Use with Function Generator

- Set up an oscilloscope for normal use
- Measure voltage using an oscilloscope
- Measure frequency using an oscilloscope

5013-3XX-XXX ELECTRONIC COMPONENTS AND POWER SYSTEMS

5013-312-xxx Components and Devices

5013-312-130 Introduction to Inductors

- Identify types of inductors
- Describe the current opposing characteristic of an inductor
- Identify the schematic symbol for an inductor
- Define inductive reactance
- Define impedance
- Identify the unit of measurement for inductance
- Identify inductor types
- Identify inductor values
- Explain the effects of an inductor failure on a system

5013-312-160 Introduction to Capacitors

- Identify types of capacitors
- Describe charge and discharge characteristics of a capacitor
- Identify the schematic symbol for a capacitor
- Define capacitive reactance
- Define impedance in a circuit with capacitance
- Identify the unit of measurement for capacitance
- Explain the effects of a capacitor failure on system
- Identify ceramic, film, mica, and electrolytic capacitors
- Read capacitance and voltage values
- Observe normal capacitor operation in a circuit
- Verify normal capacitor operation in a circuit based on signal measurements

5013-312-190 Introduction to Transformers

- Describe the purpose of transformers

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- Identify transformer schematic symbols and the reference designation
- Describe transformer operating characteristics
- Define turns ratio
- Define step-up and step-down transformers
- Understand the relationship between primary and secondary current and voltages
- Describe typical faults in transformer circuits
- Observe normal and faulty transformer operation using voltage measurements

5013-312-220 Introduction to Diodes

- Identify the purpose of a diode
- Recognize the common types of diodes
- Recognize diode schematic symbols and reference designators
- Describe the uses of diodes
- Describe semiconductor material
- Describe P and N-type semiconductor material
- Describe forward and reverse biasing

5013-314-xxx Power Supplies and Batteries

5013-314-130 Principles of DC Power Supplies

- Explain the purpose of a DC power supply
- Describe the sections of a typical linear power supply
- Describe the differences between a linear and a switched-mode power supply
- Discuss the advantages and disadvantages of a switched-mode power supply
- Identify half-wave rectifiers
- Identify full-wave rectifiers
- Identify bridge rectifiers
- Identify power supply filter circuits
- Describe basic filter operating characteristics
- Identify series and parallel voltage regulators
- Describe operating characteristics of series voltage regulators
- Describe operating characteristics of parallel voltage regulators

5013-314-140 Power Supply Experiment (New Lesson)

- Observe normal half wave and full wave rectifier operation based on measurements.
- Observe normal filter circuit operation based on signal measurements.
- Observe normal voltage regulator operation based on signal measurements.

5013-314-160 Introduction to Batteries

- Understand and describe the basic construction and operation of batteries
- Identify the components of battery construction
- Learn the various battery types and their general usage
- Understand the operation of rechargeable batteries

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- Identify rechargeable and non-rechargeable batteries
- Understand best practices for safe installation and maintenance of batteries

5013-314-190 Battery Types and Applications

- Describe different types of primary batteries and their applications
- Describe different types of secondary batteries and their applications

5013-4XX-XXX ELECTROMECHANICAL DEVICES (CIRCUIT CONTROL AND PROTECTION)

5013-412-130 Switches and Variable Resistors

- Identify the purpose of a switch
- Identify switch schematic symbols
- Describe single and double pole
- Describe single and double throw
- Describe four types of switches
- Identify the schematic symbol for each switch
- Describe the purpose of rheostats
- Describe the purpose of potentiometers
- Identify the schematic symbol for rheostats and potentiometers

5013-412-160 Overcurrent and Overvoltage Protection Devices

- Define current limiting
- Identify the schematic symbols for fuses
- Understand the purpose of fuses
- Understand the purpose of circuit breakers
- Identify the schematic symbols for fuses and circuit breakers
- Identify the causes of voltage spikes or surges
- Understand the purpose of voltage surge protection devices
- Describe voltage spike
- Describe voltage surge
- Describe the three main characteristics of voltage surge protection devices

5013-412-190 Electromagnetism and Electromagnetic Devices

- Define electromagnetism
- Identify the characteristics of electromagnets
- Describe the operation of a relay
- Describe the operation of a magnetic breaker
- Describe the operation of a meter

5013-412-220 Relays and Solenoids

- Describe the purpose and types of relays
- Describe basic relay construction and operation

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- Identify the schematic symbol and reference designator for relays
- Describe the latched and time delay relay
- Describe the operation and construction of a solenoid
- Identify the purpose for a solenoid
- Identify the schematic symbol of a solenoid
- Observe normal and faulty relay and solenoid based on voltage signal tracing

5013-412-250 DC Motor Principles

- Describe the basic principles of DC motor operation
- Describe the three different connections for brush DC motors
- Identify the schematic symbol for the DC motor
- Identify the physical characteristics of BLDC motors
- Describe the advantages of BLDC over other types
- Understand basic BLDC types and applications

5013-412-280 Transducers

- Define transducer
- Identify different types of transducers
- Understand basic transducer operating principles

5013-5XX-XXX WIRING, CABLING, AND SOLDERING

5013-512-130 Electrical Wiring Principles

- Identify common types of wire and their uses
- Describe conductor sizes
- Describe types of conductor insulation and color coding
- Describe conductor characteristics
- Describe common wire installation practices
- Identify elements of wire identification
- Define wire bundle and wire harness
- Identify various nationally recognized standards
- Describe the various methods for securing wire bundles and harnesses

5013-512-160 Wire Connections and Terminals

- Identify basic characteristics of wire connections
- Identify common types of wire connections
- Define contact resistance
- Define electrical terminal
- Identify advantages and disadvantages of types of wire connections
- Describe causes of common wire connection faults
- Verify wire connections using continuity checks and voltage checks

5013-512-190 Wire Stripping, Crimping, and Splicing

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- Identify different types of wire strippers and trimmers.
- Identify the proper tools used to strip and trim various wires
- Understand how to strip wires using wire strippers
- Identify methods of wire splicing
- Understand how and when to splice a wire
- Identify methods of wire soldering
- Understand how and when to solder wire
- Identify when and how to crimp wires
- Identify the proper tools used to crimp various wires
- Determine the difference between a plug and jack
- Make a butt splice using proper techniques

5013-512-220 Introduction to Soldering

- Identify the industry standards that must be adhered to ensure quality soldering
- Describe the purpose of basic soldering tools
- Describe the characteristics of a good solder connection
- Describe the characteristics and effects of a bad solder connection

5013-512-250 Cable Types and Connectors

- Describe general cable characteristics
- Describe the basic parts of a cable
- Identify the purpose of cable standardization
- Identify common cable connector types and their purposes
- Identify common types of cables and their purposes

5013-512-280 Troubleshooting Wiring and Cabling

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5013-6XX-XXX SOLID STATE DEVICES

5013-612-xxx Diode Devices

5013-612-130 Junction Diodes

- Describe the purpose of a junction diode
- Identify the schematic symbol for a junction diode
- Describe forward and reverse bias
- Calculate circuit current based on the knee voltage of the diode

5013-612-160 Special Purpose Diodes

- Identify the zener diode schematic symbol.
- Identify the purpose of the zener diode
- Describe the operation of the zener diode
- Identify the schematic symbols of special purpose diodes
- Identify the purpose of special purpose diodes

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- Describe the operation of special purpose diodes

5013-612-190 Diode Operation Experiment (New Lesson)

- Observe normal junction diode operation based on voltage measurements
- Observe normal zener diode operation based on voltage measurements
- Observe light emitting diode operation using voltage measurements

5013-614-xxx Transistor Devices

5013-614-130 Introduction to Transistors

- Describe the purpose of a transistor
- Describe types of transistors
- Identify transistor schematic symbols
- Identify leads on transistors
- Describe the purpose of DC bias in transistors
- Describe NPN transistor bias
- Describe PNP transistor bias

5013-614-160 Basic Transistor Operation

- Identify different biasing configurations
- Describe transistor cutoff and saturation
- Describe the purpose of an amplifier
- Define amplifier fidelity and distortion
- Describe common emitter amplifiers
- Describe common collector amplifiers
- Describe common base amplifiers
- Recognize normal operation of a transistor using voltage measurements

5013-614-190 JFETS and MOSFETS

- Recognize field effect transistor schematic symbols
- Describe the construction of Field Effect Transistors (FETs)
- Describe operating characteristics of field effect transistors
- Recognize Metal-Oxide Semiconductor Field Effect Transistor (MOSFET) schematic symbols
- Describe the construction of MOSFET devices
- Describe the operation of Depletion-mode MOSFETs
- Describe the operation of Enhancement-mode MOSFETs
- Identify various MOSFET device applications

5013-616-xxx Multilayered Solid State Devices

5013-616-130 Solid State Switches

- Define breakover voltage

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- Describe the basic characteristics of four-layer devices
- Define holding current
- Describe the purpose of a silicon controlled rectifier
- Identify the silicon controlled rectifier schematic symbol
- Describe the operating characteristics of silicon controlled rectifiers
- Describe the relationship between triacs and SCRs
- Recognize TRIAC circuit operation based on input conditions
- Explain how a DIAC is used with a TRIAC

5013-618-xxx Integrated Circuits (IC)

5013-618-130 Integrated Circuits

- Define integrated circuit
- Identify integration classifications
- Understand the various IC packaging types
- Identify markings associated with integrated circuits
- Identify basic IC packaging materials
- Identify the purpose of the IC Data Book and Technical Guide and Cross Reference book

5013-618-160 Basic Concepts of Microprocessors and Microcontrollers

- Understand the terms associated with microprocessors
- Define microprocessor
- Define microcontroller
- Describe the basic parts of a microprocessor

5013-618-190 Analog Switches and Multiplexers

- Compare the analog switch to other switching methods
- Discuss basic characteristics of analog switch operation
- Discuss basic characteristics of analog multiplexer operation
- Discuss basic characteristics of analog de-multiplexer operation

5013-618-220 Operational Amplifiers

- Describe operational amplifiers
- Describe the types of circuits used in an operational amplifier
- Describe the basic construction of IC operational amplifiers
- Describe linear operational amplifiers
- Describe arithmetic operational amplifiers
- Describe comparator operational amplifiers
- Observe normal operation of an operational amplifier in circuit

5013-7XX-XXX DIGITAL CONCEPTS AND APPLICATION

5013-712-130 Principles of Digital Electronics

- Describe the difference between analog and digital circuits

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- Identify advantages of digital circuits over analog circuits
- Define logic levels, and identify uses for logic levels
- Describe the purpose for and operation of analog to digital converters
- Describe the purpose for and operation of digital-to-analog converters
- Describe input and output conditions for digital logic circuits
- Identify AND, OR, and NOT logic functions
- Identify NAND and NOR logic functions
- Recognize a truth table
- Describe the purpose of a buffer and inverter
- Identify the difference between a sequential circuit and a combinational circuit
- Recognize SET and RESET conditions
- Identify the difference between a synchronous circuit and asynchronous circuit
- Understand basic latch and flip-flop operation
- Describe the terms data, bit, and byte
- Describe serial and parallel data transfer
- Identify the purpose of storage and shift registers
- Identify the purpose of a counter
- Describe modulus
- Define synchronous counter and asynchronous counter
- Describe how a counter divides and is used as a timing circuit

5013-712-160 Digital Electronics Hardware

- Identify advantages of CMOS digital circuits over TTL circuits
- Identify digital IC families
- Describe basic differences between ECL, TTL, CMOS, and BiCMOS families
- Describe basic operating characteristics of different digital ICs
- Observe normal digital IC circuit operation using signal measurements
- Determine the type of input and output signals that occur at digital components within an electromechanical system

5013-8XX-XXX E3 SYSTEMS LEVEL THINKING & APPLICATIONS

5013-812-xxx System Architecture and Concepts

5013-812-130 Systems Fundamentals and Architecture

- Understand the difference between component and system thinking processes
- Understand component and system design
- Understand how system thinking applies to current technology
- Understand how system thinking applies to system technicians
- Understand system architecture
- Understand various system types

5013-812-160 Systems Commissioning and Integration Concepts

- Understand and describe systems commissioning

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- Understand and explain systems commissioning objectives
- Understand and explain the systems commissioning process
- Understand and explain the difference between system convergence and system integration
- Understand and discuss how various system integration combinations naturally satisfy end-user application requirements
- Understand and discuss installation, configuration, and performance testing as it relates to systems commissioning
- Understand and discuss the importance of installation, configuration, and performance testing in relation to systems technicians' work
- Understand and discuss how installation, configuration, and performance testing applies to various systems

5013-812-190 E3 Training Systems Architecture and Commissioning

- Understand the basic architecture of actual low voltage systems in preparation for lesson experiment
- Understand and discuss actual low voltage systems and equivalent 360S trainer versions
- Perform systems commissioning utilizing the 360S trainer systems: installation, configuration, system integration, and performance testing

9XX-XXX SYSTEMS MAINTENANCE AND FAULT ISOLATION

5013-912-xxx Systems Maintenance and Troubleshooting Fundamentals

5013-912-130 Systems Maintenance

- Explain the purpose for preventive maintenance
- Describe typical preventive maintenance practices
- Describe the difference between scheduled and unscheduled maintenance
- Describe general inspection techniques for systems maintenance
- Set up and utilize a system following a given procedure
- Perform a system operational check

5013-912-160 Basic Troubleshooting Theory

- Identify the elements of an effective troubleshooting process
- Understand the basic principles of an effective systemic troubleshooting process

5013-914-xxx Systems Fault Isolation

5013-914-130 Troubleshooting System Malfunctions

- Understand system troubleshooting processes
- Understand system trouble isolation
- Demonstrate trouble location to control circuitry, peripheral device, or connection element
- Troubleshoot system connection elements (cables, connectors, patch panels, and jacks)

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- Demonstrate proficiency using standard technician aids in trouble isolation and troubleshooting malfunctioning systems

5013-914-160 Systems Fault Isolation Techniques

- Understand system fault isolation techniques
- Demonstrate fault isolation techniques in a system

5013-916-xxx E3 Systems Technician Capstone

5013-916-130 E3 Systems Practice Experiment

- Isolate system faults using 360S trainer and E3 systems modules

5013-916-160 E3 Systems Technician Performance Test 1

- Utilizing 360S system trainer, students will apply systems maintenance practices and concepts in isolating system faults to Field Replaceable Units (FRU)

5013-916-190 E3 Systems Technician Performance Test 2

- Utilizing 360S system trainer, students will apply systems maintenance practices and concepts in isolating system faults to Field Replaceable Units (FRU)

5013-916-220 E3 Systems Technician Performance Test 3

- Utilizing 360S system trainer, students will apply systems maintenance practices and concepts in isolating system faults to Field Replaceable Units (FRU)

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