FA4 Advanced Electrical Systems March 2026

Reference Materials: Note: Exam may contain "accepted practice" type questions not found in the reference material listed below.
NFPA 1900: Standard for Aircraft Rescue and Firefighting Vehicles, Automotive Fire Apparatus, Wildland Fire Apparatus, and Automotive Ambulances **(NFPA 1901 Chapters 10, 11, 21, 22 & Annex A)** 2024 edition
NFPA 1960, Standard for Fire Hose Connections, Spray Nozzles, Manufacturer's Design of Fire Department Ground Ladders, Fire Hose, and Powered Rescue Tools **(NFPA 1936 Chapters 22)** 2024 edition
NFPA 1910: Standard for the Inspection, Maintenance, Refurbishment, Testing and Retirement of In-Service Emergency Vehicles and Marine Firefighting Vessels **(NFPA 1911 Chapters 6, 26 & Annex A)** 2024 edition
to order NFPA documents call 800-344-3555 or order online at www.nfpa.org

Fundamental Electrical Troubleshooting, by Dan Sullivan 800-227-1603 http://www.esitest.com/182.html or online retailers
Essentials of Electrical Power Generation, by Dan Sullivan 800-227-1603 http://www.esitest.com/183.html or online retailers
Guide to Hydraulic Power Generation, Russell Scott Dixon. Call the EVT office at 847-426-4075 to request a copy to be emailed to you for no charge for a limited time, compliments of Scott Dixon.
V-MUX Six-Step Troubleshooting Guide *v1- v3,* ***V-MUX Input/Output Relationships Report & V-MUX Troubleshooting Checklist*** download for no charge from http://www.akronbrass.com then to Vehicle Electronics, Firmware & Software, Manuals
Any manufacturers operational and troubleshooting manual or Engine manufacturers electronic diagnostic manuals

LEARNING OBJECTIVES

The technician shall understand the concepts, terms, and phrases related to:

1. **A/C Line Voltage**
   - a. Components and terms
     - (1) Single phase
     - (2) Three phase
     - (3) Neutral wire
     - (4) Ground wire
     - (5) Bonding
     - (6) Inrush / startup current
     - (7) Soft start
     - (8) Frequency
     - (9) Sine wave
     - (10) Photo resistor
     - (11) Resistor
     - (12) True Power
     - (13) Prime Movers
     - (14) Voltage Drop
     - (15) Testing
     - (16) Hertz
   - b. Application and Troubleshooting
     - (1) Wiring connections
     - (2) Wiring methods
     - (3) Repair techniques
       - A. Tools
       - B. Electrical
       - C. Harness connectors
     - (4) Receptacle types
     - (5) Wire routing
     - (6) Diagnostic tools
     - (7) NFPA standards
       - A. Conductors
       - B. Polarity verification
       - C. Circuits
       - D. Remote power Distribution
       - E. Transfer switch
       - F. Grounding
       - G. Testing
         - (a) Full load test
       - H. Out of Service
     - (8) Effects of voltage drops on components
     - (9) Portable Equipment
       - A. Maximum voltage supplied to
   - c. Installations
     - (1) Receptacles
       - A. Mounting height in wet locations
       - B.Switching
     - (2) Light masts
     - (3) Wiring
       - A. Connection to frame rails

2. **System Knowledge**
   - a. Circuit drawings
     - (1) Resistor
     - (2) Diode
     - (3) Rectifier
     - (4) Transistors
       - A. Base
       - B. Emitter
       - C. Collector
     - (5) Thermistors
     - (6) Wire Splice
     - (7) Pulse Width Modulation
     - (8) Capacitor
     - (9) Pressure Governor
     - (10)Potentiometer
     - (11)AND gate
     - (12)OR gate
   - b. Circuit protection
     - (1) Over current protection
     - (2) Circuit rating
     - (3) Ground fault circuit interrupters
     - (4) Wet/dry listings
     - (5) Circuit breaker switches
   - c. Transfer switches
   - d. Power transmission
     - (1) Branch circuits
     - (2) Distribution remote
   - e. Amperage loads
   - f. Component information
     - (1) capacitor
     - (2) relays
   - g. Wire connections
     - (1) Wire Symbols
   - h. Crimping tools

3. **Sources**
   - a. Shoreline power
   - b. Invertors & converters
     - (1) Dynamic power
     - (2) Static power
   - c. Generators
     - (1) Interlocks
     - (2) Generator installation
       - A. Requirements
       - B. Voltage regulation
     - (3) Drives
     - (4) Generator Governors
     - (5) Generator Diagnostics
     - (6) Drive Diagnostics
     - (7) Generator poles
     - (8) Hydraulic generators
       - A. Capacitor effects
       - B. PTO inspection
       - C. Filters
       - D. Hose reversal

4. **Accessories**
   a. Cable reels
   b. Scene lighting
      (1) Requirements
      (2) Interlocks
      (3) Light masts
      (4) Remote towers
      (5) Operational testing
   c. Rescue tools
      (1) Quik-connect requirements
      (2) Battery powered
   d. Hydraulic power unit
   e. Winches

5. **Low Voltage Systems**
   a. Load managers/sequencers
      (1) 1900/1910
         A. Inspection and Maintenance
   b. Troubleshooting
      (1) Testing
         A. Voltage drop test
         B. Functional test
   c. Low Voltage System Knowledge
      (1) Parallel & Series wiring
      (2) PWM
      (3) Manufacture Recommendations
      (4) Inspection & Maintenance
      (5) Kirchoff's Law
      (6) Ohm's Law
      (7) Power Law
   d. Data Recorders
      (1) Data recorded
   e. Seat Belt Warning System
      (1) Warning Devices
         A. Audible
         B. Visual
   f. 1910/1901
      (1) Power Supply
      (2) Low Voltage Batteries

6. **Multiplex Systems**
   a. Components
      (1) V-MUX modules
         A.Hercules node
         B.Vista node
         C.Mini node
         D.Deutsch connectors
      (2) Sensors
         A.Active
         B.Passive
      (3) Class 1 ES-Key Modules
   b. Interface
      (1) Fast idle function
      (2) PEER to PEER
   c. Programming
      (1) Interlocks
      (2) Control Module
      (3) Reports
      (4) Communication
   d. Terminology
      (1) CAN
   e. Troubleshooting
      (1) VMUX
      (2) Welding
      (3) CAN
   f. System Knowledge
      (1) Wiring
      (2) Amount of components
      (3) Effect of AC voltage

7. Operations
   a. Load minder
   b. Water tank level indicating system
   c. Rotation limiting
   d. Pressure governor
   e. Transducers
   f. Proximity switches
   g. Engine Controls
      (1) Throttle position sensor
      (2) Electronic unit injector
      (3) Sensors
      (4) ECU
      (5) D.P.F. Systems
   h. Vehicle data recorder
   i. Ground connections