

Reference Materials: Note: This exam may contain some "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 1917 Chapters**) 2024 edition (800) 344-3555 or www.nfpa.org

NFPA 1910: Standard for the Inspection, Maintenance, Refurbishment, Testing and Retirement of In-Service Emergency Vehicles and Marine Firefighting Vessels (**NFPA 1911 Chapters**) 2024 edition (800) 344-3555 or www.nfpa.org

Any Heavy Truck Electrical Manual-- Suggestions listed below.

Fundamental Electrical Troubleshooting, by Dan Sullivan 800-227-1603 <https://www.esitest.com/C/31/TrainingBooks>

OR

Auto Electricity & Electronic Technology, by James Duffy. Goodheart-Wihlcox 1-708-687-5000 or the book can be ordered from www.Amazon.com

LEARNING OBJECTIVE

1. Basic Principles of Electricity - Define or identify:

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| <ul style="list-style-type: none"> a. Electron Flow <ul style="list-style-type: none"> (1) Resistance in circuits (2) Causes of voltage drops (3) Principles of Electron Flow (4) Cause & effect of bad connections in circuits b. Ohms Law as applied to electrical circuits <ul style="list-style-type: none"> (1) Using the formula (2) Proper terminology c. Principles of Electromagnetism <ul style="list-style-type: none"> (1) Motors | <ul style="list-style-type: none"> d. Electrical symbols and schematics e. Circuit theory <ul style="list-style-type: none"> (1) Proper terminology f. Laws for resistance in series and parallel circuits g. Understanding of SAE electrical symbols h. Definition of a microprocessor i. Major Repairs |
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2. Principles of Operation-Describe or identify:

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| <ul style="list-style-type: none"> a. Function and application of electrical components and accessories <ul style="list-style-type: none"> (1) Invertors & on board chargers (2) Five terminal automotive relays (3) Relays, switches, solenoids, potentiometer, thermistor, sensors etc. (4) spike suppression diodes b. Function and application of electronic components <ul style="list-style-type: none"> (1) Strobe lights (2) Wig wag flashers (3) Load managers (4) Auto throttle (5) Diodes, capacitors, resistors, circuit breakers, etc (6) Proximity Switches (7) LED Lights (8) Halogen lights (9) Low voltage circuit breaker <ul style="list-style-type: none"> (a) Types I, II, & III c. System requirements and performance evaluation d. Evaluation of wire size, insulation, and circuit e. Proper wire repair procedures and proper routing techniques, installation procedures | <ul style="list-style-type: none"> f. Equipment & component protection & installation <ul style="list-style-type: none"> (1) uninterruptable chassis power supply and grounds (2) Proper welding practices g. Function, operation, & testing <ul style="list-style-type: none"> (1) Shunts (2) Gauges (3) Warning devices <ul style="list-style-type: none"> (a) Low voltage audible (b) Dash warning lamps (c) Door ajar alarms (4) Hall effect current sensors h. 115 VAC electrical systems <ul style="list-style-type: none"> (1) Types of circuit breakers (2) Auto reset (3) Manual reset (4) Outlet installation (5) Shoreline receptacle i. Multiplexing circuitry j. Engine Controls k. Schottky isolation diode l. Cot location |
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3. Use of Diagnostic Equipment

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| <ul style="list-style-type: none"> a. Describe diagnostic equipment used to measure voltage, current, and resistance <ul style="list-style-type: none"> (1) Digital and analog meters (2) Scan tools and oscilloscopes (3) Volt, amp, and ohm meters, multimeters (4) Load tester (carbon piles) | <ul style="list-style-type: none"> b. Correct application of diagnostic equipment <ul style="list-style-type: none"> (1) Scan tools (2) Oscilloscopes (3) Volt, amp, and ohm meters <ul style="list-style-type: none"> (a) Minimum Input Impedance (4) Load testers (carbon pile) (5) Test lights (6) Voltage drops, positive and negative side (7) Ammeter (8) Ohmmeter (9) Voltmeter |
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4. Vehicle Batteries-Describe and Identify:

- a. Battery construction and performance
 - (1) test for CCA- Cold Cranking Amps Rating
 - (2) RC-Reserve Capacity Rating
- b. How to evaluate battery requirement
- c. Proper battery charging procedures
- d. Proper battery testing procedures
 - (1) minimum charge
- e. Interpreting charging system volt readings
- f. Multiple battery systems
- g. Jump starting procedures
- h. Maintenance free, low maintenance

5. Cranking Systems-Understand construction and operation of cranking system components

- a. Starting system
 - (1) Types of starting motors
 - (2) Construction
 - (3) Operation
- b. Cranking system diagnosis and testing
 - (1) Connections and grounds
 - (2) Starter draw
- c. Identify proper repair procedures

6. Charging Systems-Understand construction and operation of charging system and components

- a. Alternators
 - (1) Component definitions
 - (2) Component functions
 - (3) Construction, operation, and performance
 - (a) Voltage drop
- b. Alternator
 - (1) Proper maximum output test
 - (2) Radio noise
 - (3) Diagnosis and testing
 - (4) Single and dual alternator systems
 - (5) Effects of Diode Failure
- c. Repair
 - (1) Belt adjustments
 - (2) Proper procedure
- d. Voltage sensing auto-throttle
 - (1) Component operation
 - (2) Troubleshooting
- e. Voltage regulator
 - (1) Adjustments
 - (2) A & B circuits
 - (3) Field relay
 - (4) Function and operation
- f. Charging system circuitry
 - (1) Schematics and symbols
 - (2) System troubleshooting
- g. Maintenance free batteries
- h. Ambulance electrical load

7. Troubleshooting-Understand accepted practices used to diagnose and repair electrical circuits

- a. Voltage drops in components & cabling; Positive & negative
- b. Auto-throttle systems
- c. Strobe light systems
- d. Schematic drawings
 - (1) Symbols
 - (2) Relays and switches
- e. Suction aspirator systems
- f. Relays, components, solenoids
- g. Proper grounding techniques
- h. Battery drain and key off current
- i. Air bag systems
- j. On board computer sensors
- k. ABS
- l. On board computers

8. Vehicle Computer Controls

- a. Definitions
 - (1) Active and passive sensors
 - (2) Sensor operation
 - (3) Analog and digital signals
 - (4) Computer memory operation
 - (5) Diagnostic trouble codes (DTC)
 - (6) VREF
 - (7) Actuators
 - (8) Open & closed loop
- b. Engine controls
 - (1) Glow plug operation and circuits
 - (2) Inputs/outputs
- c. Transmission controls
 - (1) Speed sensors
- d. Brake controls
- e. CAN Bus