

Reference Materials: Note: This exam also contains many hands-on type questions you may not find in any reference material listed below
 NFPA reference listed below - National Fire Protection Association, Quincy, MA, (800) 344-3555 or www.nfpa.org

NFPA 1900: Standard for Aircraft Rescue and Firefighting Vehicles, Automotive Fire Apparatus, Wildland Fire Apparatus, and Automotive Ambulances (**NFPA 1901 section**) 2024 edition Chapter 10

NFPA 1910: Standard for the Inspection, Maintenance, Refurbishment, Testing and Retirement of In-Service Emergency Vehicles and Marine Firefighting Vessels (**NFPA 1911 section**) 2024 edition Chapter 3,6,9,14,21,26

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-Wilcox 1-708-687-5000 or the book can be ordered from www.Amazon.com

LEARNING OBJECTIVES

1. Basic Principles of Electricity-Define or identify:

- | | |
|--|--|
| <ul style="list-style-type: none"> a. Principles of electron flow <ul style="list-style-type: none"> (1) Causes of resistance in circuits (2) Definitions and terms (3) Current flow in parallel circuits (4) Current flow in series circuits (5) Spike suppression b. Ohms Law as applied to electrical circuits <ul style="list-style-type: none"> (1) Relationship of volt, amp, resistance (2) Calculating resistance in parallel circuits (3) Units of measure for Ohm's Law (4) Calculating resistance and voltage in series circuits | <ul style="list-style-type: none"> c. Principles of electromagnetism <ul style="list-style-type: none"> (1) How an electromagnet is created (2) Uses of electromagnet (3) Straight conductor vs. coiled conductor d. Electrical symbols and schematics <ul style="list-style-type: none"> (1) Switch & relay symbol & terminal identification (2) General circuit & symbols, i.e. ground, motors, etc e. Power Formulas as applied to Electrical circuits <ul style="list-style-type: none"> (1) Relationship of volts, amps, & watts (2) Calculating power, amp, and voltage requirements f. Circuit types <ul style="list-style-type: none"> (1) Series & parallel (2) Combo series/parallel (3) Shielded Circuits |
|--|--|

2. Basic Principles of Operation-Describe or identify:

- | | |
|--|--|
| <ul style="list-style-type: none"> a. Function & application of electrical components and accessories <ul style="list-style-type: none"> (1) Relays & diodes (2) Switches (3) Solenoids (4) Interlocks (5) Interface (6) Inverter & convertors (7) Load managers & sequencer (8) Electronic throttles (9) ECM/ECU (10) Programable logic controller b. Function and application of electronic components <ul style="list-style-type: none"> (1) Diodes (2) Capacitors (3) Resistors (4) Lighting-incandescent, halogen, L.E.D., & strobes (5) Data buses (6) Multiplexing (7) Traffic preemption devices (8) Electric motors | <ul style="list-style-type: none"> c. System requirements and performance evaluation <ul style="list-style-type: none"> (1) Voltage drop, current draw, resistance d. Evaluation of wire size, insulation, and circuit protection <ul style="list-style-type: none"> (1) Fuses and circuit breakers-types (2) Wire gauge size e. Proper wire repair procedures and proper routing techniques <ul style="list-style-type: none"> (1) Wire termination, terminal & crimping tool f. Equipment and component protection <ul style="list-style-type: none"> (1) Welding precautions (2) Spike protections (3) Static discharge g. Function, operation, & testing of gauges & warning devices <ul style="list-style-type: none"> (1) Ammeters, voltmeters (2) Gauges (3) Electric speedometers & tachometer |
|--|--|

3. Basic Use of Diagnostic Equipment/Tools

- | | |
|--|--|
| <ul style="list-style-type: none"> a. Describe diagnostic equipment used to measure voltage, current, resistance & impedance <ul style="list-style-type: none"> (1) Proper diagnostic equipment/meter connections <ul style="list-style-type: none"> (a) Voltmeter (b) Ammeter (c) Ohmmeter | <ul style="list-style-type: none"> b. Evaluate quality and application of diagnostic equipment <ul style="list-style-type: none"> (1) Applications of DVOM(DMM) (2) Applications of load testers (3) Applications of analog meters (4) Diagnostic equipment usage <ul style="list-style-type: none"> (a) Testing diodes (5) Inductive ammeters (6) Meter Impedance |
|--|--|

4. Vehicle Batteries-Describe or Identify:

- | | |
|--|--|
| <ul style="list-style-type: none"> a. Battery construction and performance <ul style="list-style-type: none"> (1) Safety-jump starting (2) Purpose-types-construction <ul style="list-style-type: none"> (a) Lead-acid (3) Causes of battery failure b. How to evaluate battery requirements <ul style="list-style-type: none"> (1) Reserve capacity (2) CC./C.A. <ul style="list-style-type: none"> (a) Battery cold cranking rating | <ul style="list-style-type: none"> (3) Battery pack combinations c. Proper battery maintenance procedures <ul style="list-style-type: none"> (1) Types of chargers (2) Charging rates d. Proper battery testing procedures <ul style="list-style-type: none"> (1) Replacement (2) Load Testing (3) Determine state of charge w/DMM |
|--|--|

5. Starting Systems -- Understand the construction and operation of starting system components

- a. Describe starting system construction and operation
 - (1) Circuit component
 - (2) Mechanical components
 - (a) Starter solenoid
 - (3) Pull in & hold in coils
- b. Proper cranking system & component testing procedure
 - (1) Wiring and connections
 - (2) Current draw
 - (3) Slow cranking engine
 - (a) Voltage drop
 - (4) Starter activation circuits
- c. Identify proper repair procedures
 - (1) Connections
 - (2) Starter interlock system

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

- a. Alternator construction and operation
 - (1) Function of components
 - (a) Voltage regulator
 - (2) Alternator output/operation
 - (3) Alternator Design
 - (4) Component recognition
 - (a) Stator
- b. Alternator & Regulator diagnosis and testing
 - (1) Unit testing
 - (2) Component testing
 - (3) On vehicle/off vehicle testing
 - (a) Undercharge/overcharge condition
 - (4) Belt tension and wrap
- c. Proper repair procedures
 - (1) Alternator failures

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

- a. Analyzing results
 - (1) Interpretation of functional drawing reading
 - (2) Circuit wiring/connection
 - (3) Current draw
- b. Components
 - (1) Relays/solenoids
 - (2) Interlocks & Interfaces
 - (3) Switches & proximity
 - (4) Load managers
 - (5) Proper ground connections
 - (6) Gauges
 - (7) Terminals
- c. Tools and equipment
 - (1) DVOM/DMM
- d. Diagnostic tests
 - (1) Voltage drop

8. NFPA 1910

- a. Low Voltage Electrical Systems
 - (1) Inspection and Maintenance
 - (a) Automatic electrical load management systems
 - (2) Performance Testing
 - (a) Battery testing
 - (b) Alternator testing
 - (I) Parameters
 - (II) Electrical load
 - (c) Total continuous electrical load test
 - (I) Load Shedding
 - (d) Solenoid and Relay Test
 - (I) Voltage drop maximum
 - (e) Conductivity Test
 - (f) Starter wiring test
 - (g) Regulator test
 - (h) Voltage Drop Spec's
 - (i) On Board Battery Charger/Conditioner Test
 - (3) Out of Service Criteria
- b. Line Voltage Electrical Systems
 - (1) Inspection and Maintenance
 - (2) Performance Testing
 - (3) Out of Service Criteria
 - (4) Power Source Testing