

Reference Materials: Note: This exam also contains many hands-on type questions you may not find in any reference material listed below

NFPA 1901, **Standard for Automotive Fire Apparatus**, 2003 edition, (800) 344-3555 or www.nfpa.org

Any Heavy Truck Electrical Manual

Suggestions for reference material are listed below.

Heavy Duty ProClinic Manual by Interstate Battery call Jeff Barron at 469-221-4655 for your local interstate dealer ordering information

OR

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

Any emergency apparatus service and operator manual (OEM)

LEARNING OBJECTIVES FOR THE F-4 EXAM

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) Definition of terms (3) Current flow in parallel circuits (4) Current flow in series circuits 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 in series circuits c. Principles of electromagnetism <ul style="list-style-type: none"> (1) How an electromagnet is created (2) Uses of electromagnet (3) Definitions and terms | <ul style="list-style-type: none"> 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 requirements (3) Calculating amp requirements (4) Calculating 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 and application of electrical components and accessories <ul style="list-style-type: none"> (1) relays (2) switches (3) solenoids (4) interlocks (5) interface (6) inverter & convertors (7) load managers & sequencer (8) electronic throttles (9) ECM/ECU 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 c. System requirements and performance evaluation <ul style="list-style-type: none"> (1) voltage drop (2) current draw (3) resistance | <ul style="list-style-type: none"> d. Evaluation of wire size, insulation, and circuit protection <ul style="list-style-type: none"> (1) Fuses and circuit breakers-types (2) insulation ratings (3) wire gauge size e. Proper wire repair procedures and proper routing techniques <ul style="list-style-type: none"> (1) Solder techniques (2) wire termination, terminal & crimping tool (3) wire loom ratings (4) corrosion protections 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) instrument voltage regulators (4) electric speedometers & tachometer |
|--|---|

3. Basic Use of Diagnostic Equipment

- | | |
|--|---|
| <ul style="list-style-type: none"> a. Describe diagnostic equipment used to measure voltage, current, resistance & impedance <ul style="list-style-type: none"> (1) Interpretation of oscilloscopes (2) Proper diagnostic equipment connections (3) Definitions and terminology | <ul style="list-style-type: none"> b. Evaluate quality and correct 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 (5) Inductive ammeters |
|--|---|

continued next page

4. Vehicle Batteries--Describe and Identify:

- a. Battery construction and performance
 - (1) Safety-jump starting
 - (2) Components
 - (3) Purpose-types-construction
 - (4) Define a battery
- b. How to evaluate battery requirements
 - (1) Reserve capacity
 - (2) C.C.A./C.A.
 - (3) BCI group identification
 - (4) Operating temperature
 - (5) Battery pack combinations
- c. Proper battery maintenance procedures
 - (1) Types of chargers
 - (2) Charging rates
 - (3) Battery maintenance
- d. Proper battery testing procedures
 - (1) Replacement
 - (2) Load Testing
 - (3) Conductivity testing
 - (4) Define surface charge
 - (5) 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
 - (3) Protection, Protection systems and devices
 - (4) Field winding types
 - (5) Pull in & hold in coils
- b. Proper cranking system & component testing procedure
 - (1) Wiring and connections
 - (2) Mechanical components/drive pinions
 - (3) Current draw
 - (4) Voltage drop
 - (5) Starter activation circuits
- c. Identify proper repair procedures
 - (1) Connections
 - (2) Solenoid switch contact
 - (3) 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
 - (2) Alternator output
 - (3) Alternator Design
 - (4) Component recognition
 - (5) Drive requirements
 - (6) Noise suppression
- b. Alternator & Regulator diagnosis and testing
 - (1) Unit testing
 - (2) Component testing
 - (3) On vehicle/off vehicle testing
 - (4) Battery isolator/isolated systems
 - (5) Mounting hardware
 - (6) Regulator adjustment procedure
 - (7) Belt tension and wrap
- c. Proper repair procedures
 - (1) Component failures
 - (2) Replacement of regulators and remote rectifier
- d. Evaluate charging system requirements
 - (1) Load analysis
 - (2) Cable size
 - (3) Set output requirements

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
- b. Components
 - (1) Relays/solenoids
 - (2) Interlocks & Interfaces
 - (3) Switches and proximity
 - (4) Load managers
 - (5) Sequencer
- c. Tools and equipment
 - (1) DVOM/DMM
 - (2) Induction meters
 - (3) load tests
- d. Diagnostic tests
 - (1) Voltage drop