

**Reference Materials:** Note: This exam may contain some "accepted practice" type questions not found in the reference material listed below.

KKK-A-1822F **Federal Specification for the Star-of-Life Ambulance**, download for no charge at <http://www.ntea.com/WorkArea/showcontent.aspx?id=1352>

**Ford Ambulance QVM** Guide, [www.fleet.ford.com/truckbbas/non-html/qpg/2004/ambulanceguidelines04.pdf](http://www.fleet.ford.com/truckbbas/non-html/qpg/2004/ambulanceguidelines04.pdf)

**Any** good automotive or electrical repair manual . The following are suggested reference materials

**Auto Electricity & Electronics** by James Duffy, Goodheart-Wilcox 1-708-687-5000 or the book can be ordered from [www.Amazon.com](http://www.Amazon.com) for \$52

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

### LEARNING OBJECTIVES FOR THE E-2 EXAM

#### 1. Basic Principles of Electricity - Define or identify:

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

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| <ul style="list-style-type: none"> <li>a. Function and application of electrical components and accessories               <ul style="list-style-type: none"> <li>(1) Invertors &amp; on board chargers</li> <li>(2) 5 terminal automotive relays</li> <li>(3) relays, switches, solenoids, potentiometer, thermistor, sensors etc.</li> <li>(4) spike suppression diodes</li> </ul> </li> <li>b. Function and application of electronic components               <ul style="list-style-type: none"> <li>(1) Strobe lights</li> <li>(2) Wig wag flashers</li> <li>(3) Load managers</li> <li>(4) Auto throttle</li> <li>(5) Diodes, capacitors, resistors, circuit breakers, etc</li> <li>(6) Proximity Switches</li> <li>(7) LED Lights</li> <li>(8) Halogen lights</li> </ul> </li> <li>c. System requirements and performance evaluation</li> <li>d. Evaluation of wire size, insulation, and circuit</li> <li>e. Proper wire repair procedures and proper routing</li> </ul> | <ul style="list-style-type: none"> <li>f. techniques, installation procedures</li> <li>Equipment &amp; component protection &amp; installation               <ul style="list-style-type: none"> <li>(1) KKK dedicated power supply and grounds</li> <li>(2) Proper welding practices</li> </ul> </li> <li>g. Function, operation, &amp; testing               <ul style="list-style-type: none"> <li>(1) Shunts</li> <li>(2) gauges</li> <li>(3) warning devices</li> <li>(4) Hall effect current sensors</li> </ul> </li> <li>h. 115 VAC electrical systems               <ul style="list-style-type: none"> <li>(1) Types of circuit breakers</li> <li>(2) Auto reset</li> <li>(3) Manual reset</li> <li>(4) Outlet installation</li> </ul> </li> <li>i. Multiplexing circuitry</li> <li>j. Engine Controls</li> <li>k. Schottkey isolation diode</li> </ul> |
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#### 3. Use of Diagnostic Equipment

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

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| <ul style="list-style-type: none"> <li>a. Battery construction and performance</li> <li>b. How to evaluate battery requirement; CCA, CA, RC</li> <li>c. Proper battery charging procedures</li> </ul> | <ul style="list-style-type: none"> <li>d. Proper battery testing procedures</li> <li>e. Interpreting charging system volt readings</li> <li>f. Multiple battery systems</li> <li>g. Jump starting procedures</li> <li>h. Maintenance free, low maintenance</li> </ul> |
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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
  - b. Alternator
    - (1) Proper maximum output test
    - (2) Radio noise
    - (3) Diagnosis and testing
    - (4) Single and dual alternator systems
  - 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
  
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
  - i. 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
  - c. Transmission controls
    - (1) Speed sensors
  - d. Brake controls