

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

**Snap on Training Manual Air Conditioning** ...ACT 279C, 1999, for local dealer information call 877-740-1900

**Chilton's Motor Age Heating & A/C Self-Study** Guide, call 800-240-1968 \$17.95 order online [www.PassTheASE.com](http://www.PassTheASE.com)

**Ambulance Performance Standards**, AMD 001009, NTEA, AMD Division, 37400 Hills Tech Dr., Farmington Hills, MI 48331-3414 248-489-7090. Available for no charge at <http://www.ntea.com/WorkArea/showcontent.aspx?id=1346>

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>

### LEARNING OBJECTIVES FOR THE E-3 EXAM

#### 1. Definitions or Terms

- |                                     |  |                                  |
|-------------------------------------|--|----------------------------------|
| a. Heat exchanger                   | h. FOTCC-Fixed Orifice Tube Cycling Clutch | p. Ambient temperature           |
| b. Evacuate                         | i. FFOT-Ford Fixed Orifice Tube            | q. Compressor (1) types          |
| c. Conduction                       | j. Evaporator                              | r. British Thermal Unit (B.T.U.) |
| d. Convection                       | k. Condenser                               | s. Material types                |
| e. Radiation                        | l. Refrigerant                             | t. Latent heat                   |
| f. Orifice tube                     | m. Receiver-dryer                          | u. Expansion valves & tubes      |
| g. CCOT-Cycling Clutch Orifice Tube | n. Accumulator-dryer                       | v. TXV valves                    |
|                                     | o. Desiccant bag                           | w. VIR valves                    |

#### 2. Specification and Design--As stated in KKK-A-1822

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|--|---|
| a. Environmental systems<br>(1) Controls<br>(2) Electrical wiring  | f. Component installation & routing<br>(1) Hoses and lines<br>(2) Accessibility<br>(3) Securing hoses |
| b. Heating and cooling criteria<br>(1) Sufficient capacity<br>(2) Temperature ranges<br>(3) Performance test<br>(4) Patient Compartment Requirements | g. Ventilation requirements<br>(1) Air exchange   |
| c. Auxiliary A/C condenser   | h. Patient compartment insulation<br>(1) rates and specifications                                     |
| d. Sound level requirements<br>(1) AMD standard<br>(2) Interior Levels, KKK Standard   | i. Electronic/computer controlled systems   |
| e. Windshield defrosting   | j. Compressor design types  |
|  | k. Paint effect of temperature  |
|  | l. Environmental control storage cabinet<br>(1) types   |

#### 3. Heating and air conditioning theory

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|--|--|
| a. Heat & heat transfer<br>(1) Movement of heat<br>(2) Principles                                  | d. Pressure and temperature<br>(1) System performance<br>(2) Function of compressor<br>(3) Relationship between pressure and temperature   |
| b. Matter<br>(1) Compressibility<br>(2) Solid, liquids, and gases<br>(3) Physical states of matter | e. Basic A/C theory of operation<br>(1) Compressor controls<br>(2) Expansion device<br>a. Orifice tube<br>b. TXN<br>(3) "Highside-Lowside" |
| c. Evaporation and Condensation<br>(1) B.T.U.<br>(2) Desiccants                                    | f. Physical comfort  |

#### 4. Operation Systems Components and Controls--Describe or identify:

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|--|--|
| a. Types of clutch cycling systems<br>(1) CCOT<br>(2) FCCOT-FFOT   | e. Patient compartment air distribution system<br>(1) Purpose of blower motor function |
| b. TXV thermostatic controls   | f. Electronic temperature control systems<br>(1) High idle controls                    |
| c. A/C pressure cycling controls<br>(1) Low pressure cut off controls  | g. Refrigerant filter systems<br>(1) Filter dryer<br>(2) In-line filters               |
| d. Rear HVAC(heating, ventilation, A/C) system<br>(1) Auxiliary condensers<br>(2) Rear unit hot water controls (heating) | h. Compressor clutch   |

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#### 5. Trouble Shooting, Repair and Service

- a. Identify types and use of leak detectors
- b. Describe the use of gauges and test equipment used in troubleshooting A/C systems
- c. Reclaiming/recycling & recharging units
  - (1) Certification and specification
  - (2) Describe the use of reclaiming/recycling & recharging units
- d. Hoses, fittings, belts, and components
  - (1) Hose fitting and connections
  - (2) Identify visual checks of
- e. Compressor & clutch
  - (1) Service valves/isolation valves
  - (2) Component replacement
  - (3) Identification
  - (4) repair & replacement
- f. Diagnosis/repair of expansion valve/orifice tube system
- g. Condenser & evaporator diagnosis and replacement
- h. Engine cooling/heater - defrosting systems
  - (1) Preventative maintenance
  - (2) diagnosis, repair and replacement of components
  - (3) ATC control system
  - (4) SATC control system
  - (5) EATC control system
- i. Evacuation and recharging of A/C systems
  - (1) Temperature/pressure ranges
  - (2) Describe evacuation and recharging
- j. Diagnosis and repair of A/C cooling performance problems
  - (1) Air duct temperature ranges
  - (2) Blocked orifice tube
  - (3) Ambient temperature switch
  - (4) TXN controlled systems
- k. Electrical system repair and troubleshooting
  - (1) Components and functions
  - (2) System limit controls
  - (3) Load manager/high idle control
  - (4) Reading electrical schematics
- l. Heating system troubleshooting and repair
  - (1) Control valves
  - (2) Performance
- m. Retrofit to R134A refrigerant systems
  - (1) Component replacement
  - (2) In-line filter
- n. Proper flushing of A/C systems
  - (1) Components
- o. Identify proper use of refrigerants
  - (1) contaminants
- p. Refrigerant oils
  - (1) 134a & R-12
  - (2) Checking and adding oil (compatibility)
  - (3) Desiccant material compatibility
- q. Engine coolant systems
  - (1) Types of coolant
  - (2) Frequency of change
  - (3) Altitude variations - pressurized systems

## 6. Safety and Environmental Concerns

- a. Refrigerant recovery and recycling
- b. Federal Clear Air Act
  - (1) Technician Certification requirements
  - (2) Equipment certification requirements
- c. Equipment and tool specifications
  - (1) Charging hoses, manifolds, and connections
  - (2) Refrigerant container
- d. Refrigerant compatibility
  - (1) Retrofitting
- e. Use & maintenance of recharging station
- f. Leak detector safety
  - (1) Flame leak detector
  - (2) Electronic leak detector
    - (a) Probe tip damage and safety
    - (b) Explosive atmosphere
- g. Personal protective equipment
  - (1) Refrigerants
  - (2) Oils
- h. Refrigerant safety and handling
  - (1) Container capacity
  - (2) Container specifications
  - (3) Flammability of R-134a
    - (a) relative to atmospheric pressure
    - (b) introduction of compressed air
  - (4) Container disposal
- i. Environmental awareness
  - (1) Refrigerants
  - (2) Coolants
    - (a) disposal
  - (3) Carbon monoxide levels
  - (4) Material safety data sheet
  - (5) Bio hazards & sharps container
  - (6) Performance tests
- j. Engine Cooling - Heater - Defroster Safety
  - (1) Radiator Cap
- k. Environment system filters
  - (1) Pathogens
- l. Patient compartment windows & doors
  - (1) Tinting
  - (2) Seals for carbon monoxide
- m. Material safety data sheets
  - (1) Suppliers responsibility
  - (2) Users responsibility
- n. Medical waste in ambulances
  - (1) Shop procedures