

E-3 Ambulance Heating, Air Conditioning, and Ventilation

June 2010

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

Motor Age T7 Heating & A/C Self-Study Guide, call 800-240-1968 order online www.PassTheASE.com

Motor Age A7 Heating & A/C Self-Study Guide, call 800-240-1968 order online 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>

Automotive Air-Conditioning and Climate Control Systems: order online at www.amazon.com or www.books.elsevier.com

Mobil Air Conditioning Society (MACS) Worldwide Certification Training Manual can be downloaded for no charge at:

http://www.macsw.org/AM/Template.cfm?Section=Section_609&Template=/CM/ContentDisplay.cfm&ContentID=5397

Mobil Air Conditioning Society (MACS) Worldwide Recommended service procedures can be download fo no charge at:

http://www.macsw.org/AM/Template.cfm?Section=Service_Practices&Template=/CM/ContentDisplay.cfm&ContentID=1427

LEARNING OBJECTIVES FOR THE E-3 EXAM**1. Definitions or Terms**

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|-------------------------------------|--|----------------------------------|
| 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 (1) Controls (2) Electrical wiring | f. Component installation & routing (1) Hoses and lines (2) Accessibility (3) Securing hoses |
| b. Heating and cooling criteria (1) Sufficient capacity (2) Temperature ranges (3) Performance test (4) Patient Compartment Requirements a. Flow & Make-up air b. Drafts | g. Ventilation requirements & criteria (1) Air exchange rate |
| c. Auxiliary A/C condenser | h. Patient compartment insulation (1) rates and specifications |
| d. Sound level requirements (1) AMD standard (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 (1) types |

3. Heating and air conditioning theory

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| a. Heat & heat transfer (1) Movement of heat (2) Principles | e. Basic A/C theory of operation (1) Compressor controls (2) Expansion device a. Orifice tube b. TXV |
| b. Matter (1) Compressibility (2) Solid, liquids, and gases (3) Physical states of matter | (3) "Highside-Lowside" (4) Preventing evaporator freeze-up a. Cycling clutch system b. Variable displacement compressors |
| c. Evaporation and Condensation (1) B.T.U. (2) Desiccants | f. Physical comfort |
| d. Pressure and temperature (1) System performance (2) Function of compressor (3) Relationship between pressure and temperature (4) Effect of air in refrigerant during recovery | g. Refrigerant control |

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

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

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
 - (1) Compound gauge
- 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) Other necessary 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
 - a. Locate N.T.C. sensor
 - (5) EATC control system
- i. Evacuation and recharging of A/C systems
 - (1) Temperature/pressure ranges
 - (2) Describe evacuation and recharging
 - a. Time required
- 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
 - (2) OEM requirement
- p. Refrigerant oils
 - (1) 134a & R-12
 - (2) Checking and adding oil (compatibility)
 - (a)OEM requirements
 - (3) Desiccant material compatibility
- q. Engine coolant systems
 - (1) Types of coolant
 - (a)OEM requirements
 - (2) Frequency of change
 - (3) Altitude variations - pressurized systems
- r. Disable air bag system

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
 - (3) Best practices & equipment
- g. Personal protective equipment
 - (1) Refrigerants
 - (2) Oils
- h. Refrigerant safety and handling
 - (1) Container capacity
 - (2) Container specifications
 - (3) Flamibility 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
- o. European refrigerant rules