E-3 Ambulance Heating, Air Conditioning, and Ventilation Jan 2018

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

NFPA 1917, Standard for Automotive Ambulances, including annexes National Fire Protection Association (800) 344-3555 or www.nfpa.org

Mobil Air Conditioning Society (MACS) Worldwide Certification Training Manual can be downloaded for no charge at: http://www.macsw.org/web/MACS/Certification/Section_609_Certifcation.aspx?WebsiteKey=d89ff0bc-ce9d-41d9-a243-d885ad993b37&hkey=a4bf82fe-9db6-4507-8ddd-27fd9b9153f6&Technician_Panel=2#Technician_Panel

MACS R1234yf info http://macsworldwide.wordpress.com/2011/03/17/just-the-faqs-about-r-1234yf/

RedDot Heavy-Duty HVAC Service Manual https://www.btrac.com/documents/svc-manual-revision-i-feb-2011.pdf

Haynes Automotive Heating & AC *Chapter 1* http://www.volkspage.net/technik/manuaisecatalogos/01/AutomotiveHeatingandAirConditioning.pdf

OSHA Bloodborne Pathogens - https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=10051

OSHA Global Harmonized System of Classification and Labeling of Chemicals (GHS) https://www.osha.gov/dsg/hazcom/ghsguideoct05.pdf

LEARNING OBJECTIVES FOR THE E-3 EXAM

1. Definitions or Terms

a. Heat exchanger
b. Evacuate
c. Conduction
d. Convection
e. Radiation
f. Orifice tube
g. CCOT-Cycling Clutch Orifice Tube
h. FOTCC-Fixed Orifice Tube Cycling Clutch
i. FFOT-Ford Fixed Orifice Tube
j. Evaporator
k. Condenser
l. Refrigerants
m. Receiver-dryer
n. Accumulator-dryer
o. Desiccant bag
p. Ambient temperature
q. Compressor
(1) types
r. British Thermal Unit (B.T.U.)
s. Latent heat
t. In-Line filter
u. Diagnostic codes
v. Compressor head pressure
w. Supplemental coolant additives
x. Law of heat transfer

2. Specification and Design

a. Environmental systems
(1) Controls
(2) Electrical wiring
b. Heating and cooling criteria
(1) Sufficient capacity
(2) Temperature ranges
(a) out of service criteria
(3) Performance test
(a) HVAC Settings during electrical load test
(4) Patient Compartment Requirements
(5) NFPA 1917
c. Auxiliary A/C condenser
d. Sound level requirements
(1) Interior Levels, 1917 Standard
e. Windshield defrosting
f. Component installation & routing
(1) Hoses and lines
(2) Accessibility
(3) Securing hoses
g. Ventilation requirements & criteria
(1) Ambient air exchange
h. Patient compartment insulation
(1) rates and specifications
i. Electronic/computer controlled systems
j. Compressor design types
k. Paint effect of temperature
l. Special Design Considerations (1917)
m. Driver's compartment
(1) air box blend doors
n. Condenser
(1) contaminated (cleaning)

3. Heating and air conditioning theory

a. Heat & heat transfer
(1) Movement/transfer of heat
(2) Principles
b. Matter
(1) Compressibility
(2) Solid, liquids, and gases
(3) Physical states of matter
c. Evaporation and Condensation
(1) B.T.U.
(2) Desiccants
(a) When to replace
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
(5) Effect of air in operation A/C system
e. Basic A/C theory of operation
(1) Compressor controls
(a) Variable displacement compressors
(2) Expansion device
a. Orifice tube
b. TXV
(3) "Highside-Lowside"
f. Physical comfort
g. Refrigerant control

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

a. Types of clutch cycling systems
(1) CCOT
(2) FCCOT-FFOT
b. Expansion Device
(1) TXV
(2) Orifice tube
c. A/C pressure cycling controls
(1) Low pressure cut off controls
(2) High pressure cut off controls
d. Rear HVAC system
(1) Auxiliary condensers
e. Patient compartment air distribution system
(1) Purpose of blower motor function
f. Electronic temperature control systems
(1) High idle controls
g. Refrigerant filter systems
(1) Filter dryer
(2) In-line filters
a. Service life length
b. Installatin location
(3)Accumulator
h. Compressor clutch
i. Electric cooling fans
j. A/C Performance Testing Methods
(1) Using a Manifold Gauge Set
(2) Diagnosis by "Sight, Sound, Smell & Touch"
k. New Refrigerant Types (R-1234YF)
l. Refrigerant oils
(1)Type
(2) Quantity
m. Windshield defrosting
n. Refrigerant recovery
o. Out of Service Criteria
(1)HVAC
(2)Engine Coolant System

continued next page

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
   (3) Refrigerant identifier
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
      (b) Amounts of refrigerants
j. Diagnosis and repair of A/C cooling performance problems
   (1) Air duct temperature ranges
   (2) Blocked orifice tube
   (3) Ambient temperature switch
   (4) TXV controlled system
   (5) Passenger compartment
   (6) Air flow duct filters
   (7) Air flow doors
   (8) Engine coolant assemblies
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
   (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
s. Refrigerant dye for leaks
t. Out of Service Criteria
   (1) HVAC
   (2) Engine Coolant 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
   (3) Recovery & recharging machines
d. Refrigerant compatibility
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
   (4) UV leak detectors
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 and detector (NFPA 1917)
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. Safety Data Sheets
   (1) Suppliers responsibility
   (2) Users responsibility
n. Medical waste in ambulances
   (1) Shop procedures
o. European refrigerant rules
p. Automatic cooling fan
q. R-1234YF
   (1) Equipment & tools
   (2) Flamibility