F-3 Fire Pumps & Accessories February 2024

Reference Materials: This exam also contains "accepted practice" questions not found in the reference material listed below.
Pumping Apparatus DRIVER/OPERATOR Handbook 3rd editon. Oklahoma State University, Stillwater, OK. (800) 654-4055 or www.ifsta.org Chapters 2 5,7, 8, 9, 10, 11,14, 15, glossary.
NFPA 1900: Standard for Aircraft Rescue and Firefighting Vehicles, Automotive Fire Apparatus, Wildland Fire Apparatus, and Automotive Ambulances **(NFPA 1901 Chapters)** 2024 edition
NFPA 1910: Standard for the Inspection, Maintenance, Refurbishment, Testing and Retirement of In-Service Emergency Vehicles and Marine Firefighting Vessels **(NFPA 1911 Chapters)** 2024 edition www.nfpa.org 800–344-3555
Fire pump manufacturer's repair manuals (Hale, Waterous, Darley, Trident) www.haleproducts.com
https://smhttp-ssl-61500.nexcesscdn.net/media/pdf/029-0020-63-0-C_Midship_Muscle_Pump_Manual.pdf
https://tridentdirect.com/images/companies/1/AirPrime_Install-Ops_Guide_01-21-19_email.pdf?1523384889866
www.waterousco.com Search for F-1031 2114, 4212, 1000
www.wsdarley.com - Pump Operaton Manual - Midship pump

LEARNING OBJECTIVES FOR THE F-3 EXAM

1. **Hydraulic Principles:** Understand the hydraulic principles of water movement in pump operations.
   - a. Pressure
     - (1) Force per unit area
     - (2) Static pressure
     - (3) Measure of residual pressure
     - (4) Net pump pressure
       - (a) Friction loss
     - (5) Head pressure
   - b. Vacuum
     - (1) inches of mercury
   - c. Drafting
     - (1) Effect of Atmospheric pressure on vacuum
     - (2) Lift
   - d. Venturi application
     - (1) eductor
   - e. Cavitation/Water hammer
     - (1) Symptoms
     - (2) Cause/Prevention
     - (3) Pump RPM to pressure relationship

2. **Mechanical Principles of Pumps:** Understand the theory and mechanical principles of pumps, pump controls and accessories:
   - a. Positive-displacement pumps
     - (1) Vane Primers
       - (a) Sealing Lubricant
   - b. Centrifugal Pump
     - (1) Two-stage
       - (a) Route of water
       - (b) Transfer valve
         - (i) Volume/parallel
         - (ii) Pressure/series
     - (2) Packing/Mechanical seal
       - (a) Drip rate
         - (i) mechanical seal
         - (ii) packing
       - (b) Flinger/Slinger ring
       - (c) Stuffing box
       - (d) Purpose of packing adjustment
       - (e) Lantern rings
     - (3) Impeller Design
       - (a) Purpose of eye
     - (4) Housing stripping edge/cut water
     - (5) Priming methods
       - (a) Air Primer
       - (b) Exhaust Primer
   - c. Pressure control devices
     - (1) Relief valves
       - (a) Purpose
       - (b) Controls
       - (c) Pilot Valve
     - (2) Governors
       - (a) Controls
   - d. Intake and discharge valves
     - (1) Ball valve
   - e. Coolers
     - (1) Engine
     - (2) Pump
       - (a) Thermal relief valve
   - f. Foam system proportioning
   - g. Vernier throttle purpose
   - h. Gauges
     - (1) Compound Pressure gauge
     - (2) Liquid filled gauge
       - (a) Acceptable condition
   - i. Flow meters
     - (1) Mounting
     - (2) Paddle wheel
   - j. Water tank to pump check valve

3. **Fire Pump Operation:** Understand the operation of a fire pump and related accessories.
   - a. Pumping at Draft
     - (1) Two Stage
       - (a) Volume/Parallel
       - (b) Pressure/Series
       - (c) Transfer valve positioning
       - (d) Swing check valve
     - (2) Choosing a draft site
       - (a) Contamination
       - (b) Maximum allowable lift
     - (3) Vacuum
       - (a) Effect of Leaks
       - (b) Priming
       - (c) Vacuum readings when drafting
       - (d) Pump packing adjustment
     - (4) Reduced flow/losing prime - Cause & Effect
       - (a) worn impeller
       - (b) leak on intake
       - (c) aeration
       - (d) hoseliner collapse
       - (e) Transmission Lockup
       - (f) Relief Valve
     - (5) Pressure controlling systems
       - (a) Pressure relief valves
       - (b) Maximum pressure rise continued on other side
       - (c) intake relief valves
       - (d) Pilot valves
   - b. Auxiliary Cooling system
   - c. Butt Tooth condition during pump shifting
   - d. Cause of cavitation
   - e. Pump transmission

4. **Preventive Maintenance, Checks & Inspection**: Understand the periodic preventive maintenance and inspection requirements.
   a. Lubricant
      (1) Types
      (2) Primer pumps
      (3) Fluid level check
      (4) Hale Auto-lube front bearing
   b. Documentation
      (1) PM
      (2) Schedule responsibility
      (3) Fluid analysis
   c. Frequency / Required monthly checks
      (1) Flushing/Back Flushing
   d. Pump Packing
      (1) Reason for Adjustment
      (2) Cause/Effect of Incorrect Adjustment
      (3) Maintenance
   e. Mechanical pump seals
      (1) Acceptable leak rate
   f. Transfer Valve Maintenance
   g. Pump transmission
      (1) Maintenance intervals
      (2) Incorrect fluid levels
      (3) Drain plug function
      (4) Water Contamination
      (5) Leaks
         (a) Class 3
      (6) Primer Maintenance
      (7) Oiled Primer leaks
   h. Pressure relief system
      (1) Checks
      (2) Maintenance
   i. Valve maintenance
   j. Gauges and instruments
      (1) Flow meter Paddle wheel inspection
   k. Pump assembly
      (1) Waterous Out board bearing Lubrication
   l. Anodes/Intake strainer inspection
   m. Water and foam tank maintenance
   n. Out of service
      (1) Pressure Control system
      (2) Water Tank
      (3) Fire Pump engagement

5. **Repair and Overhaul:** Understand the necessary procedures to repair and overhaul a fire pump
   a. Probable Causes and Effects of defects
      (1) Pump components
         (a) Galvanic corrosion
         (b) Impeller damage from Cavitation
         (c) Shaft damage from packing
         (d) Primer systems
            (i) Primer Valve stuck open
            (ii) Oiled primer leaks
            (iii) Primer will not engage
         (e) Pump transmission Fluid analysis
         (f) Drive line out of phase
         (g) Relief valve delayed response
         (h) Valves
            (i) leakage
            (ii) locking
         (i) Worn clearance ring effect
         (j) Missing flinger / slinger ring
         (k) Pump component specifications
      (2) Pump Controls and accessories
         (a) Transmission Lockup
         (b) Gauge problems
         (c) Improper operation
   b. Out of Service criteria
      (1) Pump out of service requirements
      (2) Pump out of service signage / warning
      (3) Water tank level indicator
      (4) Class 2 valve leak
   c. Procedures
      (1) Proper impeller assembly
      (2) Transfer valve removal
      (3) Intake Valve installation
      (4) Packing
         (a) Installation
      (5) Replacing mechanical seal
      (6) Gauge troubleshooting
      (7) Worn or Damaged parts
         (a) Pump packing
         (b) Impeller shaft
      (8) Determining condition
         (a) Pump performance
         (b) Out of Service
         (c) Safety - Reliability
      (9) Special tools
      (10) Workplace safety and cleanliness
   d. Reference material
      (1) Pump info needed
      (2) Utilizing technical/repair manuals

6. **Pump Performance Testing:** Understand the procedures of conducting a pump performance test.
   a. Repair and overhaul testing requirements
   b. Documentation
      (1) Purpose of maintaining records
      (2) Records retention
   c. Frequency of tests
   d. Setup and equipment
      (1) Conditions
         (a) Required Electric load during test
         (b) Ambient air
         (c) Water temperature
         (d) Hydraulic Generator
         (e) Salt water testing
         (f) Test layout conditions
      (2) Required equipment
         (a) Pitot gauge
         (b) Equipment to take RPM readings
         (c) Required Test gauge Accuracy and Calibration
      (3) Parallel/series
   e. Required Performance Tests
      (1) Primer Test
      (2) Vacuum test
         (a) high altitude
      (3) Overload pump test
      (4) No load governor test
      (5) Flow meter test
      (6) Tank to pump flow test
      (7) Pressure controlling device test
         (a) Fire pumps/Wildland pumps
      (8) Flow test
         (a) Fire pumps/Wildland pumps
   f. Calculating net pump pressure
   g. Re-rating/de-rating pump
   h. Troubleshooting
      (1) Stuck swing check valves
      (2) Draft problems / RPM not maintainable
      (3) test pit aeration
      (4) Causes for failing flow test
      (5) Failed vacuum test
   i. Out of Service
      (1) Failure of test
      (2) gauges
      (3) signage
      (4) inoperable pressure controlling device
      (5) Engine overheat during test
      (6) Leaks
         (a) Class 3