



Pumps and Accessories (2020)

Course Plan

Course Details

Certification:	Emergency Vehicle Technician 1
CTS Guide:	Emergency Vehicle Technician (2020)
Description:	This course provides an overview of the knowledge and skills utilized by an emergency vehicle technician to inspect, maintain, repair, and test pumps and their accessories including the priming system, plumbing and valves, gauges, indicator and warning systems, interlocks, and packing and seals.
Designed For:	The emergency vehicle technician pursuing SFT-certification or anyone seeking an overview of how to inspect, maintain, repair, and test pumps and their accessories
Prerequisites:	None
Standard:	Complete all labs, activities, and formative tests. Complete all summative tests with a minimum score of 80%.
Hours:	Lecture: 35:00 Activities: 0:00 Testing: 1:00
Hours (Total):	36:00
Maximum Class Size:	50
Instructor Level:	Primary Instructor
Instructor/Student Ratio:	1:50
Restrictions:	None
SFT Designation:	CFSTES

Required Resources

Instructor Resources

To teach this course, instructors need:

- NFPA 1901: Standard for Automotive Fire Apparatus (current edition/ physical copy)
- NFPA 1911: Inspection, Maintenance, Testing, and Retirement of In-Service Automotive Fire Apparatus (current edition / physical copy)
- Student Supplement
 - Provided by California Fire Mechanic's Academy, Inc.
- Personal protective equipment (PPE)

Online Instructor Resources

The following instructor resources are available online at

<https://osfm.fire.ca.gov/divisions/state-fire-training/cfstes-professional-certification/>:

- None

Student Resources

To participate in this course, students need:

- Access to NFPA 1901: Standard for Automotive Fire Apparatus (current edition)
- Access to NFPA 1911: Inspection, Maintenance, Testing, and Retirement of In-Service Automotive Fire Apparatus (current edition)
- Student Supplement
 - Provided by California Fire Mechanic's Academy, Inc.
- Personal protective equipment (PPE)

Facilities, Equipment, and Personnel

The following facilities, equipment, or personnel are required to deliver this course:

Classroom

- Standard classroom equipped for 50 students
- Projector with appropriate laptop connections
- Wifi/Internet access

Facilities

- Outdoor space for emergency response vehicle with a clear perimeter for student activities
- Pump test pit

Equipment

- Emergency response vehicle with a pump or an apparatus
- Pitot gauge set or flow meter

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- Test, calibration, and diagnostic equipment
- Tools required to inspect, maintain, and repair tanks and accessories
- Appropriate safety gear

Unit 1: Introduction

Topic 1-1: Orientation and Administration

Terminal Learning Objective

At the end of this topic, a student will be able to identify facility and classroom requirements and identify course objectives, events, requirements, assignments, activities, resources, evaluation methods, and participation requirements in the course syllabus.

Enabling Learning Objectives

1. Identify facility requirements
 - Restroom locations
 - Food locations
 - Smoking locations
 - Emergency procedures
2. Identify classroom requirements
 - Start and end times
 - Breaks
 - Electronic device policies
 - Special needs and accommodations
 - Other requirements as applicable
3. Review course syllabus
 - Course objectives
 - Calendar of events
 - Course requirements
 - Student evaluation process
 - Assignments
 - Activities
 - Required student resources
 - Class participation requirements

Discussion Questions

1. What is a formative test? What is a summative test?

Activities

1. To be determined by the instructor

Topic 1-2: Emergency Vehicle Technician Certification Process

Terminal Learning Objective

At the end of this topic, a student will be able to identify different levels in the Emergency Vehicle Technician certification track, the courses and requirements for State Fire Training (SFT) Emergency Vehicle Technician (EVT) certification, and can describe the task book and testing process.

Enabling Learning Objectives

1. Identify the different levels of certification in the Emergency Vehicle Technician (EVT) certification track

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- EVT 1
 - EVT 2
 - EVT 3
2. Identify the SFT courses required for EVT 1
 - State Fire Training
 - Emergency Vehicle Technician 1A: Chassis, Cab, Body, Tank and Accessories (2020)
 - Emergency Vehicle Technician 1B: Electrical Systems A (2020)
 - Emergency Vehicle Technician 1C: Pumps and Accessories (2020)
 3. Identify the SFT courses required for EVT 2
 - State Fire Training
 - Emergency Vehicle Technician 2A: Electrical Systems B (2020)
 4. Identify the SFT courses required for EVT 3
 - State Fire Training
 - Emergency Vehicle Technician 3A: Human Resource Management / Fleet Specifications and Records (2020)
 5. Identify additional requirements for Emergency Vehicle Technician 1
 - Experience (one of the following)
 - Have a minimum of two (2) years full-time, paid experience in a California fire department, public agency, or private industry as an automotive or truck mechanic, with one (1) year of which must be related to the maintenance of emergency response vehicles; or
 - Have a minimum of three (3) years full-time, paid experience in a California fire department, public agency, or private industry as a truck mechanic with no emergency response vehicles required; or
 - Have a minimum of four (4) years volunteer time or paid part-time, paid experience in a California fire department, public agency, or private industry as a truck mechanic with primary duties performing as a truck mechanic.
 6. Identify additional requirements for Emergency Vehicle Technician 2
 - Experience (one of the following)
 - Have a minimum of three (3) years full-time, paid experience in a California fire department, public agency, or private industry as an automotive or truck mechanic, with one (1) year of which must be related to the maintenance of emergency response vehicles; or
 - Have a minimum of four (4) years full-time, paid experience in a California fire department, public agency, or private industry as a truck mechanic with no emergency response vehicles required; or
 - Have a minimum of five (5) years volunteer time or paid part-time, paid experience in a California fire department, public agency, or private industry as a truck mechanic with primary duties performing as a truck mechanic.
 7. Identify additional requirements for Emergency Vehicle Technician 3
 - Have a minimum of four (4) years full-time, paid experience in a California fire department, public agency, or private industry as an automotive or truck

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- mechanic, with one (1) year of which must be related to the maintenance of emergency response vehicles; or
 - Have a minimum of five (5) years full-time, paid experience in a California fire department, public agency, or private industry as a truck mechanic with no emergency response vehicles required; or
 - Have a minimum of six (6) years volunteer time or paid part-time, paid experience in a California fire department, public agency, or private industry as a truck mechanic with primary duties performing as a truck mechanic.
- 8. The following requirements are required for each EVT 1, EVT 2, and EVT 3
 - Code of Federal Regulations (CFR) 396.25: Department of Transportation Brake Inspector Qualification
 - Successful completion of the CFMA Certification Exam or CFMA Recertification Exam for the respective SFT Level of Certification. This exam is administered by the California Fire Mechanics Academy (CFMA).
 - EVT 1 Requires the following ASE Certifications:
National Institute for Auto Service Excellence (ASE)
 - Gasoline Engines [T1]
 - Diesel Engines [T2]
 - Drive Train [T3]
 - Brakes [T4]
 - Suspension and Steering [T5]
 - Preventative Maintenance Inspections [T8]
 - EVT 2 and EVT 3 Requires the following ASE Certifications:
National Institute for Auto Service Excellence (ASE)
 - Gasoline Engines (T1)
 - Diesel Engines (T2)
 - Drive Train (T3)
 - Brakes (T4)
 - Suspension and Steering (T5)
 - Electrical / Electronic Systems (T6)
 - Heating, Ventilation and Air Conditioning (HVAC) (T7)
 - Preventative Maintenance Inspections (T8)
- 9. Describe the task book process
 - Complete all prerequisites and course work
 - Complete all job performance requirements included in the task book
 - Must have identified evaluator verify individual task completion via signature
 - Submit application and fees
 - A candidate may apply for the EVT 1, EVT 2, and EVT 3 task books at the same time (three applications and three fees)
 - Shall not submit the EVT 2 task book until he or she receives EVT 1 certification (a prerequisite for EVT 2)
 - Shall not submit the EVT 3 task book until he or she receives EVT 2 certification (a prerequisite for EVT 3)

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- Must have Fire Chief or authorized representative verify task book completion via signature
- Must be employed by a California Fire Agency or be in a position as a volunteer or paid part-time, in a California fire department, or public agency, or private industry as a truck mechanic with primary duties performing as a truck mechanic as noted above for experience.
- This experience must be documented prior to submitting completed task book to State Fire Training

10. Complete Continuing Education

- Persons with EVT Certification are required to renew their certification every five years. The recertification requires that the applicant completes 36 hours of approved continuing education (CE) and meet all prerequisites stated for Recertification Requirements. All recertification applications must be postmarked on or before the certification expiration date. If the certified EVT did not meet all recertification requirements by the expiration date, the EVT Certification is considered to be lapsed.
- If the EVT Certification lapsed, the applicant will be required to complete 36 hours of CE in addition to the completion of additional CE hours. If the certification lapsed less than 6 months, you can regain EVT Certification by completing an additional 8 hours of approved CE. If the certification lapsed between 6 months and less than 12 months, you can regain EVT Certification by completing an additional 16 hours of approved CE. If the certification lapsed between 12 months and less than 18 months, you can regain EVT Certification by completing an additional 24 hours of approved CE.
- For expiration, greater than 18 months, the applicant will need to reapply for initial EVT 1 certification which includes successful completion of the EVT certification exam and completion of a new Certification Task Book.

11. Complete all formative and summative tests administered during the course deliveries

Discussion Questions

1. To be determined by the instructor

Activities

1. To be determined by the instructor

Instructor Notes

1. SFT teaches most EVT 1 (inspect and maintain) and EVT 2 (repair and replace) content together because depending on the size of the agency or shop, there are different expectations of the technician.

Unit 2: Overview

Topic 2-1: Terminology

Terminal Learning Objective

At the end of this topic, a student, given NFPA 1071 terminology, will be able to define inspection, maintenance, repair, and overhaul (rebuild) in accordance NFPA standards

Enabling Learning Objectives

1. Define “inspect(ion)”
 - To determine the condition or operation of a component(s) by comparing its physical, mechanical, and/or electrical characteristics with established standards, recommendations, and requirements through examination by sight, sound, or feel
2. Define “maintenance”
 - The act of servicing a fire apparatus or a component in order to keep the vehicle and its components in proper operating condition
3. Define “repair”
 - To restore to sound condition after failure or damage
4. Define “overhaul (rebuild)”
 - To make extensive repairs in order to restore a component to like-new condition in accordance with the original manufacturer’s specifications

Discussion Questions

1. Why is it important to inspect before testing?

Activities

1. To be determined by the instructor

CTS Guide Reference: None

Topic 2-2: The Inspection, Maintenance, Repair, and Testing Cycle

Terminal Learning Objective

At the end of this topic, a student, given circumstances that initiate the inspection process, safety requirements, and an overview of appropriate facilities and equipment, will be able to describe the cycle of inspecting, maintaining, repairing, testing, diagnostics checks, and documentation of emergency vehicle pumps and tanks in accordance with NFPA standards

Enabling Learning Objectives

1. Identify circumstances that initiate the inspection process
 - Acceptance test of new vehicle
 - Meeting manufacturer and/or AHJ inspection cycle
 - Responding to a suspected or reported problem
 - Acceptance test of repaired vehicle
2. Identify safety requirements
 - Vehicle safety
 - Technician safety
3. Identify facilities and equipment
 - Proper location(s) for inspection, maintenance, repair/replace, testing

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- Required tools/equipment
 - Test, calibration, and diagnostic
 - Pitot gauge
 - Flowmeter
 - External test vacuum
 - External pressure gauge
 - Maintenance and repair
- 4. Describe the inspection process
 - Evaluate reported conditions (if applicable)
 - Perform operational checks
 - What if you can't duplicate or validate the concern?
 - Identify and report defects and deficiencies, including broken, loose, worn, or missing parts
 - Complete checklist and document findings
 - Return vehicle to service or move to maintenance or repair
- 5. Describe the maintenance process
 - Evaluate reported conditions
 - Perform operational checks
 - Perform maintenance duties
 - Conduct performance tests
 - Complete checklist and document findings
 - Return vehicle to service or move to repair
- 6. Describe the repair and/or replacement process
 - Evaluate reported conditions
 - Perform operational checks
 - Repair or replace deformed, broken, loose, worn, or missing parts
 - Conduct performance checks
 - Complete checklist and document findings
 - Release to manufacturer or third-party shop for repair (if applicable)
 - Acceptance testing (inspection) on returned/repaired vehicle
 - Complete checklist and document findings
 - Return vehicle to service
- 7. Identify basic record-keeping requirements
 - Regular inspection
 - Static operation
 - Annual service test
 - Major engine, transmission, pump, or auxiliary devices calibration, repairs, or parts replacement
 - Completed pump service test form

Discussion Questions

1. Why do pump operations need to be tested?
2. When should you test pump operations?

Activities

1. Determined by instructor

CTS Guide Reference: None

Unit 3: Inspection, Maintenance, and Repair

Topic 3-1: Function, Construction, and Operation

Terminal Learning Objective

At the end of this topic, a student, given an emergency response vehicle with a fire pump or an auxiliary pump, wildland pump, ultra-high-pressure, or industrial pump, SOPs, and manufacturer specifications, will be able to describe the function, construction, and operation of fire pumps, auxiliary pumps, primer pumps, and related components, and associated diagnostic checks, in accordance with manufacturer specifications and the authority having jurisdiction (AHJ) requirements

Enabling Learning Objectives

1. Identify the function of a pump within an emergency response vehicle
 - Move water
 - Move by volume
 - Move by pressure
2. Identify types of pumps
 - Centrifugal
 - Positive displacement
3. Describe the function, construction, and operation of the pump system
 - Fire Pump (Centrifugal)
 - Impeller
 - Volute
 - Cutwater
 - Clearance rings
 - Shaft
 - Bearings
 - Packing/seals
 - Housing/casing
 - Pump drive
 - Hydraulic
 - PTO (power take off unit)
 - Crankshaft
 - Midship
 - Flywheel
 - Direct engine drive
 - Diesel
 - Gas
 - Single-stage pump

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- Multi-stage pump
 - Transfer valve and controls
 - Auxiliary Pump
 - Impeller
 - Volute
 - Cutwater
 - Clearance rings
 - Shaft
 - Bearings
 - Packing/seals
 - Housing
 - Pump drive
 - Hydraulic
 - PTO (power take off unit)
 - Crankshaft
 - Midship
 - Flywheel
 - Direct engine drive
 - Diesel
 - Gas
4. Describe the function, construction, and operation of the priming system [(A or B) + C]
- Positive displacement pump
 - Rotary gear
 - Rotary vane
 - Piston
 - Miscellaneous priming systems
 - Air
 - Engine vacuum
 - Engine exhaust
 - Hand primers
 - Piston
 - Diaphragm
 - Priming valve and controls
5. Describe the function, construction, and operation of the plumbing
- Piping system
 - Intake
 - Discharge
 - Fittings
 - Materials
 - Static
 - Stainless steel
 - Steel
 - Galvanized steel

- Brass
 - Copper tube
 - Flexible
 - Braided line
 - PVC/poly
 - Rubber
- Hoses
 - Steel braid
 - Poly
- 6. Describe the function, construction, and operation of the valves
 - Circulating valve
 - Booster line cooling valve
 - Ball-type valve
 - Gate valve
 - Butterfly valve
 - Drain valve
 - Bleeder valve
 - Transfer valve
 - Check valve
 - Thermal valve
 - Indirect cooling valve
 - Valve actuators
 - Push/pull (manual) handle
 - Hydraulic
 - Pneumatic
 - Electric
 - Manual rotary/crank
 - Pressure control devices
 - Internal and/or external relief valve
 - Engine governor
 - Controlled manually or electronically
 - Valve operation
 - Manual
 - Air
 - Water
 - Electric
 - Valve parts
 - Housing
 - Actuator
 - O-rings
 - Ball or butterfly/keystone
 - Seals
- 7. Describe the function, construction, and operation of the gauges

- Engine
 - Oil
 - Water temperature
 - Volts
 - Vacuum
 - Pressure
 - Water level
 - Tachometer
 - Individual pressure gauges
8. Describe the function, construction, and operation of the indicator/warning systems
 - Audible
 - Visual
 9. Describe the function, construction, and operation of the interlocks
 - Park/Brake
 - Transmission Neutral interlock/pump shift
 10. Describe the function, construction, and operation of the packing
 - Adjustable
 - Rope
 - Pellets
 - Mechanical
 - Non-adjustable
 11. Describe the function, construction, and operation of the seals
 - Gear box
 - Valve

Discussion Questions

1. What is the purpose of a primer?
2. What is the purpose of the anodes?

Activities

1. Determined by instructor

CTS Guide Reference: CTS 5-1 / CTS 5-2 / CTS 5-3

Topic 3-2: Pump System

Terminal Learning Objective

At the end of this topic, a student, given an emergency response vehicle with a fire pump or an auxiliary pump, wildland pump, ultra-high-pressure, or industrial pump, SOPs, manufacturer specifications, an inspection checklist, a maintenance checklist (or assignment), an inspection report detailing a deficiency or deformation (or assignment), tools, and test, calibration, and diagnostic equipment will be able to inspect and perform maintenance and repairs on fire pumps and auxiliary pumps so that the security of the mounting of all system components (e.g., primer pump, plumbing and valves, pressure control devices, gauges) is verified; operation and condition of the system components, warning system, and interlocks are verified to be within manufacturer specifications;

adjustments are made where required; fluids are at recommended levels; leaks and fluid contamination are identified and reported; recommended lubricants are applied; all checklist items are inspected; defective and deficient components are diagnosed; additional repair needs are reported; deformed, broken, loose, worn, or missing parts are identified and reported and then repaired, replaced, or rebuilt to manufacturer specifications; all packing and seals are adjusted to specification; hoses, valves, and fittings are in good condition and free of leaks; indicator lights are operational and electrical connections are clean and tight; instrumentation is operational; controls are adjusted, lubricated, and operational; the system's operational condition is preserved or restored; operational and service tests are conducted and performance is verified; and inspection, tests, repairs, and diagnostic checks are documented in accordance with the procedures of the manufacturer and the authority having jurisdiction (AHJ)

Enabling Learning Objectives

1. Identify types of defects, deficiencies, and potential problems associated with fire pumps, auxiliary pumps, and related components
 - Engagement
 - Full input speed and power to impeller
 - Correct transmission range
 - Restricted intake/discharge
 - Debris clogs
 - Hose collapse
 - Valve not fully open/closed
 - Low pressure/flow
 - Incorrect pressure control device settings
 - Air/vacuum leaks
 - Damaged impeller
 - Worn clearance ring
 - Worn shaft
 - Priming pump
 - Vent plugged
 - Out of oil
 - Worn primer shaft
 - Auxiliary input drives
 - Power take off
 - Auxiliary engine
 - Electric driven
 - Cavitation
 - Sounds
 - Gauge readings
 - Potential damage
 - Suction/friction lift loss (impacted by elevation)
2. Describe the inspection, diagnostic, and repair procedures of the manufacturer and the authority having jurisdiction

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3. Describe how to select test, calibration, and diagnostic equipment
4. Identify types, grades, and viscosity of lubricating oils
 - Per manufacturer specifications
 - Primary pump oils
 - Automatic transmission fluid
 - 80w – 140 gear oil
 - hydraulic fluid
5. Describe packing and seal adjustment and replacement methods and procedures
6. Describe sacrificial anode replacement procedure and schedules
7. Describe principles of pressure control devices
8. Describe troubleshooting procedures
9. Describe overhaul procedures
 - Drain pump
 - Remove drive shafts
 - Remove transfer case
 - Remove plumbing, cooling, and gauge lines/hoses/fittings
 - Remove front and rear impeller shaft support and bearings/bushings
 - Remove shell casing (as needed)
 - Remove impeller shaft assembly
 - Remove wear ring
 - Repair or replace damaged or defective parts as needed to manufacturer specifications
 - Reassemble per manufacturer specifications
10. Describe operational and service testing procedure and requirements
11. Identify inspection, maintenance, and repair record-keeping requirements
12. Recognize and identify symptoms and conditions of fire pumps and auxiliary pumps
13. Recognize characteristics of fluid contamination
14. Determine defects and deficiencies
15. Identify and evaluate reported conditions
16. Use test, calibration, and diagnostic equipment
17. Perform all required maintenance (including checklist items)
18. Perform all required repairs to resolve deficiencies
19. Perform operational checks
20. Perform hydraulic flow calculations
21. Complete inspection, maintenance, repair checklists, and diagnostic checks and performance test systems and complete required documentation

Discussion Questions

1. How do you check for water in the transfer case?
2. How does water get into the transfer case?
3. What is a stripping edge?

Activities

1. Determined by instructor

Instructor Notes

1. Throughout hands-on lecture in the shop, utilize students to inspect the pump system, identify maintenance requirements, and recommend potential repairs.

CTS Guide Reference: CTS 5-1 / CTS 5-2 / CTS 5-3

Topic 3-3: Priming System

Terminal Learning Objective

At the end of this topic, a student, given an emergency response vehicle with a fire pump or an auxiliary pump, wildland pump, ultra-high-pressure, or industrial pump, SOPs, manufacturer specifications, an inspection checklist, a maintenance checklist (or assignment), an inspection report detailing a deficiency or deformation (or assignment), tools, and test, calibration, and diagnostic equipment will be able to inspect and perform maintenance and repairs on the priming system and related components so that the security of the mounting of all system components is verified; operation and condition of the system components are verified to be within manufacturer specifications; adjustments are made where required; fluids are at recommended levels; leaks and fluid contamination are identified and reported; recommended lubricants are applied; all checklist items are inspected; defective and deficient components are diagnosed; additional repair needs are reported; deformed, broken, loose, worn, or missing parts are identified and reported and then repaired, replaced, or rebuilt to manufacturer specifications; all packing and seals are adjusted to specification; hoses, valves, and fittings are in good condition and free of leaks; indicator lights are operational and electrical connections are clean and tight; instrumentation is operational; controls are adjusted, lubricated, and operational; the system's operational condition is preserved or restored; operational and service tests are conducted and performance is verified; and inspection, tests, and repairs are documented in accordance with the procedures of the manufacturer and the authority having jurisdiction (AHJ)

Enabling Learning Objectives

1. Identify types of defects, deficiencies, and potential problems associated with priming system and related components
2. Describe the inspection, diagnostic, and repair procedures of the manufacturer and the authority having jurisdiction
3. Describe how to select test, calibration, and diagnostic equipment
4. Identify types, grades, and viscosity of lubricating oils
5. Describe packing and seal adjustment and replacement methods and procedures
6. Describe sacrificial anode replacement procedure and schedules
7. Describe principles of pressure control devices
8. Describe troubleshooting procedures
9. Describe overhaul procedures
10. Describe operational and service testing procedure and requirements
11. Identify inspection, maintenance, and repair record-keeping requirements

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12. Recognize and identify symptoms and conditions of priming system and related components
13. Recognize characteristics of fluid contamination
14. Determine defects and deficiencies
15. Identify and evaluate reported conditions
16. Use test, calibration, and diagnostic equipment
17. Perform all required maintenance (including checklist items)
18. Perform all required repairs to resolve deficiencies
19. Perform operational tests and diagnostic checks
20. Complete inspection, maintenance, and repair checklists and documentation

Discussion Questions

1. For how long should you operate the primer meter?
2. What components make up a primer system?
 - What do the different components do?

Activities

1. Determined by instructor

Instructor Notes

1. Throughout hands-on lecture in the shop, utilize students to inspect the priming system, identify maintenance requirements, and recommend potential repairs.

CTS Guide Reference: CTS 5-1 / CTS 5-2 / CTS 5-3

Topic 3-4: Plumbing and Valves

Terminal Learning Objective

At the end of this topic, a student, given an emergency response vehicle with a fire pump or an auxiliary pump, wildland pump, ultra-high-pressure, or industrial pump, SOPs, manufacturer specifications, an inspection checklist, a maintenance checklist (or assignment), an inspection report detailing a deficiency or deformation (or assignment), tools, and test, calibration, and diagnostic equipment will be able to inspect and perform maintenance and repairs on plumbing and valves and related component so that the security of the mounting of all system components is verified; operation and condition of the system components are verified to be within manufacturer specifications; adjustments are made where required; all checklist items are inspected; defective and deficient components are diagnosed; additional repair needs are reported; deformed, broken, loose, worn, or missing parts are identified and reported and then repaired, replaced, or rebuilt to manufacturer specifications; hoses, valves, and fittings are in good condition and free of leaks; indicator lights are operational and electrical connections are clean and tight; instrumentation is operational; controls are adjusted, lubricated, and operational; the system's operational condition is preserved or restored; operational and service tests are conducted and performance is verified; and inspection, tests, repairs, and diagnostic checks are documented in accordance with the procedures of the manufacturer and the authority having jurisdiction (AHJ)

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Enabling Learning Objectives

1. Identify types of defects, deficiencies, and potential problems associated with plumbing and valves
2. Describe the inspection, diagnostic, and repair procedures of the manufacturer and the authority having jurisdiction
3. Describe how to select test, calibration, and diagnostic equipment
4. Identify types, grades, and viscosity of lubricating oils
5. Describe packing and seal adjustment and replacement methods and procedures
6. Describe sacrificial anode replacement procedure and schedules
7. Describe principles of pressure control devices
8. Describe troubleshooting procedures
9. Describe overhaul procedures
10. Describe operational and service testing procedure and requirements
11. Identify inspection, maintenance, and repair record-keeping requirements
12. Recognize and identify symptoms and conditions of plumbing and valves
13. Recognize characteristics of fluid contamination
14. Determine defects and deficiencies
15. Identify and evaluate reported conditions
16. Use test, calibration, and diagnostic equipment
17. Perform all required maintenance (including checklist items)
18. Perform all required repairs to resolve deficiencies
19. Perform operational tests
20. Perform hydraulic flow calculations
21. Complete inspection, maintenance, and repair checklists and documentation

Discussion Questions

1. Why do you need to exercise the valves?
2. How do you find leaky valves?

Activities

1. Determined by instructor

Instructor Notes

1. Throughout hands-on lecture in the shop, utilize students to inspect the plumbing and valves, identify maintenance requirements, and recommend potential repairs.

CTS Guide Reference: CTS 5-1 / CTS 5-2 / CTS 5-3

Topic 3-5: Gauges

Terminal Learning Objective

At the end of this topic, a student, given an emergency response vehicle with a fire pump or an auxiliary pump, wildland pump, ultra-high-pressure, or industrial pump, SOPs, manufacturer specifications, an inspection checklist, a maintenance checklist (or assignment), an inspection report detailing a deficiency or deformation (or assignment), tools, and test, calibration, and diagnostic equipment will be able to inspect and perform maintenance and repairs on gauges and related components so that the security of the

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mounting of all system components is verified; operation and condition of the system components are verified to be within manufacturer specifications; adjustments are made where required; fluids are at recommended levels; leaks and fluid contamination are identified and reported; recommended lubricants are applied; all checklist items are inspected; defective and deficient components are diagnosed; additional repair needs are reported; deformed, broken, loose, worn, or missing parts are identified and reported and then repaired, replaced, or rebuilt to manufacturer specifications; all packing and seals are adjusted to specification; hoses, valves, and fittings are in good condition and free of leaks; the system's operational condition is preserved or restored; operational and service tests are conducted and performance is verified; and inspection, tests, and repairs are documented in accordance with the procedures of the manufacturer and the authority having jurisdiction (AHJ)

Enabling Learning Objectives

1. Identify types of defects, deficiencies, and potential problems associated with gauges
2. Describe the inspection, diagnostic, and repair procedures of the manufacturer and the authority having jurisdiction
3. Describe how to select test, calibration, and diagnostic equipment
4. Identify types, grades, and viscosity of lubricating oils
5. Describe troubleshooting procedures
6. Describe overhaul procedures
7. Describe operational and service testing procedure and requirements
8. Identify inspection, maintenance, and repair record-keeping requirements
9. Recognize and identify symptoms and conditions of gauges
10. Recognize characteristics of fluid contamination
11. Determine defects and deficiencies
12. Identify and evaluate reported conditions
13. Use test, calibration, and diagnostic equipment
14. Perform all required maintenance (including checklist items)
15. Perform all required repairs to resolve deficiencies
16. Perform operational tests
17. Complete inspection, maintenance, and repair checklists and documentation

Discussion Questions

1. If a dampened gauge leaks, does the vehicle go out of service?
4. Can gauges be calibrated?
 - Why or why not?

Activities

1. Determined by instructor

Instructor Notes

1. Throughout hands-on lecture in the shop, utilize students to inspect the gauges, identify maintenance requirements, and recommend potential repairs.

CTS Guide Reference: CTS 5-1 / CTS 5-2 / CTS 5-3

Topic 3-6: Indicator/Warning Systems

Terminal Learning Objective

At the end of this topic, a student, given an emergency response vehicle with a fire pump or an auxiliary pump, wildland pump, ultra-high-pressure, or industrial pump, SOPs, manufacturer specifications, an inspection checklist, a maintenance checklist (or assignment), an inspection report detailing a deficiency or deformation (or assignment), tools, and test, calibration, and diagnostic equipment will be able to inspect and perform maintenance and repairs on interlock/warning systems and related components so that the security of the mounting of all system components is verified; operation and condition of the system components are verified to be within manufacturer specifications; adjustments are made where required; all checklist items are inspected; defective and deficient components are diagnosed; additional repair needs are reported; deformed, broken, loose, worn, or missing parts are identified and reported and then repaired, replaced, or rebuilt to manufacturer specifications; indicator lights are operational and electrical connections are clean and tight; instrumentation is operational; controls are adjusted, lubricated, and operational; the system's operational condition is preserved or restored; operational and service tests are conducted and performance is verified; and inspection, tests, and repairs are documented in accordance with the procedures of the manufacturer and the authority having jurisdiction (AHJ)

Enabling Learning Objectives

1. Identify types of defects, deficiencies, and potential problems associated with interlock/warning systems
2. Describe the inspection, diagnostic, and repair procedures of the manufacturer and the authority having jurisdiction
3. Describe how to select test, calibration, and diagnostic equipment
4. Describe troubleshooting procedures
5. Describe overhaul procedures
6. Describe operational and service testing procedure and requirements
7. Identify inspection, maintenance, and repair record-keeping requirements
8. Recognize and identify symptoms and conditions of interlock/warning systems
9. Determine defects and deficiencies
10. Identify and evaluate reported conditions
11. Use test, calibration, and diagnostic equipment
12. Perform all required maintenance (including checklist items)
13. Perform all required repairs to resolve deficiencies
14. Perform operational tests
15. Complete inspection, maintenance, and repair checklists and documentation

Discussion Questions

1. What is the purpose of the different warning devices in the pump system?

Activities

1. Determined by instructor

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Instructor Notes

1. Throughout hands-on lecture in the shop, utilize students to inspect the indicator/warning systems, identify maintenance requirements, and recommend potential repairs.

CTS Guide Reference: CTS 5-1 / CTS 5-2 / CTS 5-3

Topic 3-7: Interlocks

Terminal Learning Objective

At the end of this topic, a student, given an emergency response vehicle with a fire pump or an auxiliary pump, wildland pump, ultra-high-pressure, or industrial pump, SOPs, manufacturer specifications, an inspection checklist, a maintenance checklist (or assignment), an inspection report detailing a deficiency or deformation (or assignment), tools, and test, calibration, and diagnostic equipment will be able to inspect and perform maintenance and repairs on interlocks and related components so that the security of the mounting of all system components is verified; operation and condition of the system components are verified to be within manufacturer specifications; adjustments are made where required; all checklist items are inspected; defective and deficient components are diagnosed; additional repair needs are reported; deformed, broken, loose, worn, or missing parts are identified and reported and then repaired, replaced, or rebuilt to manufacturer specifications; the system's operational condition is preserved or restored; operational and service tests are conducted and performance is verified; and inspection, tests, and repairs are documented in accordance with the procedures of the manufacturer and the authority having jurisdiction (AHJ)

Enabling Learning Objectives

1. Identify types of defects, deficiencies, and potential problems associated with interlocks
2. Describe the inspection, diagnostic, and repair procedures of the manufacturer and the authority having jurisdiction
3. Describe how to select test, calibration, and diagnostic equipment
4. Describe troubleshooting procedures
5. Describe overhaul procedures
6. Describe operational and service testing procedure and requirements
7. Identify inspection, maintenance, and repair record-keeping requirements
8. Recognize and identify symptoms and conditions of interlocks
9. Determine defects and deficiencies
10. Identify and evaluate reported conditions
11. Use test, calibration, and diagnostic equipment
12. Perform all required maintenance (including checklist items)
13. Perform all required repairs to resolve deficiencies
14. Perform operational tests
15. Complete inspection, maintenance, and repair checklists and documentation

Discussion Questions

1. Do defective interlocks put a vehicle out of service?

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Activities

1. Determined by instructor

Instructor Notes

1. Throughout hands-on lecture in the shop, utilize students to inspect the interlocks, identify maintenance requirements, and recommend potential repairs.

CTS Guide Reference: CTS 5-1 / CTS 5-2 / CTS 5-3

Topic 3-8: Packing and Seals

Terminal Learning Objective

At the end of this topic, a student, given an emergency response vehicle with a fire pump or an auxiliary pump, wildland pump, ultra-high-pressure, or industrial pump, SOPs, manufacturer specifications, an inspection checklist, a maintenance checklist (or assignment), an inspection report detailing a deficiency or deformation (or assignment), tools, and test, calibration, and diagnostic equipment will be able to inspect and perform maintenance and repairs on packing and seals and related components so that the security of the mounting of all system components is verified; operation and condition of the system components are verified to be within manufacturer specifications; adjustments are made where required; fluids are at recommended levels; leaks and fluid contamination are identified and reported; recommended lubricants are applied; all checklist items are inspected; defective and deficient components are diagnosed; additional repair needs are reported; deformed, broken, loose, worn, or missing parts are identified and reported and then repaired, replaced, or rebuilt to manufacturer specifications; all packing and seals are adjusted to specification; the system's operational condition is preserved or restored; operational and service tests are conducted and performance is verified; and inspection, tests, and repairs are documented in accordance with the procedures of the manufacturer and the authority having jurisdiction (AHJ)

Enabling Learning Objectives

1. Identify types of defects, deficiencies, and potential problems associated with packing and seals
2. Describe the inspection, diagnostic, and repair procedures of the manufacturer and the authority having jurisdiction
 - Mechanical seal = no maintenance, always replaced
 - Adjustable packing = maintain and repair per manufacturer specifications
3. Describe how to select test, calibration, and diagnostic equipment
4. Identify types, grades, and viscosity of lubricating oils
5. Describe troubleshooting procedures
6. Describe overhaul procedures
7. Describe operational and service testing procedure and requirements
8. Identify inspection, maintenance, and repair record-keeping requirements
9. Recognize and identify symptoms and conditions of packing and seals
10. Recognize characteristics of fluid contamination
11. Determine defects and deficiencies

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12. Identify and evaluate reported conditions
13. Use test, calibration, and diagnostic equipment
14. Perform all required maintenance (including checklist items)
15. Perform all required repairs to resolve deficiencies
16. Perform operational tests
17. Complete inspection, maintenance, and repair checklists and documentation

Discussion Questions

1. What are the different ways to seal a pump system?
2. Should pump seals leak?
 - Why or why not?

Activities

1. Determined by instructor

Instructor Notes

1. Throughout hands-on lecture in the shop, utilize students to inspect the packing and seals, identify maintenance requirements, and recommend potential repairs.

CTS Guide Reference: CTS 5-1 / CTS 5-2 / CTS 5-3

Unit 4: Testing

Topic 4-1: Testing

Terminal Learning Objective

At the end of this topic, a student, given an emergency response vehicle with a fire pump or auxiliary pump, wildland pump, ultra-high-pressure, or industrial pump, and related components, manufacturer specifications, SOPs, facilities, tools, and test, calibration, and diagnostic equipment, will be able to complete performance testing on fire pumps and related components in accordance with NFPA 1911 so that the pump/engine combination, and pumping systems, is capable of meeting the performance requirements of the original certification without exceeding 110 per cent of the original certification test rpm; and all testing is documented in accordance with the procedures of NFPA standards and the authority having jurisdiction (AHJ)

Enabling Learning Objectives

1. Describe operational and performance testing procedures and requirements
 - Apply parking brakes, put vehicle in neutral, and chock wheels
 - Engage pump
 - Direct drive and auxiliary pump procedures per manufacturer specifications
 - Reverse procedure to disengage pump
 - Prime until attaining positive discharge pressure
 - Maintain water supply
 - Draft
 - Tank
 - Hydrant
 - Adjust discharge pressure using input RPM and valve control
 - Set pressure control device
 - Relief valve
 - Pressure governor
2. Describe how to select test, calibration, and diagnostic equipment
3. Describe safety procedures
4. Describe diagnostic checking and performance testing procedures
5. Describe hydraulic flow calculations
6. Identify testing record-keeping requirements
7. Conduct fire pump performance tests
8. Use test, calibration, and diagnostic equipment
9. Identify defects and deficiencies
10. Perform hydraulic flow calculations
11. Complete required documentation

Discussion Questions

1. How do you “engage” pump mode?
2. Do you inspect prior to performing a pump test?

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Activities

1. Determined by instructor

Instructor Notes

1. There are 9 hours allotted to this topic to enable every student to perform at least a portion of a full NFPA 1911 pump test.

CTS Guide Reference: CTS 5-6

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Time Table

Segment	Lecture Time	Activity Time	Total Unit Time
Unit 1: Introduction			
Topic 1-1: Orientation and Administration			
Lecture	0:30		
Activity 1-1: Determined by instructor		0:00	
Topic 1-2: Emergency Vehicle Certification Process			
Lecture	0:30		
Activity 1-2: Determined by instructor		0:00	
Unit 1 Totals	1:00	0:00	1:00
Unit 2: Overview			
Topic 2-1: Terminology			
Lecture	0:10		
Activity 2-1: Determined by instructor		0:00	
Topic 2-2: The Inspection, Maintenance, Repair, and Testing Cycle			
Lecture	0:20		
Activity 2-2: Determined by instructor		0:00	
Unit 2 Totals	0:30	0:00	0:30
Unit 3: Inspection, Maintenance, and Repair			
Topic 3-1: Function, Construction, and Operation			
Lecture	12:00		
Activity 3-1: Determined by instructor		0:00	
Topic 3-2: Pump System			
Lecture	8:00		
Activity 3-2: Determined by instructor		0:00	
Topic 3-3: Priming System			
Lecture	1:00		
Activity 3-3: Determined by instructor		0:00	
Topic 3-4: Plumbing and Valves			
Lecture	1:00		
Activity 3-4: Determined by instructor		0:00	
Topic 3-5: Gauges			
Lecture	0:30		
Activity 3-5: Determined by instructor		0:00	
Topic 3-6: Indicator/Warning Systems			

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Lecture	0:30		
Activity 3-6: Determined by instructor		0:00	
Topic 3-7: Interlocks			
Lecture	1:00		
Activity 3-7: Determined by instructor		0:00	
Topic 3-8: Packing and Seals			
Lecture	0:30		
Activity 3-8: Determined by instructor		0:00	
Unit 3 Totals	24:30	0:00	24:30
Unit 4: Testing			
Topic 4-1: Testing			
Lecture	9:00		
Activity 4-1: Determined by instructor		0:00	
Unit 4 Totals	9:00	0:00	9:00
Lecture, Activity, and Unit Totals:	35:00	0:00	35:00

Course Totals

Segment Type	Time
Total Lecture Time (LT)	35:00
Total Activity Time (AT)	0:00
Total Testing Time (TT)	1:00
Total Course Time	36:00