Date: February 22, 2018

To: State Board of Fire Services

From: Jim Eastman, Fire Service Training Specialist, State Fire Training

SUBJECT/AGENDA ACTION ITEM:

Recommended Actions:
Informational only

Background Information:
The California Fire Service Training and Education System (CFSTES) was established to provide a single statewide focus for fire service training in California. CFSTES is a composite of all the elements that contribute to the development, delivery, and administration of training for the California fire service. The authority for the central coordination of this effort is vested in the State Fire Training (SFT) of the California State Fire Marshal's Office with oversight provided by the State Training Education Committee (STEAC) and State Board of Fire Services (SBFS).

CFSTES facilitates, coordinates, and assists in the development and implementation of standards and certification for the California fire service. CFSTES:

Administers the California Fire Academy System
Provides accredited courses leading to certification and approved standardized training programs for local and regional delivery
Administers the national accreditation process in California
Publishes certification training standards, course plans, and a capstone task book for each certified level in the California fire service

CFSTES is a fire service system developed by the fire service, for the fire service. It is only as successful and effective as the people involved in it.

One of the most historical established stakeholders within CFSTES is the California Fire Mechanics, Incorporated (CFMA). CFMA is the oldest and largest Emergency Vehicle

“The Department of Forestry and Fire Protection serves and safeguards the people and protects the property and resources of California.”
Technician Training Academy in the United States (U.S.). Since 1971, CFMA has been providing the finest training opportunities for emergency apparatus repair and maintenance. The workshops are very hands-on, giving participants not only the theory but the opportunity to work on trucks, take pumps apart, get their hands on the actual apparatus they'll be using in the field.

Historically, CFMA has been using instructors from the industry such as fire apparatus manufacturers, pump manufacturers, transmission manufacturers and other manufacturers that provide apparatus and replacement components for emergency response equipment throughout the U.S. and here in California. These manufactures have very specific guidelines and restrictions for who is qualified and allowed to make authorized manufacturer repairs to stay within guidelines of warranties and or maintaining manufacturers designed recommendations. These instructors are not registered as instructors with SFT. Historically, the quality assurance of these instructors has been maintained directly by CFMA.

A joint meeting was held with SFT Staff, Fire Mechanics, and Chief Coleman on August 18, 2014. At this meeting, Chief Coleman presented a brief historical review of STEAC for the 1980’s up to the current Blueprint 2020. Some discussion centered around the utilization of these instructors. Chief Coleman challenged the group of attendees by asking this question, “How do we redesign the future? By designing where you want to be.”

At this meeting, it was identified to continue with the direction to update the curriculum to model and streamline with the standards developed and adopted by the National Fire Protection Association (NFPA).

**Cadre Leadership:**
Jim Eastman, Cadre Leader with State Fire Training, and Allison Shaw, Cadre Editor with Sacramento State University.

**Development Cadre Members:**
Lawrence Achen  
Training Captain, Central Fire Protection District, Santa Cruz  
Vice President, California Fire Mechanics Academy, Inc.

John Borges  
Burtons Fire Apparatus

Anthony Bulygo  
Santa Clara County Fire Department (retired)  
Northern/Southern California Liaison, California Fire Mechanics Association

Boyd Clegg  
San Ramon Valley Fire Protection District (retired)  
Instructor, California Fire Mechanics Academy, Inc.

Doug Link  
San Miguel Fire Protection District (retired)  
Treasurer, California Fire Mechanics Academy, Inc.

Mark McLean  
Los Angeles City Fire

Rick Nogueira  
Fleet Mechanic, San Ramon Valley Fire Protection District  
President, Northern California Fire Mechanics Association
Analysis/Summary of Issue:
Following is an analysis of Emergency Vehicle Technician Curriculum (2018).

1. The legacy course for the new Emergency Vehicle Technician (EVT) Curriculum (2018) originally started in 1971 by CFMA. CFMA continued to provide the finest training opportunities for emergency apparatus repair and maintenance. The curriculum was updated in 2011 and existed under a different curriculum format before being updated to the new curriculum design process that SFT adopted in 2012.

2. The Fire Mechanics Academy utilized instructors recognized as manufacturer experts to deliver, train, approve and authorized repairs, direct maintenance and modifications as authorized by the industry manufacturers within the guidelines of their design and operation.


4. The new Emergency Vehicle Technician Curriculum (2018) will conform to the best practices recognized by the cadre and will be adaptable for the fire service mechanics throughout the California Fire Service or by recognized fire apparatus service providers and/or agencies.
Emergency Vehicle Technician Certification
Implementation of New Curriculum and Certification Requirements

This document is intended to provide information for all State Fire Training (SFT) stakeholders on the new Emergency Vehicle Technician curriculum and certification requirements. Stakeholders are encouraged to study this information carefully and seek clarification from SFT if questions arise.

New Emergency Vehicle Technician (2017) curriculum and certification requirements will be phased in for the California Fire Service Training and Education System. A new Certification Training Standard (CTS) with nine (9) Course Plans have been developed based on current National Fire Protection Association (NFPA) Standards, which includes NFPA 1071, Standard for Emergency Vehicle Technician Professional Qualifications (2016). The CTS and Course Plan will be available on the SFT website.

**New Courses for Emergency Vehicle Technician I Certification**

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<thead>
<tr>
<th>Course Plan</th>
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<tr>
<td>Emergency Vehicle Technician 101 (8 Hours)</td>
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<tr>
<td>Chassis Systems and Components (16 Hours)</td>
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<tr>
<td>Cab and Body Systems and Components (12 Hours)</td>
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<td>Electrical Systems A (36 Hours)</td>
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<td>Pumps and Accessories (36 Hours)</td>
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<td>Tanks and Accessories (8 Hours)</td>
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**New Courses for Emergency Vehicle Technician II Certification**

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<td>Electrical Systems B (36 Hours)</td>
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**New Courses for Emergency Vehicle Technician III Certification**

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<th>Course Plan</th>
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<tr>
<td>Fleet Specifications and Records (16 Hours)</td>
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<tr>
<td>Human Resource Management (12 Hours)</td>
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Existing Fire Mechanic courses and certification will continue to be available until December 31, 2019, for candidates who find it more advantageous to continue pursuing this certification track. Candidates who choose to meet the existing Fire Mechanic Certification must complete the certification requirements and submit all paperwork and fees by December 31, 2019. The Fire Mechanic certification and its content will have limited correlation with the new Emergency Vehicle Technician certifications and course curriculum.
**Certification Testing:** In response to Blueprint 2020 stakeholder comments, certification examinations will become a standardized process statewide. SFT anticipates implementation of certification examinations for the new Emergency Vehicle Technician Certification at a future date.

**Task Books/Application Form:** Implementation of the new Emergency Vehicle Technician (2017) requires that candidates complete a comprehensive task book for each certification level. The task books cover all of the job performance requirements contained in the aforementioned professional qualification standards and CTS. The task book will be made available to candidates by SFT upon completion of all course work and with authorization from their employer. Occupational experience will be verified by the Fire Chief or designee on file signing the task book upon completion. In addition, a new application form will be implemented.

**TRANSITION PERIOD.......................................................... Effective January 1, 2017 - December 31, 2019**

SFT recognizes that many candidates are vested in the current Fire Mechanic track. Therefore, the existing Fire Mechanic curriculum and certification requirements will be available for those candidates during the transition period. Candidates entering the certification system after January 1, 2018 should enroll in the new Emergency Vehicle Technician courses and comply with the new Emergency Vehicle Technician certification requirements. There is limited cross over between the Fire Mechanic and Emergency Vehicle Technician courses.

**COURSE/CERTIFICATION PHASE OUT ........................................... Effective December 31, 2019**

Effective December 31, 2019, SFT will retire and no longer support the Fire Mechanic certification.

**INSTRUCTOR REQUIREMENTS....................................................... Effective January 1, 2019**

Instructors for the new Emergency Vehicle Technician courses must meet the SFT Registered Instructor requirements and any Fire Mechanics Academy, Inc. requirements.

However, the following transition exceptions apply: current instructors, in good standing, will be historically recognized (including national or factory certified instructors that are considered vocational trade journalists). These instructors will be approved and endorsed by California Fire Mechanics Academy, Inc.
**Fire Mechanic Course:** Current Fire Mechanic instructors combined with the required course prerequisites are authorized to deliver these new courses. New instructors will be required to either complete the new course or apply for a PACE II review of their instructor qualifications, including appropriate education included in the new course plan and practical experience relating to course content.

SFT shall review applications as they are received. These instructors will continue to be approved and endorsed by California Fire Mechanics Academy, Inc. The reviewing committee will be made up of State Fire Training personnel and authorized representatives of the California Fire Mechanics Academy, Inc.

**POTENTIAL AGENCY IMPACTS**

Fire agencies utilizing the existing Fire Mechanics certification or curriculum as a requirement for their recruitment/promotion activities need to review the new Emergency Vehicle Technician curriculum and certification requirements to be sure that all agency training needs are being met. After review, fire agencies should update their job specifications and recruitment documentation to reflect the new course and certification requirements.

Accredited Regional Training Programs (ARTP), Accredited Local Academies (ALA), community colleges, and all other local delivery venues need to review the curriculum and seek approval from their curriculum committee / program sponsor, as appropriate. ARTPs should review the new Emergency Vehicle Technician curriculum and discuss potential impacts with their advisory committees.
Human Resource Management
Course Plan

Course Details

Certification: Emergency Vehicle Technician III

CTS Guide: Emergency Vehicle Technician [(Month Year)]

Description: This course provides an overview of human resource management knowledge and skills utilized by a supervisory or managerial level emergency vehicle technician in a multiple technician agency or shop.

Designed For: The SFT-certified Emergency Vehicle Technician (EVT) II advancing to EVT III or anyone with supervisory or managerial level responsibilities in a multiple technician agency or shop.

Prerequisites: [Short Course Title]: Emergency Vehicle Technician 101

Standard: Complete all activities and formative tests.
Complete all summative tests with a minimum score of 80%.

Hours: Lecture: 9:00
Activities: 2:00
Testing: 1:00

Hours (Total): 12:00

Maximum Class Size: 30

Instructor Level: Primary Instructor

Instructor/Student Ratio: 1:30

Restrictions: None

SFT Designation: CFSTES
Required Resources

Instructor Resources
To teach this course, instructors need:

- Student Supplement
  - Provided by California Fire Mechanics Academy, Inc.
- Sample policies and procedures that address:
  - Safety compliance
  - Discipline
  - Employee evaluations
  - Professional development

Online Instructor Resources
The following instructor resources are available online at http://osfm.fire.ca.gov/training/SFTCurriculum:

- None

Student Resources
To participate in this course, students need:

- Student Supplement
  - Provided by California Fire Mechanics Academy, Inc.
- Agency or AHJ policies and procedures that address:
  - Safety compliance
  - Discipline
  - Employee evaluations
  - Professional development

Facilities, Equipment, and Personnel
The following facilities, equipment, or personnel are required to deliver this course:

- Standard classroom equipped for 30 students
- Projector with appropriate laptop connections
- Wifi/Internet access
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 be able to describe the capstone task book and testing process.
Enabling Learning Objectives

1. Identify the different levels of certification in the Emergency Vehicle Technician (EVT) certification track
   - EVT I
   - EVT II
   - EVT III
2. Identify the courses required for EVT I
   - State Fire Training
     - [Short Course Title]: Emergency Vehicle Technician 101
     - [Short Course Title]: Electrical Systems A
     - [Short Course Title]: Chassis Systems and Components
     - [Short Course Title]: Cab and Body Systems and Components
     - [Short Course Title]: Pumps and Accessories
     - [Short Course Title]: Tanks and Accessories
   - National Institute for Auto Service Excellence (ASE)
     - Gasoline Engines (T1)
     - Drive Train (T3)
     - Brakes (T4)
     - Suspension and Steering (T5)
     - Preventative Maintenance Inspections (T8)
3. Identify the courses required for EVT II
   - State Fire Training
     - [Short Course Title]: Electrical Systems B
   - National Institute for Auto Service Excellence (ASE)
     - Diesel Engines (T2)
     - Electrical / Electronic Systems (T6)
     - Heating, Ventilation and Air Conditioning (HVAC) (T7)
4. Identify the courses required for EVT III
   - State Fire Training
     - [Short Course Title]: Fleet Specifications and Records
     - [Short Course Title]: Human Resource Management
   - National Institute for Auto Service Excellence (ASE)
     - See eight courses listed for EVT I and EVT II
5. Identify any other requirements for EVT I
   - Code of Federal Regulations (CFR) 396.25: Department of Transportation Brake Inspector Qualification
   - Experience (one of the following)
     - Have a minimum of two years’ full-time paid experience in a state or provincial fire agency, public agency, or private industry as an automotive or truck mechanic with minimum one year related to emergency vehicle maintenance
6. Describe the capstone task book process
   • Complete all prerequisites and course work
   • Submit application and fees and to request capstone task book
     o A candidate may apply for the EVT I and EVT II task books at the same time
       (two applications and two fees), but may not submit the EVT II task book until
       he or she receives EVT I certification (a prerequisite for EVT II)
   • Complete all job performance requirements included in the task book
   • Must have identified evaluator verify individual task completion via signature
   • Must have Fire Chief or authorized representative verify task book completion via
     signature
   • Must be employed by a California Fire Agency in the position prior to submitting
     completed task book to State Fire Training
7. Describe the capstone testing process
   • Emergency Vehicle Technician certification exams (EVT I, EVT II, and EVT III) are
     administered by an independent third-party testing agency

Discussion Questions
   1. To be determined by the instructor

Activities
   1. To be determined by the instructor

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

Unit 2: Employee Development

Topic 2-1: Assigning Tasks or Responsibilities

Terminal Learning Objective
   At the end of this topic, a student, given a work order, an apparatus, work space, and
required tools, equipment, and parts, will be able to assign tasks or responsibilities to
technicians so that the instructions are complete, clear, and concise; safety considerations
are addressed; and the work is completed and within the scheduled time

Enabling Learning Objectives
   1. Identify the function, construction, and operation of vehicles and systems
   2. Identify required testing
   3. Identify required record-keeping and documentation
4. Identify common deficiencies
5. Identify repair procedures
6. Identify testing procedures
7. Identify apparatus safety requirements
8. Identify skill levels of assigned technicians
   • Involve labor and management
   • Job performance analysis
     o Training
     o Monitoring
     o Evaluation
     o Feedback
     o Modification
9. Identify agency priorities
10. Identify available resources
11. Communicate verbally and in writing
12. Evaluate technician performance

Discussion Questions
1. How does your agency identify technician skill level?

Activities
1. Determined by instructor

CTS Guide Reference: CTS 11-1

Topic 2-2: Conducting Individual Technician Training

Terminal Learning Objective
At the end of this topic, a student, given an apparatus, an assignment, a workspace, and all necessary tools, will be able to conduct individual training for technicians so that the technician understands the procedure and is able to demonstrate proficiency at the given task

Enabling Learning Objectives
1. Identify the function, operation, and construction of component
2. Identify applicable standards
3. Identify manufacturer specifications
4. Identify recommended procedures
5. Determine the technician’s capability
6. Research, communicate, and deliver training material based on methods and practices
7. Evaluate the results

Discussion Questions
1. How can an EVT utilize a work order?
2. How can you determine EVT work hours for a work order?
3. What are an administrator’s responsibilities for work injury reduction in the assigned shop area?
Activities
1. Determined by instructor

Instructor Notes
1. If time permits, review the individual training and professional development policies and procedures that students bring to class.

CTS Guide Reference: CTS 11-2

Unit 3: Employee Evaluation

Topic 3-1: Evaluating Technician Performance

Terminal Learning Objective
At the end of this topic, a student, given time records, pertinent work orders, and evaluation forms, will be able to provide input on the performance level of a technician so that the abilities and weaknesses of the technician can be determined; required counseling and training can be scheduled to maintain or improve a technician's proficiency; or an issue can be referred to the next level of supervision.

Enabling Learning Objectives
1. Identify allowable repair times
2. Describe how to evaluate and analyze technician strengths and weaknesses
   - Give assignment
   - Measure performance completion
   - Evaluate skill completion (or lack of completion)
     - Skill degradation
     - Skill enhancement
   - Maintain work history base on equipment/specific brand
   - Sometimes it may intuition or instinct
3. Identify agency policies and procedures
4. Describe appropriate workplace behavior
5. Identify job descriptions
6. Describe goals of the evaluation program
7. Communicate verbally and in writing
   - 5 W's (who, what, when, when, why)
   - End date / start date
   - “What ifs”
   - Write first, then communicate verbally
8. Evaluate and document performance

Discussion Questions
1. How does your agency evaluate technician performance?
2. How does your agency recognize outstanding performance?
3. How does your agency handle weak performance?

Activities
1. Given several sample employee evaluations have students:
• Prepare a professional development plan for employee improvement
• Identify strengths and how they can be acknowledged or rewarded

Instructor Notes
1. If time permits, review the individual employee evaluation policies and procedures that students bring to class.

CTS Guide Reference: CTS 11-3

Topic 3-2: Recommending and Enforcing Discipline

Terminal Learning Objective
At the end of this topic, a student, given an employee’s history and agency SOPs, will be able to recommend, specify, and enforce discipline so that the employee is given the guidance necessary to improve or resolve issues

Enabling Learning Objectives
1. Identify agency policies and procedures
2. Demonstrate an awareness of the situation and the individual involved
3. Communicate verbally and in writing
4. Assess employee abilities and attitudes
5. Implement the most effective alternative

Discussion Questions
1. What is the difference between discipline and professional development?
2. Who is involved in the disciplinary process?

Activities
1. Given the following scenario, have students break into small groups and identify what they would do for each option listed below. Share with the group and share strategies.
   • Two employees are horsing around in the shop throwing a rag at each other. One escalates the event by soaking or spraying accelerant on the rag, which catches on fire. He or she throws it back, just as you enter the workspace.
      o Option 1: Both are technicians who work for you
      o Option 2: One is your technician and one is management
      o Option 3: One is your technician and one is a firefighter dropping off a vehicle

Instructor Notes
1. If time permits, review the individual disciplinary policies and procedures that students bring to class.

CTS Guide Reference: CTS 11-4

Unit 4: Employee Safety

Topic 4-1: Recommending and Enforcing Safety Policies and Procedures

Terminal Learning Objective
At the end of this topic, a student, given agency safety policies and procedures; federal, state, local, and industry standards for workplace safety; and safety hazards, will be able to
recommend and enforce safety policies and procedures so that workplace safety is monitored and recommendations for deficiencies are documented

**Enabling Learning Objectives**
1. Identify agency safety policies and procedures
2. Identify federal, state, local, and industry standards for workplace safety
3. Identify safety hazards
4. Identify safe practices
5. Identify equipment limitations
6. Identify personal protection devices
7. Communicate verbally and in writing
8. Promote a safe working environment

**Discussion Questions**
1. How does your agency enforce safety policies and procedures?
2. How do you determine which safety policy or procedure takes priority?

**Activities**
1. Determined by instructor

**Instructor Notes**
1. If time permits, review the individual safety policies and procedures that students bring to class.

**CTS Guide Reference:** CTS 11-5

**Topic 4-2: Monitoring Environmental Safety Compliance**

**Terminal Learning Objective**
At the end of this topic, a student, given agency policies and procedures; federal, state, and local environmental regulations; and material safety data sheets (MSDS), will be able to monitor compliance of applicable environmental regulations so that the workplace is in compliance with all required regulations; and all deficiencies are identified and corrected

**Enabling Learning Objectives**
1. Identify agency policies and procedures
   - Annual inspections
   - Location of documents
2. Identify federal, state, and local environmental regulations
   - Occupational Safety and Health Administration (OSHA)
     - Hazard Communication Standard (HCS) / HazCom 2012
   - Fire marshal
   - Authority having jurisdiction (AHJ)
3. Identify location of material safety data sheets (MSDS)
4. Identify the 16 sections of the SDS
5. Communicate verbally and in writing

**Discussion Questions**
1. What is the replacement document for the material safety data sheet (MSDS)?
2. Do the MSDS in your agency have pictograms?
   - Are they required on an SDS?

Activities
1. Determined by instructor

Instructor Notes
1. In 2012 OSHA renamed the MSDS (material safety data sheet). It is now SDS (safety data sheet).

CTS Guide Reference: CTS 11-6
## Time Table

<table>
<thead>
<tr>
<th>Segment</th>
<th>Lecture Time</th>
<th>Activity Time</th>
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<tr>
<td><strong>Unit 1: Introduction</strong></td>
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<tr>
<td>Topic 1-1: Orientation and Administration</td>
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<td>Topic 1-2: Emergency Vehicle Technician Certification Process</td>
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<td><strong>Unit 2: Employee Development</strong></td>
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<td>Topic 2-2: Conducting Individual Technician Testing</td>
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Course Totals

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Emergency Vehicle Technician 101

Course Plan

Course Details

Certification: Emergency Vehicle Technician I

CTS Guide: Emergency Vehicle Technician [(Month Year)]

Description: This course provides an overview of the roles and responsibilities of an emergency vehicle technician from entry-level technician knowledge and skills to personnel and fleet management.

Designed For: The emergency vehicle technician pursuing SFT-certification or anyone seeking an overview of the roles and responsibilities of an emergency vehicle technician

Prerequisites: None

Standard: Complete all summative test with a minimum score of 80%.

Hours:
- Lecture: 7:30
- Activities: 0:00
- Testing: 0:30

Hours (Total): 8:00

Maximum Class Size: 40

Instructor Level: Primary

Instructor/Student Ratio: 1/40

Restrictions: None

SFT Designation: CFSTES
Required Resources

Instructor Resources
To teach this course, instructors need:

- NFPA 1500: Standard on Fire Department Occupational Safety and Health Program (current edition / physical copy or access to digital copy)
- NFPA 1901: Standard for Automotive Fire Apparatus (current edition / physical copy)
- Student Supplement
  - Provided by California Fire Mechanics Academy, Inc.

Online Instructor Resources
The following instructor resources are available online at http://osfm.fire.ca.gov/training/SFTCurriculum:
- None

Student Resources
To participate in this course, students need:

- NFPA 1071: Standard for Emergency Vehicle Technician Professional Qualifications (current edition / physical copy or access to a digital copy)
- NFPA 1500: Standard on Fire Department Occupational Safety and Health Program (current edition / physical copy or access to digital copy)
- NFPA 1911: Standard for the Inspection, Maintenance, Testing, and Retirement of In-Service Emergency Vehicle (current edition / physical copy or access to a digital copy)
- Student Supplement
  - Provided by California Fire Mechanics Academy, Inc.

Facilities, Equipment, and Personnel
The following facilities, equipment, or personnel are required to deliver this course:

- Standard classroom equipped for 40 students
- Projector with appropriate laptop connections
- Wifi/Internet access
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 be able to describe the capstone task book and testing process.
Enabling Learning Objectives

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

2. Identify the courses required for EVT I
   - State Fire Training
     - [Short Course Title]: Emergency Vehicle Technician 101
     - [Short Course Title]: Electrical Systems A
     - [Short Course Title]: Chassis
     - [Short Course Title]: Cab and Body
     - [Short Course Title]: Pumps and Accessories
     - [Short Course Title]: Tanks and Accessories
   - National Institute for Auto Service Excellence (ASE)
     - Gasoline Engines (T1)
     - Drive Train (T3)
     - Brakes (T4)
     - Suspension and Steering (T5)
     - Preventative Maintenance Inspections (T8)

3. Identify the courses required for EVT II
   - State Fire Training
     - [Short Course Title]: Electrical Systems B
   - National Institute for Auto Service Excellence (ASE)
     - Diesel Engines (T2)
     - Electrical / Electronic Systems (T6)
     - Heating, Ventilation and Air Conditioning (HVAC) (T7)

4. Identify the courses required for EVT III
   - State Fire Training
     - [Short Course Title]: Fleet Specifications and Records
     - [Short Course Title]: Human Resource Management
   - National Institute for Auto Service Excellence (ASE)
     - See eight courses listed for EVT I and EVT II

5. Identify any other requirements for EVT I
   - Code of Federal Regulations (CFR) 396.25: Department of Transportation Brake Inspector Qualification
   - Experience (one of the following)
     - Have a minimum of two years’ full-time paid experience in a state or provincial fire agency, public agency, or private industry as an automotive or truck mechanic with minimum one year related to emergency vehicle maintenance
6. Describe the capstone task book process
   • Complete all prerequisites and course work
   • Submit application and fees and to request capstone task book
     o A candidate may apply for the EVT I and EVT II task books at the same time (two applications and two fees), but may not submit the EVT II task book until he or she receives EVT I certification (a prerequisite for EVT II)
   • Complete all job performance requirements included in the task book
   • Must have identified evaluator verify individual task completion via signature
   • Must have Fire Chief or authorized representative verify task book completion via signature
   • Must be employed by a California Fire Agency in the position prior to submitting completed task book to State Fire Training
7. Describe the capstone testing process
   • Emergency Vehicle Technician certification exams (EVT I, EVT II, and EVT III) are administered by an independent third-party testing agency

Discussion Questions
1. To be determined by the instructor

Activities
1. To be determined by the instructor

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

Unit 2: Roles and Responsibilities

Topic 2-1: Emergency Vehicle Technician I

Terminal Learning Objective
At the end of this topic, a student, given general knowledge and skill requirements, will be able to identify the roles and responsibilities of an Emergency Vehicle Technician (EVT) I, in accordance with State Fire Training (SFT) and NFPA 1071 (current edition)

Enabling Learning Objectives
1. Identify the general knowledge requirements associated with the roles and responsibilities of an EVT I
   • Mission of the fire service
   • Organization of the fire agency and the maintenance facility
• Role of the EVT in the organization
• Fire agency’s standard operating procedures (SOPs) and rules and regulations as they apply to the EVT
• Critical aspects of NFPA 1500, NFPA 1901, and NFPA 1911, as they apply to the EVT
• Federal motor carrier safety regulations
• Applicable federal, state, and local regulations
• Interpretation and use of manufacturer specifications, inspection checklists, maintenance schedules, maintenance checklists, and agency SOPs
• Selection of tools
• Fastener types and their usage
• Maintenance equipment and its usage
• Workplace safety practices
• Selection and use of cleaning products and procedures
• Housekeeping
• Identification and handling of hazardous materials

2. Identify the general skill requirements associated with the roles and responsibilities of an EVT I
   • Use tools in a recognized safe manner
   • Operate emergency response vehicles in compliance with applicable federal, state, and local regulations
   • Locate information in agency documents, standards, and reference materials

3. Identify the inspection and preventative maintenance duties associated with chassis systems

4. Identify the inspection and maintenance duties associated with cabs (fixed and tilt) and vehicle bodies

5. Identify the operational checks duties associate with a vehicle’s electronic and electrical systems (low voltage)

6. Identify the inspection, maintenance, and operational testing duties associated with at least one of the following systems:
   • Fire pump, auxiliary pump, and tank systems
   • Aerial systems
   • Specialized systems
     o Foam
     o Line-voltage electrical
     o Breathing air
     o Auxiliary air

**Discussion Questions**
1. Where will you find personal protective safety requirements?
2. What is the general skill set of an EVT I?
3. What systems are unique to an emergency vehicle?

**Activities**
1. Determined by the instructor
CTS Guide Reference: CTS 1-1

Topic 2-2: Emergency Vehicle Technician II

Terminal Learning Objective
At the end of this topic, a student, given general knowledge and skill requirements, will be able to identify the roles and responsibilities of an Emergency Vehicle Technician (EVT) II, in accordance with State Fire Training (SFT) and NFPA 1071 (current edition)

Enabling Learning Objectives
1. Identify the repair, performance testing, and weight verification duties associated with chassis systems of an EVT II
2. Identify the repair duties associated with cabs (fixed and tilt) and vehicle bodies of an EVT II
3. Identify the repair, operational testing, and performance testing duties associated with electronic and electrical systems (low voltage) of an EVT II
4. Identify the inspection, repair, maintenance, and operational testing duties associated with at least one of the following systems: pump and tank systems, aerial systems, or specialized (foam, line voltage electrical, breathing air, auxiliary air) systems of an EVT II

Discussion Questions
1. In what ways does responsibility increase between EVT I and EVT II?

Activities
1. Determined by the instructor

CTS Guide Reference: CTS 1-2

Topic 2-3: Emergency Vehicle Technician III

Terminal Learning Objective
At the end of this topic, a student, given general knowledge and skills requirements, will be able to identify the roles and responsibilities of an Emergency Vehicle Technician (EVT) III, in accordance with State Fire Training (SFT) and NFPA 1071 (current edition)

Enabling Learning Objectives
1. Identify the human resource management and performance evaluation duties of an EVT III
2. Identify the inspection duties of an EVT III
3. Identify the equipment and parts management duties of an EVT III
4. Identify the documentation duties of an EVT III
5. Identify the specifications development duties of an EVT III

Discussion Questions
1. How does the job change between EVT II and EVT III?
2. Why is it valuable for an EVT III to have been an EVT I and II?
3. How do roles and responsibilities of an EVT I, II, and III change depending on fleet size and shop staffing levels?

Activities
1. Determined by the instructor
Instructor Notes
1. Facilitate open discussion to involve all students regardless of shop size and experience

CTS Guide Reference: CTS 1-3

Topic 2-4: Administrative Quality Assurance

Terminal Learning Objective
At the end of this topic, a student, given manufacturer specifications, effective communication tools, and basic record-keeping requirements, will be able to successfully manage the administrative day-to-day activities an Emergency Vehicle Technician (EVT), in accordance with the authority having jurisdiction (AHJ), State Fire Training (SFT), and NFPA 1071 (current edition)

Enabling Learning Objectives
1. Describe manufacturer specifications
   • Design and performance specifications of an apparatus
   • Specific to each manufacturer
   • Should be included with vehicle delivery
2. Identify the importance of inspecting, maintaining, and repairing a vehicle to manufacturer specifications
   • Potential to void warranty
   • Potential component failure
   • Potential for injury or death
3. Identify successful communication loops
   • Effective listening, validation, and follow up between:
     o EVT and end user
     o EVT and staff (superiors and peers)
     o EVT and manufacturer/vendor
   • Verbal communication vs. written communication vs. electronic communication
4. Identify the importance of consistent, positive communication
5. Identify basic record-keeping requirements
   • Inspection requirements, checklists, and records
   • Maintenance requirements, checklists, and records
   • Repair requirements, requests, checklists, and records
   • Warranties
   • Technical service bulletins (TSB)
   • Service requests and records
   • Department of Transportation (DOT) requirements
   • NFPA requirements
   • Manufacturer specifications
   • Communications
   • AHJ requirements
6. Identify the importance of accurate and organized record keeping
• Accountability
• If you don’t write it down, it didn’t happen
• Can be used for litigation

Discussion Questions
1. What is the benefit of a complete “as-built” manufacturer document?
2. Why is it important to document any changes to the manufacturer’s design?
3. Why should communications be documented?
4. How long should records be maintained?
5. What happens to a vehicle’s documentation if it is involved in an incident?

Activities
1. Determined by the instructor

Instructor Notes
1. The general theme of this topic is accountability. Weave that concept into each ELO.

CTS Guide Reference: None

Unit 3: Road and/or Performance Testing

Topic 3-1: Road and/or Performance Testing

Terminal Learning Objective
At the end of this topic, a student, given an emergency response vehicle, an applicable driver license (if required), and an approved driving course, will be able to describe how to complete a road performance test on apparatus in accordance with NFPA 1911 so that apparatus system performance is verified to ensure that the drivability of the apparatus complies with requirements of NFPA 1911 and federal and state regulations; and all testing is documented in accordance with the requirements of NFPA standards and the authority having jurisdiction (AHJ)

Enabling Learning Objectives
1. Identify the difference between a road test and a performance test
2. Describe the legal operation of fire apparatus
3. Demonstrate familiarity with apparatus drivability
4. Identify road performance requirements of NFPA 1911 and federal and state regulations
5. Identify record-keeping requirements of NFPA 1911 and the AHJ
6. Recognize the need for a road and/or performance test

Discussion Questions
1. What are some of the legal requirements to operate a vehicle in California?
2. Where can you find weight standards for legal vehicle operation?
3. What safety aspects need to be considered during the testing process?

Activities
1. Determined by the instructor
Instructor Notes

1. This topic is only intended to cover the cognitive component of road and/or performance testing. Actual testing activities are carried out within each system-specific course.

CTS Guide Reference: CTS 2-9
## Time Table

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<tr>
<th>Segment</th>
<th>Lecture Time</th>
<th>Activity Time</th>
<th>Total Unit Time</th>
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<td>Topic 1-1: Orientation and Administration</td>
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### Course Totals

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<td><strong>Total Course Time</strong></td>
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Chassis Systems and Components

Course Plan

Course Details

Certification: Emergency Vehicle Technician I

CTS Guide: Emergency Vehicle Technician [(Month Year)]

Description: This course provides an overview of the knowledge and skills needed to inspect, maintain, repair, and test emergency vehicle chassis systems and components.

Designed For: The emergency vehicle technician pursuing SFT-certification or anyone seeking an overview of chassis systems and components

Prerequisites: [Short Course Title]: Emergency Vehicle Technician 101

Standard: Complete all activities and formative tests.

Complete all summative tests with a minimum score of 80%.

Hours: Lecture: 15:00
Activities: 0:00
Testing: 1:00

Hours (Total): 16:00

Maximum Class Size: 30

Instructor Level: Primary

Instructor/Student Ratio: 1:30

Restrictions: None

SFT Designation: CFSTES
Required Resources

Instructor Resources

To teach this course, instructors need:

- **Student Supplement**
  - Provided by California Fire Mechanics Academy, Inc.
- **Manufacturer manuals**
- **Personal protective equipment (PPE)**

Online Instructor Resources

The following instructor resources are available online at [http://osfm.fire.ca.gov/training/SFTCurriculum](http://osfm.fire.ca.gov/training/SFTCurriculum):

- **None**

Student Resources

To participate in this course, students need:

- **Access to NFPA 1911 (current edition): Inspection, Maintenance, Testing, and Retirement of In-Service Automotive Fire Apparatus**
- **Student Supplement**
  - Provided by California Fire Mechanics 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 30 students
- Projector with appropriate laptop connections
- Wifi/Internet access

Facilities

- OSHA compliant shop
- Lifts
- Safety stands

Equipment

- **Apparatus**
- **Test, calibration, and diagnostic equipment**
- **Tools required to inspect, maintain, and repair chassis systems and components**
- **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
4. 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 be able to describe the capstone task book and testing process.
Enabling Learning Objectives

1. Identify the different levels of certification in the Emergency Vehicle Technician (EVT) certification track
   - EVT I
   - EVT II
   - EVT III
2. Identify the courses required for EVT I
   - State Fire Training
     - [Short Course Title]: Emergency Vehicle Technician 101
     - [Short Course Title]: Electrical Systems A
     - [Short Course Title]: Chassis Systems and Components
     - [Short Course Title]: Cab and Body Systems and Components
     - [Short Course Title]: Pumps and Accessories
     - [Short Course Title]: Tanks and Accessories
   - National Institute for Auto Service Excellence (ASE)
     - Gasoline Engines (T1)
     - Drive Train (T3)
     - Brakes (T4)
     - Suspension and Steering (T5)
     - Preventative Maintenance Inspections (T8)
3. Identify the courses required for EVT II
   - State Fire Training
     - [Short Course Title]: Electrical Systems B
   - National Institute for Auto Service Excellence (ASE)
     - Diesel Engines (T2)
     - Electrical / Electronic Systems (T6)
     - Heating, Ventilation and Air Conditioning (HVAC) (T7)
4. Identify the courses required for EVT III
   - State Fire Training
     - [Short Course Title]: Fleet Specifications and Records
     - [Short Course Title]: Human Resource Management
   - National Institute for Auto Service Excellence (ASE)
     - See eight courses listed for EVT I and EVT II
5. Identify any other requirements for EVT I
   - Code of Federal Regulations (CFR) 396.25: Department of Transportation Brake Inspector Qualification
   - Experience (one of the following)
     - Have a minimum of two years’ full-time paid experience in a state or provincial fire agency, public agency, or private industry as an automotive or truck mechanic with minimum one year related to emergency vehicle maintenance
6. Describe the capstone task book process
   • Complete all prerequisites and course work
   • Submit application and fees and to request capstone task book
     o A candidate may apply for the EVT I and EVT II task books at the same time
       (two applications and two fees), but may not submit the EVT II task book until
       he or she receives EVT I certification (a prerequisite for EVT II)
   • Complete all job performance requirements included in the task book
   • Must have identified evaluator verify individual task completion via signature
   • Must have Fire Chief or authorized representative verify task book completion via
     signature
   • Must be employed by a California Fire Agency in the position prior to submitting
     completed task book to State Fire Training

7. Describe the capstone testing process
   • Emergency Vehicle Technician certification exams (EVT I, EVT II, and EVT III) are
     administered by an independent third-party testing agency

Discussion Questions
1. To be determined by the instructor

Activities
1. To be determined by the instructor

Instructor Notes
1. SFT teaches most EVT I (inspect and maintain) and EVT II (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”
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. Where would you find these NFPA definitions?
2. What is an AHJ?
   • What is the AHJ over your shop or agency?

Activities
1. Determined by 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, and testing emergency vehicle chassis systems 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
   • Required tools/equipment
     o Test, calibration, and diagnostic
       ▪ Tire pressure gauge
       ▪ Tire tread-depth gauge
       ▪ Voltmeter (independent digital voltmeter or onboard unit)
       ▪ Ammeter
       ▪ Tape measure
       ▪ Appropriate electronic diagnostic (e.g. scan tool, laptop, tablet, etc.) equipment
     o Inspection
- Inspection mirror
- Flashlight
- Creeper
- Basic hand tools
- Marking tool (e.g. paint pen or chalk)
- Personal protective equipment (PPE)

  Maintenance and repair
  - Torque wrench (properly calibrated)
  - Laser level
  - Cleaning supplies (e.g. appropriate cleaners, chemicals, wire brush, etc.)
  - Spectrochemical kit (if adjusting coolant concentrates in-house)
  - Metal fabrication equipment
  - Drill press
  - Hydraulic press
  - Hoists
  - Safety stands
  - Ventilation equipment
  - Lighting
  - Air compressor
  - Fluids and lubricants
  - Parts and hardware

4. Describe the inspection process
   - Gather tools and safety equipment
   - Secure vehicle in a safe environment
   - Evaluate reported conditions (if applicable)
   - Perform operational tests
     - 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
     - Checklists vary by manufacturer and authority having jurisdiction (AHJ)
     - Chassis checklist should, at a minimum, include:
       - Vehicle identification number (VIN) or unit number
       - Engine hours or mileage
       - Manufacturer inspection requirements
       - AHJ inspection requirements
       - Inspector name and signature
       - Inspection date
   - Return vehicle to service or move to maintenance or repair

5. Identify the role of a maintenance schedule and a maintenance checklist
   - Scheduling
6. Describe the maintenance process
   • Identify the appropriate scope and authority for maintenance vs. repair activities
   • Identify individual technician’s authorization for maintenance activities
   • Identify maintenance needs from inspection report
   • Gather tools and safety equipment
   • Secure vehicle in a safe environment
   • Evaluate reported conditions
     o Review inspection report
     o Identify repairs (outside maintenance scope)
     o Prioritize maintenance activities
   • Perform operational tests
   • Perform maintenance duties
   • Conduct performance tests
   • Complete checklist and document findings
   • Return vehicle to service or move to repair

7. Describe the repair and/or replacement process
   • Identify the appropriate scope and authority for internal vs. external repair activities
   • Identify individual technician’s authorization for repair activities
   • Identify repair needs from inspection and/or maintenance report
   • Gather tools and safety equipment
   • Secure vehicle in a safe environment
   • Evaluate reported conditions
   • Perform operational tests
   • Repair or replace deformed, broken, loose, worn, or missing parts
   • Conduct performance tests
   • Complete checklist and document findings
   • Release to manufacturer or third-party shop for repair (if applicable)
     o Acceptance testing (inspection) on returned/repaired vehicle
     o Complete checklist and document findings
   • Return vehicle to service

Discussion Questions
  1. How can an AHJ build an inspection form?
  2. Where should the inspection checklists reside?
3. What are the advantages to using quality tools?

Activities
1. Determined by instructor

CTS Guide Reference: None

Unit 3: Chassis Systems and Components

Topic 3-1: Function, Construction, and Operation

Terminal Learning Objective
At the end of this topic, a student, given an emergency response vehicle, SOPs, and manufacturer specifications, will be able to describe the function, construction, and operation of chassis systems and components in accordance with manufacturer specifications and the authority having jurisdiction (AHJ) requirements

Enabling Learning Objectives
1. Describe the function, construction, and operation of frames, crossmembers, and related components
2. Describe the function, construction, and operation of the steering system
   - Steering wheel to hub
   - Steering column(s)
   - Steering gear(s)
   - Auxiliary steering systems
     - All wheel steering systems
     - Tractor-drawn aerials (TDA)
   - Power steering pump
   - Power steering lines
3. Describe the function, construction, and operation of the suspension system
   - Conventional
   - Independent
   - Air
   - Spring
     - Leaf
     - Coil
     - Torsion bar
     - Combination leaf/air spring
4. Describe the function, construction, and operation of the axles
   - Drive
   - Non-drive
   - Conventional beam
   - Steering
   - Tag
   - Pusher
• Custom (new products entering the market annually)
5. Describe the function, construction, and operation of the brake system
   • Hydraulic
   • Air
   • Electric
   • Auxiliary or secondary
6. Describe the function, construction, and operation of the wheels
   • Aluminum
   • Steel
   • Stud mounted
   • Hub mounted
7. Describe the function, construction, and operation of the tires
   • Bias ply
   • Steel belted
   • Single
   • Super single
   • Wide base single
   • Dual
8. Describe the function, construction, and operation of the driveline
   • Primary drive
   • Power take off (PTO)
   • Steering
9. Describe the function, construction, and operation of the auxiliary drive systems
   • Transfer case
   • Driveline
   • Front differential
   • Power take off (PTO)
   • Power dividers
   • Hydraulic systems
10. Describe the function, construction, and operation of the cooling systems
    • Engine
    • Transmission
    • Pump transmission
    • Fuel
    • Power steering
    • Compressed air foam system (CAFS)
    • Hydraulic
    • Auxiliary
      o Direct cooling
      o Indirect cooling
Discussion Questions
1. What is the primary purpose of a chassis?
2. What is the function of the suspension system?

Activities
1. Determined by instructor

CTS Guide Reference: CTS 2-1

Topic 3-2: Electricity and Electronics

Terminal Learning Objective
At the end of this topic, a student, given principles of electricity and operational theory, will be able to apply those principles and theories to the electrical systems in a chassis in accordance with manufacturer specifications and authority having jurisdiction (AHJ) requirements

Enabling Learning Objectives
1. Identify the principles of electricity and the operational theory of electronics
   • Principles of electricity and electronics
     o Ohm’s law
       ▪ Resistance goes up / amperage goes down
       ▪ Amperage goes up / resistance goes down
     o Watt’s law
       ▪ Electrical law of work
     o Kirchhoff’s law
       ▪ All voltage is used up by the time the circuit is complete
       ▪ Amperage will be the same throughout the circuit
   • Electrical systems in a chassis
     o Low voltage
       ▪ Batteries
       ▪ Starter
       ▪ Alternator
       ▪ Wiring
     o Line voltage
       ▪ Power generation system
       ▪ Shore power
     o Electronic
       ▪ Interface electronics (e.g. pump control module, engine status center, transmission control module, anti-lock brake system module, etc.)
       ▪ Load management systems

2. Describe electrical troubleshooting procedures
   • Test system’s all-inclusive voltage drop

Discussion Questions
1. How is a DVOM utilized in a chassis system inspection?
2. How do you test voltage drop?
Activities
1. Determined by instructor

Instructor Notes
1. Electrical is referenced here as part of the complete chassis system. Complete curriculum for inspecting electrical systems is found in [Short Course Title]: Electrical Systems A and [Short Course Title]: Electrical Systems B. Keep this brief.
2. Cover the proper use of a DVOM

CTS Guide Reference: CTS 2-1

Unit 4: Inspection, Maintenance, and Repair

Topic 4-1: Frames and Crossbars

Terminal Learning Objective
At the end of this topic, a student, given an emergency response vehicle, SOPS, manufacturer specifications, an inspection checklist, a maintenance checklist, a maintenance schedule (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 frames, crossbars, and related components so that the structural integrity, operation, and condition of frames, crossbars, and related components are verified to be within manufacturer specifications; the mounting is verified; systems and components are preserved, or restored and operational and within manufacturer specifications; multiplexing, interface electronics, and load management systems are tested for proper operation; all checklist items are inspected; defects and deficiencies, including deformed, broken, loose, worn, or missing parts, are identified and reported and then repaired, rebuilt, or replaced to manufacturer specifications; components are lubricated; fluid levels are maintained; calibrations and adjustments are performed; applicable tests are conducted; performance is verified; and inspections, activities, tests, and repairs are documented in accordance with the procedures of the manufacturer and the authority having jurisdiction (AHJ).

Enabling Learning Objectives
1. List types of defects, deficiencies, and potential problems associated with frames, crossbars, and related components
   - Corrosion
   - Rust, oxidation, electrolysis
   - Warping
   - Leaks
     o Class I
     o Class II
     o Class III
   - Fluid and lubrication levels
   - Cracks, fractures, breaks
   - Loose, broken, worn, or missing components
2. Describe the inspection, diagnostic, maintenance, and repair procedures of the manufacturer and the authority having jurisdiction (AHJ)
3. Describe how to select and use test, calibration, and diagnostic equipment
4. Describe operational, diagnostic, and performance tests
   • Component must meet manufacturer, AHJ, and NFPA specifications (if applicable) to be considered operational
5. Identify the role of inspection, maintenance, and repair schedules
6. Describe how to use inspection, maintenance, and repair checklists
7. Identify and evaluate conditions and recognize deficiencies
8. Identify and describe troubleshooting and adjustment methods and procedures
   • Corrosion
     o Clean
     o Correct cause (if possible)
     o Recoil or repaint (if necessary)
   • Rust, oxidation, electrolysis
     o Clean
     o Spectrochemical analysis of fluids (onsite or offsite)
     o Neutralize
     o Correct cause (if possible)
     o Recoil or repaint (if necessary)
   • Warping
     o Send for repair
   • Leaks
     o Clean
     o Correct cause (if possible)
     o Send for repair
   • Fluid and lubrication levels
     o Use recommended fluids
     o Adjust to appropriate fluid levels at operating temperature
   • Cracks, fractures, breaks
     o Send for repair
   • Loose, broken, worn, or missing components
     o Tighten
     o Replace
     o Adjust
     o Send for repair
9. Describe electrical troubleshooting procedures
10. Describe adjustment and calibration procedures
11. Describe repair and overhaul procedures
12. Identify inspection, maintenance, and repair record-keeping requirements
   • Manufacturer
   • AHJ (vary)
• Federal, state, and local government (vary)
  o Manufacturer
  o AHJ

13. Evaluate reported conditions
14. Use test, calibration, and diagnostic equipment and any additional maintenance and repair equipment
15. Perform operational and verification tests
16. Recognize and identify symptoms and conditions
17. Perform all required maintenance (including checklist items)
18. Recognize, determine, and correct defects, deficiencies, and potential problems
19. Perform required repairs to resolve deficiencies
20. Complete and submit required inspection, maintenance, and repair documentation

Discussion Questions
1. How do you identify a broken bolt?
2. What are some causes of corrosion?

Activities
1. Determined by instructor

Instructor Notes
1. Throughout hands-on lecture in the shop, utilize students to inspect the frame and crossbars, identify maintenance requirements, and recommend potential repairs.
2. ELO 3: Describe how to select and use tools and equipment from Topic 2-2 / ELO 3 appropriate to this chassis component or system. Applies to all topics in Unit 4.
   1. ELO 11: Describe the repair and overhaul procedures for each chassis component or system to the level of detail needed to meet student need. Applies to all topics in Unit 4.
   2. ELO 12: Identify record-keeping requirements for each chassis component or system identified. Applies to all topics in Unit 4.
3. Describe how to inspect the physical parts of the multiplexing system.


Topic 4-2: Steering System – Inspection, Maintenance, and Repair

Terminal Learning Objective
At the end of this topic, a student, given an emergency response vehicle, SOPS, manufacturer specifications, an inspection checklist, a maintenance checklist, a maintenance schedule (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 steering system and related components so that the structural integrity, operation, and condition of the steering system and related components are verified to be within manufacturer specifications; the mounting is verified; systems and components are preserved, or restored and operational and within manufacturer specifications; multiplexing, interface electronics, and load management systems are tested for proper operation; all checklist items are inspected; defects and deficiencies, including deformed, broken, loose, worn, or missing parts, are identified and
reported and then repaired, rebuilt, or replaced to manufacturer specifications; components are lubricated; fluid levels are maintained; calibrations and adjustments are performed; applicable tests are conducted; performance is verified; and inspections, activities, tests, and repairs are documented in accordance with the procedures of the manufacturer and the authority having jurisdiction (AHJ)

Enabling Learning Objectives

1. List types of defects, deficiencies, and potential problems associated with the steering system and related components
   - Corrosion
   - Rust, oxidation, electrolysis
   - Warping
   - Leaks
     - Class I
     - Class II
     - Class III
   - Fluid and lubrication levels
   - Cracks, fractures, breaks
   - Loose, broken, worn, or missing components
2. Describe the inspection, diagnostic, maintenance, and repair procedures of the manufacturer and the authority having jurisdiction (AHJ)
3. Describe how to select and use test, calibration, and diagnostic equipment
4. Describe operational, diagnostic, and performance tests
5. Identify the role of inspection, maintenance, and repair schedules
6. Describe how to use inspection, maintenance, and repair checklists
7. Identify and evaluate conditions and recognize deficiencies
8. Identify and describe troubleshooting and adjustment methods and procedures
   - Corrosion
     - Clean
     - Correct cause (if possible)
     - Recoat or repaint (if necessary)
   - Rust, oxidation, electrolysis
     - Clean
     - Spectrochemical analysis of fluids (onsite or offsite)
     - Neutralize
     - Correct cause (if possible)
     - Recoat or repaint (if necessary)
   - Warping
     - Send for repair
   - Leaks
     - Clean
     - Correct cause (if possible)
     - Send for repair
• Fluid and lubrication levels
  o Use recommended fluids
  o Adjust to appropriate fluid levels at operating temperature
• Cracks, fractures, breaks
  o Send for repair
• Loose, broken, worn, or missing components
  o Tighten
  o Replace
  o Adjust
  o Send for repair

9. Describe electrical troubleshooting procedures
10. Describe adjustment and calibration procedures
11. Describe repair and overhaul procedures
12. Identify inspection, maintenance, and repair record-keeping requirements
13. Evaluate reported conditions
14. Use test, calibration, and diagnostic equipment and any additional maintenance and repair equipment
15. Perform operational and verification tests
16. Recognize and identify symptoms and conditions
17. Perform all required maintenance (including checklist items)
18. Recognize, determine, and correct defects, deficiencies, and potential problems
19. Perform required repairs to resolve deficiencies
20. Complete and submit required inspection, maintenance, and repair documentation

Discussion Questions
1. What conditions would cause you to check the steering system fluids?
2. How do you test component integrity?

Activities
1. Determined by instructor

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


Topic 4-3: Suspension System

Terminal Learning Objective
At the end of this topic, a student, given an emergency response vehicle, SOPS, manufacturer specifications, an inspection checklist, a maintenance checklist, a maintenance schedule (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 suspension system and related components so that the structural integrity, operation, and condition of the suspension system and related components are verified to be within manufacturer specifications; the
mounting is verified; systems and components are preserved, or restored and operational and within manufacturer specifications; multiplexing, interface electronics, and load management systems are tested for proper operation; all checklist items are inspected; defects and deficiencies, including deformed, broken, loose, worn, or missing parts, are identified and reported and then repaired, rebuilt, or replaced to manufacturer specifications; components are lubricated; fluid levels are maintained; calibrations and adjustments are performed; applicable tests are conducted; performance is verified; and inspections, activities, tests, and repairs are documented in accordance with the procedures of the manufacturer and the authority having jurisdiction (AHJ)

**Enabling Learning Objectives**

1. List types of defects, deficiencies, and potential problems associated with the suspension system and related components
   - Corrosion
   - Rust, oxidation, electrolysis
   - Warping
   - Leaks
     - Class I
     - Class II
     - Class III
   - Fluid and lubrication levels
   - Cracks, fractures, breaks
   - Loose, broken, worn, or missing components
2. Describe the inspection, diagnostic, maintenance, and repair procedures of the manufacturer and the authority having jurisdiction (AHJ)
3. Describe how to select and use test, calibration, and diagnostic equipment
4. Describe operational, diagnostic, and performance tests
5. Identify the role of inspection, maintenance, and repair schedules
6. Describe how to use inspection, maintenance, and repair checklists
7. Identify and evaluate conditions and recognize deficiencies
8. Identify and describe troubleshooting and adjustment methods and procedures
   - Corrosion
     - Clean
     - Correct cause (if possible)
     - Recoat or repaint (if necessary)
   - Rust, oxidation, electrolysis
     - Clean
     - Spectrochemical analysis of fluids (onsite or offsite)
     - Neutralize
     - Correct cause (if possible)
     - Recoat or repaint (if necessary)
   - Warping
     - Send for repair
• Leaks
  o Clean
  o Correct cause (if possible)
  o Send for repair
• Fluid and lubrication levels
  o Use recommended fluids
  o Adjust to appropriate fluid levels at operating temperature
• Cracks, fractures, breaks
  o Send for repair
• Loose, broken, worn, or missing components
  o Tighten
  o Replace
  o Adjust
  o Send for repair

9. Describe electrical troubleshooting procedures
10. Describe adjustment and calibration procedures
11. Describe repair and overhaul procedures
12. Identify inspection, maintenance, and repair record-keeping requirements
13. Evaluate reported conditions
14. Use test, calibration, and diagnostic equipment and any additional maintenance and repair equipment
15. Perform operational and verification tests
16. Recognize and identify symptoms and conditions
17. Perform all required maintenance (including checklist items)
18. Recognize, determine, and correct defects, deficiencies, and potential problems
19. Perform required repairs to resolve deficiencies
20. Complete and submit required inspection, maintenance, and repair documentation

Discussion Questions
1. What are the general maintenance requirements of the suspension system?
2. How many leaf springs can be broken before vehicle must be removed from service?

Activities
1. Determined by instructor

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


Topic 4-4: Axles

Terminal Learning Objective
At the end of this topic, a student, given an emergency response vehicle, SOPS, manufacturer specifications, an inspection checklist, a maintenance checklist, a maintenance schedule (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 axles and related components so that the structural integrity, operation, and condition of the axles and related components are verified to be within manufacturer specifications; the mounting is verified; systems and components are preserved, or restored and operational and within manufacturer specifications; multiplexing, interface electronics, and load management systems are tested for proper operation; all checklist items are inspected; defects and deficiencies, including deformed, broken, loose, worn, or missing parts, are identified and reported and then repaired, rebuilt, or replaced to manufacturer specifications; components are lubricated; fluid levels are maintained; calibrations and adjustments are performed; applicable tests are conducted; performance is verified; and inspections, activities, tests, and repairs are documented in accordance with the procedures of the manufacturer and the authority having jurisdiction (AHJ)

Enabling Learning Objectives

1. List types of defects, deficiencies, and potential problems associated with the axles and related components
   - Corrosion
   - Rust, oxidation, electrolysis
   - Warping
   - Leaks
     - Class I
     - Class II
     - Class III
   - Fluid and lubrication levels
   - Cracks, fractures, breaks
   - Loose, broken, worn, or missing components
2. Describe the inspection, diagnostic, maintenance, and repair procedures of the manufacturer and the authority having jurisdiction (AHJ)
3. Describe how to select and use test, calibration, and diagnostic equipment
4. Describe operational, diagnostic, and performance tests
5. Identify the role of inspection, maintenance, and repair schedules
6. Describe how to use inspection, maintenance, and repair checklists
7. Identify and evaluate conditions and recognize deficiencies
8. Identify and describe troubleshooting and adjustment methods and procedures
   - Corrosion
     - Clean
     - Correct cause (if possible)
     - Recoat or repaint (if necessary)
   - Rust, oxidation, electrolysis
     - Clean
     - Spectrochemical analysis of fluids (onsite or offsite)
     - Neutralize
9. Describe electrical troubleshooting procedures
10. Describe adjustment and calibration procedures
11. Describe repair and overhaul procedures
12. Identify inspection, maintenance, and repair record-keeping requirements
13. Evaluate reported conditions
14. Use test, calibration, and diagnostic equipment and any additional maintenance and repair equipment
15. Perform operational and verification tests
16. Recognize and identify symptoms and conditions
17. Perform all required maintenance (including checklist items)
18. Recognize, determine, and correct defects, deficiencies, and potential problems
19. Perform required repairs to resolve deficiencies
20. Complete and submit required inspection, maintenance, and repair documentation

Discussion Questions
1. Can an axle housing be welded?
2. Does a warped axle housing remove a vehicle from service?

Activities
1. Determined by instructor

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


Topic 4-5: Brake System
Terminal Learning Objective

At the end of this topic, a student, given an emergency response vehicle, SOPS, manufacturer specifications, an inspection checklist, a maintenance checklist, a maintenance schedule (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 brake system and related components so that the structural integrity, operation, and condition of the brake system and related components are verified to be within manufacturer specifications; the mounting is verified; systems and components are preserved, or restored and operational and within manufacturer specifications; multiplexing, interface electronics, and load management systems are tested for proper operation; all checklist items are inspected; defects and deficiencies, including deformed, broken, loose, worn, or missing parts, are identified and reported and then repaired, rebuilt, or replaced to manufacturer specifications; components are lubricated; fluid levels are maintained; calibrations and adjustments are performed; applicable tests are conducted; performance is verified; and inspections, activities, tests, and repairs are documented in accordance with the procedures of the manufacturer and the authority having jurisdiction (AHJ)

Enabling Learning Objectives

1. List types of defects, deficiencies, and potential problems associated with the brake system and related components
   - Corrosion
   - Rust, oxidation, electrolysis
   - Warping
   - Leaks
     - Class I
     - Class II
     - Class III
   - Fluid and lubrication levels
   - Cracks, fractures, breaks
   - Loose, broken, worn, or missing components
2. Describe the inspection, diagnostic, maintenance, and repair procedures of the manufacturer and the authority having jurisdiction (AHJ)
3. Describe how to select and use test, calibration, and diagnostic equipment
4. Describe operational, diagnostic, and performance tests
5. Identify the role of inspection, maintenance, and repair schedules
6. Describe how to use inspection, maintenance, and repair checklists
7. Identify and evaluate conditions and recognize deficiencies
8. Identify and describe troubleshooting and adjustment methods and procedures
   - Corrosion
     - Clean
     - Correct cause (if possible)
     - Recoat or repaint (if necessary)
• Rust, oxidation, electrolysis
  o Clean
  o Spectrochemical analysis of fluids (onsite or offsite)
  o Neutralize
  o Correct cause (if possible)
  o Recoat or repaint (if necessary)
• Warping
  o Send for repair
• Leaks
  o Clean
  o Correct cause (if possible)
  o Send for repair
• Fluid and lubrication levels
  o Use recommended fluids
  o Adjust to appropriate fluid levels at operating temperature
• Cracks, fractures, breaks
  o Send for repair
• Loose, broken, worn, or missing components
  o Tighten
  o Replace
  o Adjust
  o Send for repair

9. Describe electrical troubleshooting procedures
10. Describe adjustment and calibration procedures
11. Describe repair and overhaul procedures
12. Identify inspection, maintenance, and repair record-keeping requirements
13. Evaluate reported conditions
14. Use test, calibration, and diagnostic equipment and any additional maintenance and repair equipment
15. Perform operational and verification tests
16. Recognize and identify symptoms and conditions
17. Perform all required maintenance (including checklist items)
18. Recognize, determine, and correct defects, deficiencies, and potential problems
19. Perform required repairs to resolve deficiencies
20. Complete and submit required inspection, maintenance, and repair documentation

Discussion Questions
  1. What methods would you use to evaluate the brake system?
  2. How do you identify worn slack adjusters?
  3. What can cause an out of service of brake drum?

Activities
  1. Determined by instructor
Instructor Notes
1. Brakes are only referenced here as part of the complete chassis system. Brake curriculum through the Federal Motor Carrier Safety Administration (CFR 396.25) is required for State Fire Training EVT I certification.
2. Throughout hands-on lecture in the shop, utilize students to inspect the brake system, identify maintenance requirements, and recommend potential repairs.


Topic 4-6: Wheels and Tires

Terminal Learning Objective
At the end of this topic, a student, given an emergency response vehicle, SOPS, manufacturer specifications, an inspection checklist, a maintenance checklist, a maintenance schedule (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 wheels and tires and related components so that the structural integrity, operation, and condition of the wheels and tires and related components are verified to be within manufacturer specifications; the mounting is verified; systems and components are preserved, or restored and operational and within manufacturer specifications; all checklist items are inspected; defects and deficiencies, including deformed, broken, loose, worn, or missing parts, are identified and reported and then repaired, rebuilt, or replaced to manufacturer specifications; components are lubricated; calibrations and adjustments are performed; applicable tests are conducted; performance is verified; and inspections, activities, tests, and repairs are documented in accordance with the procedures of the manufacturer and the authority having jurisdiction (AHJ)

Enabling Learning Objectives
1. List types of defects, deficiencies, and potential problems associated with the wheels and tires and related components
   - Corrosion
   - Rust, oxidation, electrolysis
   - Warping
   - Cracks, fractures, breaks
   - Tire age
   - Improper inflation
   - Improper vehicle loading
   - Loose, broken, worn, or missing components
2. Describe the inspection, diagnostic, maintenance, and repair procedures of the manufacturer and the authority having jurisdiction (AHJ)
3. Describe how to select and use test, calibration, and diagnostic equipment
4. Describe operational, diagnostic, and performance tests
5. Identify the role of inspection, maintenance, and repair schedules
6. Describe how to use inspection, maintenance, and repair checklists
7. Identify and evaluate conditions and recognize deficiencies
8. Identify and describe troubleshooting and adjustment methods and procedures
   - Corrosion
     o Clean
     o Correct cause (if possible)
     o Recoil or repaint (if necessary)
   - Rust, oxidation, electrolysis
     o Clean
     o Spectrochemical analysis of fluids (onsite or offsite)
     o Neutralize
     o Correct cause (if possible)
     o Recoil or repaint (if necessary)
   - Warping
     o Send for repair
   - Cracks, fractures, breaks
     o Send for repair
   - Loose, broken, worn, or missing components
     o Tighten
     o Replace
     o Adjust
     o Send for repair
9. Describe electrical troubleshooting procedures
10. Describe adjustment and calibration procedures
11. Describe repair and overhaul procedures
12. Identify inspection, maintenance, and repair record-keeping requirements
13. Evaluate reported conditions
14. Use test, calibration, and diagnostic equipment and any additional maintenance and repair equipment
15. Perform operational and verification tests
16. Recognize and identify symptoms and conditions
17. Perform all required maintenance (including checklist items)
18. Recognize, determine, and correct defects, deficiencies, and potential problems
19. Perform required repairs to resolve deficiencies
20. Complete and submit required inspection, maintenance, and repair documentation

Discussion Questions
1. How do you read the tire date codes?
2. How do you check for worn rims?

Activities
1. Determined by instructor

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

Topic 4-7: Driveline

Terminal Learning Objective
At the end of this topic, a student, given an emergency response vehicle, SOPS, manufacturer specifications, an inspection checklist, a maintenance checklist, a maintenance schedule (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 driveline and related components so that the structural integrity, operation, and condition of the driveline and related components are verified to be within manufacturer specifications; the mounting is verified; systems and components are preserved, or restored and operational and within manufacturer specifications; all checklist items are inspected; defects and deficiencies, including deformed, broken, loose, worn, or missing parts, are identified and reported and then repaired, rebuilt, or replaced to manufacturer specifications; components are lubricated; fluid levels are maintained; calibrations and adjustments are performed; applicable tests are conducted; performance is verified; and inspections, activities, tests, and repairs are documented in accordance with the procedures of the manufacturer and the authority having jurisdiction (AHJ)

Enabling Learning Objectives
1. List types of defects, deficiencies, and potential problems associated with the driveline and related components
   - Corrosion
   - Rust, oxidation, electrolysis
   - Warping
   - Leaks
     o Class I
     o Class II
     o Class III
   - Fluid and lubrication levels
   - Cracks, fractures, breaks
   - Loose, broken, worn, or missing components
2. Describe the inspection, diagnostic, maintenance, and repair procedures of the manufacturer and the authority having jurisdiction (AHJ)
3. Describe how to select and use test, calibration, and diagnostic equipment
4. Describe operational, diagnostic, and performance tests
5. Identify the role of inspection, maintenance, and repair schedules
6. Describe how to use inspection, maintenance, and repair checklists
7. Identify and evaluate conditions and recognize deficiencies
8. Identify and describe troubleshooting and adjustment methods and procedures
   - Corrosion
     o Clean
9. Describe electrical troubleshooting procedures
10. Describe adjustment and calibration procedures
11. Describe repair and overhaul procedures
12. Identify inspection, maintenance, and repair record-keeping requirements
13. Evaluate reported conditions
14. Use test, calibration, and diagnostic equipment and any additional maintenance and repair equipment
15. Perform operational and verification tests
16. Recognize and identify symptoms and conditions
17. Perform all required maintenance (including checklist items)
18. Recognize, determine, and correct defects, deficiencies, and potential problems
19. Perform required repairs to resolve deficiencies
20. Complete and submit required inspection, maintenance, and repair documentation

Discussion Questions
1. What are the components of a driveline?
2. What can cause a driveline failure?
Activities
1. Given a chassis system, have students inspect the driveline system, identify maintenance requirements, and recommend potential repairs.

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


Topic 4-8: Auxiliary Drive Systems

Terminal Learning Objective
At the end of this topic, a student, given an emergency response vehicle, SOPS, manufacturer specifications, an inspection checklist, a maintenance checklist, a maintenance schedule (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 auxiliary drive systems and related components so that the structural integrity, operation, and condition of the auxiliary drive systems and related components are verified to be within manufacturer specifications; the mounting is verified; systems and components are preserved, or restored and operational and within manufacturer specifications; all checklist items are inspected; defects and deficiencies, including deformed, broken, loose, worn, or missing parts, are identified and reported and then repaired, rebuilt, or replaced to manufacturer specifications; components are lubricated; fluid levels are maintained; calibrations and adjustments are performed; applicable tests are conducted; performance is verified; and inspections, activities, tests, and repairs are documented in accordance with the procedures of the manufacturer and the authority having jurisdiction (AHJ)

Enabling Learning Objectives
1. List types of defects, deficiencies, and potential problems associated with the auxiliary drive systems and related components
   - Corrosion
   - Rust, oxidation, electrolysis
   - Warping
   - Leaks
     - Class I
     - Class II
     - Class III
   - Fluid and lubrication levels
   - Cracks, fractures, breaks
   - Loose, broken, worn, or missing components
2. Describe the inspection, diagnostic, maintenance, and repair procedures of the manufacturer and the authority having jurisdiction (AHJ)
3. Describe how to select and use test, calibration, and diagnostic equipment
4. Describe operational, diagnostic, and performance tests
5. Identify the role of inspection, maintenance, and repair schedules
6. Describe how to use inspection, maintenance, and repair checklists
7. Identify and evaluate conditions and recognize deficiencies
8. Identify and describe troubleshooting and adjustment methods and procedures
   • Corrosion
     o Clean
     o Correct cause (if possible)
     o Recruit or repaint (if necessary)
   • Rust, oxidation, electrolysis
     o Clean
     o Spectrochemical analysis of fluids (onsite or offsite)
     o Neutralize
     o Correct cause (if possible)
     o Recruit or repaint (if necessary)
   • Warping
     o Send for repair
   • Leaks
     o Clean
     o Correct cause (if possible)
     o Send for repair
   • Fluid and lubrication levels
     o Use recommended fluids
     o Adjust to appropriate fluid levels at operating temperature
   • Cracks, fractures, breaks
     o Send for repair
   • Loose, broken, worn, or missing components
     o Tighten
     o Replace
     o Adjust
     o Send for repair
9. Describe electrical troubleshooting procedures
10. Describe adjustment and calibration procedures
11. Describe repair and overhaul procedures
12. Identify inspection, maintenance, and repair record-keeping requirements
13. Evaluate reported conditions
14. Use test, calibration, and diagnostic equipment and any additional maintenance and repair equipment
15. Perform operational and verification tests
16. Recognize and identify symptoms and conditions
17. Perform all required maintenance (including checklist items)
18. Recognize, determine, and correct defects, deficiencies, and potential problems
19. Perform required repairs to resolve deficiencies
20. Complete and submit required inspection, maintenance, and repair documentation

Discussion Questions
1. What might cause vibration in the auxiliary drive system?

Activities
1. Determined by instructor

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


Topic 4-9: Cooling Systems

Terminal Learning Objective
At the end of this topic, a student, given an emergency response vehicle, SOPS, manufacturer specifications, an inspection checklist, a maintenance checklist, a maintenance schedule (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 cooling systems and related components so that the structural integrity, operation, and condition of the cooling systems and related components are verified to be within manufacturer specifications; the mounting is verified; systems and components are preserved, or restored and operational and within manufacturer specifications; multiplexing and interface electronics systems are tested for proper operation; all checklist items are inspected; defects and deficiencies, including deformed, broken, loose, worn, or missing parts, are identified and reported and then repaired, rebuilt, or replaced to manufacturer specifications; fluid levels are maintained; calibrations and adjustments are performed; applicable tests are conducted; performance is verified; and inspections, activities, tests, and repairs are documented in accordance with the procedures of the manufacturer and the authority having jurisdiction (AHJ)

Enabling Learning Objectives
1. List types of defects, deficiencies, and potential problems associated with the cooling systems and related components
   • Corrosion
   • Rust, oxidation, electrolysis
   • Warping
   • Leaks
     o Class I
     o Class II
     o Class III
   • Fluid and lubrication levels
   • Cracks, fractures, breaks
   • Loose, broken, worn, or missing components
2. Describe the inspection, diagnostic, maintenance, and repair procedures of the manufacturer and the authority having jurisdiction (AHJ)
3. Describe how to select and use test, calibration, and diagnostic equipment
4. Describe operational, diagnostic, and performance tests
5. Identify the role of inspection, maintenance, and repair schedules
6. Describe how to use inspection, maintenance, and repair checklists
7. Identify and evaluate conditions and recognize deficiencies
8. Identify and describe troubleshooting and adjustment methods and procedures
   • Corrosion
     o Clean
     o Correct cause (if possible)
     o Recoat or repaint (if necessary)
   • Rust, oxidation, electrolysis
     o Clean
     o Spectrochemical analysis of fluids (onsite or offsite)
     o Neutralize
     o Correct cause (if possible)
     o Recoat or repaint (if necessary)
   • Warping
     o Send for repair
   • Leaks
     o Clean
     o Correct cause (if possible)
     o Send for repair
   • Fluid and lubrication levels
     o Use recommended fluids
     o Adjust to appropriate fluid levels at operating temperature
   • Cracks, fractures, breaks
     o Send for repair
   • Loose, broken, worn, or missing components
     o Tighten
     o Replace
     o Adjust
     o Send for repair
9. Describe electrical troubleshooting procedures
10. Describe adjustment and calibration procedures
11. Describe repair and overhaul procedures
12. Identify inspection, maintenance, and repair record-keeping requirements
13. Evaluate reported conditions
14. Use test, calibration, and diagnostic equipment and any additional maintenance and repair equipment
15. Perform operational and verification tests
16. Recognize and identify symptoms and conditions
17. Perform all required maintenance (including checklist items)
18. Recognize, determine, and correct defects, deficiencies, and potential problems
19. Perform required repairs to resolve deficiencies
20. Complete and submit required inspection, maintenance, and repair documentation

Discussion Questions
1. What cooling systems are evaluated as part of the chassis system?
2. How do you test coolant?
3. How do you test a radiator cap?

Activities
1. Determined by instructor

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


Unit 5: Testing

Topic 5-1: Axle Weight Performance Testing

Terminal Learning Objective
At the end of this topic, a student, given an emergency response vehicle, an applicable driving license (if required), and a commercial certified scale, will be able to complete an axle weight performance test on an apparatus in accordance with NFPA 1911 so that the apparatus weight is determined to ensure that the weight on the vehicle does not exceed the gross axle weight rating (GAWR) and the gross vehicle weight rating (GVWR) or gross combination weight rating (GCWR) as shown on the rating plate on the fire apparatus; and all testing is documented in accordance with the requirements of NFPA standards and the authority having jurisdiction (AHJ)

Enabling Learning Objectives
1. Describe the legal operation of fire apparatus
   • Department of Motor Vehicles (DMV) identifies vehicle licensing requirements
   • Individual license holders bear responsibility for knowing which vehicle(s) they may legally operate
2. Identify the location of a certified scale
   • US DOT provides lists of certified scales (www.transportation.gov)
   • California Highway Patrol (CHP) has lists of certified commercial scales
3. Identify record-keeping requirements of NFPA 1911 and the AHJ
   • NFPA 1911 (2012) / Chapter 16: Road Tests and Annual Weight Verification
4. Describe the axle weight performance testing process
5. Complete required documentation
   • Forms identified in NFPA 1911
   • Any additional AHJ requirements
Discussion Questions
1. Why is it important to weigh an apparatus?
2. Who determines apparatus weight limits?

Activities
1. Determined by instructor

Instructor Notes
1. ELO 1: Provide the licensing information current at the time of course offering
2. ELO 3: Use the current NFPA 1911 edition (provide digital or paper copy of Chapter 16)
3. ELO 4: Use current NFPA 1911 edition paragraphs as the outline to teach the process

CTS Guide Reference: CTS 2-6

Topic 5-2: Brake Performance Testing

Terminal Learning Objective
At the end of this topic, a student, given an emergency response vehicle, an applicable driving license (if required), and a calibrated driving course, will be able to complete a braking performance test on an apparatus in accordance with NFPA 1911 so that the apparatus braking system performance is verified to ensure that the braking ability of the apparatus complies with the requirements of NFPA 1911 and federal and state regulations; and all testing is documented in accordance with the requirements of NFPA standards and the authority having jurisdiction (AHJ)

Enabling Learning Objectives
1. Recognize the need for brake performance testing
   - Validate vehicle ability
   - Fire personnel and public safety
   - Budgeting and forecasting
3. Demonstrate familiarity with brake testing course
4. Identify brake performance requirements of NFPA 1911 and federal and state regulations
   - NFPA 1911 (2012) / Chapter 16: Road Tests and Annual Weight Verification
   - US DOT Federal Motor Carrier Safety Administration / Part 393
   - California Vehicle Code (CVC) / Division 12. Equipment of Vehicles / Chapter 3, Brakes
5. Identify record-keeping requirements of NFPA 1911 and the AHJ
   - NFPA 1911 (2012) / Chapter 16: Road Tests and Annual Weight Verification
   - AHJ (vary)
6. Describe the brake performance testing process
   - NFPA covers emergency vehicles / fire apparatus
   - US DOT covers commercial vehicles
   - CVC covers any vehicle with a brake
7. Complete required documentation
Forms identified in NFPA 1911
Any additional AHJ requirements

Discussion Questions
1. Who determines brake test requirements?
2. When is a brake performance test required?

Activities
1. Determined by instructor

Instructor Notes
1. ELO 4: Use the current NFPA 1911 edition (provide digital or paper copy of Chapter 16)
2. ELO 5: Use the appropriate published regulations or requirements depending on vehicle type as the outline to teach this process

CTS Guide Reference: CTS 2-7

Topic 5-3: Parking Brake Performance Testing

Terminal Learning Objective
At the end of this topic, a student, given an emergency response vehicle, an applicable driving license (if required), and an appropriate road grade, will be able to complete a parking brake performance test on an apparatus in accordance with NFPA 1911 so that the apparatus parking brake system performance is verified to ensure that the parking ability of the apparatus complies with the requirements of NFPA 1911 and federal and state regulations; and all testing is documented in accordance with the procedures of NFPA standards and the authority having jurisdiction (AHJ)

Enabling Learning Objectives
1. Recognize the need for parking brake testing
2. Demonstrate familiarity with parking brake testing course
3. Identify parking brake performance requirements of NFPA 1911 and federal and state regulations
   - NFPA 1911 (2012) / Chapter 16: Road Tests and Annual Weight Verification
   - US DOT Federal Motor Carrier Safety Administration / Part 393
4. Identify record-keeping requirements of NFPA 1911 and the AHJ
   - NFPA 1911 (2012) / Chapter 16: Road Tests and Annual Weight Verification
5. Describe the performance brake testing process
6. Complete required documentation

Discussion Questions
1. How do you position a vehicle for park brake testing?
2. What action is required if a vehicle fails park brake testing?

Activities
1. Determined by instructor
Instructor Notes

1. ELO 3: Use the current NFPA 1911 edition (provide digital or paper copy of Chapter 16)
2. ELO 5: Use the appropriate published regulations or requirements depending on vehicle type as the outline to teach this process

CTS Guide Reference: CTS 2-8
# Time Table

<table>
<thead>
<tr>
<th>Segment</th>
<th>Lecture Time</th>
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<tr>
<td><strong>Unit 1: Introduction</strong></td>
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<td>Topic 1-1: Orientation and Administration</td>
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### Unit 5: Testing

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<td><strong>Topic 5-3: Parking Brake Performance Testing</strong></td>
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### Lecture, Activity, and Unit Totals:

| Total Lecture Time (LT) | 15:00 |
| Total Activity Time (AT) | 0:00  |
| Total Testing Time (TT)  | 1:00  |
| Total Course Time | 16:00 |
Cab and Body Systems and Components

Course Plan

Course Details

Certification: Emergency Vehicle Technician I

CTS Guide: Emergency Vehicle Technician [([Month Year])]

Description: This course provides an overview of the knowledge and skills needed to inspect, maintain, repair, and test emergency vehicle cab and body systems and components.

Designed For: The emergency vehicle technician pursuing SFT-certification or anyone seeking an overview of emergency vehicle cab and body systems and components

Prerequisites: [Short Course Title]: Emergency Vehicle Technician 101

Standard: Complete all activities and formative tests. Complete all summative tests with a minimum score of 80%.

Hours:
- Lecture: 11:00
- Activities: 0:00
- Testing: 1:00

Hours (Total): 12:00

Maximum Class Size: 30

Instructor Level: Primary

Instructor/Student Ratio: 1:30

Restrictions: None

SFT Designation: CFSTES

[Month Year]
Required Resources

Instructor Resources

To teach this course, instructors need:
- NFPA 1911 (current edition): Inspection, Maintenance, Testing, and Retirement of In-Service Automotive Fire Apparatus
- Student Supplement
  - Provided by California Fire Mechanic’s Academy, Inc.
- Manufacturer manuals and documentation
- Personal protective equipment (PPE)

Online Instructor Resources

The following instructor resources are available online at http://osfm.fire.ca.gov/training/SFTCurriculum:
- None

Student Resources

To participate in this course, students need:
- Access to NFPA 1911 (current edition): Inspection, Maintenance, Testing, and Retirement of In-Service Automotive Fire Apparatus
- Student Supplement
  - Provided by California Fire Mechanic’s Academy, Inc.
- Access to manufacturer manuals and documentation
- 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 30 students
- Projector with appropriate laptop connections
- Wifi/Internet access

Facilities
- OSHA compliant shop
- Safety stands

Equipment
- Emergency vehicle or apparatus with a cab and body
- Vehicle lifts
- Test, calibration, and diagnostic equipment
- Tools required to inspect, maintain, and repair cab and body systems and components
• 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 be able to describe the capstone task book and testing process.
Enabling Learning Objectives

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

2. Identify the courses required for EVT I
   - State Fire Training
     - [Short Course Title]: Emergency Vehicle Technician 101
     - [Short Course Title]: Electrical Systems A
     - [Short Course Title]: Chassis Systems and Components
     - [Short Course Title]: Cab and Body Systems and Components
     - [Short Course Title]: Pumps and Accessories
     - [Short Course Title]: Tanks and Accessories
   - National Institute for Auto Service Excellence (ASE)
     - Gasoline Engines (T1)
     - Drive Train (T3)
     - Brakes (T4)
     - Suspension and Steering (T5)
     - Preventative Maintenance Inspections (T8)

3. Identify the courses required for EVT II
   - State Fire Training
     - [Short Course Title]: Electrical Systems B
   - National Institute for Auto Service Excellence (ASE)
     - Diesel Engines (T2)
     - Electrical / Electronic Systems (T6)
     - Heating, Ventilation and Air Conditioning (HVAC) (T7)

4. Identify the courses required for EVT III
   - State Fire Training
     - [Short Course Title]: Fleet Specifications and Records
     - [Short Course Title]: Human Resource Management
   - National Institute for Auto Service Excellence (ASE)
     - See eight courses listed for EVT I and EVT II

5. Identify any other requirements for EVT I
   - Code of Federal Regulations (CFR) 396.25: Department of Transportation Brake Inspector Qualification
   - Experience (one of the following)
     - Have a minimum of two years’ full-time paid experience in a state or provincial fire agency, public agency, or private industry as an automotive or truck mechanic with minimum one year related to emergency vehicle maintenance
6. Describe the capstone task book process
   • Complete all prerequisites and course work
   • Submit application and fees and to request capstone task book
     o A candidate may apply for the EVT I and EVT II task books at the same time
       (two applications and two fees), but may not submit the EVT II task book until
       he or she receives EVT I certification (a prerequisite for EVT II)
   • Complete all job performance requirements included in the task book
   • Must have identified evaluator verify individual task completion via signature
   • Must have Fire Chief or authorized representative verify task book completion via
     signature
   • Must be employed by a California Fire Agency in the position prior to submitting
     completed task book to State Fire Training
7. Describe the capstone testing process
   • Emergency Vehicle Technician certification exams (EVT I, EVT II, and EVT III) are
     administered by an independent third-party testing agency

Discussion Questions
  1. To be determined by the instructor
Activities
  1. To be determined by the instructor
Instructor Notes
  1. SFT teaches most EVT I (inspect and maintain) and EVT II (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. Determined by instructor

Activities
1. Determined by 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, and testing emergency vehicle cabs and bodies and related components 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
   • Required tools/equipment
     o Test, calibration, and diagnostic
     o Inspection
     o Maintenance and repair

4. Describe the inspection process
   • Gather tools and safety equipment
   • Secure vehicle in a safe environment
   • Evaluate reported conditions (if applicable)
   • Perform operational tests
     o 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
  o Checklists vary by manufacturer and authority having jurisdiction (AHJ)
  o Chassis checklist should, at a minimum, include:
    ▪ Vehicle identification number (VIN) or unit number
    ▪ Engine hours or mileage
    ▪ Manufacturer inspection requirements
    ▪ AHJ inspection requirements
    ▪ Inspector name and signature
    ▪ Inspection date
• Return vehicle to service or move to maintenance or repair
5. Identify the role of a maintenance schedule and a maintenance checklist
• Scheduling
• Budgeting
  o Allocation
  o Cost reduction
  o Forecasting
• Fleet lifecycle
• Research and development
• Audits
• Legal protection
6. Describe the maintenance process
• Identify the appropriate scope and authority for maintenance vs. repair activities
• Identify individual technician’s authorization for maintenance activities
• Identify maintenance needs from inspection report
• Gather tools and safety equipment
• Secure vehicle in a safe environment
• Evaluate reported conditions
  o Review inspection report
  o Identify repairs (outside maintenance scope)
  o Prioritize maintenance activities
• Perform operational tests
• Perform maintenance duties
• Conduct performance tests
• Complete checklist and document findings
• Return vehicle to service or move to repair
7. Describe the repair and/or replacement process
• Identify the appropriate scope and authority for internal vs. external repair activities
• Identify individual technician’s authorization for repair activities
• Identify repair needs from inspection and/or maintenance report
• Gather tools and safety equipment
• Secure vehicle in a safe environment
• Evaluate reported conditions
• Perform operational tests
• Repair or replace deformed, broken, loose, worn, or missing parts
• Conduct performance tests
• Complete checklist and document findings
• Release to manufacturer or third-party shop for repair (if applicable)
  o Acceptance testing (inspection) on returned/repaired vehicle
  o Complete checklist and document findings
• Return vehicle to service

Discussion Questions
1. Determined by instructor

Activities
1. Determined by instructor

CTS Guide Reference: None

Unit 3: Cab and Body Systems and Components

Topic 3-1: Function, Construction, and Operation

Terminal Learning Objective
At the end of this topic, a student, given an emergency response vehicle, SOPs, and manufacturer specifications, will be able to describe the function, construction, and operation of cab and body systems and components in accordance with manufacturer specifications and the authority having jurisdiction (AHJ) requirements

Enabling Learning Objectives
1. Describe the function, construction, and operation of the crew and passenger compartments
   • Glass, windows, and mirrors
     o Manual
     o Electronic
   • Seats
   • Seatbelts and safety restraints
   • Doors, door hinges, latches, and door stops
   • Lighting
   • Climate control system
   • Instrumentation
   • Cab mounting system
     o Mounting brackets
     o Cab base structure
     o Resilient cushions
     o Securing fasteners
   • Equipment mounting systems
     o Mounting racks
- Manual
- Electronic
  - Brackets
  - Latches
  - Interlocks and warning systems
    - Visual
    - Audible
  - Radios, computers, and siren controls
  - Self-contained breathing apparatus (SCBA)
  - Portable lights
  - Hand tools
  - Emergency medical service (EMS) equipment
  - Books, street directories, maps
- Cab tilting systems
  - Switches and remote controls
  - Interlocks
  - Motors and pumps
  - Reservoirs
  - Hoses and fittings
  - Cylinders and lifting devices
  - Cab support devices
  - Pivot points
  - Latches and hold-down devices
  - Hydraulic fluids

2. Describe the function, construction, and operation of the body and compartmentation
   - Compartments and storage areas
   - Lighting
   - Hinges, latches, and seals
   - Doors
   - Shelves and dividers
   - Hazard warning lights and interlocks
     - Visual
     - Audible
   - Steps, platforms, handrails, access ladders
   - Slip-resistant surfaces
   - Mechanical steps
   - Equipment mounting racks and brackets
   - Finishes and reflective stripping
   - Signs and labels

Discussion Questions
1. What is the main purpose of the safety systems?
2. What might cause corrosion in the cab or body?
Activities
1. Determined by instructor

CTS Guide Reference: CTS 3-1 / CTS 3-3 / CTS 3-4 / CTS 3-6 / CTS 3-7 / CTS 3-8 / CTS 3-9 / CTS 3-11

Topic 3-2: Electricity and Electronics

Terminal Learning Objective
At the end of this topic, a student, given principles of electricity, electrical connection, and operational theory, will be able to apply those principles and theories to the electrical systems in the cab and body in accordance with manufacturer specifications and authority having jurisdiction (AHJ) requirements

Enabling Learning Objectives
1. Identify the principles of electricity and the operational theory of electronics
   • Principles of electricity and electronics
     o Ohm’s law
       ▪ Resistance goes up / amperage goes down
       ▪ Amperage goes up / resistance goes down
     o Watt’s law
       ▪ Electrical law of work
     o Kirchhoff’s law
       ▪ All voltage is used up by the time the circuit is complete
       ▪ Amperage will be the same throughout the circuit
   • Electrical systems in the cab and body
     o Low voltage
       ▪ Batteries
       ▪ Starter
       ▪ Alternator
       ▪ Wiring
     o Line voltage
       ▪ Power generation system
       ▪ Shore power
     o Electronic
       ▪ Interface electronics (e.g. pump control module, engine status center, transmission control module, anti-lock brake system module, etc.)
       ▪ Load management systems
2. Identify electrical connection theory and maintenance
3. Describe electrical troubleshooting procedures
   • Test system’s all-inclusive voltage drop
4. Measure voltage, amperage, and resistance

Discussion Questions
1. What are some grounding sources?
Activities
1. Determined by instructor

Instructor Notes
1. Electrical is referenced here as part of the complete cab and body system. Complete curriculum for inspecting electrical systems is found in [Short Course Title]: Electrical Systems A and [Short Course Title]: Electrical Systems B. Keep this brief.

CTS Guide Reference: CTS 3-5 / CTS 3-6 / CTS 3-8

Topic 3-3: Welding and Fabrication

Terminal Learning Objective
At the end of this topic, a student, given basic welding and fabrication principles and techniques, will be able to apply welding and fabrication procedures needed to maintain and repair systems and components and in the cab and body in accordance with manufacturer specifications and authority having jurisdiction (AHJ) requirements.

Enabling Learning Objectives
1. Describe basic welding and fabrication procedures
2. Identify welding experience and/or certification requirements for different parts of an apparatus

Discussion Questions
1. Determined by instructor

Activities
1. Determined by instructor

Instructor Notes
1. It is beyond the scope of this course to teach welding. However students should be familiar with basic techniques for minor repairs.

CTS Guide Reference: CTS 3-3 / CTS 3-6 / CTS 3-8 / CTS 3-11

Unit 4: Inspection, Maintenance, and Repair

Topic 4-1: Crew and Passenger Compartments

Terminal Learning Objective
At the end of this topic, a student, given an emergency response vehicle (with a cab tilt system) and its assigned equipment, SOPs, manufacturer specifications, an inspection checklist (or assignment), a maintenance checklist, a maintenance schedule (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 crew and passenger compartments and related components so that the operation and condition of the crew and passenger compartments and related components are verified, or preserved and restored, to be within manufacturer specifications; the condition of finishes, signs, labels, and paint is determined and documented; climate control systems are tested for proper operation; the tilt mechanism is readied safe; the structural integrity is assessed; skid-resistant walking surfaces are intact; finishes and surfaces are
clean and preserved; warning system components function; all hoses are tight; leaks are stopped; latches are aligned and adjusted to operational condition; fluids are checked and filled; any electrical connections are clean and tight; worn pads are replaced; skid-resistant walking surfaces are intact; finishes and surfaces are clean and preserved; components are fabricated, adjusted, aligned, and lubricated; all checklist items are inspected; additional repair needs are reported; defective components are diagnosed; defects and deficiencies, including broken, loose, worn, or missing parts, are identified and reported and then repaired, rebuilt, or replaced to manufacturer specifications; operational tests are conducted and performance is verified; hazardous conditions are avoided or resolved; and inspections, activities, 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 crew and passenger compartments and related components
2. Describe the inspection, diagnostic, maintenance, and repair procedures of the manufacturer and the authority having jurisdiction
3. Describe how to select test, calibration, and diagnostic equipment
4. Identify materials used in crew and passenger compartments and related components
5. Identify and describe types of fluids and lubricants
6. Identify failures and restoration of finishes, signs, labels, and paint
7. Identify leak classifications and methods to stop them
8. Describe troubleshooting procedures
9. Describe adjustment, calibration, and alignment methods and procedures
10. Identify personnel safety restraint systems that may present hazards during cab repair
11. Describe principles of pneumatic, hydraulic, and electric operation
12. Describe repair, rebuild, and replacement procedures
13. Identify required verification testing
14. Identify inspection, maintenance, and repair record-keeping requirements
15. Recognize and identify symptoms and conditions of crew and passenger compartments and related components
16. Use test, calibration, and diagnostic equipment
17. Determine defects, deficiencies, and potential problems
18. Recognize, identify, and evaluate reported conditions
19. Perform all required maintenance (including checklist items) to resolve deficiencies
20. Mitigate personnel safety restraint system hazards
21. Apply paint and finish materials
22. Perform all required repairs to resolve deficiencies
23. Perform operational and verification tests
24. Complete inspection, maintenance, and repair checklists and documentation

Discussion Questions
1. What can cause an out of service seat belt?

Activities
1. Determined by instructor
Instructor Notes

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

CTS Guide Reference: CTS 3-3 / CTS 3-1 / CTS 3-2 / CTS 3-11

Topic 4-2: Cab Mounting System

Terminal Learning Objective
At the end of this topic, a student, given an emergency response vehicle (with a cab tilt system) and its assigned equipment, SOPs, manufacturer specifications, an inspection checklist (or assignment), a maintenance checklist, a maintenance schedule (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 cab mounting system and related components so that the operation and condition of the cab mounting system and related components are verified, or preserved and restored, to be within manufacturer specifications; the condition of finishes, signs, labels, and paint is determined and documented; climate control systems are tested for proper operation; the tilt mechanism is readied safe; the structural integrity is assessed; skid-resistant walking surfaces are intact; finishes and surfaces are clean and preserved; warning system components function; all hoses are tight; leaks are stopped; latches are aligned and adjusted to operational condition; fluids are checked and filled; any electrical connections are clean and tight; worn pads are replaced; skid-resistant walking surfaces are intact; finishes and surfaces are clean and preserved; components are fabricated, adjusted, aligned, and lubricated; all checklist items are inspected; additional repair needs are reported; defective components are diagnosed; defects and deficiencies, including broken, loose, worn, or missing parts, are identified and reported and then repaired, rebuilt, or replaced to manufacturer specifications; operational tests are conducted and performance is verified; hazardous conditions are avoided or resolved; and inspections, activities, 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 cab mounting system and related components
2. Describe the inspection, diagnostic, maintenance, and repair procedures of the manufacturer and the authority having jurisdiction
3. Describe how to select test, calibration, and diagnostic equipment
4. Identify materials used in cab mounting system and related components
5. Identify and describe types of fluids and lubricants
6. Identify failures and restoration of finishes, signs, labels, and paint
7. Identify leak classifications and methods to stop them
8. Describe troubleshooting procedures
9. Describe adjustment, calibration, and alignment methods and procedures
10. Identify personnel safety restraint systems that may present hazards during cab repair
11. Describe principles of pneumatic, hydraulic, and electric operation
12. Describe repair, rebuild, and replacement procedures
13. Identify required verification testing
14. Identify inspection, maintenance, and repair record-keeping requirements
15. Recognize and identify symptoms and conditions of cab mounting system and related components
16. Use test, calibration, and diagnostic equipment
17. Determine defects, deficiencies, and potential problems
18. Recognize, identify, and evaluate reported conditions
19. Perform all required maintenance (including checklist items) to resolve deficiencies
20. Mitigate personnel safety restraint system hazards
21. Apply paint and finish materials
22. Perform all required repairs to resolve deficiencies
23. Perform operational and verification tests
24. Complete inspection, maintenance, and repair checklists and documentation

Discussion Questions
1. What might cause worn cab bushings?
2. Does fluid type matter?

Activities
1. Determined by instructor
2. Throughout hands-on lecture in the shop, utilize students to inspect the cab mounting system, identify maintenance requirements, and recommend potential repairs.

CTS Guide Reference: CTS 3-3 / CTS 3-4 / CTS 3-5 / CTS 3-6

Topic 4-3: Equipment Mounting Systems

Terminal Learning Objective
At the end of this topic, a student, given an emergency response vehicle (with a cab tilt system) and its assigned equipment, SOPs, manufacturer specifications, an inspection checklist (or assignment), a maintenance checklist, a maintenance schedule (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 equipment mounting systems and related components so that the operation and condition of the equipment mounting systems and related components are verified, or preserved and restored, to be within manufacturer specifications; the condition of finishes, signs, labels, and paint is determined and documented; the tilt mechanism is readied safe; the structural integrity is assessed; skid-resistant walking surfaces are intact; finishes and surfaces are clean and preserved; warning system components function; all hoses are tight; leaks are stopped; latches are aligned and adjusted to operational condition; fluids are checked and filled; any electrical connections are clean and tight; worn pads are replaced; skid-resistant walking surfaces are intact; finishes and surfaces are clean and preserved; components are fabricated, adjusted, aligned, and lubricated; all checklist items are
inspected; additional repair needs are reported; defective components are diagnosed; defects and deficiencies, including broken, loose, worn, or missing parts, are identified and reported and then repaired, rebuilt, or replaced to manufacturer specifications; operational tests are conducted and performance is verified; hazardous conditions are avoided or resolved; and inspections, activities, 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 equipment mounting system and related components
2. Describe the inspection, diagnostic, maintenance, and repair procedures of the manufacturer and the authority having jurisdiction
3. Describe how to select test, calibration, and diagnostic equipment
4. Identify materials used in equipment mounting system and related components
5. Identify and describe types of fluids and lubricants
6. Identify failures and restoration of finishes, signs, labels, and paint
7. Identify leak classifications and methods to stop them
8. Describe troubleshooting procedures
9. Describe adjustment, calibration, and alignment methods and procedures
10. Identify personnel safety restraint systems that may present hazards during cab repair
11. Describe principles of pneumatic, hydraulic, and electric operation
12. Describe repair, rebuild, and replacement procedures
13. Identify required verification testing
14. Identify inspection, maintenance, and repair record-keeping requirements
15. Recognize and identify symptoms and conditions of equipment mounting system and related components
16. Use test, calibration, and diagnostic equipment
17. Determine defects, deficiencies, and potential problems
18. Recognize, identify, and evaluate reported conditions
19. Perform all required maintenance (including checklist items) to resolve deficiencies
20. Mitigate personnel safety restraint system hazards
21. Apply paint and finish materials
22. Perform all required repairs to resolve deficiencies
23. Perform operational and verification tests
24. Complete inspection, maintenance, and repair checklists and documentation

**Discussion Questions**

1. Should broken equipment supports be fixed?
2. What are some different classes of leaks?

**Activities**

1. Determined by instructor

**Instructor Notes**

1. Throughout hands-on lecture in the shop, utilize students to inspect the equipment mounting systems, identify maintenance requirements, and recommend potential repairs.
CTS Guide Reference: CTS 3-3 / CTS 3-4 / CTS 3-5 / CTS 3-6

**Topic 4-4: Cab Tilting Systems**

**Terminal Learning Objective**
At the end of this topic, a student, given an emergency response vehicle (with a cab tilt system) and its assigned equipment, SOPs, manufacturer specifications, an inspection checklist (or assignment), a maintenance checklist, a maintenance schedule (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 cab tilting systems and related components so that the operation and condition of the cab tilting systems and related components are verified, or preserved and restored, to be within manufacturer specifications; the condition of finishes, signs, labels, and paint is determined and documented; the tilt mechanism is readied safe; the structural integrity is assessed; skid-resistant walking surfaces are intact; finishes and surfaces are clean and preserved; warning system components function; all hoses are tight; leaks are stopped; latches are aligned and adjusted to operational condition; fluids are checked and filled; any electrical connections are clean and tight; worn pads are replaced; skid-resistant walking surfaces are intact; finishes and surfaces are clean and preserved; components are fabricated, adjusted, aligned, and lubricated; all checklist items are inspected; additional repair needs are reported; defective components are diagnosed; defects and deficiencies, including broken, loose, worn, or missing parts, are identified and reported and then repaired, rebuilt, or replaced to manufacturer specifications; operational tests are conducted and performance is verified; hazardous conditions are avoided or resolved; and inspections, activities, 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 the cab tilting system and related components
2. Describe the inspection, diagnostic, maintenance, and repair procedures of the manufacturer and the authority having jurisdiction
3. Describe how to select test, calibration, and diagnostic equipment
4. Identify materials used in the cab tilting system and related components
5. Identify and describe types of fluids and lubricants
6. Identify failures and restoration of finishes, signs, labels, and paint
7. Identify leak classifications and methods to stop them
8. Describe troubleshooting procedures
9. Describe adjustment, calibration, and alignment methods and procedures
10. Identify personnel safety restraint systems that may present hazards during cab repair
11. Describe principles of pneumatic, hydraulic, and electric operation
12. Describe repair, rebuild, and replacement procedures
13. Identify required verification testing
14. Identify inspection, maintenance, and repair record-keeping requirements
15. Recognize and identify symptoms and conditions of the cab tilting system and related components
16. Use test, calibration, and diagnostic equipment
17. Determine defects, deficiencies, and potential problems
18. Recognize, identify, and evaluate reported conditions
19. Perform all required maintenance (including checklist items) to resolve deficiencies
20. Mitigate personnel safety restraint system hazards
21. Apply paint and finish materials
22. Perform all required repairs to resolve deficiencies
23. Perform operational and verification tests
24. Complete inspection, maintenance, and repair checklists and documentation

Discussion Questions
1. How are an electric cab tilt system and a hydraulic cab tilt system different?
   - How are they similar?
2. Is a “locked” indicator required?

Activities
1. Determined by instructor

Instructor Notes
1. Throughout hands-on lecture in the shop, utilize students to inspect the cab tilting systems, identify maintenance requirements, and recommend potential repairs.

CTS Guide Reference: CTS 3-7 / CTS 3-8

Topic 4-5: Body and Compartmentation

Terminal Learning Objective
At the end of this topic, a student, given an emergency response vehicle (with a cab tilt system) and its assigned equipment, SOPs, manufacturer specifications, an inspection checklist (or assignment), a maintenance checklist, a maintenance schedule (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 body and compartmentation and related components so that the operation and condition of the body and compartmentation and related components are verified, or preserved and restored, to be within manufacturer specifications; the condition of finishes, signs, labels, and paint is determined and documented; climate control systems are tested for proper operation; the tilt mechanism is readied safe; the structural integrity is assessed; skid-resistant walking surfaces are intact; finishes and surfaces are clean and preserved; warning system components function; all hoses are tight; leaks are stopped; latches are aligned and adjusted to operational condition; fluids are checked and filled; any electrical connections are clean and tight; worn pads are replaced; skid-resistant walking surfaces are intact; finishes and surfaces are clean and preserved; components are fabricated, adjusted, aligned, and lubricated; all checklist items are inspected; additional repair needs are reported; defective components are diagnosed; defects and deficiencies, including broken, loose, worn, or missing parts, are identified and reported and then repaired, rebuilt, or
replaced to manufacturer specifications; operational tests are conducted and performance is verified; hazardous conditions are avoided or resolved; and inspections, activities, 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 the body and compartmentation and related components
2. Describe the inspection, diagnostic, maintenance, and repair procedures of the manufacturer and the authority having jurisdiction
3. Describe how to select test, calibration, and diagnostic equipment
4. Identify materials used in the body and compartmentation and related components
5. Identify and describe types of fluids and lubricants
6. Identify failures and restoration of finishes, signs, labels, and paint
7. Identify leak classifications and methods to stop them
8. Describe troubleshooting procedures
9. Describe adjustment, calibration, and alignment methods and procedures
10. Identify personnel safety restraint systems that may present hazards during cab repair
11. Describe principles of pneumatic, hydraulic, and electric operation
12. Describe repair, rebuild, and replacement procedures
13. Identify required verification testing
14. Identify inspection, maintenance, and repair record-keeping requirements
15. Recognize and identify symptoms and conditions of the body and compartmentation and related components
16. Use test, calibration, and diagnostic equipment
17. Determine defects, deficiencies, and potential problems
18. Recognize, identify, and evaluate reported conditions
19. Perform all required maintenance (including checklist items) to resolve deficiencies
20. Mitigate personnel safety restraint system hazards
21. Apply paint and finish materials
22. Perform all required repairs to resolve deficiencies
23. Perform operational and verification tests
24. Complete inspection, maintenance, and repair checklists and documentation

**Discussion Questions**
1. Are loose mountings a concern?
2. Will “cosmetic damage” put a unit out of service?

**Activities**
1. Determined by instructor

**Instructor Notes**
1. Throughout hands-on lecture in the shop, utilize students to inspect the body and compartmentation, identify maintenance requirements, and recommend potential repairs.

**CTS Guide Reference:** CTS 3-1 / CTS 3-2 / CTS 3-3 / CTS 3-9 / CTS 3-10 / CTS 3-11
## Time Table

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<th>Total Unit Time</th>
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<td>Topic 1-1: Orientation and Administration</td>
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<td>Topic 1-2: Emergency Vehicle Technician Certification Process</td>
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<td><strong>Unit 2: Overview</strong></td>
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<td><strong>Unit 3: Cab and Body Systems and Components</strong></td>
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<td>Topic 4-2: Cab Mounting System</td>
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### Segment Table

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- **Total Activity Time (AT)**: 0:00
- **Total Testing Time (TT)**: 1:00
- **Total Course Time**: 12:00
Course Details

Certification: Emergency Vehicle Technician I
CTS Guide: Emergency Vehicle Technician [(Month Year)]
Description: This course provides an overview of the knowledge and skills needed to inspect and maintain low-voltage electrical systems in emergency vehicles.

Designed For: The emergency vehicle technicians pursuing SFT certification or anyone seeking an overview of low-voltage electrical systems.

Prerequisites: [Short Course Title]: Emergency Vehicle Technician 101

Standard: Complete all activities and formative tests.
Complete all summative tests with a minimum score of 80%.

Hours:
Lecture: 26:00
Activities: 8:00
Testing: 2:00

Hours (Total): 36:00

Maximum Class Size: 20

Instructor Level: Primary

Instructor/Student Ratio: 1:20

Restrictions: Increasing class size requires an additional qualified instructor.

SFT Designation: CFSTES
**Required Resources**

**Instructor Resources**

To teach this course, instructors need:

- *Medium/Heavy Duty Truck Electricity and Electronics* (1st edition)
  - Classroom manual and shop manual
  - Author: Sulev Oun
  - One copy of each item per student + a personal copy for the instructor
- Student Supplement
  - Provided by California Fire Mechanics Academy, Inc.
- Personal protective equipment (PPE)
- Items from the tools and test, calibration, and diagnostic equipment listed in Topic 2-1, ELO 4 (as many as possible)

**Online Instructor Resources**

The following instructor resources are available online at [http://osfm.fire.ca.gov/training/SFTCurriculum](http://osfm.fire.ca.gov/training/SFTCurriculum):

- None

**Student Resources**

To participate in this course, students need:

- *Medium/Heavy Duty Truck Electricity and Electronics* (1st edition)
  - Classroom manual and shop manual
  - Author: Sulev Oun
  - Provided by instructor for in-class use
- Student Supplement
  - Provided by California Fire Mechanics Academy, Inc.
- Personal protective equipment (PPE)
- Digital multimeter (DVOM)
  - Student must bring to class

**Facilities, Equipment, and Personnel**

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

**Facilities**

- Standard classroom equipped for 20 students
- Projector with appropriate laptop connections
• Wifi/Internet access
• Outdoor space for emergency response vehicle with a clear perimeter for student activities

Equipment
• Emergency response vehicle
• One circuit training station per student that includes:
  o Battery/power supply (12 volt)
  o Lights (LED and incandescent)
  o Connectors
  o Wires
  o Fuse
  o Fuse holder
  o Circuit breaker
  o Switches
  o Relays
• Working alternator model
• Working starter model
• Fuse replacement ammeter
• Belt tension gauge
• Schematics
  o Digital or physical
  o Must correspond to an onsite emergency response vehicle
  o Five needed for Topic 2-1 activity
• Ammeter
  o Five needed for Topic 2-1 activity
• Baseline voltage checklist
  o Five needed for Topic 2-1 activity
• Solenoids
  o Intermittent and continuous duty
  o Five needed for Topic 2-1 activity
• Inspection checklist
  o Five copies for Topic 3-1 activity
• Service repair document
  o Five copies for Topic 3-1 activity
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 be able to describe the capstone task book and testing process.
Enabling Learning Objectives

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

2. Identify the courses required for EVT I
   - State Fire Training
     - [Short Course Title]: Emergency Vehicle Technician 101
     - [Short Course Title]: Electrical Systems A
     - [Short Course Title]: Chassis Systems and Components
     - [Short Course Title]: Cab and Body Systems and Components
     - [Short Course Title]: Pumps and Accessories
     - [Short Course Title]: Tanks and Accessories
   - National Institute for Auto Service Excellence (ASE)
     - Gasoline Engines (T1)
     - Drive Train (T3)
     - Brakes (T4)
     - Suspension and Steering (T5)
     - Preventative Maintenance Inspections (T8)

3. Identify the courses required for EVT II
   - State Fire Training
     - [Short Course Title]: Electrical Systems B
   - National Institute for Auto Service Excellence (ASE)
     - Diesel Engines (T2)
     - Electrical / Electronic Systems (T6)
     - Heating, Ventilation and Air Conditioning (HVAC) (T7)

4. Identify the courses required for EVT III
   - State Fire Training
     - [Short Course Title]: Fleet Specifications and Records
     - [Short Course Title]: Human Resource Management
   - National Institute for Auto Service Excellence (ASE)
     - See eight courses listed for EVT I and EVT II

5. Identify any other requirements for EVT I
   - Code of Federal Regulations (CFR) 396.25: Department of Transportation Brake Inspector Qualification
   - Experience (one of the following)
     - Have a minimum of two years’ full-time paid experience in a state or provincial fire agency, public agency, or private industry as an automotive or truck mechanic with minimum one year related to emergency vehicle maintenance
6. Describe the capstone task book process
   • Complete all prerequisites and course work
   • Submit application and fees and to request capstone task book
     o A candidate may apply for the EVT I and EVT II task books at the same time (two applications and two fees), but may not submit the EVT II task book until he or she receives EVT I certification (a prerequisite for EVT II)
   • Complete all job performance requirements included in the task book
   • Must have identified evaluator verify individual task completion via signature
   • Must have Fire Chief or authorized representative verify task book completion via signature
   • Must be employed by a California Fire Agency in the position prior to submitting completed task book to State Fire Training

7. Describe the capstone testing process
   • Emergency Vehicle Technician certification exams (EVT I, EVT II, and EVT III) are administered by an independent third-party testing agency

Discussion Questions
8. To be determined by the instructor

Activities
9. To be determined by the instructor

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

Unit 2: Inspection

Topic 2-1: Inspecting Low-voltage Electrical Systems

Terminal Learning Objective
At the end of this topic, a student, given an emergency response vehicle, SOPs, manufacturer specifications, tools, test, calibration, and diagnostic equipment, including a belt tension gauge and a digital multimeter (DVOM), schematics, an assignment, and an inspection checklist, will be able to inspect the low-voltage electrical system so that the mounting security is verified; operation and condition of the low-voltage electrical system is verified to be within manufacturer specifications; all checklist items are inspected; defects and deficiencies, including broken, loose, worn, or missing parts,
are identified and reported; and inspection and tests are documented in accordance with the procedures of the manufacturer and the authority having jurisdiction (AHJ)

**Enabling Learning Objectives**

1. Describe the principles of magnetism
   - Magnetic fields
   - Impacts of magnetic fields
2. Describe the principles of electricity
   - Kirchhoff’s laws
   - Watt’s law
   - Ohm’s law
   - Series and parallel circuits
3. Describe the principles of circuit analysis
   - Difference in potential (flowing vs. not flowing)
   - Application of Kirchhoff’s laws
   - Application of Ohm’s law
   - Application of Watt’s law
   - Parasitic drain
4. Describe how to select test, calibration, and diagnostic equipment
   - Digital voltmeter (DVOM)
   - Ammeter
     - Inductive
       - Low amperage (< 100 A)
       - High amperage (<= 1,000 A)
     - Series
       - Shunt or direct wire
       - Fuse replacement ammeter
   - Battery testers
     - Carbon pile
     - Conductance / battery impedance testers
   - Power probes / powered test lights
     - Benefits
       - Ability to power a device
       - Ease of use
     - Problems
       - Excess voltage to computer circuits
       - Piercing
   - Test lights
     - Benefits
       - Ease of use
       - Very fast
     - Problems
       - Overloading sensitive electronics
5. Use test, calibration, and diagnostic equipment

6. Describe the function, construction, operation, and requirements of starting systems
   - Starter converts electrical energy into mechanical energy to start the engine
   - Starter must meet engine manufacturer performance standard
7. Describe the function, construction, operation, and requirements of charging systems
   - Alternator converts mechanical energy into electrical energy
   - Alternator (and all associated systems) must meet vehicle requirements
8. Describe the function, construction, operation, and requirements of chassis electrical components
   - Components include relays, solenoids (intermittent vs. continuous duty), wiring, modules, nodes, sensors, circuit protection devices, power distribution modules
   - Chassis electrical components must meet electrical load requirements and manufacturer specifications
   - High-voltage safety concerns (i.e. injector drivers, hybrid vehicles)
9. Describe the function, construction, operation, and requirements of lighting systems (chassis, emergency, and accessory)
   - Components include relays, solenoids (intermittent vs. continuous duty), wiring, modules, nodes, sensors, circuit protection devices, power distribution modules, controls
   - Lighting system components must meet electrical load requirements and manufacturer specifications
   - High-voltage safety concerns
     - Strobe lights
     - High-intensity discharge (HID)
10. List types of defects, deficiencies, and potential problems associated with low-voltage electrical systems
    - Open circuit
    - Short to power
    - Short to ground
    - Cross short
    - Excessive resistance
11. Determine defects and deficiencies
    - Troubleshooting
    - Design deficiencies
12. Describe how to read and interpret schematics
    - Basic schematic symbols
    - Manufacturer-specific schematic symbols
    - As-built schematics (per vehicle)
13. Read and interpret schematics
14. Identify mounting and adjustment requirements
15. Recognize and identify potential failure symptoms and conditions of low-voltage electrical systems
    - Hard or noisy starting
    - Smoke (sight or smell)
    - Excess heat (on contact or evidenced by melting, warping, discolor, etc.)
• Improper charging (too high or too low)
• Failure to function
• Onboard instrumentation readings outside parameters
• Operator error
• Arcing and sparking

16. Describe the inspection procedures of the manufacturer and the AHJ
   • Gather tools and safety equipment
   • Secure vehicle in a safe environment
   • Set parking brake
   • Place wheel chocks
   • Inspect low-voltage electrical system
     o Recognize and identify symptoms and conditions
     o Determine defects, deficiencies, and potential problems
     o Determine impact if not corrected
   • Complete manufacturer and AHJ inspection checklist
   • Perform operational tests
   • Complete checklist and inspection documentation
   • Release vehicle for in-service use or maintenance/repair

17. Recognize and identify symptoms and conditions
18. Determine defects, deficiencies, and potential problems
19. Perform operational tests
20. Identify record-keeping requirements
21. Complete checklist and inspection documentation

Discussion Questions
1. What do you know about voltage drop?
   • What are some causes of voltage drop?
   • What impact does voltage drop have on a circuit (or vehicle)?
   • What is an acceptable voltage drop level?
2. What problems can using the wrong test equipment create?
3. Where in the electrical system do you need to address high-voltage safety concerns?
   • What are those concerns?

Activities
1. Given an emergency apparatus and its corresponding electrical schematic, have students:
   • Identify and describe at least one circuit on the apparatus and its component relationships on the schematic
   • Select a component or device on the apparatus and locate it on the schematic
2. Given an emergency apparatus, a voltmeter, and an inductive ammeter, have students:
   • Determine proper charging system voltage and amperage
   • Measure power side and ground side voltage drops and document results
3. Given a baseline checklist, have students:
   • Compare baseline checklist data with Activity 2 data
• Diagnose and document any potential problems
4. Given solenoids, have students:
  • Determine whether they are intermittent or continuous duty
  • Describe the mounting position of the solenoids

Instructor Notes
1. ELO 4: Use ELO 4 as a way to demonstrate the laws taught in ELO 2 and 3.
2. ELO 4: All items must be covered. Demonstrate as many as possible, bringing the equipment to the class.
3. ELO 5: Teach students when and how to use the equipment identified in ELO 4.

CTS Guide Reference: CTS 4-1

Unit 3: Maintenance

Topic 3-1: Maintaining Low-voltage Electrical Systems

Terminal Learning Objective
At the end of this topic, a student, given an emergency response vehicle, manufacturer specifications, a maintenance schedule or assignment, a maintenance checklist, SOPs, test, calibration, and diagnostic equipment, and tools, will be able to perform maintenance on the low-voltage electrical system so that deformed, broken, loose, worn, or missing parts are repaired or replaced; the operational condition is preserved or restored; calibration and adjustments are performed; activities are documented; and additional repair needs are reported.

Enabling Learning Objectives
1. Describe troubleshooting and adjustment methods and procedures
   • Dead battery
     o Replace
     o Charge
   • Corrosion
     o Clean
     o Correct cause (if possible)
     o Recoat or repaint (if necessary)
   • Faulty connections
     o Clean
     o Tighten
     o Rewire
     o Replace
   • Low or high voltage
     o Adjust
     o Replace
     o Rebuild
     o Send for repair
   • Deformed, broken, loose, worn, missing, or failed components
Discussion Questions
1. What tools and information are needed to perform a proper alternator output test?
2. What are the advantages and disadvantages of using the following circuit protection devices:
   - Fuses
   - Fusible links
   - Circuit breakers
   - PTC (positive temperature coefficient)
3. What would you do if:
   - One headlight is dimmer than the other?
   - The starter cranks slowly?
   - There is no power at all?

Activities
1. Given an inspection document, have students working in groups of up to four:
   - Evaluate reported conditions and identify the problem
   - Develop and document a maintenance plan
   - Complete repairs or correct deficiencies
   - Perform operational test of the circuit
   - Complete required documentation

Instructor Notes
1. Bring as many different pieces of test, calibration, and diagnostic equipment as possible for students to manipulate in class
2. For Activity 1, create sample scenarios for the students to resolve or have them use the inspection checklist issues identified in Topic 2-1: Activity 3

CTS Guide Reference: CTS 4-2
### Time Table

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<tr>
<td><strong>Total Course Time</strong></td>
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Pumps and Accessories

Course Plan

Course Details

Certification: Emergency Vehicle Technician I
CTS Guide: Emergency Vehicle Technician [(Month Year)]
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: [Short Course Title]: Emergency Vehicle Technician 101

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 http://osfm.fire.ca.gov/training/SFTCurriculum:

- None

Student Resources
To participate in this course, students need:

- 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
• 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 be able to describe the capstone task book and testing process.
Enabling Learning Objectives

2. Identify the different levels of certification in the Emergency Vehicle Technician (EVT) certification track
   - EVT I
   - EVT II
   - EVT III

3. Identify the courses required for EVT I
   - State Fire Training
     - [Short Course Title]: Emergency Vehicle Technician 101
     - [Short Course Title]: Electrical Systems A
     - [Short Course Title]: Chassis Systems and Components
     - [Short Course Title]: Cab and Body Systems and Components
     - [Short Course Title]: Pumps and Accessories
     - [Short Course Title]: Tanks and Accessories
   - National Institute for Auto Service Excellence (ASE)
     - Gasoline Engines (T1)
     - Drive Train (T3)
     - Brakes (T4)
     - Suspension and Steering (T5)
     - Preventative Maintenance Inspections (T8)

4. Identify the courses required for EVT II
   - State Fire Training
     - [Short Course Title]: Electrical Systems B
   - National Institute for Auto Service Excellence (ASE)
     - Diesel Engines (T2)
     - Electrical / Electronic Systems (T6)
     - Heating, Ventilation and Air Conditioning (HVAC) (T7)

5. Identify the courses required for EVT III
   - State Fire Training
     - [Short Course Title]: Fleet Specifications and Records
     - [Short Course Title]: Human Resource Management
   - National Institute for Auto Service Excellence (ASE)
     - See eight courses listed for EVT I and EVT II

6. Identify any other requirements for EVT I
   - Code of Federal Regulations (CFR) 396.25: Department of Transportation Brake Inspector Qualification
   - Experience (one of the following)
     - Have a minimum of two years’ full-time paid experience in a state or provincial fire agency, public agency, or private industry as an automotive or truck mechanic with minimum one year related to emergency vehicle maintenance
o Have a minimum of three years’ full-time paid experience in a state or provincial fire agency, public agency, or private industry as a mechanic (no fire apparatus required)
o Have a minimum of four years’ volunteer or paid part-time experience in a state or provincial fire agency where emergency vehicle apparatus service and maintenance is part of assigned duties

7. Describe the capstone task book process
   • Complete all prerequisites and course work
   • Submit application and fees and to request capstone task book
     o A candidate may apply for the EVT I and EVT II task books at the same time (two applications and two fees), but may not submit the EVT II task book until he or she receives EVT I certification (a prerequisite for EVT II)
   • Complete all job performance requirements included in the task book
   • Must have identified evaluator verify individual task completion via signature
   • Must have Fire Chief or authorized representative verify task book completion via signature
   • Must be employed by a California Fire Agency in the position prior to submitting completed task book to State Fire Training

8. Describe the capstone testing process
   • Emergency Vehicle Technician certification exams (EVT I, EVT II, and EVT III) are administered by an independent third-party testing agency

Discussion Questions
1. To be determined by the instructor

Activities
1. To be determined by the instructor

Instructor Notes
1. SFT teaches most EVT I (inspect and maintain) and EVT II (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, and testing 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
   • Required tools/equipment
     o Test, calibration, and diagnostic
       ▪ Pitot gauge
       ▪ Flowmeter
       ▪ External test vacuum
       ▪ External pressure gauge
     o Maintenance and repair

4. Describe the inspection process
   • Evaluate reported conditions (if applicable)
   • Perform operational tests
     o 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 tests
• 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 tests
• Repair or replace deformed, broken, loose, worn, or missing parts
• Conduct performance tests
• Complete checklist and document findings
• Release to manufacturer or third-party shop for repair (if applicable)
  o Acceptance testing (inspection) on returned/repaired vehicle
  o 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, SOPs, and manufacturer specifications, will be able to describe the
function, construction, and operation of fire pumps, auxiliary pumps, primer pumps, and related components 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
     o Move by volume
     o 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)
     o Impeller
     o Volute
     o Cutwater
     o Clearance rings
     o Shaft
     o Bearings
     o Packing/seals
     o Housing/casing
     o Pump drive
       ▪ Hydraulic
       ▪ PTO (power take off unit)
       ▪ Crankshaft
       ▪ Midship
       ▪ Fly wheel
       ▪ Direct engine drive
         • Diesel
         • Gas
     o Single-stage pump
     o Multi-stage pump
       ▪ Transfer valve and controls
   • Auxiliary Pump
     o Impeller
     o Volute
     o Cutwater
     o Clearance rings
     o Shaft
     o Bearings
     o Packing/seals
     o Housing
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
  o Push/pull (manual) handle
  o Hydraulic
  o Pneumatic
  o Electric
  o Manual rotary/crank
• Pressure control devices
  o Internal and/or external relief valve
  o Engine governor
  o Controlled manually or electronically
• Valve operation
  o Manual
  o Air
  o Water
  o Electric
• Valve parts
  o Housing
  o Actuator
  o O-rings
  o Ball or butterfly/keystone
  o 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, 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, 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 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
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 tests
20. Perform hydraulic flow calculations
21. Complete inspection, maintenance, and repair checklists and 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, 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
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
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, 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, 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 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, 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 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?
2. 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, 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

**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, 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?

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, 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
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 different are the 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 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 is capable of meeting the performance requirements of the original certification test 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 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 testing pump test?

**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
# Time Table

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<td><strong>Unit 4: Testing</strong></td>
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**Course Totals**

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# Tanks and Accessories

## Course Plan

### Course Details

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<thead>
<tr>
<th>Certification:</th>
<th>Emergency Vehicle Technician I</th>
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<tbody>
<tr>
<td>CTS Guide:</td>
<td>Emergency Vehicle Technician [(Month Year)]</td>
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<tr>
<td>Description:</td>
<td>This course provides an overview of the knowledge and skills utilized by an emergency vehicle technician to inspect, maintain, and repair tanks and their accessories.</td>
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<tr>
<td>Designed For:</td>
<td>The emergency vehicle technician pursuing SFT-certification or anyone seeking an overview of how to inspect, maintain, and tanks and their accessories</td>
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<tr>
<td>Prerequisites:</td>
<td>[Short Course Title]: Emergency Vehicle Technician 101</td>
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<tr>
<td>Standard:</td>
<td>Complete all labs, activities, and formative tests. Complete all summative tests with a minimum score of 80%.</td>
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| Hours:         | Lecture: 7:30  
Activities: 0:00  
Testing: 0:30 |
| Hours (Total): | 8:00 |
| 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 Mechanics Academy, Inc.
- Personal protective equipment (PPE)

Online Instructor Resources

The following instructor resources are available online at http://osfm.fire.ca.gov/training/SFTCurriculum:

- None

Student Resources

To participate in this course, students need:

- Access to NFPA 1911: Inspection, Maintenance, Testing, and Retirement of In-Service Automotive Fire Apparatus (current edition)
- Student Supplement
  - Provided by California Fire Mechanics 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

Equipment

- Emergency response vehicle with a tank or an apparatus
- 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 be able to describe the capstone task book and testing process.
Enabling Learning Objectives

1. Identify the different levels of certification in the Emergency Vehicle Technician (EVT) certification track
   - EVT I
   - EVT II
   - EVT III
2. Identify the courses required for EVT I
   - State Fire Training
     - [Short Course Title]: Emergency Vehicle Technician 101
     - [Short Course Title]: Electrical Systems A
     - [Short Course Title]: Chassis Systems and Components
     - [Short Course Title]: Cab and Body Systems and Components
     - [Short Course Title]: Pumps and Accessories
     - [Short Course Title]: Tanks and Accessories
     - National Institute for Auto Service Excellence (ASE)
       - Gasoline Engines (T1)
       - Drive Train (T3)
       - Brakes (T4)
       - Suspension and Steering (T5)
       - Preventative Maintenance Inspections (T8)
3. Identify the courses required for EVT II
   - State Fire Training
     - [Short Course Title]: Electrical Systems B
   - National Institute for Auto Service Excellence (ASE)
     - Diesel Engines (T2)
     - Electrical / Electronic Systems (T6)
     - Heating, Ventilation and Air Conditioning (HVAC) (T7)
4. Identify the courses required for EVT III
   - State Fire Training
     - [Short Course Title]: Fleet Specifications and Records
     - [Short Course Title]: Human Resource Management
   - National Institute for Auto Service Excellence (ASE)
     - See eight courses listed for EVT I and EVT II
5. Identify any other requirements for EVT I
   - Code of Federal Regulations (CFR) 396.25: Department of Transportation Brake Inspector Qualification
   - Experience (one of the following)
     - Have a minimum of two years’ full-time paid experience in a state or provincial fire agency, public agency, or private industry as an automotive or truck mechanic with minimum one year related to emergency vehicle maintenance
6. Describe the capstone task book process
   - Complete all prerequisites and course work
   - Submit application and fees and to request capstone task book
     - A candidate may apply for the EVT I and EVT II task books at the same time (two applications and two fees), but may not submit the EVT II task book until he or she receives EVT I certification (a prerequisite for EVT II)
   - Complete all job performance requirements included in the task book
   - Must have identified evaluator verify individual task completion via signature
   - Must have Fire Chief or authorized representative verify task book completion via signature
   - Must be employed by a California Fire Agency in the position prior to submitting completed task book to State Fire Training

7. Describe the capstone testing process
   - Emergency Vehicle Technician certification exams (EVT I, EVT II, and EVT III) are administered by an independent third-party testing agency

Discussion Questions
1. To be determined by the instructor

Activities
1. To be determined by the instructor

Instructor Notes
1. SFT teaches most EVT I (inspect and maintain) and EVT II (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. Determined by instructor

Activities
1. Determined by 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, and testing 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
   - Required tools/equipment
     - Test, calibration, and diagnostic
     - Maintenance and repair

4. Describe the inspection process
   - Evaluate reported conditions (if applicable)
   - Perform operational tests
     - 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 tests
• 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 tests
• Repair or replace deformed, broken, loose, worn, or missing parts
• Conduct performance tests
• Complete checklist and document findings
• Release to manufacturer or third-party shop for repair (if applicable)
  o Acceptance testing (inspection) on returned/repaired vehicle
  o Complete checklist and document findings
• Return vehicle to service

Discussion Questions
1. Determined by instructor

Activities
1. Determined by instructor

CTS Guide Reference: None

Unit 3: Inspection and Repair

Topic 3-1: Function, Construction, Operation, and Mounting

Terminal Learning Objective
At the end of this topic, a student, given an emergency response vehicle with a water, foam, or agent tank, SOPs, and manufacturer specifications, will be able to describe the function, construction, operation, and mounting of water, foam, and agent tanks and related components in accordance with manufacturer specifications and the authority having jurisdiction (AHJ) requirements

Enabling Learning Objectives
1. Describe the function, construction, operation, and mounting of water tanks
2. Describe the function, construction, operation, and mounting of foam tanks
3. Describe the function, construction, operation, and mounting of agent tanks

Discussion Questions
1. Is “foam” required on an apparatus?
2. What is the minimum foam tank size?

Activities
1. Determined by instructor
CTS Guide Reference: CTS 5-4 / CTS 5-5

Topic 3-2: Water and Foam Tanks

Terminal Learning Objective

At the end of this topic, a student, given an emergency response vehicle with a water, foam, or agent tank, manufacturer specifications, SOPS, an inspection 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 repairs on water and foam tanks so that the mounting and condition of the tank is verified; all coated and non-coated interior and exterior surfaces are free of corrosion; sacrificial anodes are evaluated for life-cycle condition and replaced if necessary; the tank is flushed; all checklist items are inspected; leaks are repaired; coatings are renewed; and defects and deficiencies, including deformed, broken, loose, worn, or missing parts, are identified and reported, and repaired, replaced, or rebuilt to manufacturer specifications; service flow test of the tank(s) is conducted; 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. Describe types of materials used in water and foam tanks
2. Identify types of defects, deficiencies, and potential problems associated with water and foam tanks and related components
   - Corrosion
   - Rust, oxidation, electrolysis
   - Warping
   - Leaks
   - Cracks, fractures, breaks
   - Incompatible foam combinations
   - Loose, broken, worn, or missing components
3. Describe the inspection, diagnostic, and repair procedures of the manufacturer and the authority having jurisdiction
4. Describe how to select test, calibration, and diagnostic equipment
5. Describe testing procedures
   - Component must meet manufacturer, AHJ, and NFPA specifications (if applicable) to be considered operational
6. Describe specialized pressure systems
7. Identify flushing procedures
8. Describe sacrificial anode replacement procedures and schedules
9. Identify flow requirements
10. Describe cleaning and coating procedures
11. Describe principles of welding and fabrication
12. Describe troubleshooting procedures
13. Identify record-keeping requirements
14. Recognize and identify the effects of corrosion by different types of water and foam on selected tank materials
15. Determine defects and deficiencies
16. Recognize, evaluate, and identify reported conditions of water and foam tanks and related components
17. Use test, calibration, and diagnostic equipment
18. Perform required repairs to resolve deficiencies
19. Perform operational and service flow tests
20. Complete inspection and repair checklists and documentation

**Discussion Questions**
1. Do you have to have OEM (original equipment manufacturer) parts to warranty a tank?
2. Are tank baffles required?

**Activities**
1. Determined by instructor

**Instructor Notes**
1. Throughout hands-on lecture in the shop, utilize students to inspect the water or foam tank, identify maintenance requirements, and recommend potential repairs.

**CTS Guide Reference**: CTS 5-4 / CTS 5-5

**Topic 3-3: Agent Tanks**

**Terminal Learning Objective**
At the end of this topic, a student, given an emergency response vehicle with a water, foam, or agent tank, manufacturer specifications, SOPS, an inspection 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 repairs on agent tanks so that the mounting and condition of the tank is verified; all coated and non-coated interior and exterior surfaces are free of corrosion; sacrificial anodes are evaluated for life-cycle condition and replaced if necessary; the tank is flushed; all checklist items are inspected; leaks are repaired; coatings are renewed; and defects and deficiencies, including deformed, broken, loose, worn, or missing parts, are identified and reported, and repaired, replaced, or rebuilt to manufacturer specifications; service flow test of the tank(s) is conducted; 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. Describe types of materials used in water/foam/agent tanks
2. Identify types of defects, deficiencies, and potential problems associated with agent tanks and related components
   - Corrosion
   - Rust, oxidation, electrolysis
   - Warping
   - Leaks
   - Cracks, fractures, breaks
• Pressure vessel requirements
• Loose, broken, worn, or missing components
3. Describe the inspection, diagnostic, and repair procedures of the manufacturer and the authority having jurisdiction
4. Describe how to select test, calibration, and diagnostic equipment
5. Describe testing procedures
   • Component must meet manufacturer, AHJ, and NFPA specifications (if applicable) to be considered operational
6. Describe specialized pressure systems
7. Identify flushing procedures
8. Identify flow requirements
9. Describe cleaning and coating procedures
10. Describe principles of welding and fabrication
11. Describe troubleshooting procedures
12. Identify record-keeping requirements
13. Recognize and identify the effects of corrosion by different types of agents on selected tank materials
14. Determine defects and deficiencies
15. Recognize, evaluate, and identify reported conditions of agent tanks and related components
16. Use test, calibration, and diagnostic equipment
17. Perform required repairs to resolve deficiencies
18. Perform operational and service flow tests
19. Complete inspection and repair checklists and documentation

Discussion Questions
1. What are the requirements of a pressure vessel test?

Activities
1. Determined by instructor

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

CTS Guide Reference: CTS 5-4 / CTS 5-5
# Time Table

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<th>Segment</th>
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<td><strong>Unit 1: Introduction</strong></td>
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<td>Topic 1-1: Orientation and Administration</td>
<td>Lecture 0:30</td>
<td>Activity 1-1: Determined by instructor 0:00</td>
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<td>Topic 1-2: Emergency Vehicle Certification Process</td>
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<td><strong>Unit 2: Overview</strong></td>
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<td>Topic 2-1: Terminology</td>
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## Course Totals

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<td>Total Course Time</td>
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</table>

**[Short Course Title]**

[Month Year]
Electrical Systems B
Course Plan

Course Details

Certification: Emergency Vehicle Technician II

CTS Guide: Emergency Vehicle Technician [([Month Year])]

Description: This course provides an overview of the knowledge and skills needed to repair low-voltage electrical systems, and inspect, maintain, and repair electronic controls and instrumentation in emergency vehicles

Designed For: The SFT-certified Emergency Vehicle Technician (EVT) I advancing to EVT II or anyone seeking an overview of electronic controls and instrumentation

Prerequisites: [Short Course Title]: Electrical Systems A

Standard: Complete all activities and formative tests.
Complete all summative tests with a minimum score of 80%.

Hours: Lecture: 19:00
Activities: 15:00
Testing: 2:00

Hours (Total): 36:00

Maximum Class Size: 20

Instructor Level: Primary

Instructor/Student Ratio: 1/20

Restrictions: Increasing class size requires an additional qualified instructor

SFT Designation: CFSTES
Instructor Resources

To teach this course, instructors need:

- *Medium/Heavy Duty Truck Electricity and Electronics* (1st edition)
  - Classroom manual and shop manual
  - Author: Sulev Oun
  - One copy of each item per student + a personal copy for the instructor

- Student Supplement
  - Provided by California Fire Mechanics Academy, Inc.
- Personal protective equipment (PPE)

Online Instructor Resources

The following instructor resources are available online at [http://osfm.fire.ca.gov/training/SFTCurriculum](http://osfm.fire.ca.gov/training/SFTCurriculum):

- Activity 2-2: Testing Electrical Systems and Electronic Controls

Student Resources

To participate in this course, students need:

- *Medium/Heavy Duty Truck Electricity and Electronics* (1st edition)
  - Classroom manual and shop manual
  - Author: Sulev Oun
  - Provided by instructor for in-class use

- Student Supplement
  - Provided by California Fire Mechanics Academy, Inc.
- Personal protective equipment (PPE)
  - Student must bring to class
- Digital multimeter (DVOM)
  - Student must bring to class

Facilities, Equipment, and Personnel

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

Facilities

- Standard classroom equipped for 20 students
- Projector with appropriate laptop connections
- Wifi/Internet access
- Outdoor space for emergency response vehicle with a clear perimeter for student activities
Equipment

- Emergency response vehicle
- Schematics
  - Digital or physical
  - Must correspond to an onsite emergency response vehicle
- Low-voltage electrical systems (test, calibration, and diagnostic equipment, and tools)
  - Digital voltmeter (DVOM)
  - Ammeter
  - Battery testers
  - Power probes / powered test lights
  - Test lights
  - Test leads
  - Digital storage oscilloscopes (DSO)
  - Scanners
  - Relay substitution device
  - Soldering equipment
  - Crimping equipment
  - Remote start switches
  - Remote power supplies
  - Wire strippers
- Electronic controls and instrumentation (test, calibration, and diagnostic equipment, and tools)
  - Working alternator model
  - Working starter model
  - Working multiplex model
- Activity 2-1
  - Four different solenoids (at least four sets of each)
    - DVOM
    - Power Probe™ or jumper test lead
- Activity 2-2: Testing Electrical Systems and Electronic Controls
  - DVOM
  - Ammeter
  - Fuse-resistance chart
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 be able to describe the capstone task book and testing process.
Enabling Learning Objectives

1. Identify the different levels of certification in the Emergency Vehicle Technician (EVT) certification track
   - EVT I
   - EVT II
   - EVT III
2. Identify the courses required for EVT I
   - State Fire Training
     - [Short Course Title]: Emergency Vehicle Technician 101
     - [Short Course Title]: Electrical Systems A
     - [Short Course Title]: Chassis Systems and Components
     - [Short Course Title]: Cab and Body Systems and Components
     - [Short Course Title]: Pumps and Accessories
     - [Short Course Title]: Tanks and Accessories
   - National Institute for Auto Service Excellence (ASE)
     - Gasoline Engines (T1)
     - Drive Train (T3)
     - Brakes (T4)
     - Suspension and Steering (T5)
     - Preventative Maintenance Inspections (T8)
3. Identify the courses required for EVT II
   - State Fire Training
     - [Short Course Title]: Electrical Systems B
   - National Institute for Auto Service Excellence (ASE)
     - Diesel Engines (T2)
     - Electrical / Electronic Systems (T6)
     - Heating, Ventilation and Air Conditioning (HVAC) (T7)
4. Identify the courses required for EVT III
   - State Fire Training
     - [Short Course Title]: Fleet Specifications and Records
     - [Short Course Title]: Human Resource Management
   - National Institute for Auto Service Excellence (ASE)
     - See eight courses listed for EVT I and EVT II
5. Identify any other requirements for EVT I
   - Code of Federal Regulations (CFR) 396.25: Department of Transportation Brake Inspector Qualification
   - Experience (one of the following)
     - Have a minimum of two years’ full-time paid experience in a state or provincial fire agency, public agency, or private industry as an automotive or truck mechanic with minimum one year related to emergency vehicle maintenance
6. Describe the capstone task book process
   • Complete all prerequisites and course work
   • Submit application and fees and to request capstone task book
     ○ A candidate may apply for the EVT I and EVT II task books at the same time (two applications and two fees), but may not submit the EVT II task book until he or she receives EVT I certification (a prerequisite for EVT II)
   • Complete all job performance requirements included in the task book
   • Must have identified evaluator verify individual task completion via signature
   • Must have Fire Chief or authorized representative verify task book completion via signature
   • Must be employed by a California Fire Agency in the position prior to submitting completed task book to State Fire Training

7. Describe the capstone testing process
   • Emergency Vehicle Technician certification exams (EVT I, EVT II, and EVT III) are administered by an independent third-party testing agency

Discussion Questions
1. To be determined by the instructor

Activities
1. To be determined by the instructor

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

Unit 2: Low-voltage Electrical Systems

Topic 2-1: Repairing Low-voltage Electrical Systems

Terminal Learning Objective
At the end of this topic, a student, given an emergency response vehicle, manufacturer specifications, an assignment or inspection report detailing a deficiency or deformation, SOPs, test, calibration, and diagnostic equipment, and tools, will be able to perform repairs on low-voltage electrical system components so that defective components are diagnosed; deformed, broken, loose, worn, or missing parts are repaired, replaced, or rebuilt to manufacturer specifications; charging systems, starting systems, lighting systems, electrical accessories, and other electrical systems are returned to operation; correct test equipment is used; hazards are avoided; correct parts are used; operational tests are conducted and
performance is verified; and repairs are documented in accordance with the procedures of the manufacturer and the authority having jurisdiction (AHJ)

Enabling Learning Objectives
1. Describe the theory of electricity
2. Describe the function, construction, and operation of starting motors, alternators, and accessory electric motors, relays, solenoids, and regulators
3. Describe repair and overhaul procedures
4. Describe operational, diagnostic, and performance tests
5. Describe adjustment and calibration procedures
6. Describe how to select test, calibration, and diagnostic equipment
7. Identify common defects
8. Describe electrical troubleshooting procedures
9. Identify record-keeping requirements
10. Describe the diagnostic and repair procedures of the manufacturer and the AHJ
11. Recognize, evaluate, and identify reported conditions
12. Perform required repairs to resolve deficiencies
13. Use test, calibration, and diagnostic equipment
14. Measure voltage, amperage, and resistance
15. Distinguish defects and deficiencies
16. Operate and test system
17. Perform electrical calculations
18. Complete required documentation

Discussion Questions
1. What type of electrical problems have you experienced with your fleet?
   • How did you resolve them?
2. What does a digital multimeter measure?
   • What does a DVOM not measure?
3. What high-voltage safety concerns must you address when working with electrical systems?
4. What is the difference between a relay and a solenoid?
   • How would you confirm whether you had an intermittent duty or continuous duty solenoid?

Activities
1. Given at least four different solenoids, a DVOM, and a Power Probe™ or jumper test lead, have students determine the following for each solenoid:
   • Is it good?
   • How would it work?
   • Is it intermittent duty or continuous duty?

Instructor Notes
1. Topic 2-1 is a review of [Short Course Title]: Electrical Systems A (units 2 and 3)

CTS Guide Reference: CTS 8-1

Topic 2-2: Testing Low-voltage Electrical Systems
Terminal Learning Objective
At the end of this topic, a student, given an emergency response vehicle, manufacturer specifications, SOPs, test, calibration, and diagnostic equipment, and tools, will be able to complete performance testing on low-voltage electrical system components including batteries, charging systems, starting systems, electrical loads, solenoids, and relay devices in accordance with NFPA 1911 so that components are tested to assure they are operating in accordance with manufacturer specifications and NFPA standards; performance tests are conducted to verify that repairs are completed; and all testing is documented in accordance with the procedures of the manufacturer and the authority having jurisdiction (AHJ)

Enabling Learning Objectives
1. Describe operational, diagnostic, and performance tests
2. Describe adjustment and calibration procedures
3. Describe how to select test, calibration, and diagnostic equipment
4. Describe how to test sensors, components, and systems
   • Chassis voltage systems
     o A relay system
     o A solenoid system
     o A lighting system
     o A starting system
     o A charging system
     o A DC motor system
     o A warning system
   • Parasitic loads
     o Vehicle-based
     o Agency/body builder-added
5. Identify common defects
6. Describe electrical troubleshooting procedures
7. Identify record-keeping requirements
8. Describe the diagnostic and repair procedures of the manufacturer and the AHJ
9. Recognize, evaluate, and identify reported conditions
10. Perform required repairs to resolve deficiencies
11. Use test, calibration, and diagnostic equipment
12. Measure voltage, amperage, and resistance
13. Distinguish defects and deficiencies
14. Operate and test system
15. Perform electrical calculations
16. Complete required documentation in accordance with NFPA standards and the AHJ

Discussion Questions
1. Determined by instructor

Activities
1. Activity 2-2: Testing Electrical Systems and Electronic Controls
• Chassis Voltage Systems
• Parasitic Loads
• Individual Circuit Loads

Instructor Notes
1. ELO 4: Recommend using the schematics for the vehicle used for the course to demonstrate measurement location and technique.
2. ELO 9-16 – Covered by activity.

CTS Guide Reference: CTS 8-2

Unit 3: Electronic Controls and Instrumentation

Topic 3-1: Inspecting Electronic Controls and Instrumentation

Terminal Learning Objective
At the end of this topic, a student, given an emergency response vehicle, SOPs, manufacturer specifications, tools, test, calibration, and diagnostic equipment, schematics, and an inspection checklist, will be able to inspect the electronic controls and instrumentation so that the mounting security is verified; operation and condition of the electronic control system is verified to be within manufacturer specifications; all checklist items are inspected; defects and deficiencies, including broken, loose, worn, or missing parts, are identified and reported; and inspection and tests are documented in accordance with the procedures of the manufacturer and the authority having jurisdiction (AHJ)

Enabling Learning Objectives
1. Describe how the principles of magnetism apply to electronic control devices
   • Magnetic fields
   • Impacts of magnetic fields
   • Proper wire routing
2. Describe how the principles of electricity apply to electronic control devices
   • Kirchhoff’s laws
   • Watt’s law
   • Ohm’s law
   • Series and parallel circuits
   • Shared current paths
3. Describe the principles of circuit analysis
   • Difference in potential (flowing vs. not flowing)
   • Application of Kirchhoff’s laws
   • Application of Ohm’s law
   • Application of Watt’s law
   • Parasitic drain
1. Describe the function, construction, operation, and requirements of:
   • Electronic engine
     o Input, output, and regulations devices
• Transmission
  o Input, output, and regulation devices
• Brake controls
  o Input, output, and regulation devices
2. Describe the function, construction, operation, and requirements of:
• Instrumentation
• Load control devices
• Sequencers
• Interfaces
• Interlocks
3. Describe how to select test, calibration, and diagnostic equipment
• Digital voltmeter (DVOM)
• Ammeter
  o Inductive
    ▪ Low amperage (< 100 A)
    ▪ High amperage (<\= 1,000 A)
  o Series
    ▪ Shunt or direct wire
    ▪ Fuse replacement ammeter
• Battery testers
  o Carbon pile
  o Conductance / battery impedance testers
• Power probes / powered test lights
  o Benefits
    ▪ Ability to power a device
    ▪ Ease of use
  o Problems
    ▪ Excess voltage to delicate computer circuits
    ▪ Piercing
• Test leads
  o Quality is critical
  o Various lengths and sizes
  o Coiled or extendable
  o Auxiliary meter leads
• Digital storage oscilloscopes (DSO)
• Scanners
  o Code readers
  o Manufacture specific
  o Bi-directional
  o Laptop with interface
• Relay substitution device
• Soldering equipment
100W (medium sized electrical, base wiring, lighting systems, etc.)
- Temperature controlled (< 25W) (circuit boards, power distribution systems, computers, etc.)
- Battery powered
- Torch (propane, mapp, etc.)
- Rosin-core solder

- Crimping equipment
  - Correct crimper for device
  - Manufacturer specific
  - Hydraulic
  - Manual ratcheting

- Remote start switches
  - Safety concerns during use

- Remote power supplies
  - Battery chargers
  - Jump batteries (traditional and lightweight)
  - Bench test power supplies (adjustable current and voltage)
  - Auxiliary electronic control module/unit (ECM / ECU) power supply

- Wire strippers

4. Describe test, calibration, and diagnostic equipment to avoid

- Test lights
  - Benefits
    - Ease of use
    - Very fast
  - Problems
    - Overloading sensitive electronics
    - Trigger low amperage devices
    - Piercing
    - No accurate readings
  - Safety
    - Understand impacts of misuse (energizing relays, etc.)

5. Use test, calibration, and diagnostic equipment

6. Describe how to use a DVOM and electronic readers
  - Challenges with 5-volt reference and control circuits

7. Describe how to test sensors, components, and systems

8. Describe how to interpret fault codes
  - Generic
  - Enhanced (manufacturer specific)

9. List types of defects, deficiencies, and potential problems associated with electronic controls and instrumentation
  - Open circuit
  - Short to power
• Short to ground
• Cross short
• Excessive resistance
• Shielding and cable routing
10. Determine defects and deficiencies
• Troubleshooting
• Design deficiencies
11. Describe how to read and interpret schematics
• Basic schematic symbols
• Manufacturer-specific schematic symbols
• As-built schematics (per vehicle)
12. Read and interpret schematics
13. Identify mounting and adjustment requirements
14. Recognize and identify potential failure symptoms and conditions of electronic controls and instrumentation
• Smoke (sight or smell)
• Improper charging (too high or two low / AC voltage issues)
• Failure to function
• Onboard instrumentation reading outside parameters
• Operator error
• Arcing and sparking
15. Describe the inspection procedures of the manufacturer and the AHJ
• Gather tools and safety equipment
• Secure vehicle in a safe environment
• Set parking brake
• Place wheel chocks
• Inspect impact of low-voltage electrical system on electronic controls and instrumentation
  o Recognize and identify symptoms and conditions
  o Determine defects, deficiencies, and potential problems
  o Determine impact if not corrected
• Complete manufacturer and AHJ inspection checklist
• Perform operational tests
• Complete checklist and inspection documentation
• Release vehicle for in-service use or maintenance/repair
16. Recognize and identify symptoms and conditions of electronic control and instrumentation issues
17. Determine defects, deficiencies, and potential problems
18. Perform operational tests
19. Identify record-keeping requirements
20. Complete checklist and inspection documentation
**Discussion Questions**
1. What impact does voltage drop have on electronic control circuits?
2. What problems can using the wrong test equipment create?
3. What safety concerns are associated with using electronic control interlocks?
4. How does vehicle parasitic drain related to electronic controls?
5. How does agency/body builder based parasitic dram relate to electronic controls?

**Activities**
1. Determined by instructor

**CTS Guide Reference:** CTS 8-3

**Topic 3-2: Maintaining Electronic Controls and Instrumentation**

**Terminal Learning Objective**
At the end of this topic, a student, given an emergency response vehicle, manufacturer specifications, a maintenance schedule or assignment, a maintenance checklist, SOPs, test, calibration, and diagnostic equipment, and tools, will be able to perform maintenance on the electronic controls and instrumentation so that deformed, broken, loose, worn, or missing parts are repaired or replaced; the operational condition is preserved or restored; calibration and adjustments are performed; activities are documented; and additional repair needs are reported

**Enabling Learning Objectives**
1. Describe troubleshooting and adjustment methods and procedures
   - Corrosion
     - Clean
     - Correct cause (if possible)
     - Reccoat or repaint (if necessary)
   - Faulty connections
     - Clean
     - Tighten
     - Rewire
     - Replace
   - Low or high voltage
     - Adjust
     - Replace
     - Rebuild
     - Send for repair
   - Deformed, broken, loose, worn, missing, or failed components
     - Tighten
     - Replace
     - Adjust
     - Send for repair
2. Evaluate reported conditions
3. Use test, calibration, and diagnostic equipment
4. Perform operational tests
5. Perform all required maintenance, including all items on a maintenance checklist
6. Correct deficiencies
7. Complete required documentation

Discussion Questions
1. How does the voltage drop on an electronic control system differ from the voltage drop on a 12-volt electrical chassis circuit?

Activities
1. Determined by instructor

CTS Guide Reference: CTS 8-4

Topic 3-3: Repairing Electronic Controls and Instrumentation

Terminal Learning Objective
At the end of this topic, a student, given an emergency response vehicle, manufacturer specifications, an assignment or inspection report detailing a deficiency or deformation, SOPs, test, calibration, and diagnostic equipment, and tools, will be able to perform repairs on electronic controls and instrumentation so that defective components are diagnosed; deformed, broken, loose, worn, or missing parts are repaired, replaced, or rebuilt to manufacturer specifications; engine, transmission, and brake electronic control units or electronic control modules, pump throttles and pressure control devices, and instrumentation are returned to operation; programming is correct; load control devices, sequencer, interfaces, and interlocks are operational; correct test equipment is used; correct parts are used; correct tests and programming procedures are followed; operational tests are conducted and performance is verified; and repairs are documented in accordance with the procedures of the manufacturer and the authority having jurisdiction (AHJ)

Enabling Learning Objectives
1. Describe how to select test, calibration, and diagnostic equipment
2. Describe safety procedures
   • Personnel
     o Solenoid inductive kick
     o Strobe lights
     o High-intensity discharge (HID)
   • Vehicle
     o Welding precautions on vehicle chassis
3. Identify common deficiencies and describe correct repair procedures
   • Voltage drop
   • Sensor failure
   • Circuit driver failure
   • Radio frequency effects
   • Parasitic drain
4. Identify record-keeping requirements
• Manufacturer requirements
• NFPA requirements
• Agency/shop requirements
5. Describe the diagnostic and repair procedures of the manufacturer and the AHJ
6. Recognize, evaluate, and analyze reported conditions, defects, and deficiencies
7. Perform required repairs to resolve deficiencies
8. Use test, calibration, and diagnostic equipment
9. Operate and test system(s)
10. Perform calculations
11. Use correct parts
12. Complete required documentation

Discussion Questions
1. What types of in-house electrical repairs do you do?
   • What repairs do you transfer out?
2. What is parasitic drain?
3. What is the purpose of reference voltages?
   • How do they differ from signal voltages?

Activities
1. To be determined by the instructor

Instructor Notes
1. ELO 5 – Covered in detail in Topic 4-1: Testing Low-voltage Electrical Systems
2. ELO 11-17 – Covered by Activity 4-1: Testing Low-voltage Electrical Systems

CTS Guide Reference: CTS 8-5

Topic 3-4: Testing Electronic Controls and Instrumentation

Terminal Learning Objective
At the end of this topic, a student, given an emergency response vehicle, manufacturer specifications, SOPs, test, calibration, and diagnostic equipment, and tools, will be able to complete performance testing on electronic controls and instrumentation including electronic engine, pump control systems, transmission, brake controls, load control devices, sequencers, interfaces, and interlocks, in accordance with NFPA 1911 so that components are tested to assure they are operating in accordance with manufacturer specifications and NFPA standards; performance tests are conducted to verify that repairs are completed; and all testing is documented in accordance with the procedures of the manufacturer and the authority having jurisdiction (AHJ)

Enabling Learning Objectives
1. Describe operational, diagnostic, and performance tests
2. Describe adjustment and calibration procedures
3. Describe how to select test, calibration, and diagnostic equipment
4. Describe how to test sensors, components, and systems
   • 5-volt reference circuits
Throttle position sensor
Manifold absolute pressure sensor
Mass airflow sensor
Intake air temperature sensor
Coolant temperature sensor
Oxygen sensor

5. Identify common defects
6. Describe electronic troubleshooting procedures
7. Identify record-keeping requirements
8. Describe the diagnostic and repair procedures of the manufacturer and the AHJ
9. Recognize, evaluate, and identify reported conditions
10. Perform required repairs to resolve deficiencies
11. Use test, calibration, and diagnostic equipment
12. Measure voltage, amperage, and resistance
13. Distinguish defects and deficiencies
14. Operate and test system
15. Perform electrical calculations
16. Complete required documentation in accordance with NFPA standards and the AHJ

Discussion Questions
1. What impact will a 12-volt chassis system have on a 5-volt control system?
2. What is the purpose of twisted pair cabling in an electronic control circuit?
   • What will happen if you don’t properly re-twist the wires?
3. How can AC voltage end up in an electronic control circuit?

Activities
1. Activity 2-2: Testing Electrical Systems and Electronic Controls
   • 5-volt Reference Circuits

Instructor Notes
1. ELO 4: Recommend using the schematics for the vehicle used for the course to demonstrate measurement location and technique.
2. ELO 11-16 – Covered by activity.

CTS Guide Reference: CTS 8-6
# Time Table

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Fleet Specifications and Records

Course Plan

Course Details

Certification: Emergency Vehicle Technician III
CTS Guide: Emergency Vehicle Technician [([Month Year])]
Description: This course provides an overview of the knowledge and skills utilized by an emergency vehicle technician to oversee outsourced repair quality control, forecast inventory needs and order parts, and develop the documentation needed to prepare estimates, adhere to maintenance and repair schedule, document warranty repairs, create work orders, validate maintenance records, and develop apparatus specifications.

Designed For: The SFT-certified Emergency Vehicle Technician (EVT) II advancing to EVT III and anyone with fleet management responsibilities
Prerequisites: None
Standard: Complete all activities and formative tests.
Complete all summative tests with a minimum score of 80%.

Hours: Lecture: 11:15
Activities: 3:45
Testing: 1:00

Hours (Total): 16:00
Maximum Class Size: 30
Instructor Level: Primary Instructor
Instructor/Student Ratio: 1:30
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: Standard for the Inspection, Maintenance, Testing, and Retirement of In-Service Emergency Vehicles
  (current edition / physical copy)
- Student Supplement
  - Provided by California Fire Mechanics Academy, Inc.
- Manufacturer manuals
- Manufacturer specification sheets
- Manufacturer websites

Online Instructor Resources

The following instructor resources are available online at
http://osfm.fire.ca.gov/training/SFTCurriculum:
- Activity 2-2: Inspecting Completed Vehicles
- Activity 3-1: Forecasting Inventory Needs
  - Sample Repair History Documents
- Activity 3-2: Ordering Inventory
- Activity 4-1: Preparing Estimates
- Activity 4-2: Scheduling Maintenance and Repairs

Student Resources

To participate in this course, students need:

- NFPA 1901: Standard for Automotive Fire Apparatus
  (current edition / physical copy or access to a digital copy)
- NFPA 1911: Standard for the Inspection, Maintenance, Testing, and Retirement of In-Service Emergency Vehicles
  (current edition / physical copy or access to a digital copy)
- Student Supplement
  - Provided by California Fire Mechanics Academy, Inc.
- At least one AHJ apparatus specification from their agency

Facilities, Equipment, and Personnel

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

- Standard classroom equipped for 30 students
- Projector with appropriate laptop connections
• Wifi/Internet access
• Outdoor space for emergency response vehicle with a clear perimeter for student activities
• Activity 2-2: Inspecting Completed Vehicles
  o Vehicle/apparatus
  o Appropriate test, calibration, and diagnostic equipment and tools
• Activity 3-2: Ordering Inventory
  o Appropriate parts catalogs and manuals
• Activity 4-1: Preparing Estimates
  o Appropriate repair history, estimate forms, and parts list
• Activity 4-2: Scheduling Maintenance and Repairs
  o Black calendar pages (January – December) for the year in which the course is taught
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 be able to describe the capstone task book and testing process.
Enabling Learning Objectives

2. Identify the different levels of certification in the Emergency Vehicle Technician (EVT) certification track
   - EVT I
   - EVT II
   - EVT III

3. Identify the courses required for EVT I
   - State Fire Training
     - [Short Course Title]: Emergency Vehicle Technician 101
     - [Short Course Title]: Electrical Systems A
     - [Short Course Title]: Chassis Systems and Components
     - [Short Course Title]: Cab and Body Systems and Components
     - [Short Course Title]: Pumps and Accessories
     - [Short Course Title]: Tanks and Accessories
   - National Institute for Auto Service Excellence (ASE)
     - Gasoline Engines (T1)
     - Drive Train (T3)
     - Brakes (T4)
     - Suspension and Steering (T5)
     - Preventative Maintenance Inspections (T8)

4. Identify the courses required for EVT II
   - State Fire Training
     - [Short Course Title]: Electrical Systems B
   - National Institute for Auto Service Excellence (ASE)
     - Diesel Engines (T2)
     - Electrical / Electronic Systems (T6)
     - Heating, Ventilation and Air Conditioning (HVAC) (T7)

5. Identify the courses required for EVT III
   - State Fire Training
     - [Short Course Title]: Fleet Specifications and Records
     - [Short Course Title]: Human Resource Management
   - National Institute for Auto Service Excellence (ASE)
     - See eight courses listed for EVT I and EVT II

6. Identify any other requirements for EVT I
   - Code of Federal Regulations (CFR) 396.25: Department of Transportation Brake Inspector Qualification
   - Experience (one of the following)
     - Have a minimum of two years’ full-time paid experience in a state or provincial fire agency, public agency, or private industry as an automotive or truck mechanic with minimum one year related to emergency vehicle maintenance
7. Describe the capstone task book process
   • Complete all prerequisites and course work
   • Submit application and fees and to request capstone task book
     o A candidate may apply for the EVT I and EVT II task books at the same time
       (two applications and two fees), but may not submit the EVT II task book until
       he or she receives EVT I certification (a prerequisite for EVT II)
   • Complete all job performance requirements included in the task book
   • Must have identified evaluator verify individual task completion via signature
   • Must have Fire Chief or authorized representative verify task book completion via
     signature
   • Must be employed by a California Fire Agency in the position prior to submitting
     completed task book to State Fire Training

8. Describe the capstone testing process
   • Emergency Vehicle Technician certification exams (EVT I, EVT II, and EVT III) are
     administered by an independent third-party testing agency

Discussion Questions
1. To be determined by the instructor

Activities
1. To be determined by the instructor

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

Unit 2: Outsourced Repair Quality Control

Topic 2-1: Monitoring Outsourced Repairs

Terminal Learning Objective
At the end of this topic, a student, given a completed vehicle, a deficiency list, and a list of
completed tasks, will be able to monitor outsourced repairs so that all repairs are verified
and tests are completed and documented

Enabling Learning Objectives
1. Identify the function, construction, and operation of vehicles and systems
2. Identify qualifications and limitations of entity performing maintenance or repairs
   • In-house technicians
   • Vendor
3. Identify required testing
4. Identify required record-keeping and documentation
   - Work order identifying maintenance or repair need
   - Outsourced vehicle tracking document or database:
     - List of outsourced vehicles
     - Outsource location
     - Primary contact information
     - Outsource reason
       - Maintenance
       - Repair
     - Projected return date
     - Progress reports
       - Written
       - Verbal
       - Photos
     - Anticipated cost
   - Completed work order from entity performing maintenance or repairs
   - Inspection and return to service checklists and documentation
5. Identify common deficiencies
6. Identify repair procedures
7. Identify testing procedures
8. Identify vehicle safety requirements
9. Operate vehicles
10. Verify performance of required tests and checks
11. Use diagnostic equipment and tools
12. Communicate verbally and in writing

Discussion Questions
1. Under what circumstances might you send a vehicle out for maintenance or repair?
2. What information should you track when you send a vehicle sent out of service?

Activities
1. To be determined by the instructor

Instructor Notes
1. ELOs 1, 3, and 5-12 are covered extensively in EVT I and should be common knowledge for most students. Refresh this content if needed, but focus on ELOs 2 and 4.

CTS Guide Reference: CTS 12-2

Topic 2-2: Inspecting Completed Vehicles

Terminal Learning Objective
At the end of this topic, a student, given an apparatus, a deficiency list, completed tasks, and a required license, will be able to inspect a completed vehicle so that all deficiencies are
repaired; documentation is completed; and the vehicle is tested to manufacturer specifications

**Enabling Learning Objectives**

1. Identify the function, construction, and operation of vehicles and systems
   - Vehicle types
     - Type I
     - Type III
   - Systems (and components)
     - Chassis
     - Cab and body
     - Pumps and tanks
     - Electrical
2. Identify required testing and procedures
   - Performance test (was the vehicle repaired correctly)
3. Identify required record-keeping and documentation
   - Manufacturer requirements
   - AHJ requirements
4. Identify common deficiencies
   - Corrosion
   - Rust, oxidation, electrolysis
   - Warping
   - Leaks
     - Class I
     - Class II
     - Class III
   - Fluid and lubrication levels
   - Cracks, fractures, breaks
   - Loose, broken, worn, or missing components
5. Identify repair procedures
6. Identify vehicle safety requirements
   - Gather tools and safety equipment
   - Secure vehicle in a safe environment
   - Set parking brake and place wheel chocks
   - Wear appropriate PPE
7. Observe proper apparatus operation
8. Verify performance of required tests and checks
9. Use test, calibration, and diagnostic equipment and tools
10. Communicate verbally and in writing

**Discussion Questions**

1. Who is responsible to validate that an outsourced repair was completed and the vehicle is ready for service?
Activities
1. Activity 2-2: Inspecting Completed Vehicles

Instructor Notes
1. These inspection principles also apply to an apparatus, not just an entire vehicle.
2. ELO 1 – Addresses the minimum vehicles and systems to be addressed.
3. ELO 7 – Describe this process to the students as you do it if time, safety, and liability considerations restrict students from operating the vehicle themselves.
4. ELOs 8-10 – Covered by the required activity.

CTS Guide Reference: CTS 12-1

Unit 3: Inventory

Topic 3-1: Monitoring Inventory Levels

Terminal Learning Objective
At the end of this topic, a student, given current inventory, agency equipment lists, manufacturer specifications, manufacturer parts manuals, a maintenance schedule, and previous repair history, will be able to monitor inventory levels within the relevant level of responsibility so that the inventory is maintained at the required levels

Enabling Learning Objectives
1. Identify current suppliers
2. Evaluate previous repair history
3. Identify agency and purchase policies
4. Determine current needs
5. Use previous repair history to predict future needs

Discussion Questions
1. Does your shop stock parts?
   - Why or why not?
   - What are the pros and cons?
2. How does your agency track inventory?

Activities
1. Activity 3-1: Forecasting Inventory Needs

Instructor Notes
1. Use the activity to generate ELO/content discussion.
2. ELO 4 and 5 – Covered by required activity.

CTS Guide Reference: CTS 13-1

Topic 3-2: Ordering Parts

Terminal Learning Objective
At the end of this topic, a student, given a part number or specification and application of part required, a purchase order form and procedure, and a vendor list, will be able to order appropriate parts so that the correct part is ordered from the vendor; purchase orders are tracked; and purchase is recorded
Enabling Learning Objectives
1. Identify the function, operation, and construction of component
2. Identify applicable standards
3. Identify manufacturer specifications
4. Identify recommended part substitutions
5. Identify parts locations
6. Identify transportation systems
7. Research written and electronic sources and manuals
8. Communicate verbally and in writing

Discussion Questions
1. Which is more important, cost or delivery timeframe?
2. Which is more important, cost or quality?
   • “Buy the best, cry once”

Activities
1. Activity 3-2: Ordering Inventory

Instructor Notes
1. Use the activity to generate ELO/content discussion as activity is completed.

CTS Guide Reference: CTS 13-2

Unit 4: Documentation

Topic 4-1: Preparing Estimates

Terminal Learning Objective
At the end of this topic, a student, given an emergency vehicle, repair history, estimate forms, parts lists, required repair or upgrade hours, and a calculator, will be able to prepare an estimate of deficiencies or upgrades to be completed on an emergency vehicle so that the costs are calculated, documented, and communicated

Enabling Learning Objectives
1. Identify the function, construction, and operation of emergency response vehicles
2. Identify estimated repair times
   • Technician experience and skill level
   • Fleet priority
   • Parts availability
   • Staffing levels
3. Identify parts and component costs
   • Replacement part cost
   • Secondary costs
     o Replacing associated parts impacted by new part
     o Replacing items damaged during repair
     o Additional problems discovered during repair
   • Shipping cost
   • Labor cost
4. Identify applicable vehicle standards
   - Manufacturer specifications (vehicle)
   - Original equipment manufacturer (OEM) specifications (part or component)
   - NFPA standards
   - AHJ standards
5. Estimate and calculate costs and repair times
6. Complete documentation and record-keeping
7. Communicate verbally and in writing

Discussion Questions
1. What factors impact repair time?
2. What factors impact repair cost?

Activities
1. Activity 4-1: Preparing Estimates

Instructor Notes
1. ELOs 5-7 – Covered by Activity 4-1: Preparing Estimates

CTS Guide Reference: CTS 14-1

Topic 4-2: Adhering to Repair and Maintenance Schedules

Terminal Learning Objective
At the end of this topic, a student, given an emergency vehicle, a schedule, forms, a repair or maintenance request, current staffing and workload, work estimate, and work space availability, will be able to adhere to a schedule for maintenance or repair of an emergency vehicle so that required repairs or maintenance can be assigned and completed in accordance with the projected times

Enabling Learning Objectives
1. Identify the function, construction, and operation of emergency response vehicles
2. Identify resource availability
   - Matching resources to workload
     - Technicians available to do the work
     - Vehicle available to cover for vehicles out of service
3. Identify factors that impact resource availability
   - Fleet management
     - Required scheduled inspection cycles
     - New vehicle prep
     - Budget cycles
   - Climate
     - Fire season
     - Wet season
     - Weather
   - Staff levels
     - Training schedules
     - Vacation time
4. Identify agency requirements
5. Utilize resources
6. Evaluate requests
7. Project maintenance or repair results

Discussion Questions
1. What routine activities should you factor into your maintenance/repair schedule?
2. What events may impact your maintenance/repair schedule?

Activities
1. Activity 4-2: Scheduling Maintenance and Repairs

CTS Guide Reference: CTS 14-2

Topic 4-3: Documenting Warranty Repairs

Terminal Learning Objective
At the end of this topic, a student, given a repaired vehicle, applicable warranties, a deficiency list, technical service bulletins, and a list of completed tasks, will be able to document warranty repairs so that all repairs are completed, verified, and tested; and the warranty claim is processed

Enabling Learning Objectives
1. Identify the function, construction, and operation of emergency response vehicles
2. Identify current warranties
3. Identify technical service bulletins
   • Purpose/use
   • Where to locate
4. Identify required testing
5. Identify required record-keeping and documentation
6. Identify testing procedures
7. Identify vehicle safety requirements
8. Identify manufacturer specifications
   • Whether or not something is covered by warranty
   • Who can perform warranty repairs
     o Manufacturer-designated repair facility
     o Manufacturer-negotiated in-house repairs
9. Identify agency policies and procedures
10. Communicate verbally and in writing
11. Comply with the record-keeping requirements of the manufacturer and the authority having jurisdiction (AHJ)

Discussion Questions
1. How are inventory numbers determined?
2. Is it necessary to inspect the unit and documents prior to releasing the unit back into service?
   • Why or why not?

Activities
1. Determined by instructor

Instructor Notes
1. ELOs 1, 4, 6, and 7 are covered extensively in EVT I courses and should be common knowledge for most students. Refresh this content if needed, but focus on ELOs 2, 4, 5, and 8.

CTS Guide Reference: CTS 14-3

Topic 4-4: Creating Work Orders

Terminal Learning Objective
At the end of this topic, a student, given an emergency response vehicle, an assignment, and agency work order forms, will be able to create work orders so that all work to be performed is documented; all required information is recorded; all necessary information is communicated to the technician(s); and the emergency response vehicle is prepared for repair or maintenance

Enabling Learning Objectives
1. Identify required record-keeping
2. Identify agency record-keeping system
3. Identify previous repair history
4. Identify the function, construction, and operation of emergency response vehicles
5. Apply agency record-keeping system
6. Communicate verbally and in writing
7. Utilize diagnostic skills

Discussion Questions
1. Why is documentation important?
2. How long do you keep completed work orders?
   • How long should you keep them?

Activities
1. Given a completed work order, have students review for complete and accurate information and correct any deficiencies.

Instructor Notes
1. Recommend bringing in sample work orders and walking students through the different components and why they are important.

CTS Guide Reference: CTS 14-4

Topic 4-5: Validating Maintenance Records
Terminal Learning Objective
At the end of this topic, a student, given completed documentation of maintenance records and agency record-keeping policies will be able to validate maintenance records so that accurate records are maintained

Enabling Learning Objectives
1. Identify record-keeping and accounting procedures
2. Describe how to analyze statistics
3. Identify agency policy and procedure
4. Recognize, evaluate, analyze, and calculate statistical information, accounting reports, and cost performance reports

Discussion Questions
1. Who keeps/maintains maintenance records in your shop?
2. Should all defects and repairs be “signed off”?
   • Why or why not?

Activities
1. Determined by instructor

CTS Guide Reference: CTS 14-5

Topic 4-6: Developing Apparatus Specifications

Terminal Learning Objective
At the end of this topic, a student, given agency recommendations, agency policies and procedures, and applicable NFPA and industry standards, will be able to develop a specification through review and research of existing fire apparatus so that technical criteria are presented as a completed specification

Enabling Learning Objectives
1. Identify current quality standards and requirements of the agency, state and local laws and regulations, the American Society of Mechanical Engineers (ASME), the Society of Automotive Engineers (SAE), the Occupational Safety and Health Administration (OSHA), and NFPA for the construction of a fire apparatus
2. Recognize agency guidelines
3. Organize and identify apparatus components based on the needs of the applicable divisions
4. Communicate verbally and in writing

Discussion Questions
1. What role does maintenance play when developing apparatus specifications?
2. Should warranty [word] be considered when developing apparatus specifications?
   • Why or why not?

Activities
1. Determined by instructor

CTS Guide Reference: CTS 15-1
# Time Table

<table>
<thead>
<tr>
<th>Segment</th>
<th>Lecture Time</th>
<th>Activity Time</th>
<th>Total Unit Time</th>
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**Unit 4 Totals:**

| Unit 4 Totals | 8:00 | 1:30 | 9:30 |

**Lecture, Activity, and Unit Totals:**

| Lecture, Activity, and Unit Totals: | 11:15 | 3:45 | 15:00 |

**Course Totals**

| Total Lecture Time (LT) | 11:15 |
| Total Activity Time (AT) | 3:45 |
| Total Testing Time (TT) | 1:00 |
| **Total Course Time** | **16:00** |