

# FIRE APPARATUS DRIVER/OPERATOR 1A

Approved and Adopted by the  
Office of State Fire Marshal



Recommended for adoption by the Statewide  
Training and Education Advisory Committee  
and the  
State Board of Fire Services



## STUDENT SUPPLEMENT

January 2011



# **FIRE APPARATUS DRIVER/OPERATOR 1A**

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## **Emergency Vehicle Operations**

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### **Student Supplement**



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# FIRE APPARATUS DRIVER/OPERATOR 1A

## Emergency Vehicle Operations



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# FIRE APPARATUS DRIVER/OPERATOR 1A

## Emergency Vehicle Operations

Mission Statement



### Mission Statement

The mission of State Fire Training is to enable the California fire service to safely protect life and property through education, training, and certification.

### California Fire Service Training and Education System

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 Training Division of the California State Fire Marshal's Office with oversight provided by the State Board of Fire Services.

The role of CFSTES is one of facilitating, coordinating, and assisting in the development and implementation of standards and certification for the California fire service. CFSTES manages the California Fire Academy System by providing standardized curriculum and tests; accredited courses leading to certification; approved standardized training programs for local and regional delivery; administering the certification system; and publishing Career Development Guides, Instructors Guides, Student Manuals, Student Supplements, and other related support materials.

This system is as successful and effective as the people involved in it are. It is a fire service system developed by the fire service, for the fire service... and we believe it is the best one in the country.

### Acknowledgments

State Fire Training coordinated the development of the material contained in this guide. Before its publication, the Statewide Training and Education Advisory Committee (STEAC) and the State Board of Fire Services (SBFS) recommended this guide for adoption by the State Fire Marshal (SFM). This guide is appropriate for fire service personnel and for personnel in related occupations that are pursuing State Fire Training certification.

<b>Ken Pimlott</b> Acting Director of CAL FIRE	
<b>Tonya Hoover</b> Acting State Fire Marshal	<b>Vacant</b> Assistant State Fire Marshal
<b>Mike Richwine</b> Chief, State Fire Training	<b>Ronny J. Coleman</b> Chair, STEAC



# FIRE APPARATUS DRIVER/OPERATOR 1A

## Emergency Vehicle Operations



### Acknowledgments

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**Alicia Hamilton**  
Fire Service Training Specialist III

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*"We gratefully acknowledge the hard work and accomplishments of those before us who built the solid foundation on which this program continues to grow."*



# FIRE APPARATUS DRIVER/OPERATOR 1A

## Emergency Vehicle Operations

Course Outline



### Course Outline

**Course Objectives:** To provide the student with...

- a) Information on driver responsibilities, recognized standards, and related laws for fire apparatus.
- b) Information and techniques on basic inspections, documentation, maintenance, and troubleshooting fire apparatus.
- c) Information and techniques on driving and positioning fire apparatus.
- d) The opportunity to increase their driving skills during simulated driving conditions.

**Course Content** .....40:00

#### Unit 1: Responsibilities, Standards, and Laws

- 1-1 Orientation And Administration ..... 1:00
- 1-2 Fire Apparatus Driver/Operator Responsibilities ..... 0:45
- 1-3 Legal Aspects Of Emergency And Nonemergency Driving ..... 1:00

#### Unit 2: Inspection, Basic Maintenance, Documentation, and Troubleshooting

- 2-1 Introduction To Inspection, Basic Maintenance, and Troubleshooting ..... 0:30
- 2-2 Inspection And Basic Maintenance Of The Driver And Crew Areas, Apparatus Body, And Compartmentation ..... 0:15
- 2-3 Inspection And Basic Maintenance Of The Frame, Axles, Steering And Suspension Systems, Driveline, Wheels, And Tires ..... 0:15
- 2-4 Troubleshooting The Frame, Axles, Steering And Suspension Systems, Driveline, Wheels, And Tires ..... 0:30
- 2-5 Inspection And Basic Maintenance Of Engine Systems..... 0:45
- 2-6 Troubleshooting Engine Systems ..... 0:30
- 2-7 Inspection And Basic Maintenance Of The Transmission And Clutch ..... 0:15
- 2-8 Troubleshooting The Transmission And Clutch..... 0:15
- 2-9 Inspection And Basic Maintenance Of The Starting, Charging, And Other Electrical Systems..... 0:30
- 2-10 Troubleshooting The Starting, Charging, And Other Electrical Systems ..... 2:00
- 2-11 Inspection And Basic Maintenance Of Brake Systems..... 1:30
- 2-12 Troubleshooting Brake Systems ..... 1:00
- 2-13 Inspection And Basic Maintenance Of Auxiliary And Accessory Equipment ..... 0:15
- 2-14 Inspection Documentation And Reports..... 0:15
- 2-15 Pretrip Inspection Procedures ..... 2:00

#### Unit 3: Driving Practices

- 3-1 Accident Statistics And Liability ..... 0:30



# FIRE APPARATUS DRIVER/OPERATOR 1A

## Emergency Vehicle Operations

Texts and References



3-2	Principles Of Defensive Driving .....	2:00
3-3	Driving Apparatus To Incidents .....	1:00
3-4	Principles Of Off-Road Driving .....	1:00
3-5	Principles Of Braking And Stopping .....	0:30
3-6	Principles Of Steering And Load Control .....	1:30
3-7	Driving During Adverse Weather Conditions .....	0:15
3-8	Positioning Apparatus .....	1:00

### Unit 4: Mandatory Driving Exercises

5-1	Introduction To The Mandatory Driving Exercises.....	0:30
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### Unit 5: Optional Driving Exercises

6-1	Introduction To The Optional Driving Exercises .....	0:15
-----	--	------

<b>Practice and Testing the Driving Exercises</b> .....	14:00
---	-------

<b>Unit Tests</b> .....	3:00
-------------------------	------

<b>Review and Certification Exam</b> .....	1:00
--	------

## Texts and References

- Basic Fire Control Module 2A Automotive Battalion Student Supplement, CDF, 1999 Edition, Off Road Vehicle Operations Unit
- California Commercial Driver Handbook, DMV, 2008 Edition
- Chilton technical manuals
- Driver Awareness Instructor Course Manual, California Commission on Peace Officer Standards and Training, 1999 Edition
- Engineer Training Manual, Tiburon Fire Protection District, 2000 Edition, Section 53
- <http://www.bendix.com/troubleshooting/>
- Introduction to Fire Pump Operations, Delmar, 2005 Edition
- Motor Truck & Diesel Repair Manual, Bendix Commercial Vehicle Systems, 29th Edition
- NFPA 1001: Standard for Fire Fighter Professional Qualifications, NFPA, 2008 Edition
- NFPA 1002: Standard for Fire Apparatus Driver/Operator Professional Qualifications, 2009 Edition
- NFPA 1451: Standard for a Fire Service Vehicle Operations Training Program, 2007 Edition
- NFPA 1500: Standard on Fire Department Occupational Safety and Health Program, 2007 Edition
- NFPA 1582: Standard on Comprehensive Occupational Medical Program for Fire Departments, 2007 Edition
- NFPA 1911: Inspection, Maintenance, Testing, and Retirement of In-Service Automotive Fire Apparatus, 2007 Edition



# FIRE APPARATUS DRIVER/OPERATOR 1A

## Emergency Vehicle Operations

Texts and References



- NFPA Journal, July/August 2001 Edition
- NFPA Journal, November/December 2007 Edition
- Off Road and 4-Wheel Driver Operational Procedures Manual, Kern County Fire Department, 1999 Edition
- Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition
- Sacramento Regional Driver's Training Authority Student Manual, First Edition
- State of California 2007 Vehicle Code, DMV, 2007 Edition
- Title 49 CFR Transportation, U.S. Government Printing Office, October 2006 Edition
- University of Michigan Transportation Research Study of 1998, University of Michigan
- Webster's Unabridged Dictionary, Random House, Second Edition



# FIRE APPARATUS DRIVER/OPERATOR 1A

## Emergency Vehicle Operations

Calendar of Events



### Calendar of Events

DAY	TOPIC	TITLE	TIME	ACTIVITY	EVALUATION	
Day 1	1-1	Orientation And Administration	1:00			
	1-2	Fire Apparatus Driver/Operator Responsibilities	0:45			
	1-3	Legal Aspects Of Emergency And Nonemergency Driving	1:00	1-3-1		
	2-1	Introduction To Inspection, Basic Maintenance, And Troubleshooting	0:30			
	2-2	Inspection And Basic Maintenance Of The Driver And Crew Areas, Apparatus Body, And Compartmentation	0:15			
	2-3	Inspection And Basic Maintenance Of The Frame, Axles, Steering And Suspension Systems, Driveline, Wheels, And Tires	0:15			
	2-4	Troubleshooting The Frame, Axles, Steering And Suspension, Driveline, Wheels, And Tires	0:30			
	2-5	Inspection And Basic Maintenance Of Engine Systems	0:45			
	2-6	Troubleshooting Engine Systems	0:30			
	2-7	Inspection And Basic Maintenance Of The Transmission And Clutch	0:15			
	2-8	Troubleshooting The Transmission/Clutch	0:15			
	2-9	Inspection And Basic Maintenance Of The Starting, Charging, And Other Electrical Systems	0:30			
	2-10	Troubleshooting The Starting, Charging, And Other Electrical Systems	1:30			
		<b>Day 1 Total</b>		<b>8:00</b>		
Day 2	2-10	Troubleshooting The Starting, Charging, And Other Electrical Systems	0:30			
	2-11	Inspection And Basic Maintenance Of Brake Systems	1:30			
	2-12	Troubleshooting Brake Systems	1:00			
	2-13	Inspection And Basic Maintenance Of Auxiliary And Accessory Equipment	0:15			
			1:00			<b>Test #1</b>
	2-14	Inspection Documentation And Reports	0:15			
	2-15	Pretrip Inspection Procedures	2:00	2-15-1		
	3-1	Accident Statistics And Liability	0:30			
	3-2	Principles Of Defensive Driving	1:00			
		<b>Day 2 Total</b>		<b>8:00</b>		



# FIRE APPARATUS DRIVER/OPERATOR 1A

## Emergency Vehicle Operations



Calendar of Events

DAY	TOPIC	TITLE	TIME	ACTIVITY	EVALUATION	
Day 3	3-2	Principles Of Defensive Driving	1:00	3-2-1		
	3-3	Driving Apparatus To Incidents	1:00			
	3-4	Principles Of Off-Road Driving	1:00			
	3-5	Principles Of Braking And Stopping	0:30			
	3-6	Principles Of Steering And Load Control	1:30			
	3-7	Driving During Adverse Weather Conditions	0:15			
	3-8	Positioning Apparatus	1:00			
			1:00			<b>Test #2</b>
	4-1	Introduction To The Mandatory Driving Exercises	0:30			
	5-1	Introduction To The Optional Driving Exercises	0:15			
		<b>Day 3 Total</b>		<b>8:00</b>		
Day 4		Diminishing Clearance Exercise*	8:00	4-1-1		
		Serpentine Exercise*		4-1-2		
		Three-Point Turnaround Exercise*		4-1-3		
		Station Apparatus Backing Exercise*		4-1-4		
		Alley Dock Exercise*		4-1-5		
		Lane Change Exercise		5-1-1		
		Offset Alley Exercise		5-1-2		
		Dogleg Exercise		5-1-3		
		Parallel Parking Exercise		5-1-4		
		<b>Day 4 Total</b>		<b>8:00</b>		
Day 5		Practice Driving Exercises	7:00		<b>Performance Exams</b>	
		Graded Exercises				
		Review And Certification Exam	1:00		<b>Certification Exam</b>	
		<b>Day 5 Total</b>		<b>8:00</b>		

\*Mandatory Driving Exercises





# FIRE APPARATUS DRIVER/OPERATOR 1A

## Emergency Vehicle Operations

Topic 1-1: Orientation and Administration



## Topic 1-1: Orientation and Administration

Student information for this topic can also be found in [Pumping Apparatus Driver/Operator Handbook](#), IFSTA, Second Edition, Pages 1-10.

### Course Prerequisites

- Fire apparatus driving experience on a public way (two options).
  - California Class C driver's license and a signed verification of driving fire apparatus on a public way.
    - Section 4.3.1 of the NFPA Standard for Fire Apparatus Driver/Operator Professional Qualifications, 2009 Edition.
    - Signed by you and your Fire Chief.
  - California Class A, B, or C driver's license with a fire fighter endorsement.
- Fire Fighter I training recommended.

### Student Evaluation

- Activities.
  - Complete all activities.
- Two written unit tests.
  - Each followed with group discussion.
  - All tests must be completed and passed with a minimum score of 80%.
  - Tests must be returned to the instructor after review.
- Driving exercises.
  - Manipulative skills tracking and accountability.
  - Minimum 80% score to pass each mandatory manipulative performance test.
- Progress chart.
- State certification exam.
  - Not related to final course grade.
  - Must pass the class first before taking the exam.
  - 50 question multiple-choice exam.
  - Minimum 70% required to pass the certification exam.

## **Course Description**

- 40-hour class.
  - Classroom information and activities.
  - Reading assignments.
  - Apparatus inspection.
  - Hands-on driving exercises.
- Start and end times.
  - Class will begin on time.
  - Student attendance requirements.
    - Must attend the entire course.
    - Excused absences may be considered for emergencies.
- Proper attire.
  - Classroom.
    - Station wear or equivalent.
    - Station boots or equivalent.
  - Field exercises.
    - Station wear or equivalent.
    - Station boots or equivalent.
    - Helmet.
    - Gloves.
- Required textbooks.
  - Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition
  - California Commercial Driver Handbook, DMV
  - State Fire Training student supplement

## **Course Objectives**

Provide the students with...

- Information on driver responsibilities, recognized standards, and related laws for fire apparatus.
- Information and techniques on basic inspections, documentation, maintenance, and troubleshooting fire apparatus.
- Information and techniques on driving and positioning fire apparatus.
- The opportunity to increase their driving skills during simulated driving conditions.



# FIRE APPARATUS DRIVER/OPERATOR 1A

## Emergency Vehicle Operations

Topic 1-1: Orientation and Administration



## **Historical Overview**

The first course, and foundation, of the current Fire Apparatus Driver/Operator certification program was titled Driver/Operator I and II. This course was first offered through the California State Fire Marshal's Office in September 1982. The program consisted of sixteen 8-hour classes that had to be completed to receive California State Fire Marshal certification. The course objectives and direction was based upon the career development guide, derived from the California Fire Service Occupational Analysis. Also used as a reference and basis of the course objectives was the National Fire Protection Association (NFPA) Pamphlet 1002 titled: Fire Apparatus Driver/Operator Professional Qualifications.

Since the inception of the Driver/Operator I and II courses, the demands and expectations placed upon the fire service and the professional apparatus driver/operator have greatly increased. Legal, ethical, and operational responsibilities have grown in dimension, requiring several revisions and modifications to the original Driver/Operator I and II. This most recent redesign of the fire apparatus driver/operator curriculum encompasses these new and critical responsibilities, while maintaining the foundation of the original Driver/Operator I and II programs. The intent of this course is to maintain the highest level of ability, skills, and integrity of the professional fire apparatus driver/operator, while preparing all personnel to face the ongoing challenges of their profession.

## **Desirable Skills**

The following skills and senses have been found to be critical to be a successful driver/operator:

- Reading ability: for understanding all laws, signs, and relevant memos/orders.
- Writing ability: clearly and concisely for documentation and reporting.
- Mathematical ability: basic algebra skills necessary for hydraulics.
- Physical fit: high demands both physical and mental.
- Hearing and vision: as required by law and department standards.
- Mechanical ability: A critical skill of the professional driver/operator. If Plan A fails, what is Plan B? If Plan B fails, what is Plan C, and so on?
- Basis supervisory skills: If the company officer is injured or unavailable, it may be necessary for the fire apparatus driver/operator to make officer-level decisions.
- Have the ability to remain calm, think, and make decisions under pressure.
- Must have the ability to avoid "tunnel vision," always be aware of surroundings and the entire situation.
- Have the ability to identify safety hazards.



# FIRE APPARATUS DRIVER/OPERATOR 1A

## Emergency Vehicle Operations

Topic 1-1: Orientation and Administration



### **National Fire Protection Association Standards**

The following information is paraphrased from the actual code. The standard listing is in a priority order for this program.

#### **NFPA 1500: Standard for Fire Department Occupational Safety and Health Program**

- Chapter 5: Training and Education.
  - Section 5.2.2: Must meet applicable requirements specified in NFPA 1002.
  - Section 5.3.1: Training provided as often as necessary to meet applicable requirements of this chapter.
- Chapter 6: Fire Apparatus, Equipment, and Driver/Operators.

#### **NFPA 1001: Standard for Fire Fighter Professional Qualifications**

- Chapter 3: Fire Fighter I.
  - 3-1.1.1: General knowledge requirements.
  - 3-1.1.2: General skills requirements.

#### **NFPA 1002: Standard For Fire Apparatus Driver/Operator Professional Qualifications**

- Chapter 1: Administration.
- Chapter 4: General Requirements.
- Chapter 5: Apparatus Equipped with a Fire Pump.
- Appendix A: Explanatory Material.

#### **NFPA 1911: Standard for the Inspection, Maintenance, Testing, and Retirement of In-Service Automotive Fire Apparatus**

- Chapter 1: Administration.
- Chapter 4: General Requirements.
- Chapter 6: Out-of-Service Criteria.
- Chapter 7: Inspection and Maintenance of the Chassis, Driving and Crew Compartment, and Body.
- Chapter 8: Inspection and Maintenance of Low Voltage Electrical Systems.
- Chapter 14: Inspection and Maintenance of Utility Air and Breathing Air Systems.
- Chapter 17: Performance Testing of Low Voltage Electrical Systems.
- Chapter 22: Performance Testing of Line Voltage Electrical Systems.
- Chapter 23: Performance Testing of Breathing Air Compressor Systems.
- Appendix A: Explanatory Material.

#### **NFPA 1451: Standard For A Fire Service Vehicle Operations Training Program**

- The entire standard applies.

## Topic 1-2: Fire Apparatus Driver/Operator Responsibilities

Student information for this topic can also be found in the [California Commercial Driver Handbook](#), DMV, 2008 Edition, Pages 19-23 and [Pumping Apparatus Driver/Operator Handbook](#), IFSTA, Second Edition, Pages 1-2, 9, 31-61, 64-65, 73-74, 76-88, 99-105, 151-161, 418-425.

### Fire Fighter Injury and Death Statistics

According to NFPA statistics, the second leading cause of on-duty deaths to fire fighters is vehicle crashes and collisions. Of the 102 total "Line of Duty Deaths" of fire fighters in 2007, 20 deaths occurred in collisions or rollovers. Whether responding to an emergency incident, or in nonemergency status, safety for fire service personnel and civilians alike is of paramount importance. Not only is it the responsibility of the fire apparatus driver/operator to observe and enforce all safety issues, it is the responsibility of all fire service personnel to watch for any possible safety hazards.

### Safety

Safety is of the highest importance in every aspect of our profession. Regardless of whether you are responding to, or involved in, an active emergency incident, or merely in the nonemergency status, we all must be alert to any possible hazard. As a fire apparatus driver/operator, your primary responsibility and obligation to prevent any injury from occurring to both fire service and nonfire service personnel occurs in several areas.

- Prior to leaving the fire station.
  - All personnel must be seated, with seat belts on.
  - All cords and attachments to apparatus are removed.
  - Apparatus bay doors are completely opened.
  - Apparatus compartment doors are closed.
  - All equipment is properly stored and removed from apparatus area.
  - Proper apparatus checks have been performed.
- Driving status.
  - Always drive in the defensive mode.
  - Observe all laws and regulations related to the safe operation of fire apparatus.
  - Use a spotter whenever backing up or when proceeding forward, if necessary.
    - Spotters should always remain in the view of the driver/operator, either by line of sight or by mirror.

## **Apparatus Placement and Operation**

Scene hazards include:

- Possible building collapse.
- Electrical or wire hazards.
- Passing vehicles.
- Ground integrity.
- Civilian or emergency personnel.
- Other emergency vehicle placement.
- Weather and topography.

## **Other Responsibilities**

A critical responsibility of the fire apparatus driver/operator is knowledge of your emergency response district. Time is of essence in any emergency, as is safety. A thorough knowledge of your response district, including traffic thoroughfares, traffic habits and hazards, will reduce critical minutes from the overall response time. Other points of importance include, but are not limited to:

- Hydrant locations and any unusual hydrants, such as a dead-end main.
- High life hazards such as, hospitals, low- and high-rise residential care homes, etc.
- High hazard facilities such as, chemical storage, radiation, high storage, etc.
- Access problems such as narrow roads, setbacks, loading zones, etc.



# FIRE APPARATUS DRIVER/OPERATOR 1A

## Emergency Vehicle Operations

Topic 1-3: Legal Aspects of Emergency and Nonemergency Driving



## Topic 1-3: Legal Aspects of Emergency and Nonemergency Driving

Student information for this topic can also be found in the [California Commercial Driver Handbook](#), DMV, 2008 Edition, Pages 1-18 and [Pumping Apparatus Driver/Operator Handbook](#), IFSTA, Second Edition, Pages 9-10 and 63-64.

### Licensing

#### **Federal**

##### ***Title 49 CFR, Part 383.23***

The Federal Department of Transportation (DOT) is the federal agency with the responsibility of establishing the basic requirements for the states' commercial drivers license programs.

#### **California**

##### ***Assembly Bill 1648***

This bill, effective January 1, 2011, amends Sections 1808.1, 12804.9, and 15278 and adds Section 12804.11 to the Vehicle Code. These changes revise and recast the provisions regulating the operation of fire-fighting equipment to permit certain persons employed as a fire fighter or registered as a volunteer fire fighter to operate fire-fighting equipment only if the person holds a Class A, Class B, or Class C license, with certain exceptions, and a **fire fighter endorsement** issued by the Department of Motor Vehicles (DMV).

Applicants must provide DMV proof of current employment with a fire department as a fire fighter or registration as a volunteer fire fighter, evidence of fire equipment operation training, passing the written fire fighter examination developed by DMV with the cooperation of the Office of the State Fire Marshal (OSFM), and submitting a report of medical examination on a DMV-approved form.

##### ***Repealed Sections of the Vehicle Code***

The bill also repealed three sections of the Vehicle Code that affect fire fighters.

- Section 12954: Driver's license fire fighters emergency exemption
  - Exempted fire fighters from the requirement to have in their immediate possession the appropriate driver's license when operating fire-fighting equipment during an emergency, or when returning from an emergency
- Section 15250.6: Fire fighter equipment driver's license requirements
- Section 15250.7: Fire fighter equipment driver's license duplicate fee

##### ***California Commercial Driver Handbook (CCDH)***

Guidelines and standards based upon CFR, Title 19.

### ***Minimum Licensing***

The minimum licensing requirement to drive fire apparatus in the State of California is a Class C license with a fire fighter endorsement. Under this license, the driver/operator may only drive a single fire fighting vehicle and any passenger vehicle with a GVWR under 26,000 pounds.

### ***Medical Exam Requirements***

The medical exam requirement for a Class C fire fighter endorsed driver's license is by a physician every four years.

## **California Vehicle Code**

### **Code 3 Authorization**

#### ***CVC Section 30***

It is declared as a matter of legislative policy that red lights and sirens on vehicles should be restricted to authorized emergency vehicles engaged in police, fire, and lifesaving services; and that other types of vehicles which are engaged in activities which create special hazards upon the highways should be equipped with flashing amber warning lamps.

#### ***CVC Section 165.2***

Any forestry or fire department of any public agency or fire department organized as provided in the Health and Safety Code.

### **Warning Systems**

#### ***CVC Section 25252***

Every authorized emergency vehicle shall be equipped with at least one steady burning red warning lamp visible from at least 1,000 feet to the front of the vehicle to be used as provided in this code. ***This is the minimum allowable by law.***

#### ***CVC Section 25252.5(a)***

##### ***Flashing Headlamps on Authorized Emergency Vehicles***

Every authorized emergency vehicle may be equipped with a system, which flashes the upper-beam headlamps of the vehicle with the flashes occurring alternately from the front headlamp on one side of the vehicle to the front headlamp on the other side of the vehicle. The flashing of the headlamps shall consist only of upper-beam flashing, and not the flashing of any other light beam.

#### ***CVC Section 25258***

##### ***Authorized Emergency Vehicles: Additional Lights***

An authorized emergency vehicle operating under the conditions specified in Section 21055 may display a flashing white light from a gaseous discharge lamp designed and used for the purpose of controlling official traffic control signals.



# FIRE APPARATUS DRIVER/OPERATOR 1A

## Emergency Vehicle Operations



Topic 1-3: Legal Aspects of Emergency and Nonemergency Driving

### **CVC Section 25259(a)**

#### *Additional Warning Lights on Authorized Emergency Vehicles*

Any authorized emergency vehicle may display flashing amber warning lights to the front, sides, or rear.

### **CVC Section 25268**

#### *Use of Flashing Amber Warning Light*

No person shall display a flashing amber warning light on a vehicle as permitted by this code except when an unusual traffic hazard exists.

### **CVC Section 25269**

#### *Use of Red Warning Light*

No person shall display a flashing or steady burning red warning light on a vehicle except as permitted by Section 21055 or when an extreme hazard exists.

### **CVC Section 27000(a)**

#### *Horns or Warning Devices*

An authorized emergency vehicle may be equipped with, and use in conjunction with the siren on that vehicle, an air horn that emits sounds that do not comply with the requirements of this section.

### **CVC Section 27001(a)**

#### *Use of Horns*

The driver of a motor vehicle when reasonably necessary to insure safe operation shall give audible warning with his horn.

### **CVC Section 27002**

#### *Sirens*

No vehicle, except an authorized emergency vehicle, shall be equipped with, nor shall any person use upon a vehicle any siren except that an authorized emergency vehicle shall be equipped with a siren meeting requirements established by the department.

## **Civil Liability**

### **CVC Section 17001**

#### *Liability of a Public Entity*

A public entity is liable for death or injury to person or property proximately caused by a negligent or wrongful act or omission in the operation of any motor vehicle by an employee of the public entity acting within the scope of his employment.

### **CVC Section 17002**

#### *Extent of Liability*

Subject to Article 4 (commencing with Section 825) of Chapter 1 of Part 2 of Division 3.6 of "Title 1 of the Government Code, a public entity is liable for death or injury to person or

property to the same extent as a private person under the provisions of Article 2 (commencing with Section 17150) of this chapter.

### ***CVC Section 17004***

#### *Authorized Emergency Vehicles*

A public employee is not liable for civil damages on account of personal injury to or death of any person or damage to property resulting from the operation, in the line of duty, of an authorized emergency vehicle while responding to an emergency call or when in the immediate pursuit of an actual or suspected violator of the law, or when responding to but not upon returning from a fire alarm or other emergency call.

### **Rules of the Road**

#### ***CVC Section 21055***

The driver or an authorized emergency vehicle is exempt from Chapter 2 (commencing with Section 21350), Chapter 3 (commencing with Section 21650), Chapter 4 (commencing with Section 21800), Chapter 5 (commencing with Section 21950), Chapter 6 (commencing with Section 22100), Chapter 7 (commencing with Section 22348), Chapter 8 (commencing with Section 22450), Chapter 9 (commencing with Section 22500), Section 10 (commencing with Section 22650) of this Division, and Article 3 (commencing with Section 38305) and Article 4 (commencing with Section 38312) of Chapter 5 of Division 16.5, and under all of the following conditions:

- (a) If the vehicle is being driven in response to an emergency call or while engaged in rescue operations or is being used in the immediate pursuit of an actual or suspected violator of the law or is responding to, but not returning from, a fire alarm, except that fire department vehicles are exempt whether directly responding to an emergency call or operated from one place to another as rendered desirable or necessary by reason of an emergency call and operated to the scene of the emergency or operated from one fire station to another or to some other location by reason of the emergency call.
- (b) If the driver of the vehicle sounds a siren as may be reasonably necessary and the vehicle displays a lighted red lamp visible from the front as a warning to other drivers and pedestrians.

A siren shall not be sounded by an authorized emergency vehicle except when required under this section.

#### ***CVC Section 21056***

##### *Effect of Exemption*

Section 21055 does not relieve the driver of a vehicle from the duty to drive with due regard for the safety of all persons using the highway, nor protect him from the consequences of an arbitrary exercise of the privileges granted in that section.



# FIRE APPARATUS DRIVER/OPERATOR 1A

## Emergency Vehicle Operations

Topic 1-3: Legal Aspects of Emergency and Nonemergency Driving



### **CVC Section 21706**

#### *Following Emergency Vehicles*

No motor vehicle, except an authorized emergency vehicle, shall follow within 300 feet of any authorized emergency vehicle being operated under the provision of Section 21055.

### **CVC Section 21707**

#### *Fire Areas*

No motor vehicle, except an authorized emergency vehicle or a vehicle of a duly authorized member of a fire or police department, shall be operated within the block wherein an emergency situation responded to by any fire department vehicle exists, except that in the event the nearest intersection to the emergency is more than 300 feet there from, this section shall prohibit operation of vehicles only within 300 feet of the emergency, unless directed to do so by a member of the fire department or police department, sheriff, deputy sheriff, or member of CHP. The emergency shall be deemed to have ceased to exist when the official of the fire department in charge at the scene of the emergency shall so indicate. Officials of the fire department, police department, or the Department of the California Highway Patrol who are present shall make every effort to prevent the closing off entirely of congested highway traffic passing the scene of any such emergency.

### **CVC Section 21708**

#### *Fire Hoses*

No person shall drive or propel any vehicle or conveyance upon, over, or across, or in any manner damage any fire hose or chemical hose used by or under the supervision and control of any organized fire department. However, any vehicle may cross a hose provided suitable jumpers or other appliances are installed to protect the hose.

### **CVC Section 22104**

#### *Turning Near Fire Stations*

No person shall make a U-turn in front of the driveway entrance or approaches to a fire station. No person shall use the driveway entrance or approaches to a fire station for turning a vehicle to proceed in the opposite direction.

### **CVC Section 22454**

#### *School Bus: Meeting and Passing*

- (a) The driver of any vehicle, upon meeting or overtaking, from either direction, any school bus equipped with signs as required in this code, that is stopped for the purpose of loading or unloading any schoolchildren and displays a flashing red light signal and stop signal arm, as defined in paragraph (4) of subdivision (b) of Section 25257, if equipped with a stop signal arm, visible from front or rear, shall bring the vehicle to a stop immediately before passing the school bus and shall not proceed past the school bus until the flashing red light signal and stop signal arm, if equipped with a stop signal arm, cease operation.

- (b) (1) The driver of a vehicle upon a divided highway or multiple-lane highway need not stop upon meeting or passing a school bus that is upon the other roadway.
- (c) For the purposes of this subdivision, a multiple-lane highway is any highway that has two or more lanes of travel in each direction.

### Safety

#### **CVC Section 26700(a)**

##### *Windshields*

Every fire truck, fire engine or other fire apparatus, whether publicly or privately owned, shall be equipped with an adequate windshield.

#### **CVC Section 27305**

##### *Firefighting Vehicles*

All publicly owned firefighting vehicles designed for and used in responding to emergency fire calls and in combating fires shall be equipped with seatbelts for each seat utilized by personnel when such vehicles are being operated.

### Right-Of-Way

#### **CVC Section 21806**

##### *Authorized Emergency Vehicles*

Upon the immediate approach of authorized emergency vehicle which is sounding a siren and which has at least one lighted lamp exhibiting red light that is visible, under normal atmospheric conditions, from a distance of 1,000 feet to the front of the vehicle, the surrounding traffic shall, except as otherwise directed by a traffic officer, do the following:

- (a) (1) Except as required under paragraph (2), the driver of every other vehicle shall yield the right-of-way and shall immediately drive to the right-hand edge or curb of the highway, clear of any intersection, and thereupon shall stop and remain stopped until the authorized emergency vehicle has passed.
  - (2) A person driving a vehicle in an exclusive or preferential use lane shall exit that lane immediately upon determining that the exit can be accomplished with reasonable safety.
- (b) The operator of every streetcar shall immediately stop the streetcar, clear of any intersection, and remain stopped until the authorized emergency vehicle has passed.
- (c) All pedestrians upon the highway shall proceed to the nearest curb or place of safety and remain there until the authorized emergency vehicle has passed.



# FIRE APPARATUS DRIVER/OPERATOR 1A

## Emergency Vehicle Operations



Topic 1-3: Legal Aspects of Emergency and Nonemergency Driving

### ***CVC Section 21807***

#### *Effect of Exemption*

The provision of Section 21806 shall not operate to relieve the driver of an authorized emergency vehicle from the duty to drive with due regard for the safety of all persons and property.

### **Equipment on Vehicles**

#### ***CVC Section 24002***

##### *Vehicle Not Equipped or Unsafe*

- (a) It is unlawful to operate any vehicle or combination of vehicles which is in an unsafe condition, or which is not safely loaded, and which presents an immediate safety hazard.
- (b) It is unlawful to operate any vehicle or combination of vehicles that is not equipped as provided in this code.

#### ***CVC Section 27305***

##### *Firefighting Vehicles*

All publicly owned firefighting vehicles designed for and used in responding to emergency fire calls and in combating fires shall be equipped with seat belts for each seat utilized by personnel when such vehicles are being operated. Such seat belts shall comply with requirements established by the department.

### **Miscellaneous Laws**

#### ***CVC Section 2801***

##### *Obedience to Fire Fighters*

It is unlawful to willfully fail or refuse to comply with any lawful order, signal, or direction of any member of any fire department, paid, volunteer, or company operated, when wearing the badge or insignia of a fire fighter and when in the course of his duties he is protecting the personnel and fire department equipment.

#### ***CVC Section 2818***

##### *Crossing Flare or Cone Patterns*

It is unlawful to traverse a flare pattern, cone pattern, or combination thereof, provided for the regulation of traffic, or provided in any situation where public safety personnel are engaged in traffic control or emergency scene management.

### Activity 1-3-1

<b>Title:</b>	Legal Aspects Of Emergency And Nonemergency Driving
<b>Time Frame:</b>	0:45
<b>Materials Needed:</b>	<ul style="list-style-type: none"><li>• <u>State of California Vehicle Code</u>, DMV (one copy for each group)</li><li>• Writing board/pad with markers/erasers</li></ul>
<b>Introduction:</b>	This activity provides you the opportunity to research the laws and regulations governing emergency and nonemergency driving of fire apparatus using the California Vehicle Code.
<b>Directions:</b>	<ol style="list-style-type: none"><li>1. For each topic listed for your group, identify the applicable CVC section.</li><li>2. Using the writing board or pad, write the code section and a brief summary highlighting its important points.</li><li>3. You have 30 minutes to complete this activity.</li><li>4. Be prepared to discuss your answers with the class.</li></ol>
<b>Instructor Note:</b>	The section and page numbers listed below apply to the 2008 Edition of the California Vehicle Code. It is imperative that you update these if using a newer edition of the code.



# FIRE APPARATUS DRIVER/OPERATOR 1A

## Emergency Vehicle Operations



Topic 1-3: Legal Aspects of Emergency and Nonemergency Driving

### GROUP 1

#### **Code 3 Authorization**

1. Red lights and sirens restriction
- 

#### **Civil Liability**

2. Liability of a public entity
- 

#### **Warning Systems**

3. Red warning lamps
- 
4. Additional warning lights
- 
5. Use of flashing warning amber lights
- 
6. Use of horns
- 

#### **Rules Of The Road**

7. Exemption of authorized emergency vehicles
-



# FIRE APPARATUS DRIVER/OPERATOR 1A

## Emergency Vehicle Operations



Topic 1-3: Legal Aspects of Emergency and Nonemergency Driving

### GROUP 2

#### **Code 3 Authorization**

1. Definition of an authorized emergency vehicle
- 

#### **Civil Liability**

2. Liability of public employees
- 

#### **Warning Systems**

3. Flashing upper beams
- 
4. Limits use of flashing or steady burning red light
- 

#### **Rules Of The Road**

5. Duty of drive with due regard
- 

#### **Safety**

6. Windshields
-



# FIRE APPARATUS DRIVER/OPERATOR 1A

## Emergency Vehicle Operations



Topic 1-3: Legal Aspects of Emergency and Nonemergency Driving

### GROUP 3

#### **Civil Liability**

1. Liability of private fire departments
- 

#### **Warning Systems**

2. Controlling traffic signals
- 

3. Horns
- 

4. Sirens
- 

#### **Rules Of The Road**

5. Following emergency vehicles
- 

6. Vehicles within the identified fire areas
- 

#### **Safety**

7. Seatbelts
-

## Topic 2-1: Introduction to Inspection, Basic Maintenance, and Troubleshooting

Student information for this topic can also be found in the [California Commercial Driver Handbook](#), DMV, 2008 Edition, Pages 19-22, 115-126 and [Pumping Apparatus Driver/Operator Handbook](#), IFSTA, Second Edition, Pages 31-51.

The following are recommendations from [NFPA 1911: Inspection, Maintenance, Testing, and Retirement of In-Service Automotive Fire Apparatus](#), NFPA, 2007 Edition.

### Inspections

All inspections shall be conducted in accordance with the manufacturers recommended procedures. It shall be the responsibility of the authority having jurisdiction to develop and implement a schedule of service and maintenance for the fire apparatus, systems, and components based on manufacturer's recommendations, local experience, and operating conditions. Inspections shall be performed at least as frequently as the manufacturer's recommended intervals and when the fire apparatus or any component is suspected or reported to have defects or deficiencies. All defects or deficiencies found during an inspection shall be reported, repaired, or corrected by a qualified person.

It shall be the responsibility of the authority having jurisdiction to develop written criteria for when the apparatus is to be taken out-of-service. The presence of defects and deficiencies that reduce the operational safety and performance of the apparatus below the level established in the 49 CFR, part 390, "Federal Motor Carrier Safety Regulations"; applicable federal, state, and local regulations; applicable nationally recognized standards; manufacturers' recommendations; and guidelines established by the fire department or its designated service and maintenance organization shall be considered when developing the out-of-service criteria. The apparatus shall be returned to service only after defects and deficiencies have been corrected.

### Maintenance and Repairs

Maintenance and repairs shall be made in accordance with manufacturer's recommendations. Parts or components used to maintain or repair the fire apparatus shall meet or exceed the original manufacturer's specifications.

### Roadability

A road test shall be conducted at least annually, after each scheduled maintenance interval, and after repair, adjustment, or modification of the engine, transmission, drive train, suspension, brakes, or steering. The roadability of the fire apparatus and the operation of the power train shall be inspected to determine if any defects exist.



# FIRE APPARATUS DRIVER/OPERATOR 1A

## Emergency Vehicle Operations



Topic 2-2: Inspection and Basic Maintenance of the Driver/Crew Areas, Apparatus Body, and Compartmentation

## Topic 2-2: Inspection and Basic Maintenance of the Driver/Crew Areas, Apparatus Body, and Compartmentation

Student information for this topic can also be found in the [California Commercial Driver Handbook](#), DMV, 2008 Edition, Pages 115-126 and [Pumping Apparatus Driver/Operator Handbook](#), IFSTA, Second Edition, Pages 31-54.

The following are recommendations from [NFPA 1911: Inspection, Maintenance, Testing, and Retirement of In-Service Automotive Fire Apparatus](#), NFPA, 2007 Edition.

### Inspection and Basic Maintenance

- All glass, windows, and mirrors shall be inspected for condition and be operationally tested.
- All seats shall be inspected for security of mounting and condition and shall be operationally tested.
- All seat belts shall be inspected for security of mounting and condition and shall be operationally tested.
- Doors, door hinges, latches, and doorstops shall be inspected for security of mounting and condition, shall be operationally tested, and shall be lubricated.
- All components of the cab mounting system, including the following components, shall be inspected for security of mounting and deformation:
  - Mounting brackets.
  - Cab base structure.
  - Resilient cushions.
  - Securing fasteners.
- All equipment mounting systems shall be inspected for security of mounting and deformation and shall be maintained free of corrosion. This inspection and maintenance shall include mounting systems for the following:
  - Radios, computers, and siren controls.
  - Self-contained breathing apparatus (SCBA).
  - Portable lights.
  - Hand tools.
  - Emergency medical service (EMS) equipment.
  - Books, street directories, and maps.
- All compartments and storage areas shall be inspected for structural integrity, deformation, and leaks.
  - Hinges, latches, seals, and door positioning shall be operationally tested and shall be lubricated.

- All steps, platforms, handrails, and access ladders shall be inspected for security of mounting, structural integrity, and deformation.
- All skid-resistant surfaces shall be inspected for security of mounting and condition.
- All mechanical steps shall be operationally tested and shall be lubricated.
- All equipment mounting racks and brackets shall be inspected for security of mounting and deformation, shall be operationally tested, and shall be lubricated.
- All finishes, signs, labels, and reflective striping shall be inspected for defects, corrosion, and damage.
- The hazard warning light and interlocks shall be operationally tested for:
  - Any open passenger or equipment compartment door.
  - Any ladder or equipment rack not in the stowed position.
  - A deployed stabilizer system.
  - An extended powered light tower.

### **Out-Of-Service Criteria**

The following defects and deficiencies of the driving and crew areas, the apparatus body, and the compartmentation reduce the operational safety and performance of the fire apparatus and shall be considered when developing the out-of-service criteria:

- Body mounting that is defective.
- Cab mounting that is defective.
- Seat belts that are torn, have melted webbing, missing or broken buckles, or loose mountings. Due to the extreme safety-related consequences of a defective seat belt, and the fact that one defective seat belt (unless it is the driver's seat belt) does not render a piece of apparatus unusable, the authority having jurisdiction shall take any seating position with a defective seat belt out-of-service.
- Cracked or broken windshield that obstructs the driver's/operator's view.
- Missing or broken rearview mirrors that obstruct the driver's/operator's view.
- Windshield wipers that are missing or inoperable.
- Steering wheel that has a deficiency.
- Oil pressure gauge or engine/transmission temperature gauges that have failed.
- Air gauge or audio low air warning device that has failed.
- Door latches that are defective.
- Defrosters that are defective.
- Foot throttle that is defective.

### **CCDH**

- None stated.

## 2-3: Inspection and Basic Maintenance of the Frame, Axles, Steering/Suspension, Driveline, Wheels, and Tires

Student information for this topic can also be found in the [California Commercial Driver Handbook](#), DMV, 2008 Edition, Pages 115-126 and [Pumping Apparatus Driver/Operator Handbook](#), IFSTA, Second Edition, Pages 31-51.

The following are recommendations from [NFPA 1911: Inspection, Maintenance, Testing, and Retirement of In-Service Automotive Fire Apparatus](#), NFPA, 2007 Edition.

### Inspection and Basic Maintenance

#### **Frame and Suspension**

- All frame rails and members shall be inspected for defects, structural integrity, perforations, and missing or loose parts.
- All suspension components, including but not limited to the following components, shall be inspected for defects and functional operation and shall be lubricated:
  - Springs and spring hangers.
  - Air springs (bags), mounting brackets, and attaching hardware.
  - Equalizer beams and torque arms.
  - Shock absorbers.
  - The frame and suspension shall be inspected for proper alignment.

#### **Axles, Tires, and Wheels**

- All axle components, including the following, shall be inspected for security of mounting, structural integrity, deformation, abnormal wear, leakage, and be operationally tested and lubricated:
  - Ball-joints.
  - Kingpins.
  - Spindles and bushings.
  - Attaching hardware.
  - Axle beams and housings.
  - Axle shafts.
  - Axle power dividers.
  - Differentials and controls.
  - Two-speed axle shift units.
  - Upper and lower control arms.
  - Wheel bearings and seals shall be cleaned, shall be inspected for deformation, wear, cracks, and leakage, and shall be lubricated.

- Tires shall be inspected for damage and shall be inflated to the tire manufacturer's recommended pressure.
- Tires shall be replaced when the tread wear exceeds state or federal standards. Tread wear shall be measured with a tread depth gauge.
- Wheel-attaching nuts shall be torqued to the wheel manufacturer's recommendation.
- Wheels and rims shall be inspected for cracks, deformation, structural integrity, and corrosion.

### **Driveline**

- All drive shafts, universal joints, carrier bearings, flanges, bearing cap bolts, and slip yokes shall be inspected for alignment, security of mounting, wear, and be lubricated.
- Driveline retarding systems shall be cleaned, inspected for security of mounting, operationally tested, and lubricated.

### **Steering System**

- All steering components shall be inspected for structural integrity, security of mounting, leakage, condition, and be operationally tested and lubricated.
- The steering components shall include but not be limited to the following:
  - Power steering pump, filters, and reservoir.
  - Steering valve(s), cylinders, and hydraulic components.
  - Steering gear box(es).
  - Steering gear mounting brackets.
  - Steering rods, drag links, pitman arms, tie rods, and tie rod ends.
  - Steering column assembly and steering wheel.
  - The steering gear box(es) and power steering reservoir lubricant levels shall be maintained in accordance with the manufacturer's recommendations.
  - The steering valve(s), steering arms, drag links, pitman arms, tie rod ends, and steering column assembly shall be lubricated.
  - All belts, hoses, and lines shall be inspected for wear, adjustment, and deformation.
  - Electronic steering controls and indicators shall be maintained in accordance with the manufacturer's recommendations.

### **Out-Of-Service Criteria**

- The following defects and deficiencies of the chassis, axles, steering and suspension systems, driveline, wheels, and tires reduce the operational safety and performance of the fire apparatus and shall be considered when developing the out-of-service criteria:
  - Tires that have cuts in the sidewall that penetrate to the cord.
  - Tires that are defective.
  - Tires that have a tread depth of 4/32" or less on any steering axle or 2/32" or less on any nonsteering axle at any two adjacent major tread grooves anywhere on the tire.

- Suspension components that are defective.
- Wheel fasteners that are missing or broken.
- Wheels that are defective.
- Axle flanges that have Class 3 leakage.
- An axle that has any Class 3 leakage.
- Steering components that are defective.
- A steering component that has Class 3 leakage.
- Driveline components that are defective.

## Visual Signs of Improper Tire Wear

### **Toe Wear**

When the toe angle (in or out) is severe, the tire treads wear unevenly because the wheel is contacting the pavement at an angle causing the tire to drag sideways as it rolls. The outside edge of each tread tends to wear off while the inner edge becomes sharp and ragged. Sometimes passing the hand across the tire face easily identifies this condition.

### **Camber**

Excessive camber angle (negative or positive) causes the diameter of the tire to vary from side to side. The smallest diameter slips and slides to equal the speed of the largest diameter. This produces uneven wear on one side. The wear pattern on this tire was caused by excessive, negative camber.

### **Under-inflation**

When a tire is under-inflated, it does not have sufficient air pressure to adequately support the load. This causes the sidewalls to flex and produces maximum wear on the outside edges and minimum wear in the center of the tread. Always inspect tires for leaking or worn tire valves and proper tire pressure.

### **Over-inflation**

Over-inflation does not permit the tire to contact the road properly. Excessive wear will be noted in the central portion of the tread. This produces a "stiff" ride and reduces the tire's ability to "hold" the road.

### **Out-of-balance**

A combination of tire unbalance and intermittent camber angle change has produced numerous depressions in the tread at the outer edge. Wheel balance is extremely important for prolonged tire life and ride control. Static or dynamic unbalance place undue stress on wheel bearings and suspension parts.

### **Manufacturer's Information**

Local manufacturers or dealers may have additional information pertaining to tire wear and may be an excellent resource.

## Topic 2-4: Troubleshooting the Frame, Axles, Steering and Suspension Systems, Driveline, Wheels, and Tires

### Steering Problems

<b>SYMPTOM:</b> 1) Front End Pulls Right Or Left; 2) Apparatus Drifts Right Or Left; 3) Apparatus Is Hard To Steer.	
Possible Cause	Possible Corrective Action
<input type="checkbox"/> Low tire pressure. <input type="checkbox"/> Front end out-of-alignment. <input type="checkbox"/> Axle out-of-alignment. <input type="checkbox"/> Mixed tires. <input type="checkbox"/> Mixed rims.	<input type="checkbox"/> Check tire pressure; add air if needed. <input type="checkbox"/> Visually check components for any obvious defects. <input type="checkbox"/> If problem persists or defects found, contact your department's fleet manager for a plan of action.

### Noises

<b>SYMPTOM:</b> Growling Or Whining Coming From The Rear Axle.	
Possible Cause	Possible Corrective Action
<input type="checkbox"/> Bearing failure. <input type="checkbox"/> Low oil level in rear axle.	<input type="checkbox"/> Check oil level; add oil if needed. <input type="checkbox"/> Do not drive any further than absolutely necessary; continuous operation could cause irreversible damaged to components involved. <input type="checkbox"/> If problem persists, contact your department's fleet manager for a plan of action

<b>SYMPTOM:</b> Loud Clang When Placing The Apparatus Into Gear From Driveline	
Possible Cause	Possible Corrective Action
<input type="checkbox"/> Pinion bearing out-of-adjustment. <input type="checkbox"/> Universal joint failure/excessive wear.	<input type="checkbox"/> Visually inspect the universal joint and driveline for obvious defects. <input type="checkbox"/> Contact your department's fleet manager for a plan of action.

<b>SYMPTOM:</b> Clunking Sound In The Front End While Turning Left Or Right.	
Possible Cause	Possible Corrective Action
<input type="checkbox"/> Worn suspension parts. Oftentimes, as bushings wear out, the suspension will begin to shift from side-to-side in corners. This can potentially cause handling problems at inopportune moments.	<input type="checkbox"/> Contact your department's fleet manager for a plan of action.

### Vibrations

<p><b>SYMPTOM:</b> Fine (Mild) Vibration At Road Speeds. Any vibration indicates that something is worn out, out-of-balance, or broken. Almost all vibrations will eventually cause some sort of component failure.</p>	
Possible Cause	Possible Corrective Action
<ul style="list-style-type: none"> <li><input type="checkbox"/> Driveline out-of-balance.</li> <li><input type="checkbox"/> Failure of universal joint.</li> <li><input type="checkbox"/> Failure of carrier bearing.</li> <li><input type="checkbox"/> Failure of input or output shaft bearings.</li> </ul>	<ul style="list-style-type: none"> <li><input type="checkbox"/> Catch early.</li> <li><input type="checkbox"/> Any one of these conditions is reason to take apparatus out-of-service.</li> <li><input type="checkbox"/> Contact your department's fleet manager for a plan of action.</li> </ul>

<p><b>SYMPTOM:</b> Coarse (Hard) Vibration.</p>	
Possible Cause	Possible Corrective Action
<ul style="list-style-type: none"> <li><input type="checkbox"/> Probably progressed from a fine vibration.</li> <li><input type="checkbox"/> Most likely some kind of catastrophic failure of the drive train.</li> <li><input type="checkbox"/> Wheel/tire out-of-balance.</li> <li><input type="checkbox"/> Bent wheel.</li> <li><input type="checkbox"/> Object between dual tires.</li> </ul>	<ul style="list-style-type: none"> <li><input type="checkbox"/> Remove object from between tires.</li> <li><input type="checkbox"/> Do not move the apparatus until the problem is identified and it is safe to do so.</li> <li><input type="checkbox"/> Take out-of-service.</li> <li><input type="checkbox"/> Contact your department's fleet manager for a plan of action.</li> </ul>

### Apparatus Does Not Move

<p><b>SYMPTOM:</b> Apparatus In Gear, Driveline Turns But Apparatus Won't Move.</p>	
Possible Cause	Possible Corrective Action
<ul style="list-style-type: none"> <li><input type="checkbox"/> Pump not shifted from PUMP to ROAD position.</li> <li><input type="checkbox"/> Broken axle.</li> <li><input type="checkbox"/> Broken ring and pinion gear.</li> <li><input type="checkbox"/> Two-speed rear differential stuck between high and low.</li> </ul>	<ul style="list-style-type: none"> <li><input type="checkbox"/> Shift pump to ROAD position.</li> <li><input type="checkbox"/> Check operator's manual; may be something as simple as a blown fuse.</li> <li><input type="checkbox"/> Take out-of-service.</li> <li><input type="checkbox"/> Contact your department's fleet manager for a plan of action.</li> </ul>

### Apparatus Leans

<p><b>SYMPTOM:</b> Apparatus Leans To Left Or Right. Fire apparatus spends most of its life sitting in an apparatus bay fully loaded. Spring steel needs to be exercised in order to maintain its tension.</p>	
Possible Cause	Possible Corrective Action
<ul style="list-style-type: none"> <li><input type="checkbox"/> Sagging spring or broken spring leaf on front or rear suspension.</li> </ul>	<ul style="list-style-type: none"> <li><input type="checkbox"/> Sagging spring; contact your department's fleet manager for a plan of action.</li> <li><input type="checkbox"/> Broken spring, take out-of-service; contact your department's fleet manager for a plan of action.</li> </ul>

## Topic 2-5: Inspection and Basic Maintenance of Engine Systems

Student information for this topic can also be found in the California Commercial Driver Handbook, DMV, 2008 Edition, Pages 115-126 and Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 31-51.

The following are recommendations from NFPA 1911: Inspection, Maintenance, Testing, and Retirement of In-Service Automotive Fire Apparatus, NFPA, 2007 Edition.

### Inspection and Basic Maintenance

#### **Engine Cooling System**

- The coolant shall be inspected for contamination and maintained at the level specified by the manufacturer.
- The radiator assembly shall be inspected and cleaned of dirt, debris, and obstructions to airflow.
- All hoses and fittings shall be inspected for condition and leakage.
- The water pump(s) shall be inspected for condition and leakage.
- The cooling system shall be pressure tested for leakage.
- All belts shall be inspected for wear, deformation, and proper adjustment.
- The chemical components of the coolant shall be tested and maintained at the proper balance.
- Auxiliary heat exchangers installed in the engine cooling system shall be inspected for security of mounting, deformation, and leaks.
- Cooling system temperature indicators and gauges shall be operationally tested.
- Temperature control devices, including but not limited to the following devices, shall be operationally tested:
  - Thermostats.
  - Clutch fans.
  - Radiator shutters.
  - Electric cooling fans.

#### **Engine Fuel System**

- Fuel filters and fuel-water separators shall be maintained in accordance with the manufacturers' recommendations.
- The fuel tank, lines, and all connections shall be inspected for security of mounting, deformation, and leakage.

- The carburetor or the injection pump and injectors shall be maintained in accordance with the engine manufacturer's recommendations.
- Gauges, indicators, and sending units shall be operationally tested.
- Fuel level shall be maintained at the specified level.
- All mechanical throttle linkage and stops shall be inspected for proper adjustment and operationally tested.
- All electronic throttle components and throttle position sensors (TPS) shall be inspected for counts and operationally tested.

### Engine Air Filtration System

- The air filtration system shall be maintained in accordance with the manufacturer's severe service recommendation. If no severe service recommendation exists, the shortest service interval recommended by the engine manufacturer, based on time or mileage, shall be adhered to.
- The air system shall include but not be limited to the following:
  - Air cleaner element.
  - Piping.
  - Turbocharger.
  - After-cooler.
  - Intercooler.
  - Air-to-air cooler.
  - Blower.
- With engines so equipped, the charged air after-cooler shall be inspected visually for outward signs of damage or deformation.
- All hoses, tubes, and fittings shall be inspected for deformation and leakage.
- The airflow shall be tested for restriction greater than that recommended by the engine manufacturer.

### Engine Exhaust System

- The exhaust system shall be inspected for security of mounting, deformation, and exhaust leaks and shall be maintained in accordance with the engine manufacturer's recommendations.
- The exhaust system shall include but not be limited to the following:
  - Exhaust manifold(s).
  - Exhaust pipes.
  - Muffler(s).
  - Tailpipe(s).

- Exhaust clamps, brackets, and mounting hardware.
- Turbocharger.
- Catalytic converter(s).
- Exhaust filtration system.

### **Out-of-Service Criteria**

The following defects and deficiencies of the engine systems reduce the operational safety and performance of the fire apparatus and shall be considered when developing the out-of-service criteria:

#### **General Engine Systems**

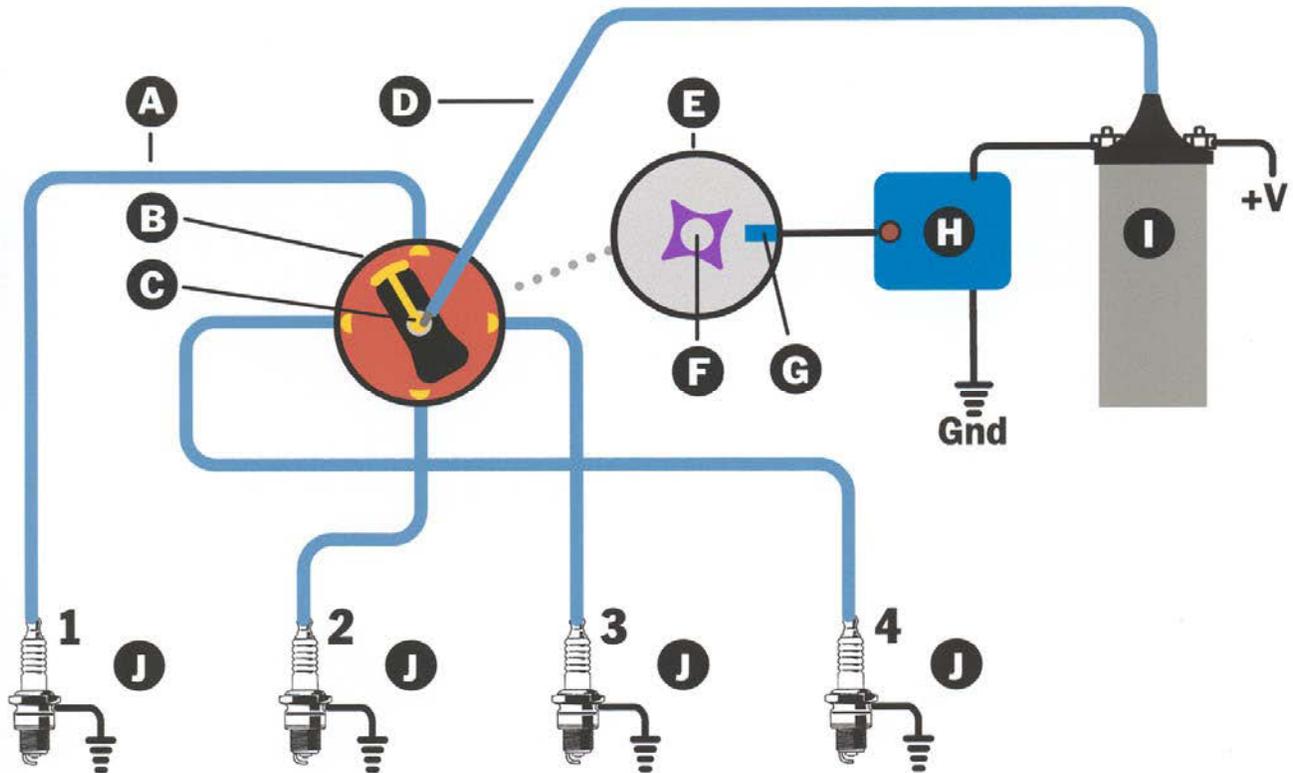
- Air filter restriction indicator that shows maximum restriction.
- Engine that will not crank or start.
- Engine system that has Class 3 leakage of oil.
- Engine that is overheating.
- Oil that contains coolant.
- Oil that is diluted with fuel.
- A fuel system component that has Class 2 leakage of fuel.
- Fuel tank, mountings, or straps that are defective.
- Stop-engine light that fails to turn off after engine is started.

#### **Engine Cooling System**

- Cooling system component that has Class 3 leakage.
- Coolant that contains oil.
- Radiator that is defective.
- Water pump bearing that is defective.
- Cooling fan that is defective.
- Coolant system components that are defective.

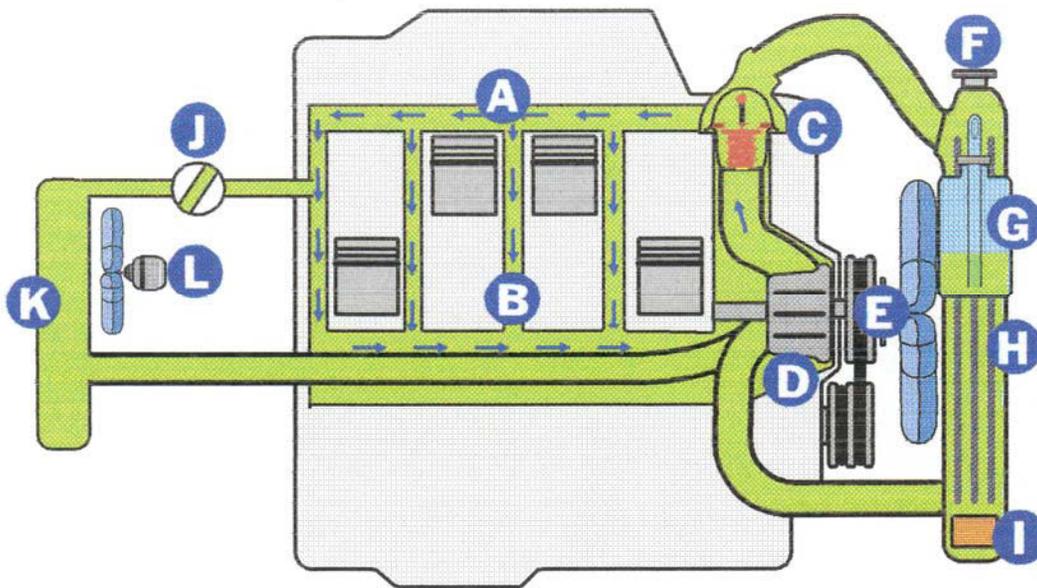
#### **Secondary Ignition Systems**

- Any portion of the secondary ignition system that is defective.



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- |                                 |                                 |
|---------------------------------|---------------------------------|
| <b>A</b> Spark Plug Wire        | <b>F</b> Distributor Cam        |
| <b>B</b> Distributor Cap        | <b>G</b> Ignition Signal Sensor |
| <b>C</b> Rotor                  | <b>H</b> Ignition Module        |
| <b>D</b> High Voltage Coil Lead | <b>I</b> Ignition Coil          |
| <b>E</b> Distributor Body       | <b>J</b> Spark Plugs            |



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- |                        |                              |
|------------------------|------------------------------|
| <b>A</b> Head Cooling  | <b>G</b> Overflow Tank       |
| <b>B</b> Block Cooling | <b>H</b> Radiator            |
| <b>C</b> Thermostat    | <b>I</b> Transmission Cooler |
| <b>D</b> Water Pump    | <b>J</b> Heater Valve        |
| <b>E</b> Radiator Fan  | <b>K</b> Heater Core         |
| <b>F</b> Radiator Cap  | <b>L</b> Heater Fan          |

## Topic 2-6: Troubleshooting Engine Systems

Student information for this topic can also be found in Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 45-51.

### Gasoline Engine

Gasoline fuel systems are often linked to the emission systems and can become very complicated. Contact your department's fleet manager for assistance.

<b>SYMPTOM:</b> Engine Will Not Start	
<b>Possible Cause</b>	<b>Possible Corrective Action</b>
<input type="checkbox"/> Flooded; too much fuel in the engine.	<input type="checkbox"/> Ensure the choke is off. Slowly push the throttle all the way to the floor; do not let off. Crank the engine over until it starts. If the engine still will not start, allow it to set for approximately five minutes and then try again.  <input type="checkbox"/> If problem persists, contact your department's fleet manager for a plan of action.
<input type="checkbox"/> No fuel to the engine	<input type="checkbox"/> Remove the air intake from the carburetor and look down the throat of the carburetor. Simultaneously pump the throttle. You should see fuel spray inside the carburetor. If not, you have no fuel to the engine and your fuel pump is probably out.  <input type="checkbox"/> Take out-of-service; contact your department's fleet manager for a plan of action.

### Diesel Engine

Diesel engines rely on the fuel system being completely sealed from any contaminants. The system is very sensitive to dirt and air pockets. The slightest air pocket inside the fuel system can cause a drop in fuel pressure, causing the engine to misfire. Diesel fuel systems are also set up with very close tolerance between components. The slightest bit of dirt can ruin a fuel pump or fuel injector.

<b>SYMPTOM:</b> Engine Will Not Start	
<b>Possible Cause</b>	<b>Possible Corrective Action</b>
<input type="checkbox"/> No fuel to the system	<input type="checkbox"/> Ensure fuel tank is at least one-half full <input type="checkbox"/> Ensure fuel is reaching the clean side of the filter Open the pet cock on top of the fuel filter If fuel is not present at the filter, use the fuel primer (if equipped) to pump up the system <input type="checkbox"/> Take apparatus out-of-service, if engine still will not start
<input type="checkbox"/> Air leak in the fuel system	<input type="checkbox"/> Check all fuel lines for signs of leaking fuel If fuel comes out, then air will go in Tighten leaking fittings, if possible Bleed the air in accordance with the manufacturer's recommendations and specifications <input type="checkbox"/> Contact your department's fleet manager for a plan of action if the apparatus still will not start

## Coolant Level

External coolant levels on fire apparatus are generally easy to see when a coolant leak shows up on the clean apparatus bay floor. An internal leak may not be so obvious. Water in the oil, however, may separate, settle to the bottom of the oil reservoir, and go undetected until it is too late.

<b>SYMPTOM:</b> Loosing Coolant	
<b>Possible Cause</b>	<b>Possible Corrective Action</b>
<input type="checkbox"/> External leak caused by damage or corrosion.	<input type="checkbox"/> Check the entire cooling system for coolant leaks. May be able to fix the leaks by simply tightening a hose clamp or replacing a radiator cap.
<input type="checkbox"/> Internal leaks caused by a failed head gasket, cylinder head, or piston sleeve.	<input type="checkbox"/> Check the motor oil. If it has a milky white appearance to it, you have coolant in the oil. <input type="checkbox"/> Take out-of-service.

## Lubrication System

Oil leaks on older apparatus are common and should be watched carefully.

<b>SYMPTOM:</b> Loud Engine Knock Accompanied By A Dramatic And Sudden Drop In Oil Pressure	
<b>Possible Cause</b>	<b>Possible Corrective Action</b>
<input type="checkbox"/> External damage to the oil reservoir and loss of oil. <input type="checkbox"/> Broken connecting rod. <input type="checkbox"/> Catastrophic (complete) failure of oil pump.	<input type="checkbox"/> Shutdown immediately. <input type="checkbox"/> Take out-of-service.

<b>SYMPTOM:</b> Leaking Oil, Creating A Puddle Larger Than Two Inches In Diameter On The Floor	
<b>Possible Cause</b>	<b>Possible Corrective Action</b>
<input type="checkbox"/> Leaking gaskets. <input type="checkbox"/> Leaking oil lines. <input type="checkbox"/> Loose drain plug. <input type="checkbox"/> Loose oil filter.	<input type="checkbox"/> If the leak is found, attempt to tighten to stop the leak. <input type="checkbox"/> If the leak is coming from a source you cannot see or cannot repair, contact your department's fleet manager for a plan of action.

## Air System (Intake and Exhaust)

<b>SYMPTOM:</b> Sudden Loss Of Power Without Increase In Engine Noise	
<b>Possible Cause</b>	<b>Possible Corrective Action</b>
<input type="checkbox"/> Failure of pressure tube from exhaust that drives the turbocharger.	<input type="checkbox"/> Attempt to reattach or repair the hose until you can get to a location where proper repairs can be made.

<b>SYMPTOM:</b> Gradual Loss Of Power With Heavy Black Smoke Coming From Exhaust	
<b>Possible Cause</b>	<b>Possible Corrective Action</b>
<input type="checkbox"/> Turbo failure.	<input type="checkbox"/> Take out-of-service.

The most common cause of turbo failure is due to improper shutdown procedures. The turbo turns at 10,000 rpms and relies on oil from the main engine to keep it lubricated. If the main engine is shutdown before the turbo stops turning, the turbo will not receive sufficient lubrication and may be destroyed.

### Exhaust Systems

<b>SYMPTOM:</b> Sudden Increase In Exhaust Noise	
<b>Possible Cause</b>	<b>Possible Corrective Action</b>
<input type="checkbox"/> Damaged muffler or pipe. <input type="checkbox"/> Damaged or worn out exhaust gaskets (donuts).	<input type="checkbox"/> None of these problems would take the apparatus immediately out-of-service. <input type="checkbox"/> Contact your department's fleet manager for a plan of action.

<b>SYMPTOM:</b> Gradual Increase In Exhaust Noise Starting As A Slight Ticking Noise	
<b>Possible Cause</b>	<b>Possible Corrective Action</b>
<input type="checkbox"/> Failing exhaust manifold gasket at the cylinder head.	<input type="checkbox"/> Does not require apparatus to be taken out-of-service. As the noise increases, it can become a serious problem. Problem should be addressed. <input type="checkbox"/> Contact your department's fleet manager for a plan of action.

## Topic 2-7: Inspection and Basic Maintenance of the Transmission and Clutch

Student information for this topic can also be found in the [California Commercial Driver Handbook](#), DMV, 2008 Edition, Pages 115-126 and [Pumping Apparatus Driver/Operator Handbook](#), IFSTA, Second Edition, Pages 31-54.

The following are recommendations from [NFPA 1911: Inspection, Maintenance, Testing, and Retirement of In-Service Automotive Fire Apparatus](#), NFPA, 2007 Edition.

### **Inspection and Basic Maintenance**

- The transmission shall be inspected for security of mounting, structural integrity, and leakage and shall be operationally tested.
- The clutch and linkage, if the fire apparatus is so equipped, shall be inspected for condition and adjustment, be operationally tested, and maintained in accordance with the manufacturer's recommendations.
- Transmission lubricants and filters shall be inspected for contamination. Lubricants shall be maintained at the level specified by the manufacturer.
- The lubricant and filters shall be serviced in accordance with the transmission manufacturer's severe service recommendation. If no severe service recommendation exists, the shortest interval recommended by the transmission manufacturer, based on time or mileage, shall be adhered to.
- The transmission controls and shift linkage shall be inspected for condition and maintained in accordance with the manufacturer's recommendations.
- All transmission indicators and gauges shall be tested for proper operation and accuracy.
  - The diagnostic codes for all electronically controlled transmissions shall be inspected.
  - PTOs (power takeoffs) shall be inspected for security of mounting, leakage, and be operationally tested.
- The lockup system for pumps and other accessories shall be inspected for leakage and be operationally tested.
- Transmission braking systems shall be maintained in accordance with the manufacturer's recommendations.
- Auxiliary heat exchangers installed in the transmission cooling system shall be inspected for security of mounting, deformation, and leaks.

### **Out-of-Service Criteria**

- The following defects and deficiencies of the transmission and clutch reduce the operational safety and performance of the fire apparatus and shall be considered when developing the out-of-service criteria:
  - Shift linkages or clutch and transmission components that are defective.
  - Automatic transmission that overheats in any range.
  - Automatic transmission that has a "Do not shift" light on.
  - Transmission components that have Class 3 leakage of transmission oil.

## Topic 2-8: Troubleshooting the Transmission and Clutch

### Manual Transmissions

<b>SYMPTOM:</b> Transmission Growls Under A Load	
<b>Possible Cause</b>	<b>Possible Corrective Action</b>
<input type="checkbox"/> Failure of one of the main bearings in the transmission.	<input type="checkbox"/> Take out-of-service; contact your department's fleet manager for a plan of action.

Bearing failure may be caused by low oil levels in the transmission. An apparatus with this condition needs to be looked at by a qualified mechanic.

<b>SYMPTOM:</b> Transmission Growls All Of The Time	
<b>Possible Cause</b>	<b>Possible Corrective Action</b>
<input type="checkbox"/> Clutch is out-of-adjustment causing the throw-out bearing to fail.	<input type="checkbox"/> Take out-of-service; contact your department's fleet manager for a plan of action.

The clutch pedal needs to have some free play in it. Otherwise, the throw-out bearing will be running all of the time and burn out.

<b>SYMPTOM:</b> Transmission Growls When You Press On The Clutch	
<b>Possible Cause</b>	<b>Possible Corrective Action</b>
<input type="checkbox"/> Throw-out bearing is failing due to improper use or adjustment Most common failure in manual transmissions	<input type="checkbox"/> Take out-of-service; contact your department's fleet manager for a plan of action

### Automatic Transmissions

<b>SYMPTOM:</b> Transmission Is Leaking Large Amounts Of Fluid When In Gear	
<b>Possible Cause</b>	<b>Possible Corrective Action</b>
<input type="checkbox"/> Too much fluid.	<input type="checkbox"/> Shutdown immediately; take out-of-service until the level of fluid has been reduced to normal.  <input type="checkbox"/> Transmission has been inspected and tested by a qualified technician.

Offentimes, overfilling a transmission with fluid can cause the transmission case to become overpressurized. This can cause the seals to be blown out, allowing fluid to leak.

<b>SYMPTOM:</b> Engine Is Running But The Transmission Will Not Engage	
<b>Possible Cause</b>	<b>Possible Corrective Action</b>
<input type="checkbox"/> Auxiliary systems that override transmission control may be in use.	<input type="checkbox"/> Check all auxiliary systems to ensure they are in the lock-down position.
<input type="checkbox"/> Most likely low on fluid.	<input type="checkbox"/> Check for leaks; add fluid if needed. <input type="checkbox"/> If transmission still will not engage, contact your department's fleet manager for a plan of action.

If the transmission is so low on fluid that the pump cannot pick it up, the vehicle will not move. This generally will not damage the components unless it runs for an extended period without fluid. However, if the fluid is low but the pump still picks it up, there is the risk of overheating the transmission.

<b>SYMPTOM:</b> Transmission Will Not Shift Up Or Down	
<b>Possible Cause</b>	<b>Possible Corrective Action</b>
<input type="checkbox"/> Low fluid level.	<input type="checkbox"/> Add fluid.
<input type="checkbox"/> Computer failure.	<input type="checkbox"/> Shutoff engine. Disconnect, and then reconnect the batteries (this reboots the computer). <input type="checkbox"/> Try it again. <input type="checkbox"/> Contact your department's fleet manager for a plan of action if transmission still will not engage.

## Topic 2-9: Inspection and Basic Maintenance of the Starting, Charging, and Other Electrical Systems

Student information for this topic can also be found in the California Commercial Driver Handbook, DMV, 2008 Edition, Pages 115-126 and Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 31-54.

The following are recommendations from NFPA 1911: Inspection, Maintenance, Testing, and Retirement of In-Service Automotive Fire Apparatus, NFPA, 2007 Edition.

### Inspection and Basic Maintenance

#### **Low Voltage Electrical System**

- All components of the electrical system shall be maintained in a clean condition and free of corrosion.
- All components of the starting system, including but not limited to the following, shall be inspected for security of mounting and deformation and shall be operationally tested:
  - Batteries, cabling, and connections.
  - Cranking motor.
  - Solenoid, relays, and switches.
  - Interlock systems.
- The battery(ies) shall be tested for storage and performance capabilities in accordance with the manufacturer's recommendations.

#### **Charging Systems**

- All components of the charging system shall be inspected for security of mounting, deformation, and alignment, and shall be operationally tested:
  - Alternator, regulator, and associated wiring and cables.
  - Rectifiers.
  - Isolators.
  - Alternator drive belts.
  - Solenoids, relays, switches, instrumentation, and lighting.
  - Interlock systems.
- The alternator shall be operationally tested for the output performance.

#### **Primary Ignition Systems**

- All components of the ignition system, including but not limited to the following, shall be inspected for security of mounting, deformation, and be operationally tested:
  - Associated wiring and cables.

- Solenoid, relays, switches, instrumentation, and lighting.
- Primary systems.
  - Glow plugs.

### **Electrical Load Management System (ELMS)**

- If so equipped, all components of the automatic electrical load management system shall be inspected for security of mounting and deformation:
  - Electronic hardware.
  - Associated wiring and cables.
  - Solenoid, relays, switches, instrumentation, and lighting.
  - Low-voltage warning devices.
- The electrical load management system shall be tested for activation and operation of low-voltage warning devices in accordance with the manufacturer's recommendations.

### **Miscellaneous Electrical Components**

- Miscellaneous electrical components, including but not limited to the following components, shall be inspected for security of mounting, deformation, and be operationally tested:
  - Battery conditioners and chargers.
  - Shoreline receptacles.
  - Radios and intercoms.
  - Converters and inverters.
  - Fast idle system.
  - Interlock system(s).
  - Operator alert devices.

### **Fire Apparatus Lighting**

- All fire apparatus lighting, including but not limited to the following, shall be inspected for security of mounting, deformation, and be operationally tested:
  - Headlights.
  - Marker lights.
  - Clearance lights.
  - Turn signals and hazard lights.
  - Brake lights.
  - Backup lights.
  - Dash lights.

### Work Lighting

- All work lighting, including but not limited to the following, shall be inspected for security of mounting, deformation, and be operationally tested:
  - Ground lights.
  - Step lights.
  - Flood, spot, and scene lights.
  - Cab interior lights.
  - Compartment lights.

### Electrical Accessories

- All electrical accessories shall be operationally tested:
  - Heater and defroster.
  - Air-conditioning system.
  - Windshield wipers and washers.
  - Instrumentation.

### Warning Devices – Code 3 Lighting

- All warning devices, including but not limited to the following, shall be inspected for security of mounting, deformation, and be operationally tested:
  - Emergency warning lights.
  - Electric and electronic sirens.
  - Automotive traffic horn.
  - Air horns.
  - Backup alarm.
  - Traffic preemption.

### Out-of-Service Criteria

- The following defects and deficiencies of the low voltage electrical system and the line voltage electrical system reduce the operational safety and performance of the fire apparatus and shall be considered when developing the out-of-service criteria:
  - Federal Department of Transportation lighting that is defective.
  - Ignition or charging system that is defective.
  - Grounding and bonding of the line voltage electrical system that is defective.

## Topic 2-10: Troubleshooting the Starting, Charging, and Other Electrical Systems

Student information for this topic can also be found in Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 48, 49, and 51.

### Basic Units

The three basic units in electricity are voltage (**V**), current (**I**), and resistance (**r**). Voltage is measured in **volts**, current is measured in **amps**, and resistance is measured in **ohms**. A clever analogy to help understand these terms is to visualize a system of plumbing pipes. The voltage is equivalent to the water pressure, the current is equivalent to the flow rate, and the resistance is similar to the pipe size.

### **Voltage**

Voltage can be defined as an electrical pressure and is the electromotive force that causes movement of the electrons in a conductor. Voltage is the difference between the positive and negative charges. An electrical pressure difference is created when there is an excess of electrons at one point in the circuit and a lack of electrons at another point in the circuit. In the automotive application, the battery or alternator is used to apply the electrical pressure. The amount of pressure applied to a circuit is stated in the number of volts. If a voltmeter is connected across the terminals of an automobile battery, it may indicate 12.6 volts. This is actually indicating here is a difference in potential of 12.6 volts. There is 12.6 volts of electricity at one battery terminal compared to zero volts at the other terminal.

### **Current**

Current can be defined as the rate of electron flow and is measured in amperes. Current is a measurement of the electrons passing any given point in the circuit in one second. Because the flow of electrons is at the speed of light, it would be impossible to physically see electron flow. However, the rate of electron flow can be measured. Current will increase as pressure or voltage is increased-provided circuit resistance remains constant.

### **Resistance**

There is a basic equation in electrical engineering that states how the three terms relate. It says that the current is equal to the voltage divided by the resistance. Let us see how this relation applies to the plumbing system. If you have a tank of pressurized water connected to a hose you use to water the garden, what happens if you increase the pressure in the tank? You probably can guess that this makes more water come out of the hose. The same is true of an electrical system -- increasing the voltage will make more current flow. What would happen if you increase the diameter of the hose and all of the fittings to the tank? You probably guessed that this also makes more water come out of the hose. This is similar to decreasing the resistance in an electrical system, which increases the current flow.

## Ohm's Law ( $\Omega$ )

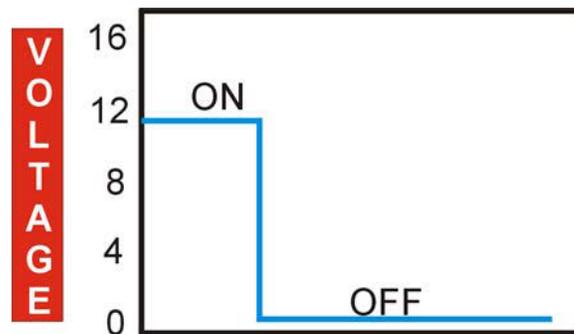
The ohm ( $\Omega$ ) is the resistance of a conductor such that a constant current of 1 ampere in it produces a voltage of 1 volt between its ends. Ohm's Law defines the relationship between current, voltage, and resistance. If any two of these three electrical values are known, the third can be found. Ohm's law is the Mathematical formula that shows how current, voltage and resistance work together to produce electricity.

## Watt's Law

Power is another term used in analyzing electrical circuits. Power is found by using Watt's Law, which defines the relationship between current, voltage, and power.

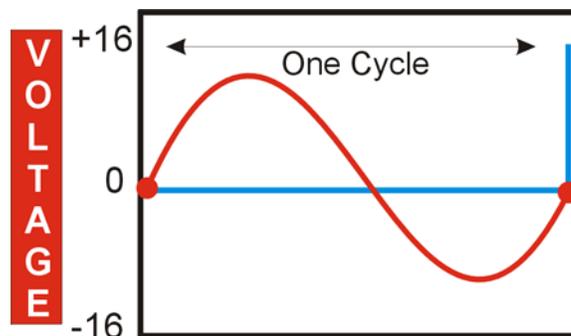
## Direct Current

Direct current (DC) results from a source voltage and current that remains constant and flows in the same direction. Voltage and current are constant if the switch is turned to the on or off position. Most of the electrically controlled units in fire apparatus use direct current (stored power).



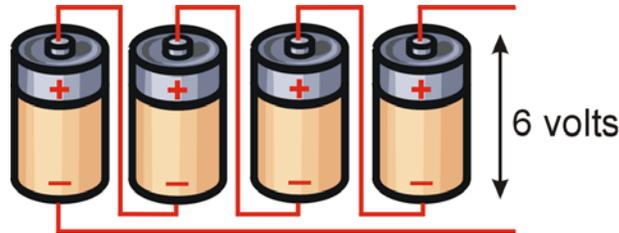
## Alternating Current

In an alternating current (AC) circuit, voltage and current do not remain constant. AC changes direction from positive to negative. The voltage in an AC circuit starts at zero and rises to a positive value. Then, it falls back to zero and goes to a negative value. Each cycle of AC occurs in an equal amount.



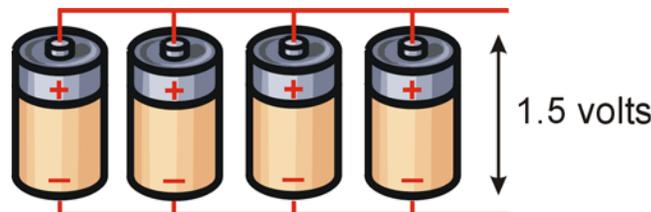
## Series Circuit

A series circuit consists of one or more resistors (loads) with only one path for current to flow. If any of the components in the circuit fails, the entire circuit will not function. All of the current that comes from the positive side of the battery must pass through each resistor, and then back to ground.



## Parallel Circuit

In a parallel circuit, each path of current flow has separate resistances that operate either independently or in conjunction with each other (depending on circuit design). In a parallel circuit, current can flow through more than one resistor at a time. Failure of a component in one shunt does not affect the components in the other shunts of the circuit.



## Test Equipment

### Jumper Wires

Jumper wires (not the same as jumper cables) are simply a wire with an alligator clip on each end. **Warning!** Never connect a jumper wire across the terminals of the battery; the battery could explode causing serious injury. Connecting one end of the jumper wire to positive battery post will provide an excellent 12-volt power supply for testing components.

Jumper wires can be used to check the load of components by bypassing switches, conductors, and connections in the circuit. They can also be used to provide the ground to test that portion of the circuit.

### Test Lights

Test lights are used when you need to "look" for electrical power in the circuit. The handle on a test light is transparent and contains a light bulb. A sharp probe extends from one end of

the handle and a ground wire with a clamp extends from the other end. The lamp should light after clamping the lead of the test light to ground and probing a live circuit.

**Warning!** It is not recommended that a test light be used to probe for power in a computer-controlled circuit. The increased draw of the test light may damage the system components.

### Self-Powered Continuity Tester

A self-powered continuity tester is used to test circuits without power and looks similar to a test light. This tester has a battery that lights when the circuit is complete between the probe and the lead.

**Warning!** Do not connect a self-powered test light to a circuit that is powered; doing so will damage the test light.

### Voltmeter

The voltmeter is one of the most used meters in the shop and is used to read the pressure behind the flow of electrons. It is connected in parallel with a circuit and reads directly in volts.

### Ammeter

An ammeter is used to measure current draw. Many styles require them to be connected in series with the current load to read the amount of current draw. To make the series connection, disconnect the load and reconnect it with all of the current going through the ammeter. Polarity must be followed.

**Warning!** Do not connect the meter in parallel with the circuit; this can cause damage to the test meter.

## Circuit Defects

### Open

An open circuit is a circuit in which there is a break in continuity. It is similar to turning off the switch, resulting in the system not operating.

### Short

A short circuit is a circuit that allows current to bypass part of the normal path. An example of this would be insulation that breaks down, allowing two wires to contact each other, copper to copper.

### Ground

Ground is a condition that allows current to return to ground before it has reached the intended load component. This can be checked by removing the fuse and connecting a test lamp in series across the fuse connections. If the lamp lights, the circuit is grounded.

### Excessive Voltage Drop

Voltage drop occurs when current flows through a load component (resistance). There must be a voltage drop present for current to flow through a resistor. If resistance is excessive at any point, it will result in an excessive voltage drop across that portion of the circuit.

### Charging and Starting Systems

#### Batteries, Starter, and Alternator

##### Batteries

Batteries are reservoirs that hold energy. They are the first components in the electrical system, and the first place that should be checked when a problem occurs.

- Is the battery switch on?
- Are battery terminals clean and serviced?

A corroded battery terminal can be the only problem in 80% of electrical problems.

The first step is to perform a voltage test. Check the voltmeter on the apparatus or use a hand-held voltmeter. If the voltage is below 11.5 volts, try charging the battery. After charging the battery completely, perform a load test using a load tester. Once this is done and the load test is positive, you have eliminated the batteries as the problem.

##### Starter

Engaging the starter is a two-step process. Step 1 activates the solenoid. In Step 2, the solenoid activates the starter motor.

<b>SYMPTOM:</b> Engine Will Not Turn Over	
<b>Possible Cause</b>	<b>Possible Corrective Action</b>
<input type="checkbox"/> Solenoid hangs up or it has a loose connection to the battery.	<input type="checkbox"/> Check the battery. <input type="checkbox"/> Check the connections at the starter. Both the solenoid and starter motor hook up. Make sure that the cables are disconnected. <input type="checkbox"/> Contact your department's fleet manager for a plan of action.

##### Alternator

Responsible for maintaining voltage (pressure) in the electrical system

<b>SYMPTOM:</b> Low Voltage (Low Pressure)	
Voltmeter is dropping below 12 volts and staying there. May place your apparatus out-of-service when electronic systems begin to shut down if the voltage (pressure) drops below 11.5 volts.	
<b>Possible Cause</b>	<b>Possible Corrective Action</b>
<input type="checkbox"/> Can be caused by a variety of system failures.	<input type="checkbox"/> Contact your department's fleet manager for a plan of action.

<b>SYMPTOM:</b> Growling Sound Coming From The Alternator Or Squealing Sound From The Belts	
<b>Possible Cause</b>	<b>Possible Corrective Action</b>
<input type="checkbox"/> Alternator may have bearing failure. <input type="checkbox"/> Voltmeter is rising above 16 volts and staying there.	<input type="checkbox"/> Take out-of-service; contact your department's fleet manager for a plan of action

### Lighting Circuits

<b>SYMPTOM:</b> Head Lights, Tail Lights, Or Marker Lights Do Not Light	
<b>Possible Cause</b>	<b>Possible Corrective Action</b>
<input type="checkbox"/> Light bulb failure. <input type="checkbox"/> Broken wire. <input type="checkbox"/> Corroded connection.	<input type="checkbox"/> Change the bulb. <input type="checkbox"/> Check the circuit using a test light. <input type="checkbox"/> Clean the corroded connection. <input type="checkbox"/> Contact your department's fleet manager for a plan of action.

<b>SYMPTOM:</b> Turn Signals Or Hazard Flashers Do Not Flash	
<b>Possible Cause</b>	<b>Possible Corrective Action</b>
<input type="checkbox"/> Bad light bulb. <input type="checkbox"/> Bad flasher unit. <input type="checkbox"/> Failure in the lighting circuit.	<input type="checkbox"/> Replace light bulb. <input type="checkbox"/> Change flasher unit. <input type="checkbox"/> Test the circuit with a test light. <input type="checkbox"/> Contact your department's fleet manager for a plan of action.

<b>SYMPTOM:</b> Brake Lights Do Not Light	
<b>Possible Cause</b>	<b>Possible Corrective Action</b>
<input type="checkbox"/> Light bulb failure. <input type="checkbox"/> Switch failure. <input type="checkbox"/> Circuit failure.	<input type="checkbox"/> Change light bulb. <input type="checkbox"/> Test brake light switch using a test light. <input type="checkbox"/> Test circuit using a test light. <input type="checkbox"/> Contact your department's fleet manager for a plan of action.

<b>SYMPTOM:</b> Auxiliary Systems And/Or Code 3 Systems Not Functioning Properly	
<b>Possible Cause</b>	<b>Possible Corrective Action</b>
<input type="checkbox"/> Can be caused by a variety of system failures. <input type="checkbox"/> Load manager operating. <input type="checkbox"/> Opticom™ installed with door or brake termination switch.	<input type="checkbox"/> Check load manager. <input type="checkbox"/> Close doors and/or release brake. <input type="checkbox"/> Contact your department's fleet manager for a plan of action.

## Topic 2-11: Inspection and Basic Maintenance of Brake Systems

Student information for this topic can also be found in the California Commercial Driver Handbook, DMV, 2008 Edition, Pages 63-74 and Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Page 44.

The following are recommendations from NFPA 1911: Inspection, Maintenance, Testing, and Retirement of In-Service Automotive Fire Apparatus, NFPA, 2007 Edition.

### Inspection and Basic Maintenance

#### **Braking Systems - General**

- The braking system shall be inspected and maintained in accordance with the manufacturer's severe service recommendation.
  - If no severe service recommendation exists, the shortest interval recommended by the braking system manufacturer, based on time or mileage, shall be adhered to.
- The parking brake shall be inspected for structural integrity, security of mounting, missing or broken parts, wear, and be operationally tested.
- The parking brake controls and activating mechanism shall be inspected for structural integrity, security of mounting, missing or broken parts, and be operationally tested and lubricated.
- The brake linings shall be replaced when they are contaminated, worn to the minimum thickness for safe operation as defined by the brake manufacturer, or when the brake drum or rotor is replaced.
- Linings shall be replaced in accordance with the brake manufacturer's severe service recommendation.
- The drums or rotors shall be inspected during scheduled maintenance, when there is a suspected problem, or at the time of brake lining replacement. This inspection shall consist of the following:
  - Evidence of extensive heat or heat cracking.
  - Out-of-round.
  - Wear beyond manufacturer's specifications.
  - Rust.
  - Taper.
  - Rotor parallelism.
  - Metal fatigue.
- Machining of brake drums or rotors shall be done only in accordance with manufacturer's recommendations.

- All components of the braking system shall be inspected for damage and wear when performing a brake overhaul.
- Antilock braking systems, including the electronic control unit, cables, switches, relays, sensors, and valves, shall be inspected for any deficiencies and shall be operationally tested.

### Air Brake Systems

- If the fire apparatus has an air brake system, the components to be inspected and maintained shall include but not be limited to the following:
  - Air compressor.
  - Pedal assembly.
  - All valves.
  - Hoses and lines.
  - Brake switches.
  - Brake air chambers.
  - Slack adjusters.
  - Cams and wedges.
  - Brake shoes or pads.
  - Brake drums or rotor.
  - Air dryers.
  - Drain valves.
  - Air tanks.
  - Warning devices.
  - Mounting hardware.
  - Drains.
  - Cylinders.
  - Compressor.
  - Inlet filter system.
  - Belts.
- Air brake system pressure protection valves shall be operationally tested (to the shutoff point).
  - If air accessories connected to the chassis air brake system drop the air pressure below 80 psi (552 kPa), the pressure protection valve shall disable the air accessories to ensure adequate air pressure for the braking system.
- The cut-in and cut-out pressure settings of the air compressor governor shall be tested and maintained at the manufacturer's recommended settings.

- The low-air warning systems shall be tested to ensure that activation occurs at the manufacturers recommended setting. Air pressure indicators shall be operationally tested.
- Leak-down rate (time) of the applied side of the air brake system shall be tested. An air pressure drop of more than 3 psi (20.7 kPa) in 1 minute for single fire apparatus or more than 4 psi (27.6 kPa) in 1 minute for combination fire apparatus, with the engine stopped and the service brakes applied, shall be considered unacceptable.
- Leak-down rate (time) of the supply-side of the chassis air system shall be tested. An air pressure drop of more than 2 psi (13.8 kPa) in 1 minute for single fire apparatus or more than 3 psi (20.7 kPa) in 1 minute for combination fire apparatus, with the engine stopped and the service brakes released, shall be considered unacceptable.

### Hydraulic Brake Systems

- If the fire apparatus has a hydraulic brake system, the components to be inspected and maintained shall include the following:
  - Pedal and linkage.
  - Brake switches.
  - Master cylinder.
  - Brake booster.
  - Hydraulic lines.
  - Valves.
  - Wheel cylinders or calipers.
  - Brake shoes or pads.
  - Brake drums or rotors.
  - Warning devices.
  - Mounting hardware.
  - Fluid level.
  - Contamination.

### Out-of-Service Criteria

#### Air Brake System

- The following defects and deficiencies of the air brake system reduce the operational safety and performance of the fire apparatus and shall be considered when developing the out-of-service criteria:
  - Service brakes that have an air pressure drop of more than 2 psi (13.8 kPa) in 1 minute for single fire apparatus or more than 3 psi (20.7 kPa) in 1 minute for combination fire apparatus, with the engine stopped and the service brakes released.

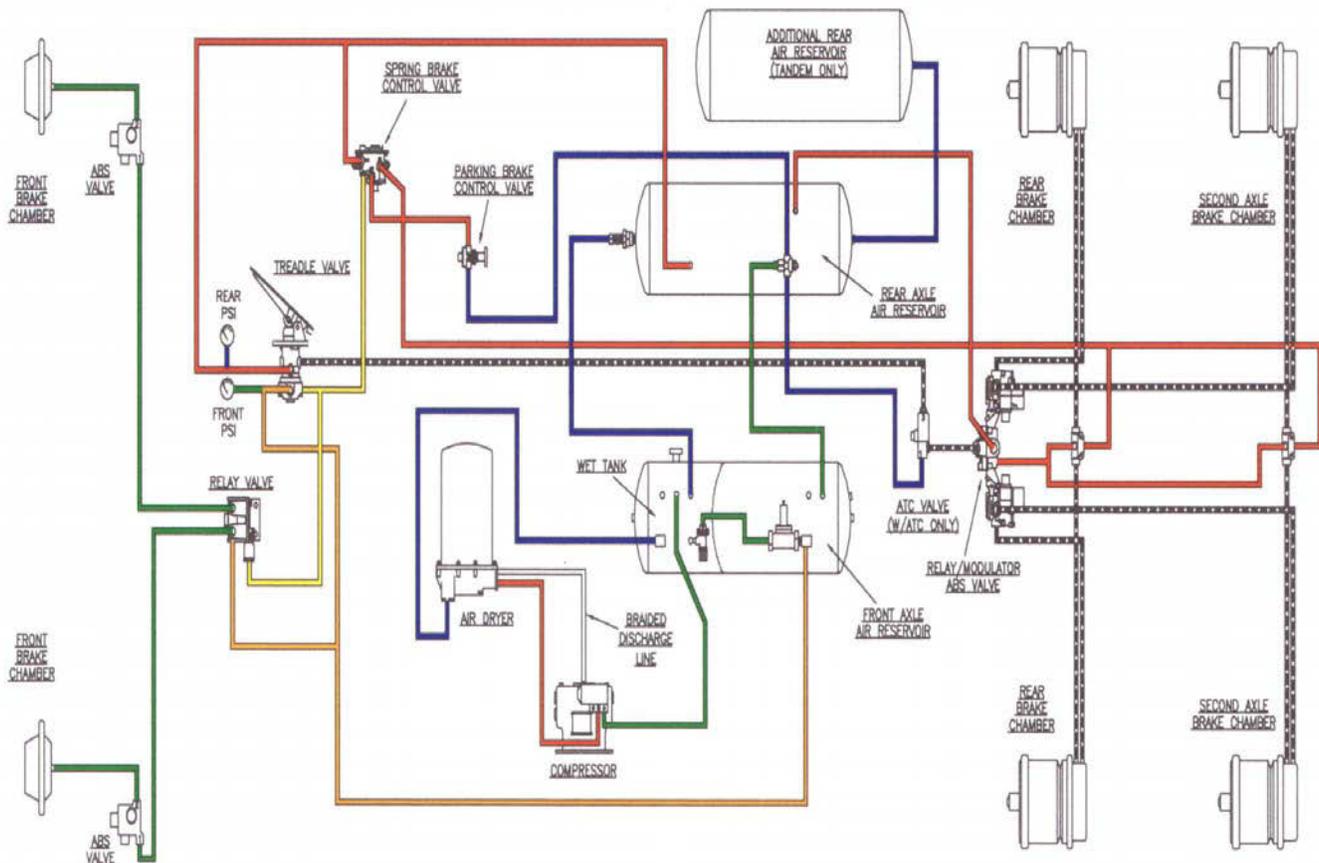
- Leak-down rate (time) of the applied side of the air brake that is more than 3 psi (20.7 kPa) in 1 minute for single fire apparatus or more than 4 psi (27.6 kPa) in 1 minute for combination fire apparatus, with the engine stopped and the service brakes applied.
- Brakes that are out-of-adjustment.
- Braking system components that are defective.
- Braking operation that is ineffective.
- Parking brake operation that is ineffective.
- Air compressor that fails to build air pressure.
- Air compressor that fails to maintain 80-90 psi (552-621 kPa) pressure in the system with the service brakes applied and the engine at idle, or air compressor that fails to fill the air system to the air compressor governor cutout pressure with the service and parking brakes released.
- Friction surfaces, brake shoes, or disc brake pads that have grease or oil on them.
- Brake lining or pads that are worn beyond the brake system manufacturer's minimum specifications.
- Rotors and drums that are worn beyond the brake system manufacturer's minimum specifications.
- Antilock braking system (ABS) warning indicator that is activated.

### Hydraulic Brake System

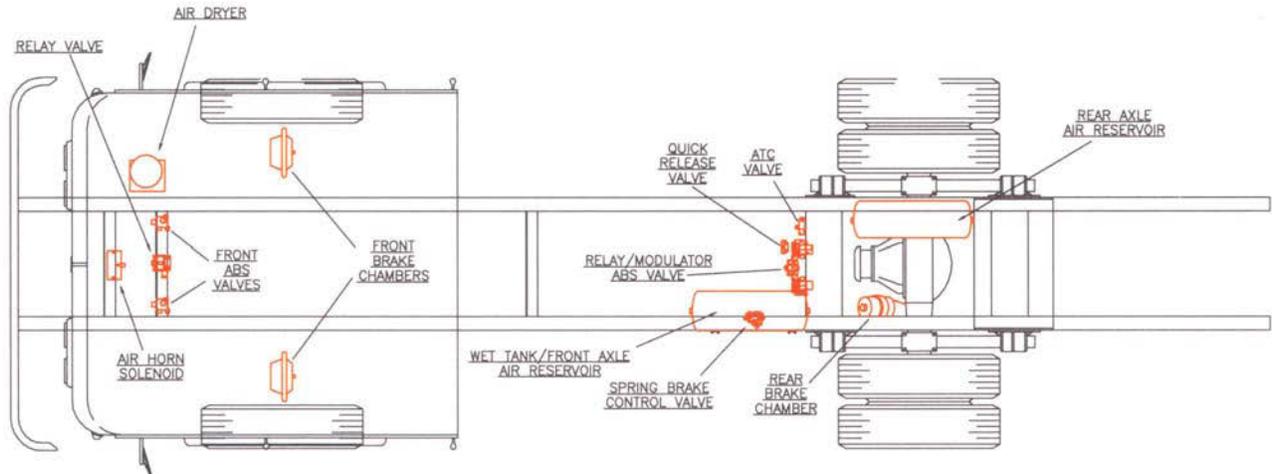
- The following defects and deficiencies of the hydraulic brake system reduce the operational safety and performance of the fire apparatus and shall be considered when developing the out-of-service criteria:
  - Brake system components that have Class 2 leakage of brake fluid.
  - Friction surfaces, brake shoes, or disc brake pads that have grease or oil on them.
  - Braking system components that are defective.
  - Braking operation that is ineffective.
  - Parking brake operation that is ineffective.
  - Brake warning light that is activated or brake pedal that falls away or drifts toward the flooring when brake pressure is applied.
  - Brake lining or pads that are worn beyond the brake system manufacturer's minimum specifications.
  - Rotors and drums that are worn beyond the brake system manufacturer's minimum specifications.
  - ABS warning indicator that is activated.

### Air Brakes

With the exception of an additional rear air reservoir and the second axle brake chambers, tandem axle systems are identical to single axle systems. The second axle brake chambers are plumbed to parallel to the first. This is a functional schematic; actual routing may vary.



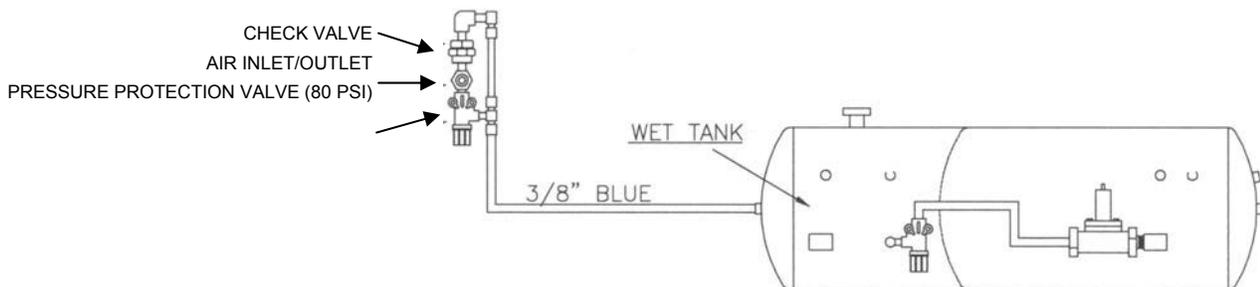
### Component Location



Typical locations for major air system components. Actual locations may vary depending on chassis model and custom modifications.

### Air Inlet/Outlet

The vehicle air system may be charged from this port through the check valve or system air can be accessed through the pressure protection valve as long as pressure is above 80 psi.



This is a functional schematic; actual routing may vary.

## Topic 2-12: Troubleshooting Brake Systems

### Air Compressor with Governor

<b>SYMPTOM:</b> Excessive Governor Cut-In/Cut-Out. Air compressor cycles too often or not often enough to keep up with the system.	
Possible Cause	Possible Corrective Action
<input type="checkbox"/> Defective compressor and/or governor.	<input type="checkbox"/> Contact your department's fleet manager for a plan of action.
<input type="checkbox"/> Excessive system leakage.	<input type="checkbox"/> Have leakage repaired.
<input type="checkbox"/> Reservoir volume reduced. System is partially filled with water, oil, or both.	<input type="checkbox"/> Drain water from system.
<input type="checkbox"/> Brakes out of adjustment.	<input type="checkbox"/> Contact your department's fleet manager for a plan of action.

<b>SYMPTOM:</b> Passing Excessive Oil While Draining Tanks	
Possible Cause	Possible Corrective Action
<input type="checkbox"/> Poorly filtered air.	<input type="checkbox"/> Check for defective intake components.
<input type="checkbox"/> No air dryers in system.	<input type="checkbox"/> Drain reservoirs daily.

<b>SYMPTOM:</b> Slow Air Buildup	
Possible Cause	Possible Corrective Action
<input type="checkbox"/> Poorly filtered air.	<input type="checkbox"/> Contact your department's fleet manager for a plan of action.
<input type="checkbox"/> Excessive governor cut-in/cut-out.	<input type="checkbox"/> Contact your department's fleet manager for a plan of action.
<input type="checkbox"/> Restricted air discharge.	<input type="checkbox"/> Contact your department's fleet manager for a plan of action.
<input type="checkbox"/> Loose pulley.	<input type="checkbox"/> Contact your department's fleet manager for a plan of action.
<input type="checkbox"/> Air dryer purge valve stuck open.	<input type="checkbox"/> Have air dryer purge valve repaired. <input type="checkbox"/> Contact your department's fleet manager for a plan of action.
<input type="checkbox"/> Braided discharge line heat fatigued.	<input type="checkbox"/> Check using a soap solution. <input type="checkbox"/> Contact your department's fleet manager for a plan of action.

## General Brake Symptoms

<b>SYMPTOM:</b> Sensitive Brakes	
<b>Possible Cause</b>	<b>Possible Corrective Action</b>
<ul style="list-style-type: none"> <li><input type="checkbox"/> Brakes improperly adjusted.</li> <li><input type="checkbox"/> Defective or improperly installed component.</li> <li><input type="checkbox"/> Chamber/slack alignment binding momentarily.</li> <li><input type="checkbox"/> Foot valve/pedal sticking.</li> <li><input type="checkbox"/> Lubrication. Too much damages rubber spring and/or boot. Too little causes plunger to stick.</li> <li><input type="checkbox"/> Installation. Body or mounting plate distortion due to uneven floor board or firewall mounting surface.</li> </ul>	<ul style="list-style-type: none"> <li><input type="checkbox"/> Contact your department's fleet manager for a plan of action.</li> </ul>

<b>SYMPTOM:</b> Brakes Will Not Apply Completely	
<b>Possible Cause</b>	<b>Possible Corrective Action</b>
<ul style="list-style-type: none"> <li><input type="checkbox"/> Brakes improperly adjusted.</li> <li><input type="checkbox"/> Automatic slack adjuster malfunction (under adjusting).</li> <li><input type="checkbox"/> Air line or component freeze-up.</li> <li><input type="checkbox"/> Faulty brake components.</li> <li><input type="checkbox"/> Foot valve/pedal sticking or movement restricted by floor board obstruction.</li> <li><input type="checkbox"/> Improper chamber/slack adjuster alignment.</li> <li><input type="checkbox"/> No air pressure in one brake circuit.</li> </ul>	<ul style="list-style-type: none"> <li><input type="checkbox"/> Contact your department's fleet manager for a plan of action.</li> </ul>

<b>SYMPTOM:</b> Brakes Will Not Release Completely	
<b>Possible Cause</b>	<b>Possible Corrective Action</b>
<ul style="list-style-type: none"> <li><input type="checkbox"/> Parking brakes on; will not release.</li> <li><input type="checkbox"/> Brakes improperly adjusted.</li> <li><input type="checkbox"/> Condition of brake components.</li> <li><input type="checkbox"/> Air lines pinched, improperly assembled into fittings, or misconnected.</li> <li><input type="checkbox"/> System contamination.</li> <li><input type="checkbox"/> Chamber/slack adjuster binding.</li> <li><input type="checkbox"/> Automatic slack adjuster malfunction (over-adjusting).</li> </ul>	<ul style="list-style-type: none"> <li><input type="checkbox"/> Contact your department's fleet manager for a plan of action.</li> </ul>

## Manual Slack Adjusters

<b>SYMPTOM:</b> Adjustment Backs Off	
<b>Possible Cause</b>	<b>Possible Corrective Action</b>
<input type="checkbox"/> Component malfunction.	<input type="checkbox"/> Contact your department's fleet manager for a plan of action.

## Automatic Slack Adjusters

Automatic slack adjusters should only be looked at by a Certified Air Brake Technician

## Air System Leaks

<b>SYMPTOM:</b> Air Leak Greater Than 2 psi In One Minute	
<b>Possible Cause</b>	<b>Possible Corrective Action</b>
<input type="checkbox"/> Air leak in system when brakes are not applied.	<input type="checkbox"/> Mix up a spray bottle of soapy water using dish soap and water. Tip: Warm water works better than cold. <input type="checkbox"/> Chock the apparatus to prevent movement. <input type="checkbox"/> Turn off the engine so you can hear possible air leaks. <input type="checkbox"/> Starting at the compressor, spray every fitting from the compressor to the foot control valve. Leaks will show up as bubbles at the location of the leak. <input type="checkbox"/> Once you have located the leak, contact your department's fleet manager for a plan of action.

<b>SYMPTOM:</b> Air Leak Greater Than 3 psi In One Minute	
<b>Possible Cause</b>	<b>Possible Corrective Action</b>
<input type="checkbox"/> Air leak in system when brakes are applied.	<input type="checkbox"/> Same as with 2 psi air leak. Hold pressure on the foot valve while you check for leaks; have someone assist you.

## Hydraulic Brake Systems

<b>SYMPTOM:</b> Brake Pedal Feels Soft And Spongy	
<b>Possible Cause</b>	<b>Possible Corrective Action</b>
<input type="checkbox"/> Low amount of fluid in the system.	<input type="checkbox"/> Add fluid to the reservoir.
<input type="checkbox"/> Air in the system.	<input type="checkbox"/> Have the air removed from the system by a qualified technician.

<b>SYMPTOM:</b> Pedal Drifts Toward Or Falls To The Floorboard	
<b>Possible Cause</b>	<b>Possible Corrective Action</b>
<input type="checkbox"/> Low amount of fluid in the system.	<input type="checkbox"/> Add fluid to the reservoir.
<input type="checkbox"/> Fluid leak in the system.	<input type="checkbox"/> Have a qualified technician repair or replace the source of the leak and restore the system to a proper working condition.

<b>SYMPTOM:</b> Lack Of Response Of A Powered Or Vacuum Assisted Brake Augmentation System	
<b>Possible Cause</b>	<b>Possible Corrective Action</b>
<input type="checkbox"/> Failure of the augmentation system or its ability to transfer energy to the brake system.	<input type="checkbox"/> Have a qualified technician restore the powered assist system.

## Secondary Braking Systems

<b>SYMPTOM:</b> Secondary Brake System Fails To Activate As Designed	
<b>Possible Cause</b>	<b>Possible Corrective Action</b>
<input type="checkbox"/> System is manually turned off.	<input type="checkbox"/> Ensure that the system is activated and is at the proper setting.
<input type="checkbox"/> System is activated but has failed.	<input type="checkbox"/> Take out-of-service. <input type="checkbox"/> Have it repaired by a qualified technician.

## Topic 2-13: Inspection and Basic Maintenance of Auxiliary and Accessory Equipment

Student information for this topic can also be found in the California Commercial Driver Handbook, DMV, 2008 Edition, Pages 115-126 and Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 31-51.

The following are recommendations from NFPA 1911: Inspection, Maintenance, Testing, and Retirement of In-Service Automotive Fire Apparatus, NFPA, 2007 Edition.

### Inspection and Basic Maintenance

#### **Voltage Electrical Systems (120/240 Volts)**

- All components of the line voltage generation unit shall be maintained in accordance with the recommendations of the manufacturer.
- All line voltage generation units shall be inspected for security of mounting, condition, fluid leakage, and proper operation.
- Inverters shall be inspected for security of mounting, condition, and be operationally tested.
- Remote controls for electric power generation units shall be inspected for condition and be operationally tested.
- All wiring and wire looms shall be inspected for security of mounting, proper routing, grommets in place, condition, and cleanliness.
- Instrumentation, including voltmeter(s), ammeter(s), and frequency meter(s); warning and indicator lights; and associated interlock systems shall be inspected for condition and operationally tested.
- All line voltage appliances and controls shall be inspected for security of mounting, condition, and be operationally tested:
  - Cord reels.
  - Extension cords.
  - Scene lights.
  - Switches.
  - Relays.
  - Receptacles.
  - Inlet devices.
  - Circuit breakers.
  - Ground fault circuit interrupters (GFCI).

### Engine-Driven Generators

- All components of an air-cooled engine-driven line voltage generator shall be inspected for security of mounting, deformation, cleanliness, leaks, and be operationally tested as recommended by the manufacturer.
- All components of a water-cooled engine-driven line voltage generator shall be inspected for security of mounting, deformation, cleanliness, leaks, and be operationally tested as recommended by the manufacturer.

### Power Takeoff (PTO)-Driven Line Voltage Generators

- All fluids in the PTO system(s) shall be inspected for contamination and be maintained at the level recommended by the manufacturer.
- All components of PTO-driven line voltage generators, including but not limited to the following components, shall be inspected for security of mounting, deformation, leaks, and be operationally tested as recommended by the manufacturer:
  - PTO.
  - Drive shafts.
  - Transfer case.
  - Gearbox.
  - Generator.

### Hydraulic-Driven Line Voltage Generators

- All fluids in the hydraulic system(s) shall be inspected for contamination and proper type and shall be maintained at the level recommended by the manufacturer.
- All components of hydraulic-driven line voltage generators, including but not limited to the following components, shall be inspected for security of mounting, deformation, leaks, and be operationally tested as recommended by the manufacturer:
  - Hydraulic pump.
  - Hydraulic motor.
  - Hydraulic fluid reservoir.
  - Hydraulic fluid cooler.
  - Control systems.
  - Hoses, lines, and valves.



# FIRE APPARATUS DRIVER/OPERATOR 1A

## Emergency Vehicle Operations



Topic 2-14: Inspection Documentation and Reports

## Topic 2-14: Inspection Documentation and Reports

Student information for this topic can also be found in Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 31-33 and 513-532.

### **Documentation**

Records shall be maintained on all inspections, maintenance requests, preventive maintenance, repairs, and testing results. Separate files shall be established and maintained for each individual fire apparatus.

## Topic 2-15: Pretrip Inspection Procedures

Student information for this topic can also be found in the California Commercial Driver Handbook, DMV, 2008 Edition, Pages 115-126 and Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 31-51 and 513-532.

The following are recommendations from NFPA 1911: Inspection, Maintenance, Testing, and Retirement of In-Service Automotive Fire Apparatus, NFPA, 2007 Edition.

### Activity 2-15-1

**Title:** Daily Apparatus and Equipment Check

**Time Frame:** 1:00

**Materials Needed:**

- Fire apparatus
- Daily apparatus and equipment checklist
- Tire pressure gauge
- Wiping rags
- Creeper
- Clipboard
- Pen or pencil

**Introduction:** This activity provides you the opportunity to complete a required daily inspection that complies with all applicable laws and standards.

**Directions:**

1. In your group, perform a complete inspection on the apparatus.
2. Document the inspection on the check sheet.
3. Your group has 30 minutes to complete this activity.
4. Be prepared to discuss your inspection results with the class.

**Student Note:** The instructor must demonstrate a complete inspection in detail before you perform this activity.  
The attached forms are sample checklists that may be used.  
The instructor can substitute his or her department's checklist.



# FIRE APPARATUS DRIVER/OPERATOR 1A



## Emergency Vehicle Operations

Topic 2-15: Pretrip Inspection Procedures

GROUP: \_\_\_\_\_ APPARATUS: \_\_\_\_\_ DATE: \_\_\_\_\_

### D A I L Y   A P P A R A T U S   A N D   E Q U I P M E N T   C H E C K

	OK	REPAIRS MADE	REPAIRS NEEDED
<b>VISUAL CHECK</b>			
Cleanliness			
Leaning to One Side			
Body Damage			
Puddles or Leaks			

	OK	REPAIRS MADE	REPAIRS NEEDED
<b>BRAKES, TIRES, AND UNDERCARRIAGE</b>			
Brake Linings and Pads			
Brake Drums and Rotors			
Brake Chambers			
Air Lines, Hose, Fittings			
Slack Adjusters			
Tire Pressure			
Tread			
Rims			
Lug Nuts			
Axle Seals			
Frame			
Exhaust System			
Drive Shaft			
Mud Flaps			
Fuel Tanks			
Fuel Lines and Fittings			
Springs			
Shocks			
Air Ride System			
Steering Box			
Steering Lines			
Steering Linkage			

	OK	REPAIRS MADE	REPAIRS NEEDED
<b>BRAKE CHECK</b>			
Air Leakage Rate Test			
Air Compressor Governor			
Cut-Out Pressure			
Cut-In Pressure			
Parking Brake Test			
Low Air Pressure Warning			
Air Pressure Buildup Rate			
Service Brake Test			

	OK	REPAIRS MADE	REPAIRS NEEDED
<b>ENGINE COMPARTMENT</b>			
Leaks			
Damaged Components			
Missing Components			
Engine Oil Level			
Coolant Level			
Power Steering Level			
Transmission Fluid Level			
Windshield Washer Level			
Drive Belts			
Radiator Hoses			
Air Hoses			
Fuel Lines			
Oil Lines			
Air Filter			
Battery			
Battery Terminals			

	OK	REPAIRS MADE	REPAIRS NEEDED
<b>CAB AREA – PRESTART</b>			
Battery Switch			
Key/Ignition Switch			
Seats			
Seatbelts			
Windshield Wipers/Blades			
Mirrors			
Glass			
Gauges			
Load Manager			
Floor Area Clean			
Maps and Books			
Fuel Tank Level			
Dome and Map Lights			

	OK	REPAIRS MADE	REPAIRS NEEDED
<b>CAB AREA - POSTSTART</b>			
Gauges			
Heater and Defroster			
Horn			
Emergency Lights, Sirens			
Radio, Portable Radio			
Computer/MDT			
Headlights			
Parking Lights			
Backup Lights			
Backup Alarm			
Flashers/Turn Signals			



# FIRE APPARATUS DRIVER/OPERATOR 1A

## Emergency Vehicle Operations

Topic 2-15: Pretrip Inspection Procedures



GROUP: \_\_\_\_\_ APPARATUS: \_\_\_\_\_ DATE: \_\_\_\_\_

### A P P A R A T U S O P E R A T O R S D A I L Y C H E C K L I S T

Check off each item as completed and indicate any fluids that are added. Log and record all fluids added and all maintenance problems in apparatus logbook with date, mileage, and your initials. Follow proper channels for needed repairs. Send all completed forms to the shop on the last day of every month. Also, complete a form after all significant class and daily when on a strike team.

#### I FLUID LEVELS

- |                                  |       |
|----------------------------------|-------|
| _____ Radiator                   | _____ |
| _____ Engine Oil                 | _____ |
| _____ Transmission Fluid         | _____ |
| _____ Hot and running in neutral | _____ |
| _____ Fuel                       | _____ |
| _____ Water Tank                 | _____ |
| _____ Assigned Equipment         | _____ |
| _____ Generators, Blowers, etc.  | _____ |
| _____ Priming Oil                | _____ |
| _____ Power Steering Fluid       | _____ |

#### QUANTITY ADDED

#### IV EQUIPMENT

- \_\_\_\_\_ Knox Box Key  
 \_\_\_\_\_ Portable Radios

#### V BODY AND RUNNING GEAR

- \_\_\_\_\_ Any New Body Damage Not Logged  
 \_\_\_\_\_ Tires (nails, glass, air, etc.)  
 \_\_\_\_\_ Belts and Hoses (condition and tension)  
 \_\_\_\_\_ Undercarriage (location of leaks and fluid color)  
 \_\_\_\_\_ Valve Operation (open and close) lube as necessary  
 \_\_\_\_\_ After Steam Cleaning, Lube All Effected Moving Parts

#### II ELECTRICAL SYSTEMS

- \_\_\_\_\_ Warning Lights  
 \_\_\_\_\_ Head and Parking Lights  
 \_\_\_\_\_ Turn Signals and Brake Lights  
 \_\_\_\_\_ Portable Radio Chargers  
 \_\_\_\_\_ Siren and Public Addresses  
 \_\_\_\_\_ Horns and Warning Buzzers (air and electric)  
 \_\_\_\_\_ Gauges (cab and panel)  
 \_\_\_\_\_ Cab and Compartment Lights

#### VI REMARKS

- Battery Readings \_\_\_\_\_  
 Brake Piston Travel \_\_\_\_\_  
 Amount of Water Discharge from Air Tanks \_\_\_\_\_  
 Operation of Relief and Change Over Valves \_\_\_\_\_  
 Oil Needed, Lubrication, etc. \_\_\_\_\_  
 Engine Miles \_\_\_\_\_  
 Road Miles \_\_\_\_\_  
 Tire Pressure \_\_\_\_\_  
 Other \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

#### III AIR SYSTEMS

- \_\_\_\_\_ Air Pressure  
 \_\_\_\_\_ Parking Brakes (set and release)  
 \_\_\_\_\_ Air Leaks in Brake System  
 \_\_\_\_\_ Full pressure, engine off, foot brakes applied  
 \_\_\_\_\_ Air Line and Hose

#### WEEKLY

- Monday Check batteries. Inspect cables. Dip fuel tanks and check for water.  
 Tuesday Check brake piston travel, tire pressure, lug nuts, and axle nuts.  
 Wednesday Clean and inspect undercarriage. Clean engine compartment. Tighten all loose screws, nuts, and bolts.  
 Thursday Check batteries. Clean compartments. Bleed air tanks.  
 Friday Clean, flush, and operate relief and change over valves. Wax and touch up.  
 Saturday Run and clean all mechanical equipment, electrical equipment, and ground ladders. Lube and discharge rods and valves.  
 Sunday Make-up day. Bleed air tanks. Operate aerial ladders. Check ground jacks

#### MONTHLY

- 1<sup>st</sup> Monday Remove and clean battery cables. Check hydraulic fluids.  
 1<sup>st</sup> Tuesday Inventory first aid kit. Date and record findings. Check intake valves and all screens.  
 1<sup>st</sup> Wednesday Pressure check all spare oxygen cylinders. Date sign tag.  
 1<sup>st</sup> Thursday Clean communicator rings. Grease fifth wheel. Grease locks.  
 1<sup>st</sup> Friday Inventory toolbox. Date and sign record.  
 1<sup>st</sup> Saturday Check and clean any special equipment. Rotate all ground ladders.  
 1<sup>st</sup> Sunday Inspect extinguisher. Date and sign both tags/records. Tighten driveline bolts.



# FIRE APPARATUS DRIVER/OPERATOR 1A

## Emergency Vehicle Operations

Topic 2-15: Pretrip Inspection Procedures



GROUP: \_\_\_\_\_ APPARATUS: \_\_\_\_\_ DATE: \_\_\_\_\_

### DAILY VEHICLE INSPECTION REPORT

#### ENGINE COMPARTMENT

- |                          |                          |                            |
|--------------------------|--------------------------|----------------------------|
| OK                       | DEF                      |                            |
| <input type="checkbox"/> | <input type="checkbox"/> | Fluid Leaks Under Vehicle* |
| <input type="checkbox"/> | <input type="checkbox"/> | Oil Fluid Level            |
| <input type="checkbox"/> | <input type="checkbox"/> | Transmission Fluid Level   |
| <input type="checkbox"/> | <input type="checkbox"/> | Power Steering Fluid       |
| <input type="checkbox"/> | <input type="checkbox"/> | Coolant Level/Filter       |
| <input type="checkbox"/> | <input type="checkbox"/> | Battery Condition          |
| <input type="checkbox"/> | <input type="checkbox"/> | Exhaust System             |
| <input type="checkbox"/> | <input type="checkbox"/> | Belts and Hoses            |
| <input type="checkbox"/> | <input type="checkbox"/> | Other _____                |

- |                          |                          |                                |
|--------------------------|--------------------------|--------------------------------|
| OK                       | DEF                      |                                |
| <input type="checkbox"/> | <input type="checkbox"/> | Glass/Windshield               |
| <input type="checkbox"/> | <input type="checkbox"/> | Windshield Wipers              |
| <input type="checkbox"/> | <input type="checkbox"/> | Seat Belts                     |
| <input type="checkbox"/> | <input type="checkbox"/> | Warning Devices                |
| <input type="checkbox"/> | <input type="checkbox"/> | Gauges and Horns               |
| <input type="checkbox"/> | <input type="checkbox"/> | Fuel Gauge/Level (3/4 minimum) |
| <input type="checkbox"/> | <input type="checkbox"/> | Mirrors                        |
| <input type="checkbox"/> | <input type="checkbox"/> | Radios (UHF and VHF)           |
| <input type="checkbox"/> | <input type="checkbox"/> | Master Key Ring                |

#### BRAKE SYSTEM TESTS

- |                          |                          |                                    |
|--------------------------|--------------------------|------------------------------------|
| OK                       | DEF                      |                                    |
| <input type="checkbox"/> | <input type="checkbox"/> | Low Air Warning Signal (Test 1)    |
|                          |                          | Air Compressor Governor (Test 2)   |
| <input type="checkbox"/> | <input type="checkbox"/> | Cut In >85 psi                     |
| <input type="checkbox"/> | <input type="checkbox"/> | Cut Out > 110-120 psi              |
|                          |                          | Static Air Pressure Loss (Test 3)  |
| <input type="checkbox"/> | <input type="checkbox"/> | Single – Maximum Loss 2 psi/min.   |
|                          |                          | Applied Air Pressure Loss (Test 4) |
| <input type="checkbox"/> | <input type="checkbox"/> | Maximum Loss 3 psi/min.            |
| <input type="checkbox"/> | <input type="checkbox"/> | Service Brake (Test 5)             |
| <input type="checkbox"/> | <input type="checkbox"/> | Parking Brake (Test 6)             |

#### Tuesday

- |                          |                          |                                 |
|--------------------------|--------------------------|---------------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | Battery Water Level             |
| <input type="checkbox"/> | <input type="checkbox"/> | Rotate Portable Radio Batteries |
| <input type="checkbox"/> | <input type="checkbox"/> | Check/Discharge Mag-lites       |

#### Saturday

- |                          |                          |                         |
|--------------------------|--------------------------|-------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | Battery Water Level     |
| <input type="checkbox"/> | <input type="checkbox"/> | Bleeder Valves          |
| <input type="checkbox"/> | <input type="checkbox"/> | Decontaminate Equipment |

#### OUTSIDE APPARATUS

- |                          |                          |                                      |
|--------------------------|--------------------------|--------------------------------------|
| OK                       | DEF                      |                                      |
| <input type="checkbox"/> | <input type="checkbox"/> | Tire Pressure Front _____ Rear _____ |
| <input type="checkbox"/> | <input type="checkbox"/> | Wheels, Rims, and Lug Nuts           |
| <input type="checkbox"/> | <input type="checkbox"/> | Steering Mechanism                   |
| <input type="checkbox"/> | <input type="checkbox"/> | Springs and Shock Absorbers          |
| <input type="checkbox"/> | <input type="checkbox"/> | Tilt Cab Pump Reservoir              |
| <input type="checkbox"/> | <input type="checkbox"/> | Operator Panel Lights                |
| <input type="checkbox"/> | <input type="checkbox"/> | Primer Tank Oil                      |
| <input type="checkbox"/> | <input type="checkbox"/> | Activate Priming Pump                |
| <input type="checkbox"/> | <input type="checkbox"/> | Fuel Tank Mounting and Filters       |
| <input type="checkbox"/> | <input type="checkbox"/> | Head Lamps High/Low                  |
| <input type="checkbox"/> | <input type="checkbox"/> | Running Lights/Reflectors            |
| <input type="checkbox"/> | <input type="checkbox"/> | Turn Signals                         |
| <input type="checkbox"/> | <input type="checkbox"/> | Brake Lights/Backup Lights           |
| <input type="checkbox"/> | <input type="checkbox"/> | Emergency Lighting                   |
| <input type="checkbox"/> | <input type="checkbox"/> | Door/Compartment Latches             |
| <input type="checkbox"/> | <input type="checkbox"/> | Covers                               |
| <input type="checkbox"/> | <input type="checkbox"/> | Equipment Secure                     |
| <input type="checkbox"/> | <input type="checkbox"/> | Body Damage*                         |
| <input type="checkbox"/> | <input type="checkbox"/> | Fifth Wheel Assembly                 |

\*Remarks

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

F-G 2s Made

Overall Condition of Apparatus

- |                          |                |
|--------------------------|----------------|
| <input type="checkbox"/> | Satisfactory   |
| <input type="checkbox"/> | Unsatisfactory |

### AIR SYSTEM TEST

#### TEST 1: Low Air Warning Signal and Emergency Brake Test

- 1) With engine OFF, ignition ON
- 2) Chock wheels
- 3) Release all brakes
- 4) Pump brake pedal to activate low pressure warning signal at 60 psi\*\*
- 5) Confirm parking brakes are still released
- 6) Continue pumping brake pedal until parking brake control knob pops out (approximately 30 psi)

\*\*When performing Step 4, applying the brake pedal will be accompanied by the sound of air escaping from the spring brake relay valve. This is due to the operation of the spring brake control valve being operated by the treadle valve.

#### TEST 2: Air Compressor Governor Test

- 1) With engine running, build pressure to 110-125 psi (should hear air dryer release air, indicating compressor has shut-off)
- 2) Pump brake pedal to reduce pressure to 85 psi (air compressor should build pressure to 100 psi within 45 seconds)
- 3) Build pressure to 110-125 psi

#### TEST 3: Static Air Pressure Loss Test

- 1) Chock wheels
- 2) Release all brakes
- 3) Shut-off engine with air pressure at 110-125 psi
- 4) Time air pressure reading for one minute (maximum drop 2 psi for single vehicle)

#### TEST 4: Applied Air Pressure Test

- 1) With engine off, chock wheels
- 2) Release parking brake
- 3) Apply steady pressure to brake pedal for one minute (after initial drop, maximum drop 3 psi)

#### TEST 5: Service Brake Test

- 1) Start apparatus
- 2) Place in gear and move apparatus
- 3) Apply brake pedal (apparatus should stop)

#### TEST 6: Parking Brake Test

- 1) Set parking brake
- 2) Place in gear
- 3) Try to move apparatus (should not move)



# FIRE APPARATUS DRIVER/OPERATOR 1A



## Emergency Vehicle Operations

Topic 2-15: Pretrip Inspection Procedures

GROUP: \_\_\_\_\_ APPARATUS: \_\_\_\_\_ DATE: \_\_\_\_\_

### D A I L Y   A P P A R A T U S   C H E C K O U T   S H E E T

	S	M	T	W	T	F	S	COMMENTS
<b>ENGINE COMPARTMENT</b>								
Fluid levels								
▪ radiator								
▪ engine oil								
▪ power steering								
▪ automatic transmission								
▪ priming oil								
Belts and hoses								
▪ radiator hoses								
▪ all belts								
<b>ELECTRICAL SYSTEMS</b>								
Warning lights, four-way lights								
Headlights (low and high beam)								
Turn signal indicators								
Gauges (all)								
Brake lights								
Backup lights								
Code 3 lights (light bar, strobes)								
Pump panel								
Miscellaneous lights								
<b>AIR SYSTEMS</b>								
Brakes								
▪ air pressure (static and applied)								
▪ low pressure warning light								
▪ air governor (cut-out and cut-in)								
▪ air lines and hoses								
<b>PUMP CHECKOUT</b>								
Valve operation (open and closed)								
Transfer valve (pressure and volume)								
Relief valve								
Water level gauge								
Water tank (leaks)								
<b>EQUIPMENT</b>								
All assigned equipment								
<b>BODY</b>								
Tires (including rims)								
Exterior paint and gold leaf								

**WEEKLY**

- Monday Start and run all equipment
- Tuesday Check tires, lug nuts, and axle nuts
- Wednesday Check all batteries
- Thursday Bleed air tanks
- Friday Flush, clean, and operate relief and change-over valves
- Saturday Wash, clean, and inspect apparatus
- Sunday Check and weight all extinguishers

**MONTHLY**

- 1<sup>st</sup> Saturday Check undercarriage and transmission for grease
- 1<sup>st</sup> Sunday Check radio batteries
- 1<sup>st</sup> Monday Clean and inspect all ground ladders
- 1<sup>st</sup> Tuesday Perform any missed or needed maintenance
- 25<sup>th</sup> Complete apparatus reports

## Topic 3-1: Accident Statistics and Liability

Student information for this topic can also be found in Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 60-61.

### Fire Fighter Injuries While On Apparatus

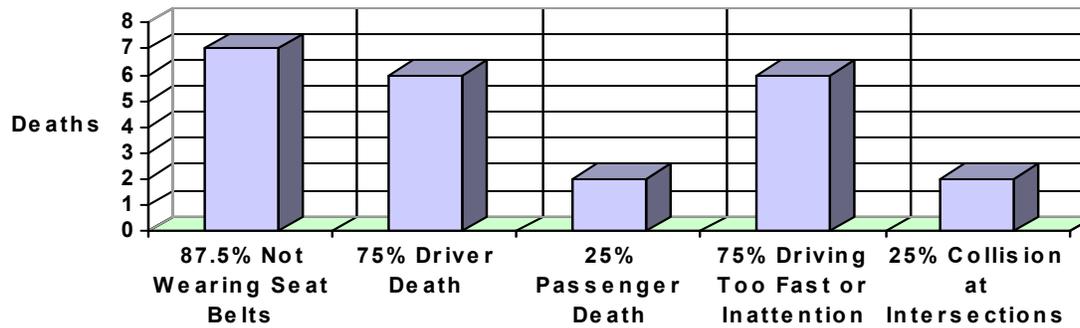
Fire department vehicle accidents and resulting fire fighter injuries while responding to or returning from incidents, 1999-2006.

Year	Involving Fire Department Emergency Vehicles		Involving Fire Fighter's Personal Vehicles	
	Collisions	Fire Fighter Injuries	Collisions	Fire Fighter Injuries
1990	11,325	1,300	950	175
1991	12,125	1,075	1,375	125
1992	11,500	1,050	1,575	150
1993	12,250	900	1,675	200
1994	13,775	1,035	1,610	285
1995	14,670	950	1,690	190
1996	14,200	910	1,400	240
1997	14,950	1,350	1,300	180
1998	14,650	1,050	1,350	315
1999	15,450	875	1,080	90
2000	15,300	990	1,160	170
2001	14,900	960	1,325	140
2002	15,550	1,040	1,030	210
2003	15,900	850	980	85
2004	15,420	980	1,150	220
2005	15,885	1,120	1,080	125
2006	16,020	1,250	1,070	210

Source: "Fire Fighter Injuries for 2006", NFPA Journal, November/December 2007 Edition.

## Fire Fighter Deaths While In Apparatus

Source: "U.S. Firefighter Fatalities 2000," NFPA Journal, July/August 2001 Edition.



## Topic 3-2: Principles of Defensive Driving

Student information for this topic can also be found in the California Commercial Driver Handbook, DMV, 2008 Edition, Pages 24-27 and Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 76-83.

### Activity 3-2-1

<b>Title:</b>	Principles of Defensive Driving
<b>Time Frame:</b>	0:15
<b>Materials Needed:</b>	<ul style="list-style-type: none"><li>• Notes</li><li>• Pen or pencil</li></ul>
<b>Introduction:</b>	This activity provides you the opportunity to review the material covered in the principles of defensive driving.
<b>Directions:</b>	<ol style="list-style-type: none"><li>1. Using information from your notes, answer the following questions.</li><li>2. You have 5 minutes to complete this activity.</li><li>3. Be prepared to discuss your answers with the class.</li></ol>



# FIRE APPARATUS DRIVER/OPERATOR 1A

## Emergency Vehicle Operations

Topic 3-2: Principles of Defensive Driving



### PRINCIPLES OF DEFENSIVE DRIVING

1. What is the most important aspect of safe driving?

---

2. List four of the six components of defensive driving?

(1) \_\_\_\_\_

(2) \_\_\_\_\_

(3) \_\_\_\_\_

(4) \_\_\_\_\_

3. Where do most collisions involving an emergency vehicle occur?

---

4. List two of the five control factors.

(1) \_\_\_\_\_

(2) \_\_\_\_\_

5. To get the "big picture" in town at lower speeds you should be seeing ahead \_\_\_\_\_ block and at highway speeds about \_\_\_\_\_ mile.

(a) \_\_\_\_\_

(b) \_\_\_\_\_



# FIRE APPARATUS DRIVER/OPERATOR 1A

## Emergency Vehicle Operations

Topic 3-2: Principles of Defensive Driving



6. If you must stop on or by a one-way or divided highway, what three locations should you place your warning devices?

(1) \_\_\_\_\_

(2) \_\_\_\_\_

(3) \_\_\_\_\_

7. What is the first thing to consider when passing a vehicle, pedestrian, or cyclist?

\_\_\_\_\_

8. Which is greater, total stopping distance or total braking distance?

\_\_\_\_\_

9. What four special situations require more than regular mirror checks?

(1) \_\_\_\_\_

(2) \_\_\_\_\_

(3) \_\_\_\_\_

(4) \_\_\_\_\_

10. Define the "law of inertia."

\_\_\_\_\_

\_\_\_\_\_

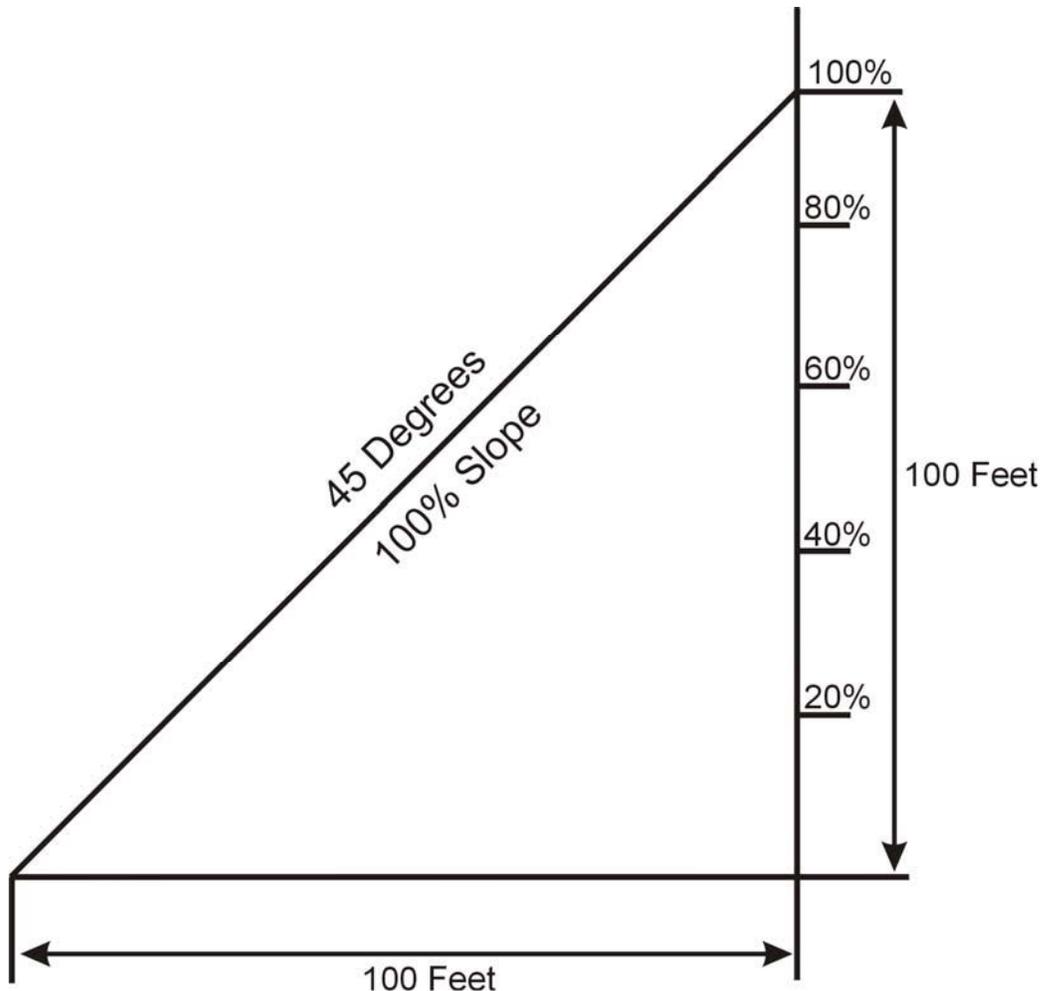


## Topic 3-4: Principles of Off-road Driving

Student information for this topic can also be found in Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 115-120.

### Percentage and Degree of Slope Profile

Percentage of slope equals height in feet. 1 foot equals 1%, 20 feet equals 20%, etc. Safe maximum limit is 40%.



**1 foot of rise over 100 feet = 1% of slope**

**20 feet of rise over 100 feet = 20% slope**



## Topic 3-6: Principles of Steering and Load Control

Student information for this topic can also be found in the [California Commercial Driver Handbook](#), DMV, 2008 Edition, Pages 22, 45, 46, and [Pumping Apparatus Driver/Operator Handbook](#), IFSTA, Second Edition, Pages 81-82.

### **Skids**

An apparatus is supported on a cushion of air that exists within the tires. Control of the apparatus is transmitted through tire "footprints." Each footprint is about the size of a person's hand. Changes of direction or speed are made by changing the direction of these footprints. The cohesive quality between the rubber and the roadway is called the coefficient of friction. This coefficient of friction will vary depending upon the roadway surface or foreign substances on the roadway such as sand, oil, water, or ice. When one or more of the tires exceeds the coefficient of friction, a loss of adhesion to the roadway and subsequent skidding occurs.

### **Acceleration Skids**

Acceleration skids involve only the drive wheels. To maintain control of the apparatus, wheel slippage may be reduced or stopped by easing up on the throttle, which will reduce torque to the drive wheels. Accelerating to the point of breaking wheel traction serves no useful purpose, placing tremendous strain on drive train components, wearing out tires, and resulting in a slower start than is obtained with controlled acceleration.

### **Locked-wheel Skids**

Locked-wheel skids sacrifice all directional control of the apparatus and should be avoided. The front wheels steer only by rolling friction. With the brakes locked, all efforts to steer the car are futile.

### **Four-wheel Drift**

The term "four-wheel drift" is often misunderstood. For instructional purposes, four-wheel drift describes that condition when a cornering apparatus is above the limits of adhesion and in a balanced understeer/oversteer attitude. The apparatus is pointed in the direction it is traveling and all wheels are following a line of the curve, however, the apparatus is evenly drifting toward the outside of the curve. If there is adequate roadway available, the apparatus may negotiate the turn without event.

### **Oversteer (Rear-wheel Skid)**

Oversteer results from over acceleration; excessive steering; improper brake usage, or from road conditions that provide little traction (e.g., wet, bumpy, or covered with debris). Countersteer using a rapid and smooth steering input in the direction of the skid. This allows the front end to stay ahead of the back end until recovery is complete.

If a rear-wheel skid (oversteer) occurs in a front-wheel drive apparatus, it may be necessary to apply appropriate throttle, in addition to countersteering, to "pull out" of the skid and

recover apparatus control. You must smoothly take out the steering you have put in as the apparatus is recovering. Failure to do so may cause a second skid (caused by lateral weight transfer). Acceleration and brake use should be avoided. Front-wheel drive can be an exception to this as acceleration can assist in recovery.

### **Understeer (Front-wheel Skid)**

Understeer results from approaching the turn at an excessive speed; excessive steering; improper brake usage; or from road conditions that provide little traction (e.g., wet, bumpy, or covered with debris). Avoid additional steering input, and when the apparatus slows enough to regain rolling friction, the understeer condition will diminish. Acceleration and brake use should be avoided.

### **Hydroplaning**

"Hydroplaning" is the term used when an apparatus is skimming along the surface of a wet road. When an apparatus is hydroplaning, the normal contact patch of the tire tread and the road begins to separate. Hydroplaning is a serious condition because the driver/operator cannot control the apparatus. Three factors contribute to the hydroplaning effect.

#### ***Water Depth***

Normally a quarter inch of water is enough to cause hydroplaning.

#### ***Tire Condition***

Tread depth, air pressure, design, and width can affect hydroplaning.

#### ***Apparatus Speed***

The faster the tires are rotating, the more likely that the apparatus will skim the surface of the water. Total hydroplaning on one inch of water may be expected at about 58 mph, and partial hydroplaning can occur at significantly slower speeds.

### **Roadway Position<sup>1</sup>**

The position of the apparatus on the roadway to best facilitate the negotiation of a turn or curve at a safe rate of speed; the use of the available roadway to its fullest advantage with the least amount of steering. Roadway position could also be referred to as the "driving line" through a turn.

### **Typical Turn Classifications**

#### **Constant Radius (90° Turn)**

The most efficient driving line to negotiate a 90° turn is one with a constant radius. This turn would become a full circle if permitted to continue a full 360°. There are three essential points of reference that are relevant to the turning maneuver.

---

<sup>1</sup> Driver Awareness Instructors Course Manual, California Commission on Peace Officer Standards and Training, 1999

### ***Entry***

This places the apparatus to the extreme outside edge of the available roadway, and is the point of steering input to perform the turning maneuver.

### ***Geometric Apex***

Geometric apex is the tightest innermost part of the available roadway. It is directly centered within the driving arc.

### ***Exit***

Exit places the apparatus at the extreme outside edge of the roadway. If steering is input correctly from entry and maintained to the apex, the apparatus will seek the exit point on its own accord.

### ***Driving Advantages***

- Minimize weight transfer.
- Minimize steering input.
- Smooth apparatus control.
- Greatest attainable safe speed through the turn.

### ***Decreasing Radius***

This is a continually tightening turn. The driving speed will be decreased in proportion to the tightening of the turn. Negotiate the turn by taking the line of least resistance to the apparatus' travel.

### ***Increasing Radius***

This turn gradually straightens. The apparatus speed will be slower at the entry point and can be increased upon exiting.

### ***180° Turn***

The configuration of this turn corresponds to driving through one half of a circle. Entry should start from the extreme outside edge of the available roadway. This line will be maintained to the approach of the apex. Although not any faster speed-wise than an "inside" or "outside" driving line, this route provides a degree of safety for maneuvering in the case of a slide.

The apex area is relatively close to the exit of the turn, not geometrically located. Exit point will be on the outside of the roadway, beyond the apex area.

### ***Multiple Turn Situation***

Multiple turns create a situation where apparatus control problems are likely to occur. Correct roadway position through multiple turns is a path that will reduce the amount of directional change from one turn to another. This will lessen side-to-side weight transfer, give the tires improved traction, and allow greater control.

In order to drive the correct roadway position, the driver/operator will have to equalize turning motions from one turn to another while maintaining a consistent speed. The reason is that these two ingredients create centrifugal force.

Correct road position will vary as to the configuration of the turns. The driving line selected should provide for optimum efficiency and control at the exit of the final turn.

### Control Considerations

To establish proper roadway position through a turn, the driver/operator must scan the curve during the approach. The path of travel should bring the apparatus to the apex or low side just before the exit of the turn. The apparatus should be held as close as possible to the apex to allow adequate distance when exiting the turn. Apparatus stress and weight transfer may be reduced by allowing the apparatus to smoothly drift out to the high side (outside) upon leaving the turn.

### Speed Control

For the purposes of speed control in a turning maneuver, consideration must be given to throttle and brake application in relation to the apparatus' position in the driving lane. This is accomplished by dividing the driving line into zones of activity regarding brake and throttle usage.

#### **Zone 1, Approach Zone (Speed Adjustment)**

This area consists of the approach up to the turn entry point. This can be accomplished by:

- Speed increase.
- Speed reduction.
  - Straight-line threshold braking.
  - Extended release.

#### **Zone 2, Entry Zone**

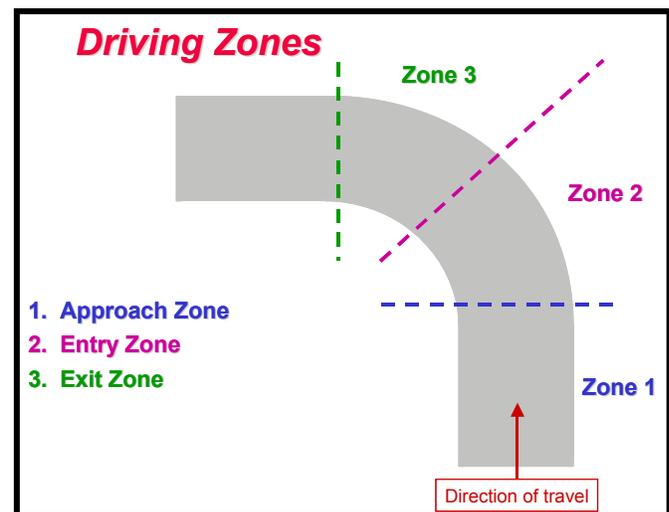
This area consists of the turning arc (driving line) between the entry point and the apex. The following two methods are acceptable:

- No throttle is used until lateral weight transfer is set.
- Apparatus speed may be maintained by appropriate throttle pressure.

#### **Zone 3, Exit Zone**

This area consists of the roadway from the apex to the exit point. Options are exercised in this area:

- Speed maintenance.
- Speed increase.
- Speed decrease.







## Topic 4-1: Introduction to the Mandatory Driving Exercises

Student information for this topic can also be found in Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 90-92.

### Mandatory Driving Exercise 4-1-1

**Exercise:**

Diminishing Clearance Exercise

This exercise measures your ability to steer the apparatus in a straight line, to judge distances from wheel to object, and to stop at a designated finish line. The speed at which the apparatus is driven is fast enough to require you to exercise quick judgment.

**Time Frame:**

None

**Authority:**

2009 NFPA 1002: Section A.4.3.5

**Materials Needed:**

- Fire apparatus
- 8,250 square foot area
- 48-inch pillars (9)
- Stopwatch
- 100-foot tape measure

**Student Directions:**

1. Accelerate to the course speed in the approach area.
2. Maneuver the apparatus through the lane without touching the side markers.
3. At the designated end marker, stop the apparatus with the front bumper short of the end marker.
4. Wait for the end measurement to be taken.
5. When instructed, back the apparatus through the lane without touching the side markers.
6. Stop the apparatus after clearing entry markers.

**Scoring:**

**100 points possible**

**80% passing**

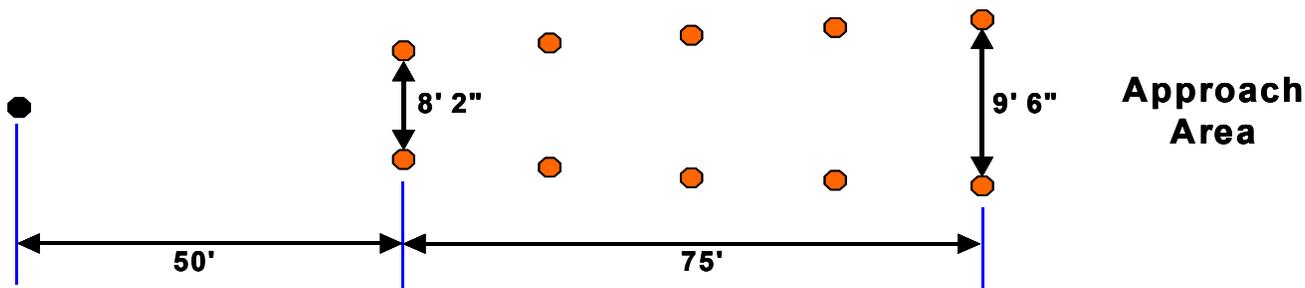
1. **5 points** subtracted each time the apparatus touches a side marker.
2. **5 points** subtracted each time the apparatus stops before reaching the end marker.
3. **10 points** subtracted if apparatus stops 6-12 inches before the end marker or **20 points** subtracted if apparatus stops more >12-18 inches before the end marker.

The student **fails** if the apparatus stops >18 inches from the end marker. Distance is measure from the end marker to the front bumper.

4. The student **fails** if the apparatus touches the end marker.
5. The student **fails** if a speed of 15-20 mph is not maintained during the exercise.
6. The student **fails** if he or she does not maintain control of the apparatus during the exercise.

**Site Preparation:**

- Markers are set up as shown.
- Unless indicated, marker spacing shall be of equal distance.
- Two rows of side markers form a lane 75-feet long.
- Beginning width of 9 inches wider than the apparatus.
- Lane diminishes to a clearance width of 1 inch.



### Mandatory Driving Exercise 4-1-2

**Exercise:**

Serpentine Exercise

This exercise simulates maneuvering around parked and stopped vehicles and tight corners. You maneuver the apparatus forward and backward in one continuous motion without touching any of the course markers.

**Time Frame:**

None

**Authority:**

2009 NFPA 1002: Section A.4.3.3

**Materials Needed:**

- Fire apparatus
- 8,000 square foot area
- 48-inch pillars (3)
- 100-foot tape measure

**Student Directions:**

1. Drive the apparatus along the left side of the markers in a straight line.
2. Stop just beyond the last marker.
3. Back the apparatus between the markers by passing to the left of Marker #1, to the right of Marker #2, and to the left of Marker #3.
4. Stop the apparatus.
5. Drive the apparatus forward between the markers by passing to the right of Marker #3, to the left of Marker #2, and to the right of Marker # 1.

**Scoring:**

**100 points possible**

**80% passing**

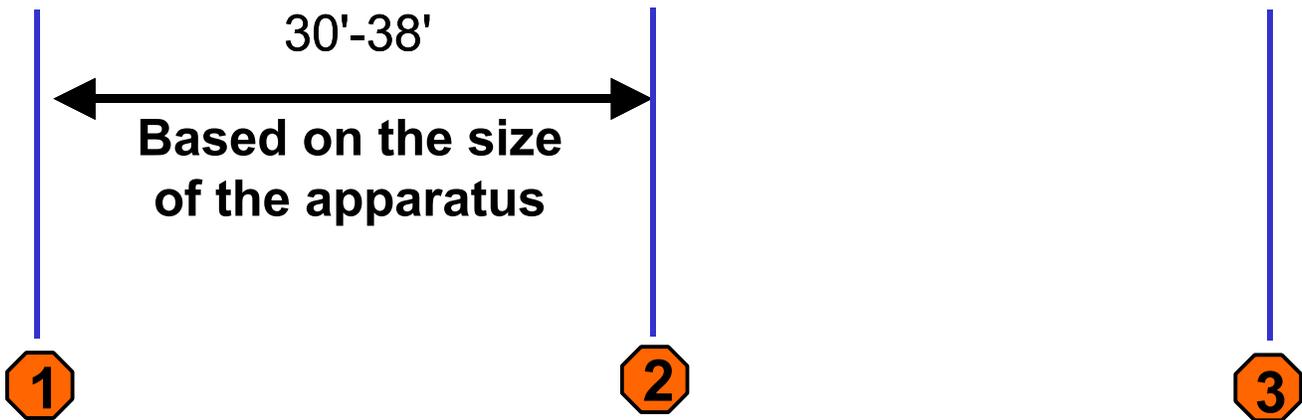
1. **5 points** subtracted for each marker passed on the wrong side.
2. **5 points** subtracted each time the apparatus stops during the exercise.
3. The student **fails** if the apparatus touches a marker.
4. The student **fails** the performance exam if he or she does not maintain control of the apparatus during the exercise.

**Exercise:**

Serpentine Exercise

**Site Preparation:**

- Markers are set up as shown.
- Place three markers in a straight line, equal distance apart.
- Ensure adequate space is available on both sides of the markers for the apparatus to move freely.



### Mandatory Driving Exercise 4-1-3

**Exercise:**

Three-Point Turnaround Exercise

This exercise tests your ability to turn the apparatus around within a confined space without striking obstacles.

**Time Frame:**

None

**Authority:**

2009 NFPA 1002: Section A.4.3.4

**Materials Needed:**

- Fire apparatus
- 5,000 square foot area
- 18-inch cones (16)
- 100-foot tape measure

**Student Directions:**

1. Drive forward through the 12-foot opening in the center of one of the 50-foot legs.
2. Turn the apparatus either direction (left or right).
3. Bring the apparatus to a complete stop without touching a marker or extending beyond the course boundaries.
4. Back the apparatus far enough to accommodate the turn to proceed out without touching a marker or extending beyond the course boundaries.
5. Make the turn.
6. Proceed to the exit point.
7. Bring the apparatus to a complete stop after clearing the exit point.

**Scoring:**

**100 points possible**

**80% passing**

1. **10 points** subtracted if the wheels are turned when the apparatus is stopped.
2. The student **fails** if the apparatus touches a marker.
3. The student **fails** if the apparatus travels outside the exercise boundaries.
4. The student **fails** if he or she exceeds three directional changes as outlined in the diagram.
5. The student **fails** if he or she does not maintain control of

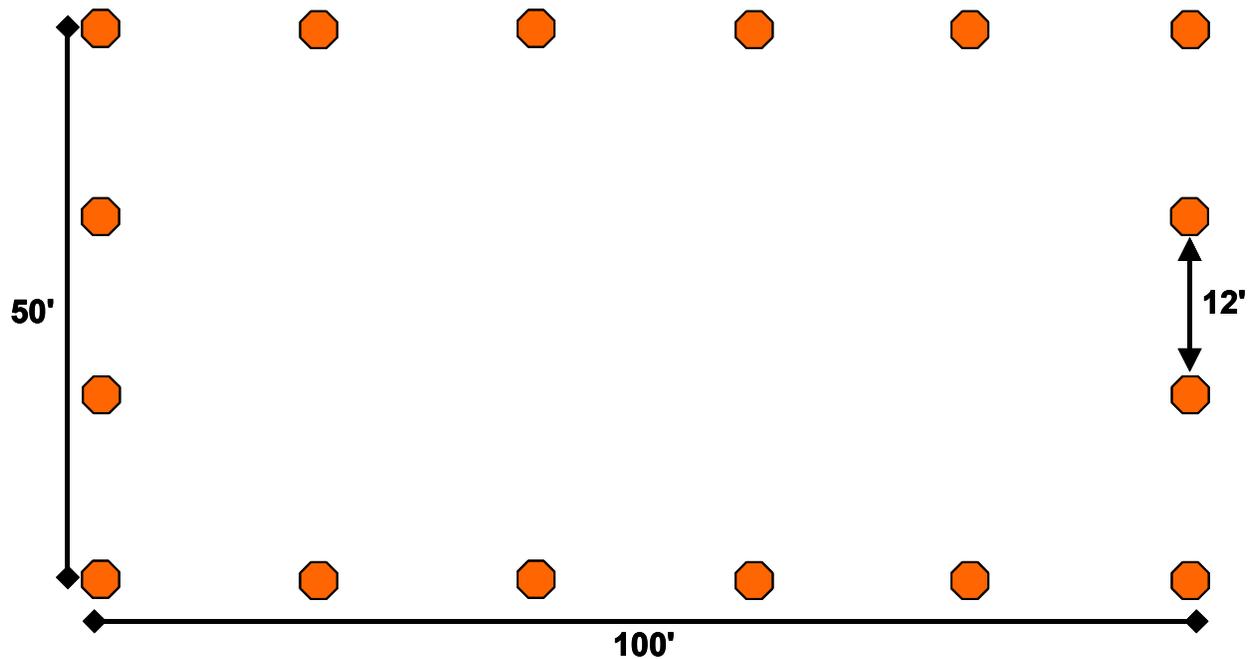
**Exercise:**

Three-Point Turnaround Exercise

the apparatus during the exercise.

**Site Preparation:**

- Markers are set up as shown.
- Align markers in straight lines, equal distance apart.
- Size of exercise is 50'x100'.
- Width of approach gate is 12 feet.



### Mandatory Driving Exercise 4-1-4

Exercise 4-1-5, the Alley Dock, may be substituted for this exercise.

**Exercise:**

Station Apparatus Backing Exercise

This exercise tests your ability to move the apparatus backward within a restricted area and into a fire station without striking the walls and to bring the apparatus to a smooth stop close to a rear wall.

**Time Frame:**

None

**Authority:**

2009 NFPA 1002: Section A.4.3.2(b)

**Materials Needed:**

- Fire apparatus
- 5,000 square foot area
- 48-inch pillars (4)
- 18-inch cones (14)
- 100-foot tape measure

**Student Directions:**

1. Drive down the simulated street in a straight line, past the driveway apron located on your left.
2. Bring the apparatus to a complete stop after passing the driveway apron opening.
3. Back the apparatus into the designated bay.
4. Bring the apparatus to a complete stop after the front bumper clears the first two 48-inch pillars.
5. Drive the apparatus forward, making a right turn.
6. Bring the apparatus to a complete stop after finishing the turn.
7. Back the apparatus into the designated bay.
8. Bring the apparatus to a complete stop after the front bumper clears the first two 48-inch pillars.

**Scoring:**

**100 points possible**

**80% passing**

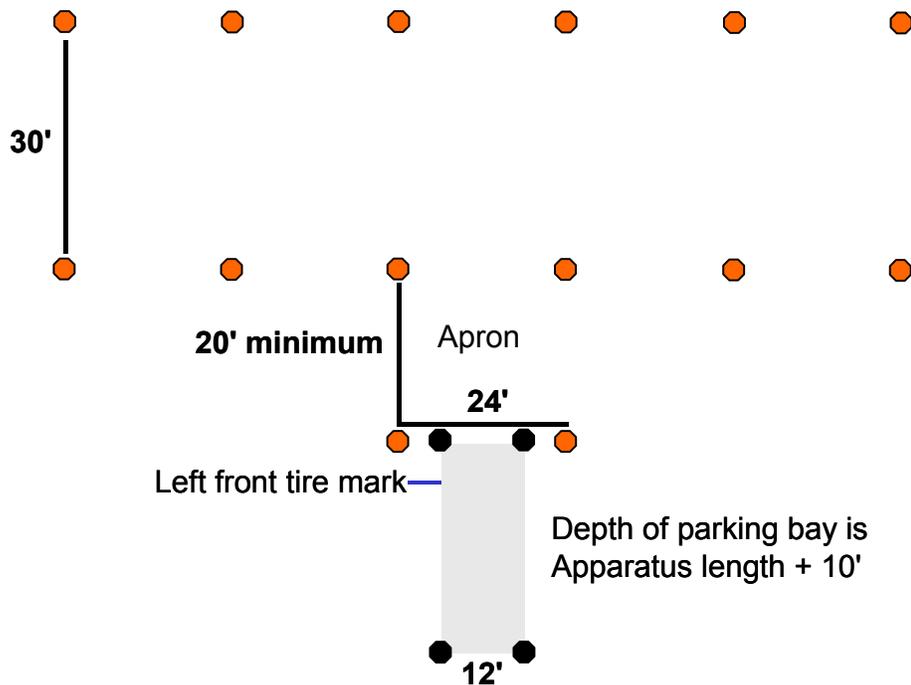
1. **5 points** subtracted each time the apparatus stops within the alley before reaching the end.
2. The student **fails** if the apparatus touches a marker.
3. The student **fails** if he or she does not maintain control of the apparatus during the exercise.

**Exercise:**

Station Apparatus Backing Exercise

**Site Preparation:**

- Markers are set up as shown.
- Unless indicated, marker spacing shall be of equal distance.
- The boundary lines for the restricted area should be 30 feet wide, similar to curb-to-curb distance
- Along one side and perpendicular is another simulated area 20' x 24' and again reduced to 12 feet x vehicle length plus 10 feet.
- Each simulated area shall be centered end from end of next largest area.



### Mandatory Driving Exercise 4-1-5

Exercise 4-1-4, Station Apparatus Backing, may be substituted for this exercise.

**Exercise:**

Alley Dock Exercise

This exercise tests your ability to move the apparatus backward within a restricted area and into an alley, dock, or fire station without striking the walls and to bring the apparatus to a smooth stop close to a rear wall.

**Time Frame:**

None

**Authority:**

2009 NFPA 1002: Section A.4.3.2(a)

**Materials Needed:**

- Fire apparatus
- 6,000 square foot area (60x100)
- 48-inch pillars (5)
- 18-inch cones (12)
- 100-foot tape measure

**Student Directions:**

1. Drive past the alley dock area located on the your left.
2. Bring the apparatus to a complete stop after passing the alley dock area.
3. Back the apparatus into the alley dock area, making a hard left turn.
4. Bring the apparatus to a complete stop within 18 inches of the center marker.
5. Set the parking brake.
6. When instructed, drive forward out of the alley dock area.

**Scoring:**

**100 points possible**

**80% passing**

1. **5 points** subtracted each time the apparatus stops within the alley before reaching the end marker.
2. **10 points** subtracted if apparatus stops 6-12 inches before the end marker or **20 points** subtracted if apparatus stops more > 12-18 inches before the end marker. The student **fails** if the apparatus stops > 18 inches from the end marker.

### Exercise:

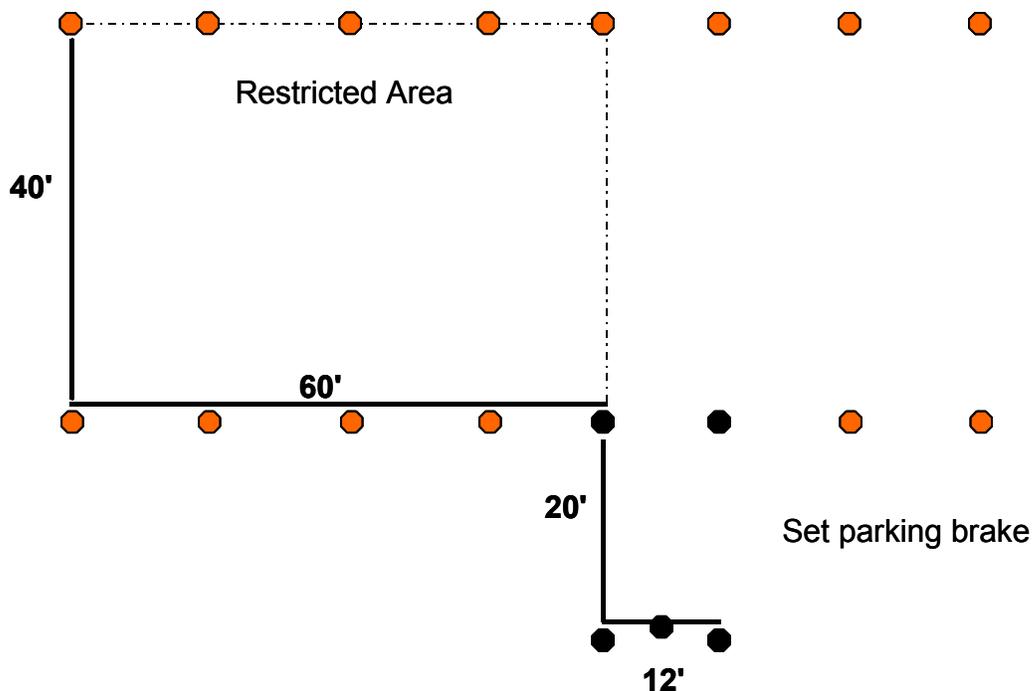
### Alley Dock Exercise

Distance is measured from the end marker to the front bumper.

3. The student **fails** if the apparatus touches the end marker.
4. The student **fails** if the apparatus touches a side marker.
5. The student **fails** if he or she breaks the plane denoted by the markers.
6. The student **fails** if he or she does not maintain control of the apparatus during the exercise.

### Site Preparation:

- Markers are set up as shown.
- Markers shall be aligned in straight lines.
- Unless indicated, marker spacing shall be of equal distance.
- The boundary lines for the restricted area should be 40-feet wide, similar to curb-to-curb distance.
- Along one side and perpendicular is another simulated area 12' x 20'.
- Smaller simulated area is 60 feet from the end of the opposite approach.





# FIRE APPARATUS DRIVER/OPERATOR 1A

## Emergency Vehicle Operations



Topic 4-1: Introduction to the Mandatory Driving Exercises

### Mandatory Driving Exercises Scoring Sheet

STUDENT: \_\_\_\_\_ DATE: \_\_\_\_\_

4-1-1: DIMINISHING CLEARANCE EXERCISE		Penalty points subtracted from 100 possible points.		
	Rated Component	Frequency	Value	100
1.	Apparatus touches a side marker		5	
2.	Apparatus stops before reaching the end marker		5	
3.	Apparatus stops 0-6 inches before the end marker	<input type="checkbox"/> 0-6	0	
	OR Apparatus stops >6-12 inches before the end marker	<input type="checkbox"/> >6-12	10	
	OR Apparatus stops >12-18 inches before the end marker	<input type="checkbox"/> >12-18	20	
	OR Apparatus stops >18 inches before the end marker	<input type="checkbox"/> >18	Failure	
4.	Apparatus touches the end marker	<input type="checkbox"/> Yes	Failure	
5.	Speed is not maintained (>3 seconds in lane)	<input type="checkbox"/> Yes	Failure	
6.	Driver/operator fails to maintain control of the apparatus	<input type="checkbox"/> Yes	Failure	
			<b>TOTAL POINTS:</b>	
			<b>PASSING SCORE:</b>	80

Scorer's Name: \_\_\_\_\_

Signature: \_\_\_\_\_

Pass  
PASS/FAIL:  Fail  
 Retest

#### 4-1-1 NOTES:

4-1-2: SERPENTINE EXERCISE		Penalty points subtracted from 100 possible points.		
	Rated Component	Frequency	Value	100
1.	Apparatus passes a marker on the wrong side		5	
2.	Apparatus stops during the exercise		5	
3.	Apparatus touches a marker	<input type="checkbox"/> Yes	Failure	
4.	Driver/operator fails to maintain control of the apparatus	<input type="checkbox"/> Yes	Failure	
			<b>TOTAL POINTS:</b>	
			<b>PASSING SCORE:</b>	80

Scorer's Name: \_\_\_\_\_

Signature: \_\_\_\_\_

Pass  
PASS/FAIL:  Fail  
 Retest

#### 4-1-2 NOTES:



# FIRE APPARATUS DRIVER/OPERATOR 1A

## Emergency Vehicle Operations



Topic 4-1: Introduction to the Mandatory Driving Exercises

STUDENT: \_\_\_\_\_ DATE: \_\_\_\_\_

4-1-3: THREE-POINT TURNAROUND EXERCISE		Penalty points subtracted from 100 possible points.		
	Rated Component	Frequency	Value	100
1.	Wheels turned while the apparatus is stopped		10	
2.	Apparatus touches a marker	<input type="checkbox"/> Yes		Failure
3.	Apparatus travels outside the exercise boundaries	<input type="checkbox"/> Yes		Failure
4.	Driver/operator exceeds three directional changes	<input type="checkbox"/> Yes		Failure
5.	Driver/operator fails to maintain control of the apparatus	<input type="checkbox"/> Yes		Failure
			<b>TOTAL POINTS:</b>	
			<b>PASSING SCORE:</b>	80

Scorer's Name: \_\_\_\_\_

Signature: \_\_\_\_\_

Pass  
PASS/FAIL:  Fail  
 Retest

### 4-1-3 NOTES:

4-1-4: STATION APPARATUS BACKING EXERCISE		Penalty points subtracted from 100 possible points.		
	Rated Component	Frequency	Value	100
1.	Apparatus stops within the alley before reaching the end		5	
2.	Apparatus touches a marker	<input type="checkbox"/> Yes		Failure
3.	Driver/operator fails to maintain control of the apparatus	<input type="checkbox"/> Yes		Failure
			<b>TOTAL POINTS:</b>	
			<b>PASSING SCORE:</b>	80

Scorer's Name: \_\_\_\_\_

Signature: \_\_\_\_\_

Pass  
PASS/FAIL:  Fail  
 Retest

### 4-1-4 NOTES:



# FIRE APPARATUS DRIVER/OPERATOR 1A

## Emergency Vehicle Operations



Topic 4-1: Introduction to the Mandatory Driving Exercises

STUDENT: \_\_\_\_\_ DATE: \_\_\_\_\_

4-1-5: ALLEY DOCK EXERCISE		Penalty points subtracted from 100 possible points.		
	Rated Component	Frequency	Value	100
1.	Apparatus stops within the alley before reaching the end marker		5	
2.	Apparatus stops 0-6 inches before the end marker	<input type="checkbox"/> 0-6	0	
	OR Apparatus stops >6-12 inches before the end marker	<input type="checkbox"/> >6-12	10	
	OR Apparatus stops >12-18 inches before the end marker	<input type="checkbox"/> >12-18	20	
	OR Apparatus stops >18 inches before the end marker	<input type="checkbox"/> >18		Failure
3.	Apparatus touches the end marker	<input type="checkbox"/> Yes		Failure
4.	Apparatus touches a side marker	<input type="checkbox"/> Yes		Failure
5.	Apparatus breaks the plane denoted by the markers	<input type="checkbox"/> Yes		Failure
6.	Driver/operator fails to maintain control of the apparatus	<input type="checkbox"/> Yes		Failure
			<b>TOTAL POINTS:</b>	
			<b>PASSING SCORE:</b>	80

Scorer's Name: \_\_\_\_\_

Signature: \_\_\_\_\_

Pass  
 PASS/FAIL:  Fail  
 Retest

### 4-1-5 NOTES:

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## Topic 5-1: Introduction to the Optional Driving Exercises

### Optional Driving Exercise 5-1-1

**Exercise:**

Lane Change Exercise

This exercise tests your ability to change lanes and judge distances from wheel to object while moving at a constant speed.

**Time Frame:**

25 seconds maximum

**Authority:**

SBFS

**Materials Needed:**

- Fire apparatus
- 1 assistant instructor
- 36,000 square foot area
- 48-inch pillars (4)
- 18-inch cones (59)
- 8½"x11" numbered cards (8)
  - "1" (2)
  - "2" (2)
  - "3" (2)
  - "4" (1)
  - "5" (1)
- 8½"x11" "STOP" card (1)
- Stopwatch
- 100-foot tape measure

**Student Directions:**

1. Time begins when the instructor signals you to proceed through the entry gate.
2. Time ends when the front bumper of the apparatus passes the exit gate.
3. Lane assignments will be displayed just before the apparatus enters the first lane.
4. Maneuver the apparatus through the assigned lanes.
5. You have 25 seconds from entry gate to exit gate.
6. Proceed through the exit curve until the apparatus clears the last set of markers.
7. Bring the apparatus to a complete stop.

**Exercise:**

Lane Change Exercise

**Scoring:**

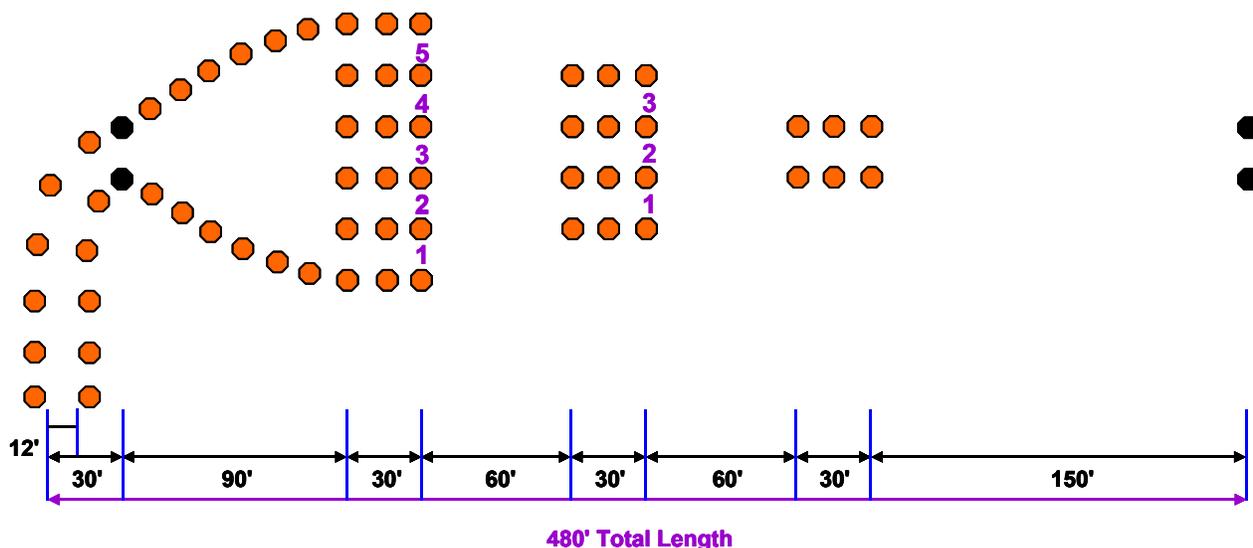
**100 points possible**

**80% passing**

1. **5 points** subtracted for each marker touched by the apparatus.
2. The student **fails** if the apparatus stops or fails to maintain a constant forward motion within the course.
3. The student **fails** if he or she does not take the lane marked by the evaluator.
4. The student **fails** if time exceeds 25 seconds.
5. The student **fails** if he or she does not maintain control of the apparatus during the exercise.

**Site Preparation:**

- Markers are set up as shown, with each set of lanes being 30-feet long and each lane 10-feet wide.
- Measure the markers base to base.
- The distance from one set of lane markers to the next is 60 feet. This area is called the change space.
- The entry and exit gates are in line with the first lane, #2 lane of the first set, and #3 lane of the second set.
- Exit curve width is 12 feet, starting at the first set of markers after the exit gate.



All gates are 10 feet wide

### Optional Driving Exercise 5-1-2

**Exercise:**

Offset Alley Exercise (Forward and Backward)

This exercise simulates responding to an emergency and making a lane change through a narrow passageway without striking any nearby vehicles. It tests your ability to maneuver the apparatus at a constant speed within a confined space. To do this, you must accurately judge the distance between the apparatus and the barriers.

**Time Frame:**

None

**Authority:**

SBFS

**Materials Needed:**

- Fire apparatus
- 100 square foot area
- 48-inch pillars (4)
- 18-inch cones (12)
- 100-foot tape measure

**Student Directions:**

1. Maintain a constant speed throughout the exercise.
2. Drive through the entry gate.
3. Turn the apparatus into the offset lane.
4. Exit the offset lane.
5. Enter the exit lane.
6. Bring the apparatus to a complete stop after rear bumper clears the exit gate.
7. Back the apparatus following the same path, maintaining a constant speed.
8. Bring the apparatus to a complete stop after front bumper clears the entry gate.

**Scoring:**

**100 points possible**

**80% passing**

1. **10 points** subtracted for each marker touched by the apparatus.

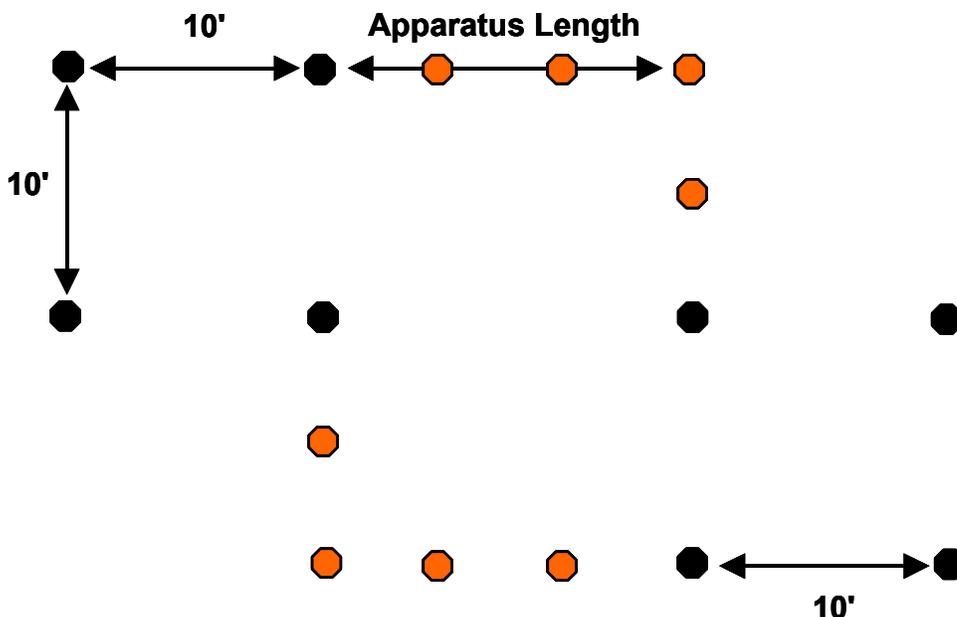
**Exercise:**

Offset Alley Exercise (Forward and Backward)

2. **10 points** subtracted each time the apparatus stops before reaching the end markers.
3. The student **fails** if he or she continues the exercise without realigning the apparatus after touching a marker.
4. The student **fails** if he or she does not maintain control of the apparatus during the exercise.

**Site Preparation:**

- Place two sets of markers in line and one apparatus length apart to form an alley.
- These alleys are arranged with course markers and are 10 feet wide.
- The 10 foot alley from which the driver/operator must exit is arranged 10 feet out of line to the opposite 10 foot alley into which the apparatus must be maneuvered.
- No set speed should be established for this exercise, but the driver/operator should not stop or back the apparatus during the maneuver.



### Optional Driving Exercise 5-1-3

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**Exercise:**

Dogleg Exercise

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This exercise measures your ability to maneuver apparatus within a confined space. Judging distance between apparatus and objects while driving at a constant speed in both forward and reverse.

---

**Time Frame:**

Minimum: 0:50

Maximum: 1:15

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**Authority:**

SBFS

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**Materials Needed:**

- Fire apparatus
  - 1 assistant instructor
  - 8,400 square foot area
  - 48-inch pillars (17)
  - 18-inch cones (46)
  - Stopwatch
  - 100-foot tape measure
- 

**Student Directions:**

1. Maintain a constant speed throughout the exercise.
  2. Drive through the entry gate.
  3. Drive through first direction gate.
  4. Turn in the changing space.
  5. Align apparatus to enter next direction gate.
  6. Proceed through all direction gates in the same manner.
  7. Enter the diminishing gate.
  8. Bring the apparatus to a complete stop.
  9. Before touching the center marker.
  10. Back the apparatus through the course following the same path.
  11. Maintaining a constant speed.
  12. Bring the apparatus to a complete stop after the front bumper passes the entry/exit gate.
  13. Minimum time to complete this exercise is 0:50.
  14. Maximum time to complete this exercise is 1:15.
-

**scoring:**

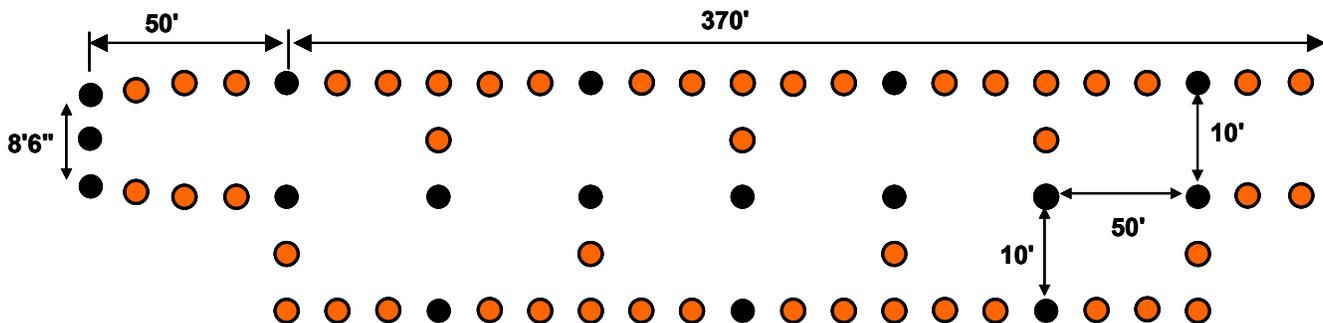
**100 points possible**

**80% passing**

1. **5 points** subtracted for each marker touched by the apparatus.
2. The student **fails** if he or she completes the course in less than 0:50 seconds.
3. The student **fails** if he or she completes the exercise in more than 1:15 minutes.
4. The student **fails** if he or she does not maintain control of the apparatus during the exercise.

**Site Preparation:**

- Markers are set up as shown, with each gate being 10-feet wide.
- Opposing gates are spaced at 50-foot intervals.
- Perimeter markers are spaced evenly throughout.
- Marker spacing is measured from base to base.



### Optional Driving Exercise 5-1-4

**Exercise:**

Parallel Parking Exercise

In this exercise, you are required to parallel park within 18 inches of the curb. This exercise tests your ability to align the apparatus with the curb without hitting the curb or markers and with a minimum loss of apparatus motion. This exercise simulates aligning an apparatus for hydrant hookups or elevating device operations.

**Time Frame:**

None

**Authority:**

SBFS

**Materials Needed:**

- Fire apparatus
- 1 assistant instructor
- 1,800 square foot area
- 48-inch pillars (4)
- 100-foot tape measure

**Student Directions:**

1. Drive the apparatus along the left side of the designated parking area.
2. Bring the apparatus to a complete stop after the rear bumper passes the last markers.
3. Back the apparatus between the markers, turning as needed.
4. Bring the apparatus to a complete stop before touching the markers or exceeding the parking area boundaries.
5. Drive the apparatus forward to straighten, if needed.
6. Bring the apparatus to a complete stop.
7. Set the parking brake.
8. Apparatus must be within 18 inches of the curb.

**Scoring:**

**100 points possible**

**80% passing**

1. **5 points** subtracted if apparatus tire brushes the curb.
2. The student **fails** if the apparatus touches a marker.
3. The student **fails** if the rear wheels roll up and onto the curb.

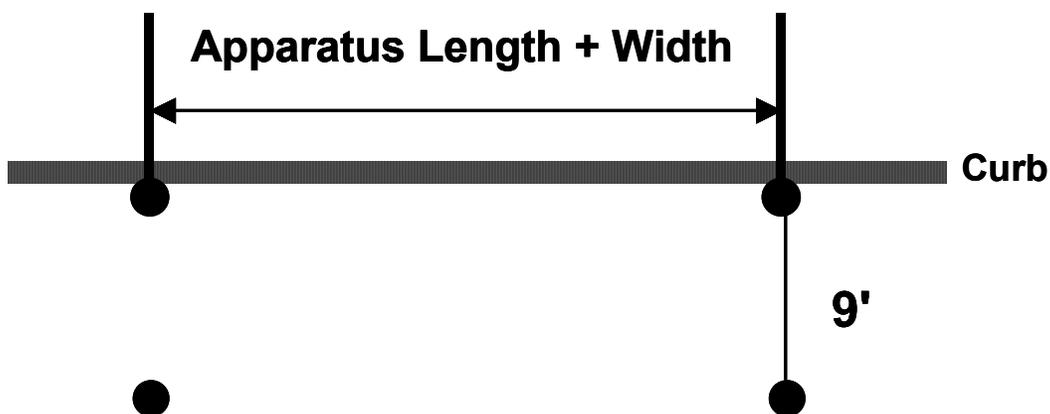
**Exercise:**

Parallel Parking Exercise

4. The student **fails** if the front or rear wheels are > 18 inches from the curb when the parking brake is set.
5. The student **fails** if he or she exceeds two directional changes as outlined in the diagram.
6. The student **fails** if he or she does not maintain control of the apparatus during the exercise.

**Site Preparation:**

- Site must be free of all obstacles.
- Measure the markers from base to base.





# FIRE APPARATUS DRIVER/OPERATOR 1A

## Emergency Vehicle Operations



Topic 5-1: Introduction to the Optional Driving Exercises

### Optional Driving Exercises

These exercises are for skill development only and are not part of the testing process.

STUDENT: \_\_\_\_\_ DATE: \_\_\_\_\_

<b>5-1-1: LANE CHANGE EXERCISE</b>		Penalty points subtracted from 100 possible points.		
	<b>Rated Component</b>	<b>Frequency</b>	<b>Value</b>	<b>100</b>
1.	Apparatus touches a marker		5	
2.	Apparatus stops or fails to maintain a constant forward motion		25	
3.	Failure to take the lane marked by the proctors	<input type="checkbox"/> Yes	25	
4.	Driver/operator fails to maintain control of the apparatus	<input type="checkbox"/> Yes		
<b>TOTAL POINTS:</b>				

Scorer's Name: \_\_\_\_\_

Signature: \_\_\_\_\_

#### 5-1-1 NOTES:

\_\_\_\_\_  
\_\_\_\_\_

<b>5-1-2: OFFSET ALLEY EXERCISE</b>		Penalty points subtracted from 100 possible points.		
	<b>Rated Component</b>	<b>Frequency</b>	<b>Value</b>	<b>100</b>
1.	Apparatus touches a marker		10	
2.	Failure to realign the apparatus after touching a marker		25	
3.	Driver/operator fails to maintain control of the apparatus	<input type="checkbox"/> Yes		
<b>TOTAL POINTS:</b>				

Scorer's Name: \_\_\_\_\_

Signature: \_\_\_\_\_

#### 5-1-2 NOTES:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_



# FIRE APPARATUS DRIVER/OPERATOR 1A

## Emergency Vehicle Operations



Topic 5-1: Introduction to the Optional Driving Exercises

STUDENT: \_\_\_\_\_ DATE: \_\_\_\_\_

<b>5-1-3: DOGLEG EXERCISE</b>		Penalty points subtracted from 100 possible points.		
	<b>Rated Component</b>	<b>Frequency</b>	<b>Value</b>	<b>100</b>
1.	Apparatus touches a marker		5	
2.	Driver/operator completes the course in less than 0:50	<input type="checkbox"/> Yes		
3.	Driver/operator completes the course in more than 1:15	<input type="checkbox"/> Yes		
4.	Driver/operator fails to maintain control of the apparatus	<input type="checkbox"/> Yes		
<b>TOTAL POINTS:</b>				

Scorer's Name: \_\_\_\_\_

Signature: \_\_\_\_\_

### 5-1-3 NOTES:

\_\_\_\_\_  
\_\_\_\_\_

<b>5-1-4: PARALLEL PARKING EXERCISE</b>		Penalty points subtracted from 100 possible points.		
	<b>Rated Component</b>	<b>Frequency</b>	<b>Value</b>	<b>100</b>
1.	Apparatus touches a marker		10	
2.	Rear wheels cross over or touch the curb	<input type="checkbox"/> Yes	25	
3.	Wheels are more than 18 inches from the curb at the end of the exercise	<input type="checkbox"/> Yes	25	
4.	Driver/operator exceeds two directional changes	<input type="checkbox"/> Yes		
5.	Driver/operator fails to maintain control of the apparatus	<input type="checkbox"/> Yes		
<b>TOTAL POINTS:</b>				

Scorer's Name: \_\_\_\_\_

Signature: \_\_\_\_\_

### 5-1-4 NOTES:

\_\_\_\_\_  
\_\_\_\_\_



# FIRE APPARATUS DRIVER/OPERATOR 1A

## Emergency Vehicle Operations



### Appendix A: Glossary

## Appendix A: Glossary

- Adjust** .....To maintain or regulate, within prescribed limits, by setting the operating characteristics to specified parameters.
- AHJ** .....Authority Having Jurisdiction. The organization, office, or individual responsible for approving equipment, materials, an installation, or a procedure.
- Alignment**.....To adjust components to bring about optimum or desired performance.
- Camber Angle** .....The angle of the wheel, measured in degrees, when viewed from the front of the apparatus.
- CCDH** .....California Commercial Driver Handbook
- CFR**.....Code of Federal Regulations. A codification of the general and permanent rules published in the Federal Register by the Executive departments and agencies of the Federal Government.
- Combination Fire Apparatus** .....A vehicle consisting of a pulling tractor and trailer.
- Component**.....A constituent part of a mechanical or electrical device.
- Decibel** .....A unit used to express relative difference in power or intensity, usually between two acoustic or electric signals, equal to ten times the common logarithm of the ratio of the two levels.
- Defect** .....A discontinuity in a part or a failure to function that interferes with the service or reliability for which the part was intended.
- Defective**.....Having a defect, or faulty.
- Deformation** .....Abnormal wear, defects, cracks or fractures, warpage, and deviations from the original condition that would affect safe and correct operation.
- Documentation** .....The process of gathering, classifying, and storing information.
- DOT** .....Department of Transportation. The department of the U.S. government that coordinates and institutes national transportation programs.



# FIRE APPARATUS DRIVER/OPERATOR 1A

## Emergency Vehicle Operations



### Appendix A: Glossary

- Driveline** .....See power train.
- Failure** .....A cessation of proper functioning or performance.
- Frame** .....The basic structural system that transfers the weight of the fire apparatus to the suspension system.
- High Voltage** .....Voltage that is above the normal 12 or 24 volts.
- Inspect** .....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.
- Interlock** .....A device or arrangement by means of which the functioning of one part is controlled by the functioning of another.
- Leakage** .....The escape of a fluid from its intended containment, generally at a connection. The three classes of leakage are defined.
- Leakage, Class 1** .....Seepage of fluid, as indicated by wetness or discoloration, not great enough to form drops.
- Leakage, Class 2** .....Leakage of fluid great enough to form drops, but not enough to cause drops to fall from the item being inspected.
- Leakage, Class 3** .....Leakage of fluid great enough to cause drops to fall from the item being inspected.
- Liability** .....The state of being responsible for ones actions. This could be civil or criminal, financial, moral, or legal.
- Low Voltage** .....Voltage that is usually 12 or 24 volts.
- Manufacturer's Recommendation (Specification)** .....Any requirement or suggestion a fire apparatus builder or component producer makes concerning care and maintenance of its product(s).
- Modification** .....An alteration or adjustment to any component that is a deviation from the original specifications or design of the fire apparatus.
- Operational Test** .....A test to determine the operational readiness of a component on a fire apparatus by observing the actual operation of the component.



# FIRE APPARATUS DRIVER/OPERATOR 1A

## Emergency Vehicle Operations



### Appendix A: Glossary

- Operator Alert Device** .....Any device, whether visual, audible, or both, installed in the driving compartment or at an operator's panel, to alert the operator to either a pending failure, an occurring failure, or a situation that requires his or her immediate attention.
- Optical Source** .....Any single, independently mounted, light-emitting component in a lighting system.
- Overhaul** .....To inspect, identify deficiencies, and make necessary repairs to return a component to operational condition.
- Power Train** .....The parts of a fire apparatus that transmit power from the engine to the wheels, including the transmission, split shaft power takeoff, midship pump transmission, drive shaft(s), clutch, differential(s), and axles.
- Powered Equipment Rack** .....A power-operated device that is intended to provide storage of hard suction hoses, ground ladders, or other equipment, generally in a location above apparatus compartments.
- Preventive Maintenance** .....The act or work of keeping something in proper condition by performing necessary preventive actions, in a routine manner, to prevent failure or breakdown.
- Primary Ignition System** .....The low voltage components of the ignition system including solenoids, relays, and valves that will allow the engine to start. On a gasoline driven engine, it begins with the battery and ends at the coil.
- Proper** .....As recommended by the manufacturer.
- Qualified Person** .....A person who, by possession of a recognized degree, certificate, professional standing, or skill, and who, by knowledge, training, and experience, has demonstrated the ability to deal with problems relating to a particular subject matter, work, or project.
- Repair** .....To restore to sound condition after failure or damage.
- Replace** .....To remove an unserviceable item and install a serviceable counterpart in its place.
- Secondary Ignition System** .....The high voltage components of an ignition system. This system is most often associated with gasoline-powered engines. It starts at the ignition coil and ends at the spark plug.



# FIRE APPARATUS DRIVER/OPERATOR 1A

## Emergency Vehicle Operations



### Appendix A: Glossary

- Severe Service** .....Those conditions that apply to the rigorous, harsh, and unique applications of fire apparatus, including but not limited to local operating and driving conditions, frequency of use, and manufacturer's severe service (duty) parameters.
- Shall** .....Indicates a mandatory requirement.
- Shoreline** .....A 120-volt electrical cord that attaches to the fire apparatus to maintain a full charge in the battery, run temperature control systems, maintain air pressure, and other vital systems.
- Should** .....Indicates a recommendation or that which is advised but not required.
- Single Fire Apparatus** .....A vehicle on a single chassis frame.
- SOP** .....Standard Operating Procedure. A method of performing a task that is developed by a department.
- Steering Axle** .....Any axle designed such that the wheels have the ability to turn the vehicle.
- Systems** .....A regularly interacting or interdependent group of components forming a unified whole.
- Test** .....To verify serviceability by measuring the mechanical, pneumatic, hydraulic, or electrical characteristics of an item and comparing those characteristics with prescribed standards.
- Title 49** .....A portion of the CFR that deals with transportation. The CFR is divided into 50 titles, which represent broad areas subject to Federal regulation.
- Toe Angle** .....The difference in the distance between the front of the tires and the back of the tires.
- Troubleshooter** .....An expert in discovering and eliminating the cause of trouble in mechanical equipment.
- Troubleshooting** .....To act or be employed as a troubleshooter.
- Tunnel Vision** .....Vision in which the visual field is severely constricted, as from within a tunnel looking out.