



Pumping Apparatus Operations

Course Plan

Course Details

- Certification:** Pumping Apparatus Driver/Operator (2017)
- CTS Guide:** Fire Apparatus Driver/Operator (2017)
- Description:** This course provides the knowledge and skills needed to operate and perform preventative maintenance on a pumping apparatus. Topics include routine tests, inspections, and servicing functions; producing hand, master, and foam fire streams; relay pump operations; and supplying water to fire sprinkler and standpipe systems.
- Designed For:** Personnel who drive and operate a fire department pumping apparatus
- Course Prerequisites:** OSFM certified Fire Fighter 1 or certified Fire Fighter 2 tenured path (Appointment to the rank of Officer (Lieutenant or higher) waives this prerequisite. Appointment to the CAL FIRE rank of Fire Apparatus Engineer is equivalent to Officer level. Performing in an “acting” capacity does not fulfill this requirement.)
- 1A: Fire Apparatus Driver/Operator (2008 or newer)
- A valid driver’s license
- Standard:** Successful completion of all skills and activities
- Achieve a minimum score of 80% on a cognitive summative test
- Hours (Total):** 40 hours (17 lecture / 23 application)
- Maximum Class Size:** 30
- Instructor Level:** One primary instructor and sufficient assistant instructors to meet skills ratio requirements
- Instructor/Student Ratio:** 1:30 (Lecture) / 1:10 (Application)
- Restrictions:** Sufficient fire apparatus and space to accommodate classroom and skills training
- SFT Designation:** CFSTES

Table of Contents

Required Resources.....	3
Instructor Resources	3
Online Instructor Resources.....	3
Student Resources	3
Facilities, Equipment, and Personnel	3
Time Table	5
Time Table Key	6
Unit 1: Introduction	7
Topic 1-1: Orientation and Administration	7
Topic 1-2: Pumping Apparatus Driver/Operator Certification	8
Unit 2: Roles and Responsibilities	9
Topic 2-1: Fire Pump Driver/Operator Roles and Responsibilities.....	9
Unit 3: Preventative Maintenance	10
Topic 3-1: Perform Visual and Operational Checks.....	10
Unit 4: Operations.....	11
Topic 4-1: Responding on an Apparatus to an Emergency Scene.....	11
Topic 4-2: Establishing and Operating at Emergency and Nonemergency Scenes	12
Topic 4-3: Connecting to a Water Supply.....	13
Topic 4-4: Producing Effective Hand Lines and Master Streams.....	14
Topic 4-5: Pumping a Supply Line for a Relay Operation	16
Topic 4-6: Producing a Foam Fire Stream	17
Topic 4-7: Supplying Water to Fire Sprinkler and Standpipe Systems	18
How to Read a Course Plan	19

Required Resources

Instructor Resources

To teach this course, instructors need:

- *Fire Apparatus Driver/Operator: Pump, Aerial, Tiller, and Mobile Water Supply* (Jones & Bartlett, current edition)
or
Pumping and Aerial Apparatus Driver/Operator Handbook (IFSTA, current edition)
- Maintenance and inspection forms
- Manufacturer's specifications and requirements
- Digital or print access to NFPA 13, NFPA 13D, NFPA 13E, NFPA 13R, NFPA 14, and NFPA 20

Online Instructor Resources

The following instructor resources are available online at

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

- Pumping Apparatus Operations required activities
 - Activity 3-1: Produce an Effective Hand Line and Master Stream
 - Activity 3-2: Pump a Supply Line for a Relay Operation
 - Activity 3-3: Produce a Foam Fire Stream
 - Activity 3-4: Supply Water to Fire Sprinkler and Standpipe Systems

Student Resources

To participate in this course, students need:

- *Fire Apparatus Driver/Operator: Pump, Aerial, Tiller, and Mobile Water Supply* (Jones & Bartlett, current edition)
or
Pumping and Aerial Apparatus Driver/Operator Handbook, (IFSTA, current edition)
- Personal protective equipment

Facilities, Equipment, and Personnel

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

- Standard learning environment or facility
- Writing board or paper conference pads
- Markers, erasers
- Computer or tablet with presentation or other viewing software
- Amplification devices
- Projector and screen
- Sufficient pumping apparatus to accommodate the students in the class
 - Recommend at least 30 minutes of pumping time per student across Topics 4-1 through 4-7.
- Tools and equipment for inspection and testing

- Pressurized water source (hydrant or supply line from another pumping apparatus)
- Static water source (drafting pit, portable tank, or natural water source)
- Hard suction hose
- Foam portioning system
- Foam or foam substitute
- Sprinkler system or mockup appliance
- Standpipe system or mockup appliance
- Tools and equipment
- Personal protective equipment (students)
- Adequate space to accommodate the required skills

Time Table

Segment	Lecture	Application	Unit Total
Unit 1: Introduction			
Topic 1-1: Orientation and Administration	0.5	0.0	
Topic 1-2: Pumping Apparatus Driver/Operator Certification	0.5	0.0	
Unit 1 Totals	1.0	0.0	1.0
Unit 2: Roles and Responsibilities			
Topic 2-1: Fire Pump Driver/Operator Roles and Responsibilities	2.0	0.0	
Unit 2 Totals	2.0	0.0	2.0
Unit 3: Preventative Maintenance			
Topic 3-1: Perform Visual and Operational Checks	4.0	0.0	
Unit 3 Totals	4.0	0.0	4.0
Unit 4: Operations			
Topic 4-1: Responding on an Apparatus to an Emergency Scene	0.25	0.0	
Topic 4-2: Establishing and Operating at Emergency and Nonemergency Scenes	0.25	0.0	
Topic 4-3: Connecting to a Water Supply	0.5	0.0	
Topic 4-4: Producing Effective Hand Lines and Master Streams	7.0	*	
Topic 4-5: Pumping a Supply Line for a Relay Operation	1.0	*	
Topic 4-6: Producing a Foam Fire Stream	1.0	*	
Topic 4-7: Supplying Water to Fire Sprinkle and Standpipe Systems	2.0	*	
Unit 4 Totals	12.0	21.0	
Summative Assessment			
Determined by AHJ or educational institution	TBD	1.0	TBD
Skills Practice (Lab / Sets and Reps)			
Determined by AHJ or educational institution	TBD	TBD	TBD
Course Totals	17.0	23.0	40.0

* Individual application time determined by instructor for a total of 21 hours for Unit 4. Recommend at least 30 minutes of pumping time per student across Topics 4-1 through 4-7.

Time Table Key

1. The Time Table documents the amount of time required to deliver the content included in the course plan.
2. Time is documented using the quarter system: 15 min. = .25 / 30 min. = .50 / 45 min. = .75 / 60 min. = 1.0.
3. The Course Totals do not reflect time for lunch (1 hour) or breaks (10 minutes per each 50 minutes of instruction or assessment). It is the instructor's responsibility to add this time based on the course delivery schedule.
4. Application (activities, skills exercises, and formative testing) time will vary depending on the number of students enrolled. The Application time documented is based on the maximum class size identified in the Course Details section.
5. Summative Assessments are determined and scheduled by the authority having jurisdiction. These are not the written or psychomotor State Fire Training certification exams. These are in-class assessments to evaluate student progress and calculate course grades.

Unit 1: Introduction

Topic 1-1: Orientation and Administration

Terminal Learning Objective

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

Enabling Learning Objectives

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

Discussion Questions

1. Determined by instructor

Application

1. Determined by instructor

Instructor Notes

1. None

Topic 1-2: Pumping Apparatus Driver/Operator Certification

Terminal Learning Objective

At the end of this topic a student will be able to identify the requirements for Pumping Apparatus Driver/Operator certification and be able to describe the certification task book and examination process.

Enabling Learning Objectives

1. Identify the prerequisites for certification
 - OSFM certified Fire Fighter 1
 - or**
 - Appointment to the rank of Officer (Lieutenant or higher) or CAL FIRE rank of Fire Apparatus Engineer waives this certification prerequisite. (*Performing in an “acting” capacity does not fulfill this requirement.*)
 - and**
 - Valid Class C Firefighter Endorsed **or** Commercial A **or** Commercial B driver’s license (per California Vehicle Code, Section 12804.11)
2. Identify the course work required for certification
 - 1A: Fire Apparatus Driver/Operator (2008 or newer)
 - 1B: Pumping Apparatus Operations (2008 or newer)
3. Identify the exams required for certification
 - No exams outside of class testing
4. Identify the task book requirements for certification
 - Pumping Apparatus Driver/Operator Certification Task Book (2017)
5. Identify the experience requirements for certification
 - A minimum of one year full-time paid experience in a California fire department with the primary responsibility as a pumping apparatus driver/operator
 - A minimum of two years volunteer or part-time paid experience in a California fire department with the primary responsibility as a pumping apparatus driver/operator
6. Identify the position requirements for certification
 - Appointed to the rank or position of Fire Apparatus Driver/Operator (performing in an acting capacity does not qualify)
7. Describe the certification task book process
8. Describe the certification examination process
 - Not applicable

Discussion Questions

1. Determined by instructor

Application

1. Determined by instructor

Instructor Notes

1. None

Unit 2: Roles and Responsibilities

Topic 2-1: Fire Pump Driver/Operator Roles and Responsibilities

Terminal Learning Objective

At the end of this topic a student, given AHJ roles, responsibilities, policies and procedures, will be able to describe the roles and responsibilities of a fire pump driver/operator and identify how they differ from being a passenger.

Enabling Learning Objectives

1. Describe the organization of the fire department
2. Describe the role of the driver/operator in the organization
3. Describe the mission of the fire service
4. Describe the fire department's standard operating procedures (SOPs) and rules and regulations as they apply to the driver/operator
5. Describe the value of fire and life safety initiatives in support of the fire department mission and to reduce fire fighter line-of-duty injuries and fatalities
6. Describe the role of other agencies as they relate to the fire department
7. Describe aspects of the fire department's member assistance program
8. Describe the importance of physical fitness and a healthy lifestyle to the performance of the duties of a fire fighter
9. Identify the critical aspects of NFPA 1500

Discussion Questions

1. How are SOPs different from SOGs and they apply to pump operations?
2. What injuries are common to pump driver/operators?
3. How does your agency provide incident stress support for driver/operators?
4. Why is physical fitness important for a pump driver/operator?

Application

1. Determined by instructor

Instructor Notes:

1. None

CTS Guide Reference: CTS 4-1

Unit 3: Preventative Maintenance

Topic 3-1: Perform Visual and Operational Checks

Terminal Learning Objective

At the end of this topic a student, given a pumping apparatus, tools and equipment, maintenance and inspection forms, manufacturer's specifications and requirements, and AHJ policies and procedures, will be able to perform and document visual and operational checks on the systems and components unique to a pumping apparatus to verify their operational status.

Enabling Learning Objectives

1. Identify manufacturer specifications and requirements
2. Identify AHJ policies and procedures including documentation requirements
3. Describe pumping systems and components
 - Types
 - Positive displacement
 - Centrifugal
 - Single/multistage
 - Transfer of power
 - Priming systems
 - Pumping systems
 - Foam systems
 - Pressure control devices
 - Gauges
 - Valves and plumbing
 - Water tank and other extinguishing agent levels (if applicable)
 - Steel tanks
 - Aluminum tanks
 - Poly tanks
4. Use tools and equipment
5. Inspect fire pump and components
6. Recognize system problems and out-of-service criteria
7. Correct any deficiency noted according to AHJ policies and procedures and/or manufacturer specifications and requirements

Discussion Questions

1. What are the advantages/disadvantages of positive placement and centrifugal pumps?
2. What is the function of the priming system?
3. In what ways can power be transferred to the pump?

Application

1. Determined by instructor

Instructor Notes:

1. None

CTS Guide Reference: CTS 4-2

Unit 4: Operations

Topic 4-1: Responding on an Apparatus to an Emergency Scene

Terminal Learning Objective

At the end of this topic a student, given safety equipment as provided by the AHJ, will be able to respond on an apparatus to an emergency scene so that the apparatus is correctly mounted and dismounted and seat belts are used while the vehicle is in motion.

Enabling Learning Objectives

1. Describe mounting and dismounting procedures for riding a fire apparatus
2. Identify hazards and ways to avoid hazards associated with riding a fire apparatus
3. Identify prohibited practices
4. Describe types of department safety equipment the means for usage
5. Use each piece of provided safety equipment

Discussion Questions

1. What passenger and vehicle safety considerations should a driver/operator complete before leaving the station and en route?
2. What precautions should a driver/operator take when entering an intersection?

Application

1. Determined by instructor

Instructor Notes:

1. Although this is covered in Fire Fighter 1, reteach it here from a pumping apparatus driver/operator perspective.

CTS Guide Reference: CTS 5-1

Topic 4-2: Establishing and Operating at Emergency and Nonemergency Scenes

Terminal Learning Objective

At the end of this topic a student, given safety equipment, traffic and scene control devices, emergency and nonemergency scenes, traffic and other hazards, an assignment, and SOPs, will be able to establish and operate in work areas at emergency and nonemergency scenes so that procedures are followed, safety equipment is utilized, protected work areas are established as directed using traffic and scene control devices, and the driver/operator performs assigned tasks only in established, protected work areas.

Enabling Learning Objectives

1. Identify potential hazards involved in operation on emergency and nonemergency scenes including vehicle traffic, utilities, and environmental conditions
2. Describe proper procedures for dismounting apparatus in traffic
3. Describe procedures for safe operation at emergency and nonemergency scenes
4. Identify safety equipment available for members on emergency and nonemergency scenes
5. Use safety equipment
6. Deploy traffic and scene control devices
7. Dismount apparatus
8. Establish and operate in the protected work areas as directed

Discussion Questions

1. What items will a driver/operator need for traffic control?
2. What considerations go into vehicle placement at an incident?
3. What are some potential hazards when parking at a traffic collision?

Application

1. Determined by instructor

Instructor Notes:

1. Although this is covered in Fire Fighter 1, reteach it here from a pumping apparatus driver/operator perspective.

CTS Guide Reference: CTS 5-2

Topic 4-3: Connecting to a Water Supply

Terminal Learning Objective

At the end of this topic a student, given supply or intake hose, hose tools, and a fire hydrant or static water source, will be able to connect a pumping apparatus to a water supply as a member of a team, so that connections are tight and water flow is unobstructed.

Enabling Learning Objectives

1. Describe loading and off-loading procedures for mobile water supply apparatus
2. Describe fire hydrant operations
3. Identify suitable static water supply sources
4. Describe procedures and protocol for connecting to various water sources
5. Hand lay a supply hose
6. Connect and place hard suction hose for drafting operations
7. Deploy portable water tanks as well as the equipment necessary to transfer water between and draft from them
8. Make hydrant-to-apparatus hose connections for forward and reverse lays
9. Connect supply hose to a hydrant
10. Fully open and close the hydrant

Discussion Questions

1. What are some considerations when choosing a fire hydrant?
2. What are some considerations when spotting at a fire hydrant?
3. What are your agency's standard operations guidelines for choosing a supply line?

Application

1. Determined by instructor

Instructor Notes:

1. Although this is covered in Fire Fighter 1, reteach it here from a pumping apparatus driver/operator perspective.

CTS Guide Reference: CTS 5-3

Topic 4-4: Producing Effective Hand Lines and Master Streams

Terminal Learning Objective

At the end of this topic a student, given an internal water tank, a pressurized water source, and a static water source, will be able to produce an effective hand line and master stream by engaging the pump, setting all pressure control and apparatus safety devices, achieving and maintaining the rate flow of the nozzle, while continuously monitoring the apparatus for potential problems.

Enabling Learning Objectives

1. Describe hydraulic calculations for friction loss and flow using both written formulas and estimation methods
 - Single line
 - Multiple lines
 - Mixed GPM
 - Mixed hose lengths
2. Explain pump discharge pressure calculations
3. Describe water sources
 - Internal water tank
 - Pressurized
 - High pressure
 - Low pressure
 - Static
 - Private
4. Describe the reliability of static sources
5. Describe proper positioning of a pumping apparatus
 - Hydrant
 - Standpipes
 - Drafting
6. Describe the safe operation of the pump
 - Introduction of water
 - Cavitation
 - Water hammer
 - Overheating
 - Discharge gates
 - Pressure control devices
7. Describe how to pump
 - Single line
 - Multiple lines
 - Mixed GPM
 - Mixed hose lengths
8. Identify the problems related to small-diameter or dead-end mains
9. Describe hydrant coding systems
10. Describe the principles of drafting

11. Identify communication points between pump driver/operator and crew
 - Supply established
 - Charging hose lines
 - GPM changes
 - Low supply
12. Position a pumping apparatus to operate at a fire hydrant and at a static water source
13. Transfer power from apparatus engine to pump
14. Draft
15. Operate pumper pressure control systems
16. Operate the volume/pressure transfer valve (multistage pumps only)
17. Operate auxiliary cooling systems
18. Make the transition between internal and external water sources
19. Assemble hose lines, nozzles, valves, and appliances
20. Apply hydraulic calculations to produce an effective stream

Discussion Questions

1. Why are pump calculations important to pump operations?
2. What is the earliest indication of impending cavitation?
3. How does a discharge relief valve operate?

Application

1. Activity 3-1: Produce an Effective Hand Line and Master Stream

CTS Guide Reference: CTS 5-4 and CTS 5-5

Topic 4-5: Pumping a Supply Line for a Relay Operation

Terminal Learning Objective

At the end of this topic a student, given a relay pumping evolution the length and size of the line and the desired flow and intake pressure, will be able to pump a supply line of 2½ in. (65 mm) or larger to provide the correct pressure and flow to the next pumping apparatus in the relay.

Enabling Learning Objectives

1. Describe the need for relay pumping operations
2. Describe hydraulic calculations for friction loss and flow using both written formulas and estimation methods
3. Describe pump discharge pressure calculations
4. Identify communication points between pump driver/operators
 - Supply established
 - Charging hose lines
 - GPM changes
 - Pressure changes/needs
 - Low supply
5. Position a pumping apparatus to operate at a fire hydrant and a static water source
6. Transfer power from pumping apparatus engine to pump
7. Draft
8. Operate apparatus pressure control systems
9. Operate the volume/pressure transfer valve (multistage pumps only)
10. Operate auxiliary cooling systems
11. Make the transition between internal and external water sources
12. Assemble hose lines, nozzles, valves, and appliances
13. Apply hydraulic calculations to a relay operation

Discussion Questions

1. What method do you use when calculating your pump discharge pressure for a relay operation?
2. What needs to be considered when pumping to an aerial master stream?
3. In what situations would you use a relay pumping operation?

Application

1. Activity 3-2: Pump a Supply Line for a Relay Operation

CTS Guide Reference: CTS 5-5

Topic 4-6: Producing a Foam Fire Stream

Terminal Learning Objective

At the end of this topic a student, given a pumping apparatus, foam-producing equipment, foam concentrate, and manufacturer's specifications and requirements, will be able to produce a foam fire stream to provide properly proportioned foam.

Enabling Learning Objectives

1. Describe proportioning rates and concentrations
2. Describe equipment assembly procedures
3. Identify foam system limitations
4. Identify manufacturer's specifications and requirements
5. Identify communication points between pump driver/operator and crew
6. Operate foam proportioning equipment
7. Connect foam stream equipment

Discussion Questions

1. In which incidents would you not want to use foam?
2. How do you prime the foam system?
3. What options do you have if your primary system fails?

Application

1. Activity 3-3: Produce a Foam Fire Stream

CTS Guide Reference: CTS 5-6

Topic 4-7: Supplying Water to Fire Sprinkler and Standpipe Systems

Terminal Learning Objective

At the end of this topic a student, given a pumping apparatus, sprinkler and standpipe system, and specific system information, will be able to supply water to fire sprinkler and standpipe systems at the correct volume and pressure.

Enabling Learning Objectives

1. Describe hydraulic calculations for friction loss and flow using both written formulas and estimation methods
2. Describe how to calculate pump discharge pressure
3. Describe hose layouts
4. Identify the location of fire department connections
5. Describe alternative supply procedures if fire department connection is not usable
6. Describe operating principles of sprinkler systems as defined in NFPA 13, NFPA 13D, and NFPA 13R
7. Describe fire department operations in sprinklered properties as defined in NFPA 13E
8. Describe the operating principles of standpipe systems as defined in NFPA 14
9. Identify communication points between pump driver/operator and crew
 - Supply established
 - Charging hose lines
 - GPM changes
 - Pressure changes/needs
 - Low supply
10. Describe how to augment structures with built-in fire pumps (NFPA 20)
11. Position a pumping apparatus to operate at a fire hydrant and a static water source
12. Transfer power from pumping apparatus engine to pump
13. Operate pumper pressure control systems
14. Operate the volume/pressure transfer valve (multistage pumps only)
15. Operate auxiliary cooling systems
16. Make the transition between internal and external water sources
17. Assemble hose lines, nozzles, valves, and appliances
18. Apply hydraulic calculations to sprinkler and standpipe systems

Discussion Questions

1. How do your operations differ when supplying a wet versus a dry standpipe?
2. What is your operation when pumping to a high-rise?
3. When and how should you connect to a sprinkler or standpipe system?

Application

1. Activity 3-4: Supply Water to Fire Sprinkler and Standpipe Systems

Instructor Notes:

2. None

CTS Guide Reference: CTS 5-7

How to Read a Course Plan

A course plan identifies the details, logistics, resources, and training and education content for an individual course. Whenever possible, course content is directly tied to a national or state standard. SFT uses the course plan as the training and education standard for an individual course. Individuals at fire agencies, academies, and community colleges use course plans to obtain their institution's consent to offer course and provide credit for their completion. Instructors use course plans to develop syllabi and lesson plans for course delivery.

Course Details

The Course Details segment identifies the logistical information required for planning, scheduling, and delivering a course.

Required Resources

The Required Resources segment identifies the resources, equipment, facilities, and personnel required to deliver the course.

Unit

Each Unit represents a collection of aligned topics. Unit 1 is the same for all SFT courses. An instructor is not required to repeat Unit 1 when teaching multiple courses within a single instructional period or academy.

Topics

Each Topic documents a single Terminal Learning Objective and the instructional activities that support it.

Terminal Learning Objective

A Terminal Learning Objective (TLO) states the instructor's expectations of student performance at the end of a specific lesson or unit. Each TLO includes a task (what the student must be able to do), a condition (the setting and supplies needed), and a standard (how well or to whose specifications the task must be performed). TLOs target the performance required when students are evaluated, not what they will do as part of the course.

Enabling Learning Objectives

The Enabling Learning Objectives (ELO) specify a detailed sequence of student activities that make up the instructional content of a lesson plan. ELOs cover the cognitive, affective, and psychomotor skills students must master in order to complete the TLO.

Discussion Questions

The Discussion Questions are designed to guide students into a topic or to enhance their understanding of a topic. Instructors may add to or adjust the questions to suit their students.

Application

The Application segment documents experiences that enable students to apply lecture content through cognitive and psychomotor activities, skills exercises, and formative testing. Application experiences included in the course plan are required. Instructors may add additional application experiences to suit their student population if time permits.

Instructor Notes

The Instructor Notes segment documents suggestions and resources to enhance an instructor's ability to teach a specific topic.

CTS Guide Reference

The CTS Guide Reference segment documents the standard(s) from the corresponding Certification Training Standard Guide upon which each topic within the course is based. This segment is eliminated if the course is not based on a standard.

Skill Sheet

The Skill Sheet segment documents the skill sheet that tests the content contained within the topic. This segment is eliminated if the course does not have skill sheets.