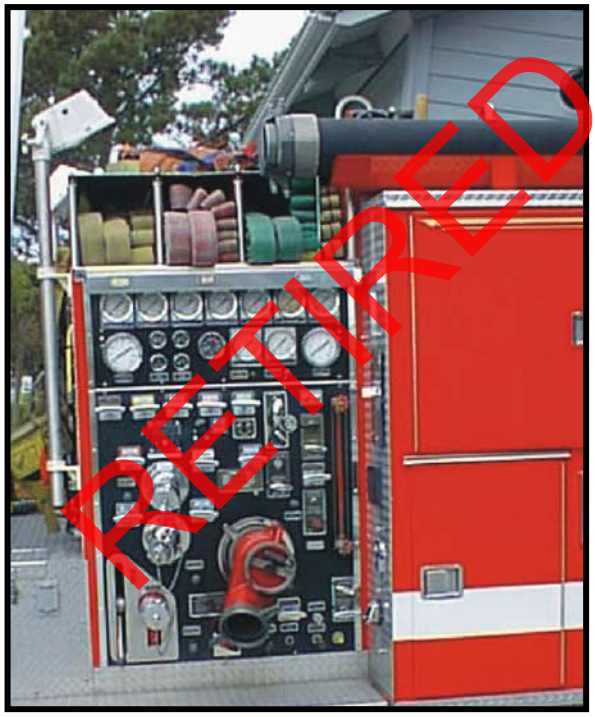
FIRE APPARATUS DRIVER/OPERATOR 1B

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



RETIRED CURRICULUM

INSTRUCTOR GUIDE

October 2008

FIRE APPARATUS DRIVER/OPERATOR 1B

PUMP OPERATIONS

INSTRUCTOR GUIDE

RETIRED CURRICULUM

Published by

STATE FIRE TRAINING
PO Box 944246
Sacramento, CA 94244-2460

October 2008

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State Fire Training

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 Certification Training Standards, 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.

Ruben Grijalva Director of CAL FIRE	
Kate Dargan State Fire Marshal	**Tonya Hoover** Assistant State Fire Marshal
Mike Richwine Chief, State Fire Training	**Ron Coleman** Chair, STEAC

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Special acknowledgement and thanks are extended to the following members of CDF/State Fire Training Curriculum Development Division for their diligent efforts and contributions that made the final publication of this document possible.

Alicia Hamilton
Fire Service Training Specialist III

The material contained in this document was compiled and organized through the cooperative effort of numerous professionals within, and associated with, the California fire service. We gratefully acknowledge these individuals who served as principal developers for this document.

Special acknowledgement and thanks are extended to Mark Romer, Roseville Fire Department and Darren Hall for this updated 2008 edition.

David Anderson CDF – Riverside Unit	**Tom Hostetter** CDF – Nevada/Yuba/Placer Unit
Gus Bryant Kern County Fire Department	**Don Mashburn** Sacramento Fire Department
Robert Confer Tiburon And Ben Lomond Fire Districts	**Tom Murray** San Francisco Fire Department (Retired)
Tom Davis Modesto Regional Fire Training Center	**Don Ockey** Fresno City Fire Department
Roy Francis Pasadena Fire Department	**John Owens** CDF – San Luis Obispo Unit
Thomas D. Gallinatti Oakland Fire Department	**Mark Romer, Team Leader** Roseville Fire Department

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

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Student Profile

Target Group

Fire service emergency response personnel

Prerequisites

- ❑ California Drivers License, Class B, fire fighter restricted (minimum)
- ❑ Fire Fighter I training recommended

Desired Attendance Time Frame

None

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Class Requirements and Space

The characteristics of the classroom and support facilities have a great impact on the learning environment and the instructor's success or failure. For this course, it is advisable for the instructor to adhere as closely as possible to the following guidelines.

Equipment

Writing board with markers/erasers

Appropriate audiovisual equipment

Appropriate audiovisual materials

Pumping Grounds and Equipment

1. Fire apparatus

Materials

- ❑ Unit 1
  - Course outline
  - Calendar of events
  - Progress chart
  - Activity 1-1-1: Math Skills Pretest
- ❑ Unit 2
  - None
- ❑ Unit 3
  - Activity 3-2-1: Mathematics Review
  - Activity 3-6-1: Calculating gpm
  - Activity 3-8-1: Calculating Friction Loss
  - Activity 3-9-1: Calculating Pump Discharge Pressure
  - Activity 3-10-1: Fireground Hydraulics
- ❑ Unit 4
  - None
- ❑ Unit 5
  - Activity 5-6-1: What's Wrong!

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- Unit 6
  - Pumping Exercise 6-1-1: Operating from Draft
  - Pumping Exercise 6-1-2: Operating Using a Forward Lay
  - Pumping Exercise 6-1-3: Operating Using a Reverse Lay
  - Grading Sheet
- Written Tests
  - Test 1
  - Test 2
  - Test 3
  - Certification Exam

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Introduction to the Manual

The **2008 Fire Apparatus Driver/Operator 1B** Instructor Guide has been updated to reflect current 2009 NFPA 1002 Standard for Fire Apparatus Driver/Operator Professional Qualifications. This course also requires two corresponding textbooks: the second edition of IFSTA's Pumping Apparatus Driver/Operator Handbook and the Fire Apparatus Driver/Operator 1B Student Supplement published by State Fire Training. All certification exam questions were developed using any one of these textbooks.

During the revision process, the developers included the following:

- An increase in group and individual activities
- Endnotes detailing specific code sections as they relate to the lesson plan
- PowerPoint slides for all lesson plans
- Video clips for the pumping exercises

This publication is intended to serve as an instructor guide and includes lesson plans, a slide index, student activities, and tests. For each topic identified in the course outline, a lesson plan has been developed that contains: a time frame, level of instruction, behavioral objective, materials needed, references, preparation statement, lesson content, and endnotes. Suggested application methods have been identified throughout the lessons for you to use during your presentation.

- **Time Frame**: The estimated duration required for in-class presentation.
- **Level Of Instruction**: Identifies the instructional level that the material was designed to fulfill. Obviously, you have the latitude to increase the level based on available time, local conditions, and the students' apperceptive base.
- **Behavioral Objective**: The behavioral objective is a statement of the student's performance desired at the end of instruction. You must ensure that enough information is given in the presentation and/or activities to enable the student to perform according to the goal.
- **Materials Needed**: This should be a complete list of everything you will need to present the lesson, including visual aids, tests, and so on.
- **References**: These are the specific references the curriculum development team used when developing the lesson plan. In addition, references may be listed as additional study aids for instructors to enhance the lesson -- books, manuals, bulletins, scripts, visual aid utilization plans, and the like. The corresponding pages in the student supplement are also listed here.

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- **Preparation**: The motivational statement connects the student with the lesson plan topic through examples or illustrations relating to their occupation, injury, and even mortality. You will need to develop this statement to fit your target audience.
- **Lesson Content**: Includes information used in the four-step method of instruction.

Cognitive Lesson Plans

PRESENTATION	APPLICATION
Everything you say or display Content Notes	Student Participation • Questions • Activities • Audiovisual Cues

Psychomotor Lesson Plan

OPERATIONS	KEY POINTS
Specific actions to be performed by the students Begin with a verb, followed by a noun	The who, what, when, where, why, and how (the "tricks of the trade") Safety practices

Appendix A – Instructor Tests

- Course tests with answer keys.

Appendix B – Student Tests

- Test masters to copy for your students. Keep these in good condition to use for future classes. Collect these tests after they have been graded and discussed in class.
- ***Do not let the students keep them since you will be using the same tests for your next class.***

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Course Outline

Course Objectives: To…

a) Provide students with information on pump construction and theory of pump operations.

b) Provide students with methods for performing basic hydraulics.

c) Provide students with information and techniques on basic inspections, documentation, maintenance, and troubleshooting fire pumps.

d) Provide students with the opportunity to increase their pumping skills during simulated pumping conditions.

Course Content.....40:00

Unit 1: Responsibilities, Standards, and Laws

1-1 Orientation And Administration.....1:30
1-2 Fire Apparatus Driver/Operator Responsibilities.....0:30

Unit 2: Fire Pump Construction and Theory

2-1 Types of Fire Pumps.....0:45
2-2 Pump Mounting And Drive Arrangements.....0:30
2-3 Pump Piping And Valves.....0:15
2-4 Automatic Pressure Control Devices.....0:15
2-5 Priming Devices.....0:15
2-6 Pump Panel Instrumentation.....0:15
2-7 Auxiliary Cooling Devices.....0:15

Unit 3: Hydraulics

3-1 Basic Hydraulic Terminology And Symbols.....0:30
3-2 Mathematics Review.....1:00
3-3 Characteristics Of Water and Principles Of Pressure.....0:30
3-4 Principle Features Of Water Systems.....0:15
3-5 Nozzle Theory.....0:30
3-6 Calculating Gallons Per Minute.....0:30
3-7 Principles Of Friction Loss.....0:15
3-8 Friction Loss Formulas And Calculations.....4:00
3-9 Pump Discharge Pressure.....0:30
3-10 Fireground Hydraulic Calculations.....1:00

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Unit 4: Inspection, Maintenance, and Troubleshooting
4-1 Inspecting The Pump Drive Systems 0:15
4-2 Inspecting The Pump Priming Systems 0:15
4-3 Inspecting The Pump Pressure Control Systems 0:15
4-4 Pump Service Testing 0:45
4-5 Maintenance Of The Pump And Control Systems 1:00
Unit 5: Pump Practices
5-1 Making The Pump Operational (From Tank) 0:30
5-2 Transitioning To An External Water Supply 0:30
5-3 Operating From A Hydrant 0:30
5-4 Principles And Practices Of Drafting Operations 0:30
5-5 Principles Of Relay Pump Operations 1:30
5-6 Troubleshooting Pump Operations 1:00
5-7 Principles Of Tandem Pumping Operations 0:15
5-8 Principles Of Dual Pumping Operations 0:15
5-9 Principles And Practices Of Foam Operations 1:00
5-10 Sprinkler And Standpipe Support 0:30
Unit 6: Pumping Exercises
6-1 Introduction To The Pumping Exercises 0:30
Practice and Testing the Pumping Exercises 13:00
Unit Tests 2:00
Review And Certification Exam 2:00

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Texts and References

- Driver Operator Training Program, Modesto Regional Training Center, Modesto Junior College, 2002 Edition
- Engineer Training Program, Tiburon Fire District, 2001 Edition
- Fire Apparatus Driver/Operator 1B Student Supplement, SFT, 2008 Edition
- Fire Fighting Hydraulics, Purington, First Edition
- Fire Service Instructor's Manual, Waterous Pump Company, 1996 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 1901: Standard for Automotive Fire Apparatus, NFPA, 1999 Edition
- NFPA 1911: Inspection, Maintenance, Testing, and Retirement of In-Service Automotive Fire Apparatus, 2007 Edition
- Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition
- Title 49 CFR Transportation, U.S. Government Printing Office, October 2006 Edition
- Type III Training Manual, Rincon Valley Fire District, 2002 Edition

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Calendar of Events

DAY	TOPIC	TITLE	TIME	ACTIVITY	EVALUATION
Day 1	1-1	Orientation And Administration	1:30	1-1-1	
	1-2	Fire Apparatus Driver/Operator Responsibilities	0:30		
	2-1	Types Of Fire Pumps	0:45		
	2-2	Pump Mounting And Drive Arrangements	0:30		
	2-3	Pump Piping And Valves	0:15		
	2-4	Automatic Pressure Control Devices	0:15		
	2-5	Priming Devices	0:15		
	2-6	Pump Panel Instrumentation	0:15		
	2-7	Auxiliary Cooling Devices	0:15		
	3-1	Basic Hydraulic Terminology And Symbols	0:30		
	3-2	Mathematics Review	1:00	3-2-1	
	3-3	Characteristics Of Water And Principles of Pressure	0:30		
	3-4	Principle Features Of Water Systems	0:15		
	3-5	Nozzle Theory	0:30		
	3-6	Calculating Gallons Per Minute	0:30	3-6-1	
	3-7	Principles Of Friction Loss	0:15		
		Day 1 Total	**8:00**		
Day 2	3-8	Friction Loss Formulas And Calculations	4:00	3-8-1	
	3-9	Pump Discharge Pressure	0:30	3-9-1	
			1:00		**Test 1**
	3-10	Fireground Hydraulic Calculations	1:00	3-10-1	
	4-1	Inspecting The Pump Drive Systems	0:15		
	4-2	Inspecting The Priming Pump Systems	0:15		
	4-3	Inspecting The Pump Pressure Control Systems	0:15		
	4-4	Pump Service Testing	0:45		
		Day 2 Total	**8:00**		
Day 3	4-5	Maintenance Of The Pump And Control Systems	1:00		
			0:30		**Test 2**
	5-1	Making The Pump Operational (From Tank)	0:30		
	5-2	Transitioning To An External Water Supply	0:30		
	5-3	Operating From A Hydrant	0:30		
	5-4	Principles And Practices Of Drafting Operations	0:30		
	5-5	Principles Of Relay Pump Operations	1:30		
	5-6	Troubleshooting Pump Operations	1:00	5-6-1	
	5-7	Principles Of Tandem Pumping Operations	0:15		

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DAY	TOPIC	TITLE	TIME	ACTIVITY	EVALUATION
	5-8	Principles Of Dual Pumping Operations	0:15		
	5-9	Principles And Practices Of Foam Operations	1:00		
	5-10	Sprinkler And Standpipe Support	0:30		
		Day 3 Total	**8:00**		
Day 4			0:30		**Test 3**
	6-1	Introduction To The Mandatory Pumping Exercises	0:30		
		Operating From Draft Exercise	7:00	6-1-1	
		Operating Using A Forward Lay Exercise		6-1-2	
		Operating Using A Reverse Lay Exercise		6-1-3	
		Day 4 Total	**8:00**		
Day 5		Practice Pumping Exercises	6:00		
		Graded Exercises		Performance Exams	
		Review And Certification Exam	2:00	Certification Exam	
		Day 5 Total	**8:00**		

*Mandatory Pumping Exercises

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TOPIC: 1-1: Orientation And Administration

TIME FRAME: 1:30

LEVEL OF INSTRUCTION: Level I

AUTHORITY: 2009 NFPA 1002: Chapters 1 and 4

BEHAVIORAL OBJECTIVE:

Condition: Given an activity and oral evaluation

Behavior: The student will confirm knowledge of the course objectives by completing the activity and oral evaluation

Standard: To the instructor's satisfaction according to the information contained in Fire Apparatus Driver/Operator 1B Student Supplement, SFT, 2008 Edition, Pages 1-8 and Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 1-10

MATERIALS NEEDED:

- Writing board/pad with markers/erasers
- Appropriate audiovisual equipment
- Appropriate audiovisual materials
- Progress chart
- Individual Activity 1-1-1: Math Skills Pretest

REFERENCES:

- NFPA 1002: Standard for Fire Apparatus Driver/Operator Professional Qualifications, 2009 Edition, Chapters 1 and 4
- NFPA 1451: Standard for a Fire Service Vehicle Operations Training Program, 2007 Edition
- NFPA 1500: Fire Department Occupational Safety and Health Program, 2007 Edition, Chapter 6
- NFPA 1582: Standard on Medical Requirements for Fire Fighters, 2007 Edition
- NFPA 1911: Inspection, Maintenance, Testing, and Retirement of In-Service Automotive Fire Apparatus, 2007 Edition
- Pumping Apparatus Driver/Operator Handbook, IFSTA, First Edition, Pages 1-10

PREPARATION: Each instructor must develop a motivational statement on why the student should learn the upcoming material. The purpose is to establish relevancy of the lesson to the audience. The ACID BASE acronym can be used to help develop student motivation.

Attention (attract)	**B**egin
Curiosity (arouse)	**A**ssociation
Interest (create)	**S**tudents
Desire (stimulate)	**E**xperience

Cite examples or use related illustrations of near-miss incidents, injuries, or fatalities. Write this section "from the heart." Be creative! Have fun with it or be serious, but remember the goal is to stimulate student motivation.

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PRESENTATION	APPLICATION
	SLIDE: 1-1-1
I. INTRODUCTIONS A. Introduce self and staff B. Cite background 1. Fire department experience 2. Education 3. Training 4. Teaching history 5. Instructor phone number(s)	
	Have the students introduce themselves. **SLIDE: 1-1-2**
C. Student Introductions **NOTE:** Announce that if there is a student with any special needs to see the instructor in private.	
	SLIDE: 1-1-3
II. COURSE PREREQUISITES A. California drivers license 1. Class B 2. Fire fighter restricted (minimum) B. Fire Fighter I training recommended **III. FACILITIES ORIENTATION** A. Classroom location(s) B. Restrooms C. Food locations D. Smoking E. Breaks F. Telephones G. Parking	

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PRESENTATION	APPLICATION
IV. STUDENT REGISTRATION	
A. Forms	
1. State Fire Training	
2. College	
NOTE: Provide step-by-step directions for completing the forms.	
B. Resolve any tuition issues as needed	
	SLIDE: 1-1-4
V. STUDENT EVALUATION	
A. Activities	
1. Complete all activities	
B. Three written unit tests	
1. Each followed with group discussion	
2. All tests must be completed and passed with a minimum score of 80%	
NOTE: Tests must be returned to the instructor after review.	
C. Pumping exercises	
1. Manipulative skills tracking and accountability	
2. Minimum score of 80% required to pass each mandatory manipulative performance test	
D. Progress chart	
1. Use student identification numbers	
a) No names	
2. Federal law prohibits publication of identifiable student grades	
	SLIDE: 1-1-5
E. State certification exam	
1. Not related to final course grade	
2. Must pass the class first before taking the exam	
3. 50 question multiple-choice exam	
4. Minimum 70% required to pass the cert exam	

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PRESENTATION	APPLICATION
	SLIDE: 1-1-6

VI. COURSE DESCRIPTION

A. 40-hour class
   1. Classroom information and activities
   2. Reading assignments
   3. Apparatus inspection
   4. Hands-on pumping exercises

B. Identify start and end times
   1. Class will begin on time
   2. Student attendance requirements
      a) Must attend the entire course
      b) State Fire Training allows considerations for excused absences up to four hours

C. Proper attire
   1. Classroom
      a) Station wear or equivalent
      b) Station boots or equivalent
   2. Field exercises
      a) Station wear or equivalent
      b) Station boots or equivalent
      c) Helmet
      d) Gloves

D. Required textbooks
   1. Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition
   2. Student supplement published by State Fire Training

SLIDE: 1-1-7

VII. COURSE OBJECTIVES

A. Provide the students with
   1. Information on pump construction and theory of pump operations

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PRESENTATION	APPLICATION
2. Information on methods for performing basic hydraulics	
3. Information and techniques on basic inspections, documentation, maintenance, testing, and troubleshooting fire pumps	
4. The opportunity to increase their pumping skills during simulated pumping conditions	
VIII. HISTORICAL OVERVIEW	
A. Course development	
1. First as a career development guide	
2. 1988, two courses were developed	
a) Fire Apparatus Driver/Operator 1A	
1) Emergency Vehicle Operations	
b) Fire Apparatus Driver/Operator 1B	
1) Pump Operations	
c) 2003, courses were updated	
d) 2008, courses were updated to meet the Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition	
	SLIDE: 1-1-8
B. Experience has demonstrated that the following skills and senses are needed to be a successful fire apparatus driver/operator	
1. Reading	
a) Able to read and understand the written word	
2. Writing	
a) Ability to write clearly and concisely	
3. Mathematics	
a) Basic mathematical skills for Fire Apparatus Driver/Operator 1A	
b) Basic algebra skills necessary for hydraulics in Fire Apparatus Driver/Operator 1B	
4. Physically fit	
a) Per department standards	

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PRESENTATION	APPLICATION

5. Vision

NOTE: NFPA 1582: Standard on Comprehensive Occupational Medical Program for Fire Departments, 2007 Edition, Section 6.4

a) Category A medical condition

1) Far visual acuity less than 20/40 binocular, corrected with contact lenses or spectacles, or far visual acuity less than 20/100 binocular for wearers of hard contacts or spectacles, uncorrected

2) Color perception

- Monochromatic vision resulting in inability to use imaging devices such as thermal imaging cameras

3) Monocular vision

4) Any eye condition that results in the candidate not being able to safely perform one or more of the essential job tasks

b) Category B medical condition

1) Diseases of the eye such as retinal detachment, progressive retinopathy, or optic neuritis

2) Ophthalmological procedures such as radial keratotomy, Lasik procedure, or repair of retinal detachment

3) Peripheral vision in the horizontal meridian of less than 110 degrees in the better eye or any condition that significantly affects peripheral vision in *both* eyes

6. Ears and hearing

NOTE: NFPA 1582: Standard on Comprehensive Occupational Medical Program for Fire Departments, 2007 Edition, Section 6.5

a) Category A medical condition

1) Chronic vertigo or impaired balance as demonstrated by the inability to tandem

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PRESENTATION	APPLICATION
gait walk	
2) On audiometric testing, average hearing loss in the unaided better ear greater than 40 decibels (dB) at 500 Hz, 1000 Hz, 2000 Hz, and 3000 Hz when the audiometric device is calibrated to ANSI Z24.5, Audiometric Device Testing	
3) Any ear condition (or hearing impairment) that results in the candidate not being able to safely perform one or more of the essential job tasks	
b) Category B medical condition	
1) Unequal hearing loss	
2) Average uncorrected hearing deficit at the test frequencies 500 Hz, 1000 Hz, 2000 Hz, and 3000 Hz greater than 40 dB in *either* ear	
	SLIDE: 1-1-9
7. Mechanical ability	
a) To understand the operation and maintenance of apparatus	
8. Basic supervisory skills	
9. Ability to remain calm	
10. Ability to avoid "tunnel vision"	
11. Ability to identify safety hazards	
IX. APPLICABLE STANDARDS	
	SLIDE: 1-1-10
A. <u>NFPA 1002: Standard for Fire Apparatus Driver/Operator Professional Qualifications</u>, NFPA, 2009 Edition	
1. Chapter 1: Administration	
2. Chapter 4: General Requirements	
3. Chapter 5: Apparatus Equipped with Fire Pump	
4. Appendix A: Explanatory Material	

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PRESENTATION	APPLICATION
	SLIDE: 1-1-11
B. NFPA 1911: Inspection, Maintenance, Testing, and Retirement of In-Service Automotive Fire Apparatus, NFPA, 2007 Edition	
1. Chapter 1 Administration	
2. Chapter 4 General Requirements	
3. Chapter 5 Retirement of Fire Apparatus	
4. Chapter 6 Out-of-service Criteria	
5. Chapters 7-15 Inspection and Maintenance	
6. Chapter 16 Road Tests and Annual Weight Verification	
7. Chapters 17-23 Performance Testing	
	SLIDE: 1-1-12
C. NFPA 1451: Standard for a Fire Service Vehicle Operations Training Program, NFPA, 2007 Edition	
1. Chapter 1: Administration	
2. Chapter 4: General Rules and Considerations	
3. Chapter 5: Training and Education	
4. Chapter 6: Laws and Liabilities	
5. Chapter 10: Vehicle and Apparatus Care	
	SLIDE: 1-1-13
D. NFPA 1500: Fire Department Occupational Safety and Health Program, NFPA, 2007 Edition	
1. Chapter 6: Fire Apparatus, Equipment, and Driver/Operators	
E. Other standards	
1. Departmental	
	SLIDE: 1-1-14
X. RELEVANCE OF STANDARDS	
A. Legal	
1. Nationally recognized	

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PRESENTATION	APPLICATION
2. Upheld in court a) Liability b) Held personally accountable 3. Negligence/liability a) Possible affects 1) Driving record 2) Personal insurance 3) Career impact	**ACTIVITY 1-1-1:** Complete the activity in the student supplement.
NOTE: Administer the pretest. Review the results before teaching Topic 3-2 to assess the students' basic math levels.	

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SUMMARY:

The professional fire apparatus driver/operator must recognize his or her role in the fire service and the responsibility that entails. The ability to remain calm, think clearly, and act decisively with intent are just part of the traits that are critical for this position.

EVALUATION:

The student will complete the activity and oral evaluation at a time determined by the instructor.

ASSIGNMENT:

Review your notes and read Fire Apparatus Driver/Operator 1B Student Supplement, SFT, 2008 Edition, Pages 1-8 and Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 1-10 in order to prepare yourself for the upcoming test. Study for our next session.

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DRIVER/OPERATOR 1B PROGRESS CHART	BEGINNING DATE:											
	ENDING DATE:											
CLASS SIZE LIMITED TO 25 STUDENTS												
STUDENT IDENTIFICATION	Activity 1-1-11	Activity 3-2-1	Activity 3-6-1	Activity 3-8-1	Activity 3-9-1	Activity 3-10-1	Activity 5-6-1		Exercise 6-1-1	Exercise 6-1-2	Exercise 6-1-3	
1.												
2.												
3.												
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DRIVER/OPERATOR 1B PROGRESS CHART	BEGINNING DATE:											
	ENDING DATE:											
CLASS SIZE LIMITED TO 25 STUDENTS												
STUDENT IDENTIFICATION	Test #1	Test #2	Test #3		Attendance Day 1	Attendance Day 2	Attendance Day 3	Attendance Day 4	Attendance Day 5		PASS/FAIL	Cert Exam
1.												
2.												
3.												
4.												
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25.												

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INDIVIDUAL ACTIVITY 1-1-1

TITLE:	Basic Math Skills
TIME FRAME:	0:30
MATERIALS NEEDED:	• Calculator • Square root chart • Pen or pencil
INTRODUCTION:	This activity provides the students the opportunity to become familiar with or sharpen their math skills as they relate to fire hydraulics.
DIRECTIONS:	1. Complete Sections I, II, III, and IV. 2. You have 15 minutes to complete this activity. 3. Be prepared to discuss your answers with the class.

SECTION I: CALCULATE THE FOLLOWING EQUATIONS

Whole Numbers

1. 18426 + 21575 ***40001***
2. 95360 – 77469 ***17891***
3. 156 x 38 ***5928***
4. (128)(15) ***1920***
5. 352 ÷ 32 ***11***
6. 4410/21 ***210***

Decimals

7. 34.3 + 18.66 ***52.96***
8. 29.05 – 6.1 ***22.95***
9. 34.3 x 3.3 ***113.19***
10. (2124.002)(10) ***21240.02***
11. 36.3 ÷ 3.3 ***11***
12. 2124.002/10 ***212.4002***

RETIRED CURRICULUM

Fractions

13.	$^1/_4 + {}^1/_2$	***$^3/_4$***	$^2/_8 + {}^2/_4$
14.	$^1/_4 - {}^1/_8$	***$^1/_8$***	$^2/_8 - {}^1/_8$
15.	$^3/_4 \times {}^1/_2$	***$^3/_8$***	$^{3 \times 1}/_{4 \times 2}$
16.	$^1/_4 \div {}^1/_2$	***$^1/_2$***	$^2/_8 \times {}^2/_1$

Percentages

17.	10% of 100	***10***	.10 x 100
18.	15% of 200	***30***	.15 x 200
19.	$^3/_8$ = _____%	***24***	.3 x 80

Proportion

What is the value of x?

20.	$\frac{1}{2} = \frac{2}{x}$	***x = 4***	1(x) = (2)(2) 1x = 4

Square Root

21.	√ 9	***3***	see chart
22.	√ 15	***3.8730***	see chart
23.	√ 50	***7.0711***	see chart
24.	√ 246	***15.6844***	see chart

Numbers Squared

25.	7^2	***49***	7 x 7
26.	12^2	***144***	12 x 12
27.	16^2	***256***	16 x 16
28.	46^2	***2,116***	46 x 46
29.	112^2	***12,544***	112 x 112

RETIRED CURRICULUM

SECTION II: CONVERT THE FOLLOWING FRACTIONS TO A DECIMAL

30.	$^3/_8$	***.0375***	3 ÷ 8
31.	$^5/_8$	***.625***	5 ÷ 8
32.	$^1/_{16}$	***.0625***	1 ÷ 16
33.	$^3/_4$	***.75***	3 ÷ 4
34.	$^2/_3$	***.667***	2 ÷ 3

SECTION III: CALCULATE THE AREA OF EACH CIRCLE

Round your answer to the nearest whole number.

35.	Diameter = 6 feet	***28***	3.14×3^2 3.14 x 9
36.	Diameter = 8 feet	***50***	3.14×4^2 3.14 x 16
37.	Diameter = 14 feet	***154***	3.14×7^2 3.14 x 49
38.	Diameter = 28 feet	***615***	3.14×14^2 3.14 x 196
39.	Radius = 16 feet	***804***	3.14×16^2 3.14 x 256

SECTION IV: CALCULATE THE CAPACITY OF EACH CYLINDER TANK (IN GALLONS)

Round your answer to the nearest whole number.

40.	Diameter = 3 feet Length = 14 feet	***756***	$(3^2 \times 6)(14)$ (9 x 6)(14) (54)(14)
41.	Diameter = 10 feet Length = 12 feet	***7,200***	$(10^2 \times 6)(12)$ (100 x 6)(12) (600)(12)
42.	Diameter = 15 feet Length = 40 feet	***54,000***	$(15^2 \times 6)(40)$ (225 x 6)(40) (1,350)(40)
43.	Diameter = 20 feet Length = 4 feet	***9,600***	$(20^2 \times 6)(4)$ (400 x 6)(4) (2,400)(4)
44.	Diameter = 25 feet Length = 8 feet	***30,000***	$(25^2 \times 6)(8)$ (625 x 6)(8) (3,750)(8)

RETIRED CURRICULUM

Square Roots of Numbers 1-250

n	$\sqrt{n}$	n	$\sqrt{n}$	n	$\sqrt{n}$	n	$\sqrt{n}$	n	$\sqrt{n}$
1	1.000	51	7.1414	101	10.0499	151	12.2882	201	14.1774
2	1.414	52	7.2111	102	10.0995	152	12.3288	202	14.2127
3	1.732	53	7.2801	103	10.1489	153	12.3693	203	14.2478
4	2.000	54	7.3485	104	10.1980	154	12.4097	204	14.2829
5	2.236	55	7.4163	105	10.2470	155	12.4499	205	14.3178
6	2.449	56	7.4833	106	10.2956	156	12.4900	206	14.3527
7	2.646	57	7.5498	107	10.3441	157	12.5300	207	14.3875
8	2.828	58	7.6158	108	10.3923	158	12.5698	208	14.4222
9	3.000	59	7.6811	109	10.4403	159	12.6095	209	14.4568
10	3.162	60	7.7460	110	10.4881	160	12.6491	210	14.4914
11	3.3166	61	7.8102	111	10.5357	161	12.6886	211	14.5258
12	3.4641	62	7.8740	112	10.5830	162	12.7279	212	14.5602
13	3.6056	63	7.9373	113	10.6301	163	12.7671	213	14.5945
14	3.7417	64	8.0000	114	10.6771	164	12.8062	214	14.6287
15	3.8730	65	8.0623	115	10.7238	165	12.8452	215	14.6629
16	4.0000	66	8.1240	116	10.7703	166	12.8841	216	14.6969
17	4.1231	67	8.1854	117	10.8167	167	12.9228	217	14.7309
18	4.2426	68	8.2462	118	10.8628	168	12.9615	218	14.7648
19	4.3589	69	8.3066	119	10.9087	169	13.0000	219	14.7986
20	4.4721	70	8.3666	120	10.9545	170	13.0384	220	14.8324
21	4.5826	71	8.4261	121	11.0000	171	13.0767	221	14.8661
22	4.6904	72	8.4853	122	11.0454	172	13.1149	222	14.8997
23	4.7958	73	8.5440	123	11.0905	173	13.1529	223	14.9332
24	4.8990	74	8.6023	124	11.1355	174	13.1909	224	14.9666
25	5.0000	75	8.6603	125	11.1803	175	13.2288	225	15.0000
26	5.0990	76	8.7178	126	11.2250	176	13.2665	226	15.0333
27	5.1962	77	8.7750	127	11.2694	177	13.3041	227	15.0665
28	5.2915	78	8.8318	128	11.3137	178	13.3417	228	15.0997
29	5.3852	79	8.8882	129	11.3578	179	13.3791	229	15.1327
30	5.4772	80	8.9443	130	11.4018	180	13.4164	230	15.1658
31	5.5678	81	9.0000	131	11.4455	181	13.4536	231	15.1987
32	5.6569	82	9.0554	132	11.4891	182	13.4907	232	15.2315
33	5.7446	83	9.1104	133	11.5326	183	13.5277	233	15.2643
34	5.8310	84	9.1652	134	11.5758	184	13.5647	234	15.2971
35	5.9161	85	9.2195	135	11.6190	185	13.6015	235	15.3297
36	6.0000	86	9.2736	136	11.6619	186	13.6382	236	15.3623
37	6.0828	87	9.3274	137	11.7047	187	13.6748	237	15.3948
38	6.1644	88	9.3808	138	11.7473	188	13.7113	238	15.4272
39	6.2450	89	9.4340	139	11.7898	189	13.7477	239	15.4596
40	6.3246	90	9.4868	140	11.8322	190	13.7840	240	15.4919
41	6.4031	91	9.5394	141	11.8743	191	13.8203	241	15.5242
42	6.4807	92	9.5917	142	11.9164	192	13.8564	242	15.5563
43	6.5574	93	9.6437	143	11.9583	193	13.8924	243	15.5885
44	6.6332	94	9.6954	144	12.0000	194	13.9284	244	15.6205
45	6.7082	95	9.7468	145	12.0416	195	13.9642	245	15.6525
46	6.7823	96	9.7980	146	12.0830	196	14.0000	246	15.6844
47	6.8557	97	9.8489	147	12.1244	197	14.0357	247	15.7162
48	6.9282	98	9.8995	148	12.1655	198	14.0712	248	15.7480
49	7.0000	99	9.9499	149	12.2066	199	14.1067	249	15.7797
50	7.0711	100	10.0000	150	12.2474	200	14.1421	250	15.8114

RETIRED CURRICULUM

RETIRED CURRICULUM

TOPIC: 1-2: Fire Apparatus Driver/Operator Responsibilities

TIME FRAME: 0:30

LEVEL OF INSTRUCTION: Level II

AUTHORITY: 2009 NFPA 1002: Chapter 1

BEHAVIORAL OBJECTIVE:

Condition: Given a written test

Behavior: The student will confirm a knowledge of fire apparatus driver/operator responsibilities by completing the written test

Standard: With a minimum 80% accuracy according to the information contained in the Fire Apparatus Driver/Operator 1B Student Supplement, SFT, 2008 Edition, Pages 9-10 and Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 1-20, 31-54, 99-131

MATERIALS NEEDED:

- Writing board/pad with markers/erasers
- Appropriate audiovisual equipment
- Appropriate audiovisual materials

REFERENCES:

- NFPA 1451: Standard for a Fire Service Vehicle Operations Training Program, 2007 Edition, Chapter 5
- NFPA 1911: Inspection, Maintenance, Testing, and Retirement of In-Service Automotive Fire Apparatus, 2007 Edition, Chapters 1-4
- Pumping Apparatus Driver/Operator Handbook. IFSTA, Second Edition, Pages 1-20, 31-54, 99-131
- Title 49 CFR Transportation, U.S. Government Printing Office, October 2006 Edition, Part 396

PREPARATION: Each instructor must develop a motivational statement on why the student should learn the upcoming material. The purpose is to establish relevancy of the lesson to the audience. The ACID BASE acronym can be used to help develop student motivation.

Attention (attract)	**B**egin
Curiosity (arouse)	**A**ssociation
Interest (create)	**S**tudents
Desire (stimulate)	**E**xperience

Cite examples or use related illustrations of near-miss

incidents, injuries, or fatalities. Write this section "from the heart." Be creative! Have fun with it or be serious, but remember the goal is to stimulate student motivation.

RETIRED CURRICULUM

PRESENTATION	APPLICATION
	SLIDE: 1-2-1
	SLIDE: 1-2-2
I. SAFETY	
A. Personnel/apparatus riders	
1. Remain seated	
2. Wear seatbelts	
3. Have a spotter	
B. Public	
1. Use caution with general public around apparatus	
C. Driving (emergency and nonemergency)	
	SLIDE: 1-2-3
D. Operating apparatus	
1. Scene	
a) Apparatus positioning	What are some considerations when positioning your apparatus at an incident?
1) Building collapse	
2) Electrical hazards	
3) Hydrant locations	
4) Other apparatus access	
b) Hose lines	
1) Attack	
2) Supply	
c) Electrical hazards	
1) Generators and cords	
2) Downed wires	
d) Equipment	
1) Doors left open	
2) Ladder rack down	
3) Tools not secured or stored	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
	SLIDE: 1-2-4
E. Station 1. Apparatus bay doors 2. Compartment doors open 3. Shorelines	
	SLIDE: 1-2-5
II. DISTRICT KNOWLEDGE	What might you want to know about your district?
A. Response routes 1. Commercial verses residential areas B. Target hazards C. Access problems	
	SLIDE: 1-2-6
D. Water supply and distribution systems 1. Water sources a) Natural b) Fabricated 2. Gravity/pump 3. Hydrants 4. Draft locations	
	SLIDE: 1-2-7
III. APPARATUS INSPECTION	When do we inspect?
A. Daily 1. Required by law a) Title 49 CFR, Part 396: Inspection, Repair, and Maintenance 2. Types of inspection a) Pretrip b) Posttrip	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
B. Weekly/monthly	
1. Not required by law	
2. Per department SOPs	
3. In accordance with the manufacturer's recommendations and specifications	
C. Written documentation	
	When should written documentation be completed?
1. Completed daily	
2. Title 49 CFR, Part 396	
3. Per department SOPs	
D. Out-at-service criteria	
1. Per department SOPs	
2. In accordance with the manufacturer's recommendations and specifications	
3. NFPA 1911: Inspection, Maintenance, Testing, and Retirement of In-Service Automotive Fire Apparatus, 2007 Edition	
	SLIDE: 1-2-8
IV. APPARATUS MAINTENANCE	
A. Regulated by Code of Federal Regulations	
1. Title 49 CFR, Part 396	
B. Daily	
1. Required by law	
a) Title 49 CFR, Part 396	
2. Per department SOPs	
3. In accordance with the manufacturer's recommendations and specifications	
C. Weekly/monthly	
1. Per department SOPs	
2. In accordance with the manufacturer's recommendations and specifications	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
D. Written documentation 1. Title 49 CFR, Part 396 2. Per department SOPs	
	SLIDE: 1-2-9
V. OPERATION A. Spot apparatus accordingly B. Operate pump and associated components C. Secure a water supply D. Produce and maintain effective fire streams	
	SLIDE: 1-2-10
VI. TRAINING A. Ongoing 1. NFPA 1451: Standard for a Fire Service Vehicle Operations Training Program, 2007 Edition a) Chapter 5: Training and Education 1) 5.2.1: On-going training must be provided 2) 5.2.3: Appropriate training and education must take place when changes in procedures and/or technology occur 2. Per department SOPs B. Mentoring/instructing 1. Assist interested personnel	

RETIRED CURRICULUM

SUMMARY:

The importance of accepting the responsibility inherent with the position of fire apparatus driver/operator cannot be understated. Knowing all the elements of your apparatus, driving regulations, response district, water supply systems, and pump operations is part of the overall responsibility of the professional fire apparatus driver/operator.

EVALUATION:

The student will complete the written test at a time determined by the instructor.

ASSIGNMENT:

Review your notes and read Fire Apparatus Driver/Operator 1B Student Supplement, SFT, 2008 Edition, Pages 9-10 and Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 1-20, 31-54, 99-131 in order to prepare yourself for the upcoming test. Study for our next session.

RETIRED CURRICULUM

TOPIC: 2-1: Types Of Fire Pumps

TIME FRAME: 0:45

LEVEL OF INSTRUCTION: Level II

AUTHORITY: 2009 NFPA 1002: Chapter 5

BEHAVIORAL OBJECTIVE:

Condition: Given a written test

Behavior: The student will confirm a knowledge of the types of fire pumps by completing the written test

Standard: With a minimum 80% accuracy according to the information contained in Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 266-281

MATERIALS NEEDED:

- Writing board/pad with markers/erasers
- Appropriate audiovisual equipment
- Appropriate audiovisual materials

REFERENCES:

- Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 266-281

PREPARATION: Each instructor must develop a motivational statement on why the student should learn the upcoming material. The purpose is to establish relevancy of the lesson to the audience. The ACID BASE acronym can be used to help develop student motivation.

Attention (attract)	**B**egin
Curiosity (arouse)	**A**ssociation
Interest (create)	**S**tudents
Desire (stimulate)	**E**xperience

Cite examples or use related illustrations of near-miss incidents, injuries, or fatalities. Write this section "from the heart." Be creative! Have fun with it or be serious, but remember the goal is to stimulate student motivation.

RETIRED CURRICULUM

PRESENTATION	APPLICATION
	SLIDE: 2-1-1
	SLIDE: 2-1-2
I. TYPES OF FIRE PUMPS	
	SLIDE: 2-1-3
A. Positive displacement	
	SLIDE: 2-1-4
B. Centrifugal	
	SLIDE: 2-1-5
II. POSITIVE DISPLACEMENT PUMPS	
	What is the biggest advantage of a positive displacement pump?
A. The biggest advantage is that it can pump air	
B. Has a small amount of slippage	
1. Slippage is defined as the ability of water to pass through the inner workings of the pump, not allowing 100% discharge	
C. Has a fixed displacement of water	
	SLIDE: 2-1-6
D. Types	
	SLIDE: 2-1-7
1. Piston pumps	
a) Single action	
1) Pumps in a forward stroke only	
b) Double action	
1) Pumps in both forward and reverse strokes	
	What are some different examples of a piston pump?
c) Examples	
1) Backpack pump	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
2) Foam injection pump	
3) Wells	
4) Bicycle pump	
	SLIDE: 2-1-8
	SLIDE: 2-1-9
2. Rotary pumps	
a) Commonly used in the fire service as a primer pump	
b) Rotary gear	
1) Two gears that rotate in a tightly meshed pattern forming pockets	
2) As each gear tooth reaches the discharge chamber, the air or water contained in that pocket is forced out of the pump	
	SLIDE: 2-1-10
	SLIDE: 2-1-11
c) Rotary vane	
1) Movable vanes that automatically compensate for wear and maintain a tighter fit	
2) Vanes are forced against the outer housing by centrifugal force	
	SLIDE: 2-1-12
	SLIDE: 2-1-13
III. CENTRIFUGAL PUMPS	
	Can a centrifugal pump actually pump air?
A. Cannot pump air	
B. Capable of 100% slippage	
C. The main fire pump used on modern fire apparatus	
D. Classified as a nonpositive displacement pump	
E. Imparts velocity on water and converts it to pressure	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
F. Types	
1. Single stage	
2. Multi-stage	
	SLIDE: 2-1-14
G. Components	
1. Intake	
2. Impeller	
a) Eye	
b) Hub	
c) Shroud	
d) Vanes	
3. Casing	
a) Volute	
4. Discharge	
5. Shaft	
a) Drives impeller	
6. Transfer valve	
a) Flap valve, clapper valve, or swing valve	
	SLIDE: 2-1-15
	SLIDE: 2-1-16
	SLIDE: 2-1-17
7. Pump wear rings	
a) Located between the pump casing and the hub	
b) Seal between the lower pressure of the intake side and the higher pressure in the volute	
c) Dirt and sediment can damage ring resulting in decreased pump effectiveness	
1) Can be replaced	
	SLIDE: 2-1-18

RETIRED CURRICULUM

PRESENTATION	APPLICATION
8. Pump packing a) Located around the pump shaft, within the stuffing box b) Lubricates and seals pump shaft c) Too loose 1) Can result in drafting difficulties and pump efficiency d) Too tight 1) Can result in damaging the pump shaft due to overheating e) Can be replaced f) Should be adjusted by a qualified technician	
	SLIDE: 2-1-19
H. Principles of operation 1. Centrifugal force	
	What is centrifugal force?
a) An outward force on a body rotating about an axis 2. The operation of a centrifugal pump is based on the principle that a rapidly revolving impeller hurls the water from the impeller eye outward 3. The faster the impeller is turned, the farther the water is thrown thus increasing the velocity 4. The casing collects the water and confines it in order to convert velocity to pressure, then directs the water to the discharge	
	SLIDE: 2-1-20 **SLIDE: 2-1-21**
5. Influencing factors of discharge pressure a) Amount of water being discharged b) Speed at which the impeller is turning 1) Doubling the speed results in four times the pressure c) Pressure of water when it enters the pump from a pressurized source	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
6. Transfer valve settings	
	SLIDE: 2-1-22
a) Series (pressure position)	
1) Definition	
• The operation of a multistage centrifugal pump in which water passes consecutively through each impeller to provide high pressure at reduced volume	
	When is higher pressure required?
2) Uses	
• Long hose lay	
• To overcome effects of head pressure due to uphill hose lay	
• Handline operations	
3) Normal operating position	
	SLIDE: 2-1-23
	SLIDE: 2-1-24
b) Parallel (volume position)	
1) Definition	
• The operation of a multistage centrifugal pump in which each impeller discharges into a common outlet, thereby providing greater flow rate at reduced pressure	
• Sometimes called "capacity operation"	
	When might you use parallel operation?
2) Uses	
• Master stream operations	
• Multiple handlines	
• Pump certification tests	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
3) Used when water flow exceeds 50% of rated capacity	
	SLIDE: 2-1-25
c) Net pump pressure should not exceed 50 psi when changing from volume to pressure or pressure to volume	

RETIRED CURRICULUM

SUMMARY:

Understanding the construction and uses of the various types of fire pumps is imperative to providing a continuous, uninterrupted, and effective fire stream. While the actual method of changing from SERIES to PARALLEL can vary from manufacturer to manufacturer, the basic principles remain the same. In series operation, the water goes from one impeller to the next. In parallel operation, the water goes through all impellers at the same time. Change over from one mode to another must be done carefully.

EVALUATION:

The student will complete the written test at a time determined by the instructor.

ASSIGNMENT:

Review your notes and read Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 266-281 in order to prepare yourself for the upcoming test. Study for our next session.

RETIRED CURRICULUM

RETIRED CURRICULUM

TOPIC: 2-2: Pump Mounting And Drive Arrangements

TIME FRAME: 0:30

LEVEL OF INSTRUCTION: Level II

AUTHORITY: 2009 NFPA 1002: Chapter 5

BEHAVIORAL OBJECTIVE:

Condition: Given a written test

Behavior: The student will confirm a knowledge of pump mounting and drive arrangements by completing the written test

Standard: With a minimum 80% accuracy according to the information contained in Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 280-285

MATERIALS NEEDED:

- Writing board/pad with markers/erasers
- Appropriate audiovisual equipment
- Appropriate audiovisual materials

REFERENCES:

- Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 280-285
- Type III Training Manual, Rincon Valley Fire District, 2002 Edition, Pages 10-15

PREPARATION: Each instructor must develop a motivational statement on why the student should learn the upcoming material. The purpose is to establish relevancy of the lesson to the audience. The ACID BASE acronym can be used to help develop student motivation.

Attention (attract)	**B**egin
Curiosity (arouse)	**A**ssociation
Interest (create)	**S**tudents
Desire (stimulate)	**E**xperience

Cite examples or use related illustrations of near-miss incidents, injuries, or fatalities. Write this section "from the heart." Be creative! Have fun with it or be serious, but remember the goal is to stimulate student motivation.

PRESENTATION	APPLICATION
	SLIDE: 2-2-1
	SLIDE: 2-2-2
I. SIX METHODS OF TRANSMITTING POWER TO THE PUMP A. Auxiliary engine B. Power take-off C. Front-mount D. Midship transfer E. Rear-mount F. Hydrostatic	
	SLIDE: 2-2-3
II. AUXILIARY ENGINE DRIVEN PUMPS A. Auxiliary engine-driven pumps are those pumps that are powered by a gasoline or diesel engine independent of an engine used to drive the vehicle 1. Portable 2. Skid-mount 3. Permanent mounting 4. Examples a) Airport rescue and fire fighting (ARFF) vehicles b) Wildland fire apparatus c) Mobile water supply apparatus d) Trailer-mounted fire pumps e) Portable fire pumps	
	SLIDE: 2-2-4
	SLIDE: 2-2-5
	What are the advantages of independent engine driven pumps?
	SLIDE: 2-2-6

RETIRED CURRICULUM

PRESENTATION	APPLICATION
B. Advantages 1. Pump speed independent of vehicle speed 2. Pump and roll capability 3. Pump can be carried to a source of water	
	What are the disadvantages of independent engine driven pumps?
C. Disadvantages 1. Limited pressure and capacity 2. Additional engine to maintain 3. Extra supply of fuel, or two types of fuel	
	SLIDE: 2-2-7
III. POWER TAKE-OFF PUMPS A. Gear assembly mounted on the side of the transmission 1. Limited to 35 horsepower due to torque limitations and/or 500 gpm 2. Caused by the physical limits of the transmission housing B. Flywheel mounted 1. Full torque application and/or 1,250 gpm 2. Directly connected to engine flywheel	
	SLIDE: 2-2-8
C. Advantages 1. Pump and roll capabilities 2. Pumps for different applications a) Midship pump b) Booster pump D. Disadvantages 1. Pump size limited unless flywheel mounted	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
	SLIDE: 2-2-9
IV. FRONT-MOUNT PUMPS	
A. Power is supplied through a coupling and/or clutch arrangement attached to crankshaft	
1. Transmitted to gear box that steps up the pump shaft rpm	
a) Pump speed runs faster than engine speed	
B. Generally mounted between the frame rails and in front of grill	
	SLIDE: 2-2-10
	What are some advantages of a front mount pump?
	SLIDE: 2-2-11
C. Advantages	
1. Simplified linkage and controls	
2. Pump is independent of drive wheels	
3. Can pump while moving	
	What are the disadvantages of a front mount pump?
D. Disadvantages	
1. Size of pump is limited	
2. While moving, pump discharge depends on engine speed	
3. Components are susceptible to freezing	
	SLIDE: 2-2-12
V. MIDSHIP PUMPS	
A. Also known as split-shaft pumps	
B. Most common application in fire service	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
	What is the power source for a midship pump?
1. Power source is main engine in the vehicle 2. Power is transmitted from the engine through the vehicle transmission to the pump gearbox 3. When the pump is engaged, power is redirected from the rear axle to fire pump	
	SLIDE: 2-2-13
C. Pump engagement 1. Either electrically, manually, air actuated or vacuum operated 2. Most common method uses a sliding collar in the pump transmission 3. Speedometer may read between 10-15 mph if in proper gear 4. Manual transmissions a) Clutch b) Gear selection – manufacturer's recommendations 5. Automatic transmissions a) Gear selection – manufacturer's recommendations	
	What keeps the transmission from shifting while in pump?
b) Transmission lock-outs 1) Transmission starts in pump gear instead of shifting up through the gears 6. Manually engage/disengage pump a) See manufacture recommendations	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
	What are some advantages of the midship pump operation?
	SLIDE: 2-2-14
D. Advantages	
1. Full engine power is available	
2. Pump size is unlimited, depending on horsepower available from the engine	
E. Disadvantages	
1. Power to rear wheels is disconnected	
2. Complex mechanical operation	
3. Need a backup system to engage pump	
	SLIDE: 2-2-15
	SLIDE: 2-2-16
VI. REAR-MOUNT PUMPS	
A. Pump located in rear of apparatus	
1. Powered by either	
a) Power take-off	
b) Split-shaft transmission	
	SLIDE: 2-2-17
B. Advantages	
1. Provides weight distribution on chassis	
2. Allows for more compartment space	
C. Disadvantage	
1. Operator exposed to oncoming traffic	
NOTE: The following information on hydrostatic driven pumps if for general information only. Students will not be tested on Section VII.	
	SLIDE: 2-2-18
VII. HYDROSTATIC DRIVEN PUMPS	
A. Primarily used on interface engines	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
B. Powered from a hydraulic pump that is driven directly off the crankshaft of the chassis engine	
C. Hydraulic system	
1. Four components	
a) Hydrostatic pump	
b) Hydrostatic motor	
c) Hydraulic reservoir	
d) Pump control	
	SLIDE: 2-2-19
D. Hydrostatic pump	
1. Mounted behind front bumper and in front of radiator	
2. Driven by a drive shaft attached to the crankshaft of the apparatus engine	
	SLIDE: 2-2-20
	SLIDE: 2-2-21
E. Hydrostatic motor	
1. Mounted forward of the fire pump between chassis frame rails	
2. Provides the power necessary to turn the pump shaft of the fire pump	
	SLIDE: 2-2-22
	SLIDE: 2-2-23
F. Hydraulic reservoir	
1. Mounted adjacent to hydrostatic pump	
	SLIDE: 2-2-24
G. Pump control	
1. Activates the hydraulic system and sets the desired pressure/flow during pumping operations	
2. Can be done during stationary and mobile pumping operations	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
	SLIDE: 2-2-25 **SLIDE: 2-2-26**
H. Operation 1. Stationary pumping a) Activate high idle switch b) Rotate pump control knob to desired pump pressure 2. Mobile pumping a) Rotate pump control valve to desired pump pressure 1) No more than 100 psi	
	SLIDE: 2-2-27
I. Advantages 1. Pump-and-roll capabilities 2. One of the simplest pump systems to operate J. Disadvantages 1. Limited to pump size 2. Very noisy	

RETIRED CURRICULUM

SUMMARY:

There are six methods, used in the fire service today, that provide the power necessary to drive fire pumps. This lesson has attempted to cover a great deal of material related to the subject. All of it is critical to ensure a successful operation on the emergency scene.

EVALUATION:

The student will complete the written test at a time determined by the instructor.

ASSIGNMENT:

Review your notes and read Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 280-285 in order to prepare yourself for the upcoming test. Study for our next session.

RETIRED CURRICULUM

RETIRED CURRICULUM

TOPIC: 2-3: Pump Piping And Valves

TIME FRAME: 0:15

LEVEL OF INSTRUCTION: Level II

AUTHORITY: 2009 NFPA 1002: Chapter 5

BEHAVIORAL OBJECTIVE:

Condition: Given a written test

Behavior: The student will confirm a knowledge of pump piping and valves by completing the written test

Standard: With a minimum 80% accuracy according to the information contained in Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 285-293

MATERIALS NEEDED:

- Writing board/pad with markers/erasers
- Appropriate audiovisual equipment
- Appropriate audiovisual materials

REFERENCES:

- Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 285-293

PREPARATION: Each instructor must develop a motivational statement on why the student should learn the upcoming material. The purpose is to establish relevancy of the lesson to the audience. The ACID BASE acronym can be used to help develop student motivation.

Attention (attract)	**B**egin
Curiosity (arouse)	**A**ssociation
Interest (create)	**S**tudents
Desire (stimulate)	**E**xperience

Cite examples or use related illustrations of near-miss incidents, injuries, or fatalities. Write this section "from the heart." Be creative! Have fun with it or be serious, but remember the goal is to stimulate student motivation.

PRESENTATION	APPLICATION
	SLIDE: 2-3-1
	SLIDE: 2-3-2
I. PIPING AND VALVES	
A. Intake manifolds and valves	
B. Discharge manifolds and valves	
C. Drains	
	SLIDE: 2-3-3
II. INTAKE MANIFOLD AND VALVES	
A. Location of manifolds	
1. Cast as integral part of pump case	
a) Smooth interior	
b) No sharp bends	
c) Rectangular shape	
	Why do we use rectangular manifolds?
1) To cut down "vortex" turbulence	
2. Covers eye of the impeller(s)	
	SLIDE: 2-3-4
	SLIDE: 2-3-5
B. Intakes	
1. Large intake	
a) Sizes vary by pump capacity	
b) Bolts on to casting flange	
c) May or may not be valved	
d) Usually on eye of the pump	
2. Small intake	
a) Valved	
b) Enters into large intake	
c) Usually 2½" female coupling	
d) May have small plumbing	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
e) Be sure plumbing size is adequate to provide needed fire flow	
f) If not, you must use the large intake	
	SLIDE: 2-3-6
	SLIDE: 2-3-7
3. Auxiliary intakes	
a) Front or rear	
b) Size varies by apparatus	
c) Valved	
d) Due to bends and length of piping, may not allow the pump to supply its rated capacity	
	SLIDE: 2-3-8
4. Tank suction intake	
	What is the purpose of the tank suction intake?
a) Connects tank to pump	
b) Bolts to flange on manifold	
c) Valved	
1) Also known as "tank-to-pump valve"	
d) Has check valve	
1) Won't allow water to go back into tank	
e) Piping should be of sufficient size	
1) Pumps rated less than 500 gpm should be capable of flowing 250 gpm from the tank	
2) Pumps rated greater than 500 gpm should be capable of flowing 500 gpm from the tank	
	SLIDE: 2-3-9

RETIRED CURRICULUM

PRESENTATION	APPLICATION
	SLIDE: 2-3-10
III. DISCHARGE MANIFOLD AND VALVES	
A. Locations	
1. Water enters discharge manifold	
a) From outlet of impeller case(s)	
b) Usually cast as integral part of pump case	
c) Made with smooth passages	
1) No bends	
2) Round passage ways	
	SLIDE: 2-3-11
	SLIDE: 2-3-12
B. Attachment of valves	
1. Manufacturers provide attachment "embossments" in the casting	
a) Some open	
b) Some have threaded plugs	
c) Some need to be drilled out	
	SLIDE: 2-3-13
	SLIDE: 2-3-14
C. Valves and piping	
1. Various sizes	
2. Size depends on volume of water needed at discharge device	
3. Each discharge will have its own valve	
4. Types of valves	
	What are the different types of valves?
	SLIDE: 2-3-15
a) Piston	
	SLIDE: 2-3-16
b) Butterfly	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
	SLIDE: 2-3-17
c) Ball	
1) ¼ turn	
d) Gate	
	SLIDE: 2-3-18
D. Tank filler	What is the tank filler used for?
1. Used to fill tank once attached to water supply	
a) Do not exceed a loss of 10 psi on the compound gauge if attack lines are in service	
2. Can be used as a circulating valve to keep pump cool while not flowing water	
E. Circulating valve	
1. Also know as a "churn valve"	
2. A small tube that connects the discharge side of the pump to the tank	
3. Opens with a valve on the pump panel	
4. Used to keep pump from overheating	
5. Normally left open/on at all times	
a) Unless drafting	
	SLIDE: 2-3-19
IV. DRAINS	
A. Drains are used to relieve or remove pressure or water from	
1. Suction intakes	
2. Discharges	
3. Main pumps	
	SLIDE: 2-3-20
B. Bleeder lines	
1. Used to bleed air from large diameter supply lines to keep air from entering pump	

RETIRED CURRICULUM

SUMMARY:

The intake manifold and valves provide a smooth system of water delivery to the pump. The discharge manifold and valves bring all of the work of the pump together and provide the means to get the water out to the attack lines.

EVALUATION:

The student will complete the written test at a time determined by the instructor.

ASSIGNMENT:

Review your notes and read Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 285-293 in order to prepare yourself for the upcoming test. Study for our next session.

RETIRED CURRICULUM

TOPIC:	2-4: Automatic Pressure Control Devices
TIME FRAME:	0:15
LEVEL OF INSTRUCTION:	Level II
AUTHORITY:	2009 NFPA 1002: Chapter 5
BEHAVIORAL OBJECTIVE:	
Condition:	Given a written test
Behavior:	The student will confirm a knowledge of automatic pressure control devices by completing the written test
Standard:	With a minimum 80% accuracy according to the information contained in Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 293-298
MATERIALS NEEDED:	• Writing board/pad with markers/erasers • Appropriate audiovisual equipment • Appropriate audiovisual materials
REFERENCES:	• Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 293-298
PREPARATION:	Each instructor must develop a motivational statement on why the student should learn the upcoming material. The purpose is to establish relevancy of the lesson to the audience. The ACID BASE acronym can be used to help develop student motivation.

Attention (attract)	**B**egin
Curiosity (arouse)	**A**ssociation
Interest (create)	**S**tudents
Desire (stimulate)	**E**xperience

Cite examples or use related illustrations of near-miss incidents, injuries, or fatalities. Write this section "from the heart." Be creative! Have fun with it or be serious, but remember the goal is to stimulate student motivation.

RETIRED CURRICULUM

PRESENTATION	APPLICATION
	SLIDE: 2-4-1
	SLIDE: 2-4-2
I. TYPES OF PRESSURE CONTROL DEVICES	
A. Pressure relief valves	
B. Pressure governor	
II. PRESSURE RELIEF VALVES	
	Why do we need pressure relief valves?
	SLIDE: 2-4-3
A. Purpose	
1. Control excessive pressure	
a) Protects fire fighters and equipment from water hammer	
2. Works on the principle of pressure differential	
	SLIDE: 2-4-4
B. Operation	
1. Discharge pressure relief valve	
a) Reroutes water from the pressure side of the pump to the inlet side of the pump	
b) Adjustable to needed pressure of the attack lines	
c) Components	
1) Pilot valve/controller	
• Controls the relief valve	
2) Four-way valve	
• On/off valve	
3) Relief valve	
• Mounted to pump casing	
	SLIDE: 2-4-5
	SLIDE: 2-4-6

RETIRED CURRICULUM

PRESENTATION	APPLICATION
	SLIDE: 2-4-7
2. Intake pressure relief valve	
a) Excess pressure from the supply line is exhausted out of system	
b) Outlet to open ground	
c) Some not easily adjustable on demand	
d) Can be external to pump panel or mounted internally onto the pump intake manifold	
	SLIDE: 2-4-8
1) External piston valves are added by the department	
• Works only when supply line is attached to valve	
	SLIDE: 2-4-9
2) Internal relief valves is added by the engine manufacturer	
• Works for all intakes	
III. PRESSURE GOVERNOR	
	SLIDE: 2-4-10
A. Purpose	
1. Control excessive pressure	
a) Protects fire fighters and equipment from water hammer	
B. Operation	
	How does a pressure governor operate?
1. Controls pump pressure by opening and closing the throttle to the engine	
a) Electronic	
b) Manual	
	SLIDE: 2-4-11

RETIRED CURRICULUM

SUMMARY:

There are two basic types of pressure control systems: pressure relief valves and pressure governors. Both control excessive pressures that could injure personnel and damage equipment.

EVALUATION:

The student will complete the written test at a time determined by the instructor.

ASSIGNMENT:

Review your notes and read Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 293-298 in order to prepare yourself for the upcoming test. Study for our next session.

RETIRED CURRICULUM

RETIRED CURRICULUM

TOPIC: 2-5: Priming Devices

TIME FRAME: 0:15

LEVEL OF INSTRUCTION: Level II

AUTHORITY: 2009 NFPA 1002: Chapter 5

BEHAVIORAL OBJECTIVE:

Condition: Given a written test

Behavior: The student will confirm a knowledge of priming methods and devices by completing the written test

Standard: With a minimum 80% accuracy according to the information contained in Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 298-301

MATERIALS NEEDED:

- Writing board/pad with markers/erasers
- Appropriate audiovisual equipment
- Appropriate audiovisual materials

REFERENCES:

- NFPA 1911: Inspection, Maintenance, Testing, and Retirement of In-Service Automotive Fire Apparatus, 2007 Edition, Chapters 9 and 18
- Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 298-301

PREPARATION: Each instructor must develop a motivational statement on why the student should learn the upcoming material. The purpose is to establish relevancy of the lesson to the audience. The ACID BASE acronym can be used to help develop student motivation.

Attention (attract)	**B**egin
Curiosity (arouse)	**A**ssociation
Interest (create)	**S**tudents
Desire (stimulate)	**E**xperience

Cite examples or use related illustrations of near-miss incidents, injuries, or fatalities. Write this section "from the heart." Be creative! Have fun with it or be serious, but remember the goal is to stimulate student motivation.

PRESENTATION	APPLICATION
	SLIDE: 2-5-1
	SLIDE: 2-5-2
I. PRIMING DEVICES OVERVIEW	
	Why are priming devices needed?
A. Priming devices are an essential part of centrifugal fire pumps	
1. Centrifugal pumps cannot pump air	
2. Provides water to the impeller	
B. Priming devices operate as the result of air pressure differential	
1. Relies on atmospheric pressure	
2. Reduces atmospheric pressure within pump cavity	
C. Uses	
1. Pump tests	
2. When drafting	
3. When apparatus tank water does not reach fire pump	
	SLIDE: 2-5-3
D. <u>NFPA 1911: Inspection, Maintenance, Testing, and Retirement of In-Service Automotive Fire Apparatus</u>, 2007 Edition recommends specific priming device performance	
1. Must be able to develop 22 in. Hg (mercury)	
2. Must be able to pull a draft within 30 seconds	
a) 45 seconds for 1500 gpm or larger fire pumps	
II. TYPES OF PRIMING DEVICES	
	SLIDE: 2-5-4
A. Positive displacement pumps	
1. Used as primers on centrifugal pumps	
2. Rotary gear and rotary vane	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
3. Power sources a) Electric motor b) Mechanically driven off pump transmission 4. Components a) Vanes or gears b) Oil tank 1) Oil provides sealing and lubrication 2) Vent hole in cap c) Tube with hole to break siphon 1) Known as the anti-siphon hole	
	SLIDE: 2-5-5 **SLIDE: 2-5-6** **SLIDE: 2-5-7**
B. Vacuum primers	Why aren't vacuum primers used on diesel engines?
1. Diesel engines produce no vacuum 2. Gasoline engines create vacuum at intake manifold 3. Connected between pump and intake manifold to use vacuum when necessary 4. Considerations when using vacuum primers a) Check valve prevents water from being drawn into engine b) Check valve prevents gases being forced into the pump c) If check valves fail, dangerous conditions can result C. Engine exhaust priming system 1. An integral part of the exhaust system a) A separate chamber	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
2. Operation	
	How does an exhaust primer work?
	SLIDE: 2-5-8
a) Venturi principle	
1) Works on the same principle as a foam eductor	
2) The gases are diverted to a chamber where the velocity of the gases passing through a venturi creates a vacuum	
b) Relatively high engine rpms are needed	
	SLIDE: 2-5-9

RETIRED CURRICULUM

SUMMARY:

There are three types of priming systems; positive displacement, vacuum, and exhaust. Priming systems are necessary when using centrifugal pumps. The operator must know and understand the purpose and operation of priming systems to be successful on the fire ground.

EVALUATION:

The student will complete the written test at a time determined by the instructor.

ASSIGNMENT:

Review your notes and read Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 298-301 in order to prepare yourself for the upcoming test. Study for our next session.

RETIRED CURRICULUM

RETIRED CURRICULUM

TOPIC: 2-6: Pump Panel Instrumentation

TIME FRAME: 0:15

LEVEL OF INSTRUCTION: Level II

AUTHORITY: 2009 NFPA 1002: Chapter 5

BEHAVIORAL OBJECTIVE:

Condition: Given a written test

Behavior: The student will confirm a knowledge of pump panel instrumentation by completing the written test

Standard: With a minimum 80% accuracy according to the information contained in Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 301-307

MATERIALS NEEDED:

- Writing board/pad with markers/erasers
- Appropriate audiovisual equipment
- Appropriate audiovisual materials

REFERENCES:

- NFPA 1901: Standard for Automotive Fire Apparatus, 2009 Edition, Chapter 16
- Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 301-307

PREPARATION: Each instructor must develop a motivational statement on why the student should learn the upcoming material. The purpose is to establish relevancy of the lesson to the audience. The ACID BASE acronym can be used to help develop student motivation.

Attention (attract)	**B**egin
Curiosity (arouse)	**A**ssociation
Interest (create)	**S**tudents
Desire (stimulate)	**E**xperience

Cite examples or use related illustrations of near-miss incidents, injuries, or fatalities. Write this section "from the heart." Be creative! Have fun with it or be serious, but remember the goal is to stimulate student motivation.

PRESENTATION	APPLICATION
	SLIDE: 2-6-1
	SLIDE: 2-6-2
I. PUMP PANEL COMPONENTS	
A. Gauges and indicators	
B. Throttle control	
C. Primer control	
D. Tank level indicators	
1. Water	
2. Foam	
E. Standards and recommendations	
	SLIDE: 2-6-3
	SLIDE: 2-6-4
	SLIDE: 2-6-5
II. GAUGES AND INDICATORS	
A. Gauges are an essential part of the pump operators panel	
1. Gauges provide the operator with information on current operating conditions	
B. Indicators provide information on the status of other various systems	
C. Types of gauges	
	SLIDE: 2-6-6
1. Analog	
a) Bourdon tube	
1) As pressure is applied to a curved tube, the tube will straighten thus moving the indicator dial	
	SLIDE: 2-6-7
2. Digital	
	SLIDE: 2-6-8
D. Each gauge furnishes information on a particular condition	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
	What does the master pump suction gauge indicate?
1. The master pump suction gauge indicates existing conditions on the intake side of the pump impeller a) It indicates vacuum to 30" Hg. and pressure up to maximum (300-600 psi) b) Also called a compound gauge 2. The master pump discharge pressure gauges indicates current conditions on the discharge side of the pump impeller a) It indicates pressure from zero to maximum (300-600 psi) 3. Pressure gauges for each 1½" or larger pump outlet indicate current conditions beyond any valve that can control flow through the outlet a) It indicates pressure in psi from zero to a maximum reading which conforms with that of the main pump gauge	
	SLIDE: 2-6-9
4. The engine tachometer indicates the present engine speed in revolutions per minute 5. The engine oil pressure gauge represents the current oil pressure of the pump engine 6. The engine coolant temperature gauge registers the current pump engine coolant temperature 7. The voltage meter monitors the output of the main engines charging system 8. "OK to Pump" indicates that the pump is engaged, the chassis transmission is in neutral, and the parking brake is engaged 9. "Pump Engaged" indicates that the pump shift has been successfully completed	
	SLIDE: 2-6-10

RETIRED CURRICULUM

PRESENTATION	APPLICATION
10. "Throttle Ready" indicates the "OK to Pump" indicator is energized or when the chassis transmission is in neutral and the parking brake is engaged	
	SLIDE: 2-6-11
III. THROTTLE CONTROL	
A. Used to increase or decrease the speed of the engine that is powering the pump	
B. Types	
1. Electronic control	
2. Manual control	
	Why does the operator need to control the engine rpms?
C. Changing the speed of the engine changes the pump pressure	
	SLIDE: 2-6-12
IV. PRIMER CONTROL	
A. Used to operate the primer system	
B. Types	
1. Push button	
2. Toggle switch	
	SLIDE: 2-6-13
3. Pull lever	
	SLIDE: 2-6-14
V. TANK LEVEL INDICATORS	
A. Water tank level	
1. Indicates the amount of water that is in the water tank of the apparatus	
a) Types	
1) Series of lights	
2) Clear site tube	
3) Digital readouts	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
	Why would knowing the water level be important?
2. Vital to operator supplying attack lines to know when they will run out of water and need an outside water source	
B. Foam tank level	
1. Used to monitor the amount of foam concentrate in the foam tank	
a) Types	
1) Series of lights	
2) Clear site tube	
3) Digital readouts	
	SLIDE: 2-6-15
	SLIDE: 2-6-16
VI. NFPA 1901 STANDARDS AND RECOMMENDATIONS	
NOTE: From NFPA 1901: Standard For Automotive Fire Apparatus, NFPA, 2009 Edition, Section 16.12.	
	What gauges must appear on a pump operator's panel?
	SLIDE: 2-6-17
A. The following controls and instruments shall be provided and installed as a group on the pump operator's panel	
1. Master pump intake pressure gauge	
2. Master pump discharge pressure gauge	
3. Pumping engine tachometer	
4. Pumping engine coolant temperature gauge	
5. Pumping engine oil pressure gauge	
6. Voltmeter	
7. Pump pressure control(s)	
8. Pumping engine throttle	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
9. Primer control 10. Water tank–to–pump valve control 11. Water tank fill valve control 12. Water tank level gauge	
B. The instruments and controls shall be placed so as to keep the pump operator as far as practicable from all discharge and intake connections and in a location where the instruments and controls are visible and operationally functional while the operator remains stationary	**SLIDE: 2-6-18**
C. Some gauges require specific placement 1. Master pump intake and pump discharge pressure gauges shall be located within 8 inches of each other, edge to edge a) Intake pressure gauge to the left of or below the pump discharge pressure gauge	**SLIDE: 2-6-19**
D. Some gauges require a specific size 1. There shall be at least a 1 inch diameter differential in viewing area between the master gauges and the individual discharge gauges a) The master gauges being the larger 2. Numerals for analog master gauges shall be a minimum of 0.25 inches 3. Digital numerals for the master gauges must have numerals at least ½ inch in height	What special construction features are required of the gauges? **SLIDE: 2-6-20**
E. Instrumentation exposed to the elements shall be weatherproof	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
F. The pumping engine oil pressure and engine coolant temperature gauges shall be equipped with audible and visual warnings G. Connections for test gauges shall be provided at the pump operator's panel	

RETIRED CURRICULUM

SUMMARY:

The gauges and indicators located at the driver/operator's pump panel serve a key role in providing essential information to the pump operator. This data is used to insure correct pump and engine operating conditions.

EVALUATION:

The student will complete the written test at a time determined by the instructor.

ASSIGNMENT:

Review your notes and read Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 301-307 in order to prepare yourself for the upcoming test. Study for our next session.

RETIRED CURRICULUM

TOPIC: 2-7: Auxiliary Cooling Devices

TIME FRAME: 0:15

LEVEL OF INSTRUCTION: Level II

AUTHORITY: 2009 NFPA 1002: Chapter 5

BEHAVIORAL OBJECTIVE:

Condition: Given a written test

Behavior: The student will confirm a knowledge of auxiliary cooling devices by completing the written test

Standard: With a minimum 80% accuracy according to the information contained in Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 307-309

MATERIALS NEEDED:

- Writing board/pad with markers/erasers
- Appropriate audiovisual equipment
- Appropriate audiovisual materials

REFERENCES:

- NFPA 1901: Standard for Automotive Fire Apparatus, NFPA, 2009 Edition, Chapter 16
- Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 307-309

PREPARATION: Each instructor must develop a motivational statement on why the student should learn the upcoming material. The purpose is to establish relevancy of the lesson to the audience. The ACID BASE acronym can be used to help develop student motivation.

Attention (attract)	**B**egin
Curiosity (arouse)	**A**ssociation
Interest (create)	**S**tudents
Desire (stimulate)	**E**xperience

Cite examples or use related illustrations of near-miss incidents, injuries, or fatalities. Write this section "from the heart." Be creative! Have fun with it or be serious, but remember the goal is to stimulate student motivation.

RETIRED CURRICULUM

PRESENTATION	APPLICATION
	SLIDE: 2-7-1
	SLIDE: 2-7-2
I. AUXILIARY COOLING DEVICES	
A. Indirect cooler	
B. Direct cooler	
	SLIDE: 2-7-3
II. REASONS FOR AUXILIARY COOLING DEVICES	What are some reasons for auxiliary cooling systems?
A. Stationary pumping	
1. Limited air movement over engine	
2. On skid mounted pump/engine equipment, main engine can overheat at idle speed	
3. Options/additions to auxiliary coolers	
a) Raise idle to 1000-1200 rpm to keep air flow over engine	
b) Lift hood or engine compartment to lower engine temperature	
B. High ambient temperature	
1. Summer temps in excess of 100°F can cause extreme engine heat	
C. Off-road pumping	
1. Weeds and grain chafe can clog radiator	
D. Automatic transmissions may become overheated on pump-and-roll operations	
E. Low radiator level	
1. Coolant level may drop during extended pumping	
	SLIDE: 2-7-4
III. INDIRECT COOLER	
A. Water from fire pump does not mix with radiator coolant	
B. Inserted into one of the hoses used in the engine cooling systems	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
C. Engaged by opening valve on pump panel a quarter of a turn at a time	
1. Water from discharge goes into coil	
2. This water absorbs heat from radiator coolant flowing around the coil of tubing	
3. This process is called "heat exchange"	
a) Heat transfers from a warm source to a cooler source	
4. Water then returns to suction side of the pump	
D. Should be engaged whenever going off road	
E. Types	
1. Marine	
a) Engine coolant travels through the tubes	
b) Pump water surrounds tubes within body	
2. Immersion	
a) Engine coolant travels through the body	
b) Pump water travels through the tubes	
	SLIDE: 2-7-5
	SLIDE: 2-7-6
IV. DIRECT COOLER	
A. Water from the pump enters directly into the radiator	
1. Sometimes called "radiator filler"	
a) Used to refill the radiator if the coolant level drops too low for effective cooling during a pumping operation	
b) The radiator fill valve should only be used in an emergency	
	What is a major disadvantage of the direct cooler?
2. May cause catastrophic failure of radiator due to overpressure	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
3. Remove radiator cap, if this system is to be used 4. After use coolant is contaminated – service or test B. Engaged by opening valve on pump panel 1. Water flows through tubing on discharge side of the pump to radiator and then out to the ground C. NFPA 1901: Standard for Automotive Fire Apparatus, 2009 Edition, Section 16.3.5.1 1. States that pump water cannot mix with radiator fluid a) Still found on older apparatus	

RETIRED CURRICULUM

SUMMARY:

Auxiliary coolers can provide additional cooling capacity under extreme operating conditions. The indirect cooler has definite advantages and should be required in some situations. The direct cooler may be useful to add water to the radiator, but must be used with caution.

EVALUATION:

The student will complete the written test at a time determined by the instructor.

ASSIGNMENT:

Review your notes and read Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 307-309 in order to prepare yourself for the upcoming test. Study for our next session.

RETIRED CURRICULUM

RETIRED CURRICULUM

TOPIC: 3-1: Basic Hydraulic Terminology And Symbols

TIME FRAME: 0:30

LEVEL OF INSTRUCTION: Level II

AUTHORITY: 2009 NFPA 1002: Section 5.2.1(A)

BEHAVIORAL OBJECTIVE:

Condition: Given a written test

Behavior: The student will confirm a knowledge of basic hydraulic terminology and symbols by completing the written test

Standard: With a minimum 80% accuracy according to the information contained in the Fire Apparatus Driver/Operator Student Supplement, SFT, 2008 Edition, Pages 18-21 and Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 571-587

MATERIALS NEEDED:

- Writing board/pad with markers/erasers
- Appropriate audiovisual equipment
- Appropriate audiovisual materials

REFERENCES:

- Driver Operator Training Program, Regional Training Center, Modesto Junior College, 2002 Edition, Basic Terminology Section
- Engineer Training Program, Tiburon Fire District, 2001 Edition, Pages 01-1 and 01-2
- Fire Fighting Hydraulics, Purington, First Edition, Pages 16 and 23
- Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 571-587

PREPARATION: Each instructor must develop a motivational statement on why the student should learn the upcoming material. The purpose is to establish relevancy of the lesson to the audience. The ACID BASE acronym can be used to help develop student motivation.

Attention (attract)	**B**egin
Curiosity (arouse)	**A**ssociation
Interest (create)	**S**tudents
Desire (stimulate)	**E**xperience

Cite examples or use related illustrations of near-miss incidents, injuries, or fatalities. Write this section "from the heart." Be creative! Have fun with it or be serious, but remember the goal is to stimulate student motivation.

RETIRED CURRICULUM

PRESENTATION	APPLICATION
	SLIDE: 3-1-1
I. BASIC HYDRAULICS	
A. Terms and symbols	
	SLIDE: 3-1-2
1. Pi	
a) <u>Symbol = π</u>	
	Where does π come from?
b) The constant derived from the length of the circumference of a circle (3.14 times the diameter length); used as part of the formula to determine the volume of a round area	
2. Appliance loss	
a) <u>Symbol = AL</u>	
b) Portion of pressure lost when water flows through an appliance	
1) Friction loss	
3. Area	
a) <u>Symbol = A</u>	
b) Surface measurement	
c) Noted as a squared linear measurement	
1) Such as square inches	
	SLIDE: 3-1-3
4. Atmospheric pressure	
a) <u>Weight</u> of the air or atmosphere	
b) 14.7 psi at sea level	
c) Pressure gauge that reads zero is actually 14.7 psi	
	What is cavitation?
5. Cavitation	
a) The formation of a vacuum around a propeller or fan, revolving at a speed above a certain critical value	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
b) Vacuum pockets form in a pump and cause vibrations, loss of efficiency	
6. Circumference	
a) Symbol = c	
b) The distance around the outside of a circle	
c) If the circumference were stretched out in a straight line, it would be 3.14 times as long as the diameter	
7. Coefficient	
a) Symbol = C	
b) Assigned to a math equation	
	SLIDE: 3-1-4
8. Constant	
a) A fixed value assigned to a mathematical equation	
9. Critical velocity	
a) The friction loss becomes so great that the entire stream is agitated by the resistance and causes turbulence	
b) At this point, it becomes necessary to parallel lines to reduce the friction	
10. Diameter	
a) Symbol = d	
b) The distance from one edge of a circle to the other passing through the center	
	SLIDE: 3-1-5
11. Elevation pressure	
a) Symbol = EP	
	What is EP?
b) Gain or loss of pressure in a hoseline due to change in elevation	
c) The pressure lost from overcoming the effects of forcing water above the level of the pump discharge	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
12. Feet per second a) Symbol = fps 13. Flow pressure a) Symbol = FP b) Forward velocity pressure measured at a discharge opening c) Can be measured with a pitot tube and gauge 14. Friction loss a) Symbol = FL	
b) That part of the total pressure lost while forcing water through pipe, fittings, hoselines, adapters, and appliances c) Varies with the type of construction and shape of pipe, fittings, hoselines, adapters, and appliances	What is friction loss?
15. Gallons per minute a) Symbol = gpm b) The measure of water flow c) Volume per time measurement 16. Gravity a) Symbol = G 17. Head pressure a) Water pressure due to elevation b) Measured from the surface of the water source to the discharge orifice c) 0.434 psi per foot of elevation 18. Height a) Symbol = h b) Measurement of elevation above a given point	**SLIDE: 3-1-6**

RETIRED CURRICULUM

PRESENTATION	APPLICATION
	SLIDE: 3-1-7
19. Hydraulics	
	What is hydraulics?
a) The science that treats the mechanics of fluid at rest and in motion	
20. Inches in mercury	
a) Symbol = in. Hg	
21. Length	
a) Symbol = L	
22. Length of line	
a) Symbol = LL	
	SLIDE: 3-1-8
23. Lift	
	Who can explain what lift is?
a) Elevation difference between the surface of the static water source and the eye of the pump impeller	
b) Distance from the surface of the water to the center of the pump	
24. Net pump discharge pressure	
a) Symbol = NPDP	
b) Actual amount of pressure being produced by the pump	
	SLIDE: 3-1-9
25. Normal operating pressure	
a) Pressure normally found in a water distribution system during normal consumption demands	
26. Nozzle pressure	
a) Symbol = NP	
	What is nozzle pressure?
b) Pressure of the water discharged at the nozzle	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
27. Nozzle reaction a) Symbol = NR b) Counterforce directed against a person holding a nozzle	
	SLIDE: 3-1-10
28. Pounds per square inch a) Symbol = psi 29. Pounds per square inch gauge a) Symbol = psig 30. Pressure a) Symbol = P b) Has a variety of meanings c) Generally defined as the force per unit area d) Measured in pounds per square inch (psi) 31. Pump discharge pressure a) Symbol = PDP b) Pressure of the water as it leaves the pump 32. Quantity of water a) Symbol = Q	
	SLIDE: 3-1-11
33. Radius a) Symbol = r b) The distance from the outer edge of the circle to the center of the circle 34. Residual pressure	
	What is residual pressure?
a) Remaining water pressure while water is flowing (left over) b) Available pressure c) Measured at compound gauge with water flowing	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
35. Specific gravity a) Symbol = sg b) The weight of a substance compared with the weight of an equal volume of water	
	SLIDE: 3-1-12
36. Square root a) Symbol = √ b) A given number multiplied by itself	
37. Static pressure a) Water pressure that is not flowing (standing still) b) Stored potential energy to force water through pipe, hoselines, and fittings	
38. Suction (draft)	
	Who can explain what suction or "draft" is?
a) Process of taking water from static sources located below the level of the eye of the pump b) By exhausting the air from the pump chamber and using atmospheric pressure to force water through the suction hose and into the pump	
	SLIDE: 3-1-13
39. Total pressure loss a) Symbol = TPL b) The amount of pressure loss due to total friction loss and elevation pressure loss	
40. Vacuum	
	How does a vacuum work to establish a draft?
a) Any pressure below atmospheric pressure b) A negative pressure 1) Usually indicated in inches of mercury	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
	SLIDE: 3-1-14
41. Velocity a) The speed of travel b) Linear measurement per time measurement 1) Feet per second (fps) or miles per hour (mph)	
42. Volume a) <u>Symbol = V</u> b) Measurement of cubic scale in a container c) Noted as a cubed linear measurement 1) Cubic inches	
43. Water flow a) Measure in gallons per minute (gpm)	
44. Water hammer a) Force created by the sudden deceleration or acceleration of water	What is a water hammer?

RETIRED CURRICULUM

SUMMARY:

Fire apparatus driver/operators are charged with the responsibility to develop effective hose streams, pump supply lines, and solve hydraulic problems on the fireground. All driver/operators must know and understand basic hydraulic terminology and symbols in order to apply them to hydraulic formulas. Although complex calculations are not performed in the field, driver/operators must know how to solve and apply them to provide a basis for developing hose streams.

EVALUATION:

The student will complete the written test at a time determined by the instructor.

ASSIGNMENT:

Review your notes and read the Fire Apparatus Driver/Operator Student Supplement, SFT, 2008 Edition, Pages 18-21 and Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 571-587 in order to prepare yourself for the upcoming test. Study for our next session.

RETIRED CURRICULUM

TOPIC: 3-2: Mathematics Review

TIME FRAME: 1:00

LEVEL OF INSTRUCTION: Level II

AUTHORITY: 2009 NFPA 1002: Sections 5.2.1(A), 5.2.2(A), and 5.2.4(A)

BEHAVIORAL OBJECTIVE:

Condition: Given a written test

Behavior: The student will confirm a knowledge of basic mathematics by completing the written test

Standard: With a minimum 80% accuracy according to the information contained in Fire Apparatus Driver/Operator 1B Student Supplement, SFT, 2008 Edition, Pages 22-24

MATERIALS NEEDED:

- Writing board/pad with markers/erasers
- Appropriate audiovisual equipment
- Appropriate audiovisual materials
- Individual Activity 3-2-1: Mathematics Review

REFERENCES:

- Fire Apparatus Driver/Operator 1B Student Supplement, SFT, 2008 Edition, Pages 22-24

PREPARATION: Each instructor must develop a motivational statement on why the student should learn the upcoming material. The purpose is to establish relevancy of the lesson to the audience. The ACID BASE acronym can be used to help develop student motivation.

Attention (attract)	**B**egin
Curiosity (arouse)	**A**ssociation
Interest (create)	**S**tudents
Desire (stimulate)	**E**xperience

Cite examples or use related illustrations of near-miss incidents, injuries, or fatalities. Write this section "from the heart." Be creative! Have fun with it or be serious, but remember the goal is to stimulate student motivation.

RETIRED CURRICULUM

PRESENTATION	APPLICATION
NOTE: Review the students' math pretest administered in Topic 1-1 to check their knowledge of basic math. Adjust the following review accordingly.	
	SLIDE: 3-2-1
	SLIDE: 3-2-2
I. BASIC MATH SKILLS	
A. Addition	
B. Subtraction	
C. Multiplication	
D. Division	
	SLIDE: 3-2-3
E. Decimals	
1. One number to the right of the decimal	
a) Tenths	
2. Two numbers to the right of the decimal	
a) Hundreds	
3. Three numbers to the right of the decimal	
a) Thousands	
4. Rounding	
	Who can explain what rounding is?
a) Truncate decimals two places to the right	
b) Make all calculations using this number	
c) When calculation is completed	
1) Round .50 or higher - round up to a whole number	
2) .49 or lower - round down to a whole number	
	SLIDE: 3-2-4
F. Fractions	
1. When adding or subtracting	
a) Use common denominator	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
2. When multiplying	
a) Multiply numerators first	
b) Multiply denominators second	
3. When dividing	
a) Invert second fraction	
b) Then multiply	
	SLIDE: 3-2-5
G. Percentages	
1. Percent means a given value per 100	
a) 45 of 100 = 45%	
2. Multiply the number by the percentage	
	SLIDE: 3-2-6
H. Square root	
1. A quantity of which a given quantity is the square	
a) $\sqrt{64} = 8$	
	What is the square root of 81?
b) $\sqrt{81} = 9$	
	SLIDE: 3-2-7
I. Numbers squared	
1. A number multiplied by itself	
a) 8^2	
1) 8 x 8 = 64	
	What is 9 squared?
b) 9^2	
1) 9 x 9 = 81	
	SLIDE: 3-2-8
J. Fraction to decimal	
1. Divide top number by bottom number	
a) ½ = 0.5	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
	What is ¾ in decimal form?
b) ¾ = 0.75	
	SLIDE: 3-2-9
K. Area of a circle	
1. $A = \pi r^2$	
a) $\pi = 3.14$	
b) r = radius (half of diameter)	
c) $A = 3.14 \times r^2$	
	If "r" is 2 feet, what is the area?
2. $A = 3.14 \times 2^2$	
a) $A = 3.14 \times 4$	
b) $A = 12.56$	
	SLIDE: 3-2-10
L. Capacity of a cylinder tank	
1. Gallons = $d^2 6L$	
a) d = diameter	
b) 6 = constant for gallons formula	
c) L = length	
	If a cylinder tank is 10 feet long and 5 feet in diameter, what is its capacity?
	SLIDE: 3-2-11
2. Gallons = $(5^2 \times 6)(10)$	
a) Gallons = $(25 \times 6)(10)$	
b) Gallons = $(150)(10)$	
c) Gallons = 1,500	
	SLIDE: 3-2-12

RETIRED CURRICULUM

PRESENTATION	APPLICATION
3. Gallons = $(10^2 \times 6)(30)$ a) Gallons = (100 x 6)(30) b) Gallons = (600)(30) c) Gallons = 18,000	If a cylinder tank is 30 feet long and 10 feet in diameter, what is its capacity? **ACTIVITY 3-2-1:** Complete the activity in the student supplement.

RETIRED CURRICULUM

SUMMARY:

The basic math skills used by the driver/operator are vital to an effective operation. The ability for the driver/operator to understand the limitations of their apparatus equipment can be enhanced with a working knowledge of basic math.

EVALUATION:

The student will complete the activity and written test at a time determined by the instructor.

ASSIGNMENT:

Review your notes and read Fire Apparatus Driver/Operator 1B Student Supplement, SFT, 2008 Edition, Pages 22-24 in order to prepare yourself for the upcoming test. Study for our next session.

RETIRED CURRICULUM

INDIVIDUAL ACTIVITY 3-2-1

TITLE:	Mathematics Review
TIME FRAME:	0:15
MATERIALS NEEDED:	• Square root chart • Calculator • Pen or pencil
INTRODUCTION:	This activity provides the students the opportunity to reference and sharpen their math skills as they relate to fire hydraulics.
DIRECTIONS:	1. Complete Sections I through V. 2. You have 10 minutes to complete this activity. 3. Be prepared to discuss your answers with the class.

RETIRED CURRICULUM

SECTION I: CALCULATE THE FOLLOWING SQUARE ROOTS

1. $\sqrt{8}$	***2.82***	See chart
2. $\sqrt{20}$	***4.47***	See chart
3. $\sqrt{100}$	***10***	See chart
4. $\sqrt{300}$	***17.32***	See chart

SECTION II: SQUARE THE FOLLOWING NUMBERS

5. 6^2	***36***	6 x 6
6. 9^2	***81***	9 x 9
7. 18^2	***324***	18 x 18
8. 101^2	***10201***	101 x 101

SECTION III: CONVERT THE FOLLOWING FRACTIONS TO A DECIMAL

9.	7/8	***.87***	7 ÷ 8
10.	1/8	***.12***	1 ÷ 8
11.	1/4	***.25***	1 ÷ 4
12.	1/2	***.50***	1 ÷ 2

SECTION IV: CALCULATE THE AREA OF EACH CIRCLE

Round your answer to the nearest whole number. (πr^2)

13.	Radius = 2 feet	***13***	3.14×2^2 3.14 x 4
14.	Radius = 10 feet	***314***	3.14×10^2 3.14 x 25
15.	Radius = 15 feet	***706.5***	3.14×15^2 3.14 x 56.25
16.	Radius = 20 feet	***1256***	3.14×20^2 3.14 x 196

SECTION V: CALCULATE THE CAPACITY OF EACH CYLINDER TANK

Round your answer to the nearest whole number. ($d^2 6L$)

17.	Diameter = 2 feet Length = 14 feet	***336***	$(2^2 \times 6)(14)$ (4 x 6)(14) 24 x 14
18.	Diameter = 10 feet Length = 10 feet	***6,000***	$(10^2 \times 6)(10)$ (100 x 6)(10) 600 x 10
19.	Diameter = 15 feet Length = 3 feet	***4,050***	$(15^2 \times 6)(3)$ (225 x 6)(3) 1,350 x 3
20.	Diameter = 20 feet Length = 5 feet	***12,000***	$(20^2 \times 6)(5)$ (400 x 6)(5) 2,400 x 5

RETIRED CURRICULUM

Square Roots of Numbers 1-250

n	$\sqrt{n}$	n	$\sqrt{n}$	n	$\sqrt{n}$	n	$\sqrt{n}$	n	$\sqrt{n}$
1	1.000	51	7.1414	101	10.0499	151	12.2882	201	14.1774
2	1.414	52	7.2111	102	10.0995	152	12.3288	202	14.2127
3	1.732	53	7.2801	103	10.1489	153	12.3693	203	14.2478
4	2.000	54	7.3485	104	10.1980	154	12.4097	204	14.2829
5	2.236	55	7.4163	105	10.2470	155	12.4499	205	14.3178
6	2.449	56	7.4833	106	10.2956	156	12.4900	206	14.3527
7	2.646	57	7.5498	107	10.3441	157	12.5300	207	14.3875
8	2.828	58	7.6158	108	10.3923	158	12.5698	208	14.4222
9	3.000	59	7.6811	109	10.4403	159	12.6095	209	14.4568
10	3.162	60	7.7460	110	10.4881	160	12.6491	210	14.4914
11	3.3166	61	7.8102	111	10.5357	161	12.6886	211	14.5258
12	3.4641	62	7.8740	112	10.5830	162	12.7279	212	14.5602
13	3.6056	63	7.9373	113	10.6301	163	12.7671	213	14.5945
14	3.7417	64	8.0000	114	10.6771	164	12.8062	214	14.6287
15	3.8730	65	8.0623	115	10.7238	165	12.8452	215	14.6629
16	4.0000	66	8.1240	116	10.7703	166	12.8841	216	14.6969
17	4.1231	67	8.1854	117	10.8167	167	12.9228	217	14.7309
18	4.2426	68	8.2462	118	10.8628	168	12.9615	218	14.7648
19	4.3589	69	8.3066	119	10.9087	169	13.0000	219	14.7986
20	4.4721	70	8.3666	120	10.9545	170	13.0384	220	14.8324
21	4.5826	71	8.4261	121	11.0000	171	13.0767	221	14.8661
22	4.6904	72	8.4853	122	11.0454	172	13.1149	222	14.8997
23	4.7958	73	8.5440	123	11.0905	173	13.1529	223	14.9332
24	4.8990	74	8.6023	124	11.1355	174	13.1909	224	14.9666
25	5.0000	75	8.6603	125	11.1803	175	13.2288	225	15.0000
26	5.0990	76	8.7178	126	11.2250	176	13.2665	226	15.0333
27	5.1962	77	8.7750	127	11.2694	177	13.3041	227	15.0665
28	5.2915	78	8.8318	128	11.3137	178	13.3417	228	15.0997
29	5.3852	79	8.8882	129	11.3578	179	13.3791	229	15.1327
30	5.4772	80	8.9443	130	11.4018	180	13.4164	230	15.1658
31	5.5678	81	9.0000	131	11.4455	181	13.4536	231	15.1987
32	5.6569	82	9.0554	132	11.4891	182	13.4907	232	15.2315
33	5.7446	83	9.1104	133	11.5326	183	13.5277	233	15.2643
34	5.8310	84	9.1652	134	11.5758	184	13.5647	234	15.2971
35	5.9161	85	9.2195	135	11.6190	185	13.6015	235	15.3297
36	6.0000	86	9.2736	136	11.6619	186	13.6382	236	15.3623
37	6.0828	87	9.3274	137	11.7047	187	13.6748	237	15.3948
38	6.1644	88	9.3808	138	11.7473	188	13.7113	238	15.4272
39	6.2450	89	9.4340	139	11.7898	189	13.7477	239	15.4596
40	6.3246	90	9.4868	140	11.8322	190	13.7840	240	15.4919
41	6.4031	91	9.5394	141	11.8743	191	13.8203	241	15.5242
42	6.4807	92	9.5917	142	11.9164	192	13.8564	242	15.5563
43	6.5574	93	9.6437	143	11.9583	193	13.8924	243	15.5885
44	6.6332	94	9.6954	144	12.0000	194	13.9284	244	15.6205
45	6.7082	95	9.7468	145	12.0416	195	13.9642	245	15.6525
46	6.7823	96	9.7980	146	12.0830	196	14.0000	246	15.6844
47	6.8557	97	9.8489	147	12.1244	197	14.0357	247	15.7162
48	6.9282	98	9.8995	148	12.1655	198	14.0712	248	15.7480
49	7.0000	99	9.9499	149	12.2066	199	14.1067	249	15.7797
50	7.0711	100	10.0000	150	12.2474	200	14.1421	250	15.8114

RETIRED CURRICULUM

RETIRED CURRICULUM

TOPIC: 3-3: Characteristics Of Water And Principles Of Pressure

TIME FRAME: 0:30

LEVEL OF INSTRUCTION: Level II

AUTHORITY: 2009 NFPA 1002: Section 5.2

BEHAVIORAL OBJECTIVE:

Condition: Given a written test

Behavior: The student will confirm a knowledge of the characteristics and principles of water and pressure by completing the written test

Standard: With a minimum 80% accuracy according to the information contained in Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 135-161

MATERIALS NEEDED:

- Writing board/pad with markers/erasers
- Appropriate audiovisual equipment
- Appropriate audiovisual materials

REFERENCES:

- Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 135-161

PREPARATION: Each instructor must develop a motivational statement on why the student should learn the upcoming material. The purpose is to establish relevancy of the lesson to the audience. The ACID BASE acronym can be used to help develop student motivation.

Attention (attract)	**B**egin
Curiosity (arouse)	**A**ssociation
Interest (create)	**S**tudents
Desire (stimulate)	**E**xperience

Cite examples or use related illustrations of near-miss incidents, injuries, or fatalities. Write this section "from the heart." Be creative! Have fun with it or be serious, but remember the goal is to stimulate student motivation.

PRESENTATION	APPLICATION
	SLIDE: 3-3-1
I. CHARACTERISTICS OF WATER	
A. Water can exist in three forms	**SLIDE: 3-3-2**
1. Liquid	
a) Exists at temperatures between 32°F - 212°F	**SLIDE: 3-3-3**
2. Solid	At what temperature will water not be in the liquid form?
a) Freezing occurs at temperatures below 32°F and converts it to ice	**SLIDE: 3-3-4**
3. Gas	
a) Converts to a vapor or steam at temperatures above 212°F	**SLIDE: 3-3-5**
B. Weight of water	How much does 1 gallon of fresh water weigh?
1. Fresh water weighs 8.33 pounds per gallon	
2. Salt water weighs 8.6 pounds per gallon	
3. 1 cubic foot of water weighs 62.5 lbs.	**SLIDE: 3-3-6**
C. Water expansion	
1. When converted to steam, expands 1,700 times	**SLIDE: 3-3-7**
D. Water hammer	What is a water hammer?
1. Force created by the sudden deceleration or acceleration of water	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
2. Causes	
a) Sudden opening and closing of nozzles or valves	
3. Damaging effects to	
a) Hoselines	
b) Water mains	
c) Hydrants	
d) Fire pumps and its related accessories	
1) Piping	
4. Life safety	
a) Sudden, violent jerking of hoselines and possible rupturing creates extreme, unsafe conditions	
5. Corrective measures	
a) All controls should be moved slowly	
1) Nozzles	
2) Hydrants	
3) Valves	
4) Hose clamps	
II. HOW PRESSURES ACT ON FLUIDS	
	SLIDE: 3-3-8
A. First principle	
1. Fluid pressure is perpendicular to any surface on which it acts	
	SLIDE: 3-3-9
B. Second principle	
1. Fluid pressure at a point in a fluid at rest is of the same intensity in all directions	
a) Fluid pressure at a point, at rest, has no direction	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
	SLIDE: 3-3-10
C. Third principle 1. Pressure applied to a confined fluid from without is transmitted equally in all directions	
	SLIDE: 3-3-11
D. Fourth principle 1. The pressure of a liquid in an open vessel is proportional to its depth 2. Example a) 1 square inch (cross-sectional area) in a vertical container 1) At 1 foot = .434 pounds 2) At 2 feet = .868 pounds 3) At 3 feet = 1.302 pounds	
NOTE: Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Page 143, Figure 6.16.	
	SLIDE: 3-3-12
E. Fifth principle 1. The pressure of a liquid in an open vessel is proportional to the density of the liquid 2. Example a) Container with 1 inch of mercury and a container with 13.55 inches of water will exert the same pressure at the bottom	
	SLIDE: 3-3-13
F. Sixth principle 1. The pressure of a liquid on the bottom of a vessel is independent of the shape of the vessel	
	Water that is 1 foot in depth will exert how much pressure?
a) Four containers with different shapes with 1 foot of water in each will all exert .434 psi at the bottom	

RETIRED CURRICULUM

SUMMARY:

Efficiently using water resources are vital to incident effectiveness. The ability to relate water characteristics and principles of pressure to the operation will help ensure successful completion of assignments.

EVALUATION:

The student will complete the written test at a time determined by the instructor.

ASSIGNMENT:

Review your notes and read Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 135-161 in order to prepare yourself for the upcoming test. Study for our next session.

RETIRED CURRICULUM

RETIRED CURRICULUM

TOPIC: 3-4: Principle Features Of Water Systems

TIME FRAME: 0:15

LEVEL OF INSTRUCTION: Level II

AUTHORITY: 2009 NFPA 1002: Sections 5.2.1(A) and 5.2.2(A)

BEHAVIORAL OBJECTIVE:

Condition: A written test

Behavior: The student will confirm a knowledge of the principal features of water systems by completing the written test

Standard: With a minimum 80% accuracy according to the information contained in Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 151-161 and 325

MATERIALS NEEDED:

- Writing board with markers/erasers
- Appropriate audiovisual equipment
- Appropriate audiovisual materials

REFERENCES:

- Engineer Training Program, Tiburon Fire District, 2001 Edition, Page 03-3
- Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 151-161 and 325

PREPARATION: Each instructor must develop a motivational statement on why the student should learn the upcoming material. The purpose is to establish relevancy of the lesson to the audience. The ACID BASE acronym can be used to help develop student motivation.

Attention (attract)	**B**egin
Curiosity (arouse)	**A**ssociation
Interest (create)	**S**tudents
Desire (stimulate)	**E**xperience

Cite examples or use related illustrations of near-miss incidents, injuries, or fatalities. Write this section "from the heart." Be creative! Have fun with it or be serious, but remember the goal is to stimulate student motivation.

PRESENTATION	APPLICATION
	SLIDE: 3-4-1 **SLIDE: 3-4-2**
I. WATER SUPPLY SOURCES A. Surface water 1. Lakes, rivers, ponds, etc. B. Ground water 1. Wells or water producing stream	How does the water get from the source to the hydrant? **SLIDE: 3-4-3**
II. PUMPS AND PUMPING STATIONS A. Used when gravity system not available or reliable 1. May be used as adjunct to gravity system B. Generally highly efficient 1. Usually completely automated C. Pumping capacity 1. Varies from a few hundred gallons per minutes to millions of gallons per day 2. Diesel pumps permit greater capacity and fuel economy	What is the most economical type of distribution system? **SLIDE: 3-4-4**
III. GRAVITY SYSTEM A. Uses natural elevation 1. Most practical method of delivery 2. Most economical method of delivery 3. Least installation costs 4. Least maintenance costs	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
B. Capacity limited by basin or reservoir	
1. System may operate with or without pumps	
	SLIDE: 3-4-5
IV. COMBINATION SYSTEM	
A. Combines gravity flow and pumps	
1. Used in majority of communities	
2. Gravity system can operate if pumps fail	
	What can be done to provide a better supply of water at a dead end?
3. Tanks used on dead ends	
B. Combined storage	
1. Elevated reservoirs	
2. If not in use, water tenders can be utilized	
	SLIDE: 3-4-6
V. DISTRIBUTION SYSTEMS	
A. Elements	
1. Pipes	
2. Valves	
3. Hydrants	
4. Meters	
5. Other appliances for conveying water	
B. System design	
1. Grid	
a) Provides circulating feed from several mains	
b) Most common	
c) Interlooped and connected at standard intervals	
2. Looped line or circulation feed	
a) A hydrant that receives water from two or more directions	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
3. Dead-end a) A hydrant that receives water from only one direction C. Grid system piping 1. Primary feeder (mains) a) Large pipes b) Wide spacing c) High capacity d) 8-52 inches or greater e) Carries water to points for local distribution 2. Secondary feeders a) Intermediate-sized pipes b) Forms loops closely spaced c) High capacity d) 8-36 inches or greater e) Carries water to distribution lines 3. Distributors a) Smaller internal grid arrangements that serve consumer blocks and individual fire hydrants b) Close spacing c) High capacity d) Pipe size 1) Residential/multiple housing districts • 6-inch minimum • Should be closely gridded by 8-inch cross-connecting mains at intervals of not more than 600 feet • May need larger size main depending on layout and occupancy	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
2) Shopping/commercial districts • 8-inch minimum • With cross-connecting mains every 600 feet • May need larger size main depending on layout and occupancy 3) 12-inch mains may be used in principal streets and in long mains not cross-connected at frequent intervals	
VI. GENERAL INFORMATION	**SLIDE: 3-4-7** What is the purpose of main line valves in the distribution system?
A. Main valves 1. Used to provide flow control in the water system 2. Valves should be tested each year	
3. High value area spacing a) 500 feet 4. Other areas' spacing a) 800 feet	What is the suggested spacing for valves in high value districts?
B. Water main pipe 1. Usually good for 30 years service C. Hydrant color codes 1. Based on gallons per minute of flow 2. Normally painted on the discharge caps and tops 3. NFPA color codes a) Light blue 1) Class AA • 1,500 gpm or greater	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
b) Green 1) Class A • 1,000-1,499 gpm c) Orange 1) Class B • 500-999 gpm d) Red 1) Class C • 499 or less	

RETIRED CURRICULUM

SUMMARY:

It is important that you determine the main components and features of a modern water system. You should also determine the types of water distribution systems and what types of problems can be anticipated within the modern water system.

EVALUATION:

The student will complete the written test at a time determined by the instructor.

ASSIGNMENT:

Review your notes and read Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 151-161 and 325 in order to prepare yourself for the upcoming test. Study for our next session.

RETIRED CURRICULUM

RETIRED CURRICULUM

TOPIC: 3-5: Nozzle Theory

TIME FRAME: 0:30

LEVEL OF INSTRUCTION: Level II

AUTHORITY: 2009 NFPA 1002: Sections 5.2.1, 5.2.2(B), 5.2.4(B)

BEHAVIORAL OBJECTIVE:

Condition: Given a written test

Behavior: The student will confirm a knowledge of nozzle theory by completing the written test

Standard: With a minimum 80% accuracy according to the information contained in Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 165-179

MATERIALS NEEDED:

- Writing board/pad with markers/erasers
- Appropriate audiovisual equipment
- Appropriate audiovisual materials

REFERENCES:

- Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 165-179

PREPARATION: Each instructor must develop a motivational statement on why the student should learn the upcoming material. The purpose is to establish relevancy of the lesson to the audience. The ACID BASE acronym can be used to help develop student motivation.

Attention (attract)	**B**egin
Curiosity (arouse)	**A**ssociation
Interest (create)	**S**tudents
Desire (stimulate)	**E**xperience

Cite examples or use related illustrations of near-miss incidents, injuries, or fatalities. Write this section "from the heart." Be creative! Have fun with it or be serious, but remember the goal is to stimulate student motivation.

PRESENTATION	APPLICATION
	SLIDE: 3-5-1
	SLIDE: 3-5-2
I. TYPES OF NOZZLES	
A. Handline nozzles	
1. Range in size from ¾" booster line nozzles	
2. To nozzles designed for 3" hoseline	
	What is the maximum flow for a handline?
3. Generally 350 gpm is maximum flow	
B. Master stream nozzles	
1. Usually designed to flow 350 gpm or greater	
	SLIDE: 3-5-3
II. HANDLINE NOZZLES	
A. Solid stream nozzles	
1. Produced from smooth bore nozzle	
2. Operates at 50 psi	
B. Fog stream nozzles	
1. Constant flow nozzles	
a) Operate at 100 psi	
b) Low pressure nozzles operate at 75 psi	
2. Manually adjustable nozzles	
a) Operate at 100 psi	
b) Low pressure nozzles operate at 75 psi	
3. Automatic nozzles	
	What pressure is maintained by an automatic nozzle?
a) Automatically regulate the opening to maintain 100 psi	
b) Driver/operator can "dial" up the pressure and volume when water supply permits	
c) Driver/operator controls gpm flow	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
1) Nozzle person does not	
d) Low pressure nozzles operate at 75 psi	
4. High pressure fog nozzles	
a) Operate at pressure up to 800 psi	
b) Low volume flow is 8-15 gpm	
C. Broken stream nozzles	
	What is an example of a broken stream nozzle?
1. Special purpose nozzles	
2. Cellar and pier nozzles	
a) Distributors	
3. Water curtain nozzles	
4. Piercing nozzles	
a) Deliver about 100 gpm	
5. Chimney nozzles	
a) Operate at 100 psi	
b) Deliver only 1½-3 gpm	
	SLIDE: 3-5-4
III. MASTER STREAMS	
A. Smooth bore operates at 80 psi	
B. Fog operates at 100 psi	
C. Four basic categories	
1. Monitor	
a) Three basic types	
1) Fixed	
• Permanently mounted on apparatus	
2) Combination	
• Mounted on apparatus	
• Can be used as a turret	
• Removed and used as a portable monitor	

RETIRED CURRICULUM

PRESENTATION	APPLICATION

3) Portable
   - Carried to location where needed

2. Turret pipe
   a) Also known as deck gun or deck pipe
3. Deluge set
   a) Large capacity nozzle on a playpipe supported by a tripod and connected by a short length of large diameter hose
4. Elevated master stream
   a) Large capacity nozzle that is designed to be placed on an aerial apparatus elevating device

SLIDE: 3-5-5

What is nozzle reaction?

IV. NOZZLE REACTION

A. Force pushing back on the fire fighter handling the hoseline
   1. Counterforce

B. For every action there is an equal and opposite reaction

C. Calculation
   1. Solid tip nozzle
      a) $NR = (1.57 \times d^2)(NP)$
   2. Fog nozzle
      a) $NR = (0.0505 \times Q)(\sqrt{NP})$
      b) $NR = Q/2$ or $NR = ½$ gpm

RETIRED CURRICULUM

SUMMARY:

The driver/operator is responsible for safely operating the apparatus and all its appliances. Having the knowledge of nozzle types and nozzle reaction will help ensure a safe efficient operation.

EVALUATION:

The student will complete the written test at a time determined by the instructor.

ASSIGNMENT:

Review your notes and read Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 165-179 in order to prepare yourself for the upcoming test. Study for our next session.

RETIRED CURRICULUM

RETIRED CURRICULUM

TOPIC: 3-6: Calculating Gallons Per Minute

TIME FRAME: 0:30

LEVEL OF INSTRUCTION: Level II

AUTHORITY: 2009 NFPA 1002: Section 5.2

BEHAVIORAL OBJECTIVE:

Condition: Given an activity and written test

Behavior: The student will confirm a knowledge of calculating gpm by completing the activity and written test

Standard: With a minimum 80% accuracy according to the information contained in Fire Apparatus Driver/Operator Student Supplement, SFT, 2008 Edition, Pages 28-30 and Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 166 and 179

MATERIALS NEEDED:

- Writing board/pad with markers/erasers
- Appropriate audiovisual equipment
- Appropriate audiovisual materials
- Individual Activity 3-6-1: Calculating gpm

REFERENCES:

- Driver Operator Training Program, Modesto Regional Training Center, 2002 Edition, Calculating GPM Section
- Engineer Training Program, Tiburon Fire District, 2001 Edition, Pages 28-1, 28-2, 28A-1, 28A-2
- Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 166 and 179

PREPARATION: Each instructor must develop a motivational statement on why the student should learn the upcoming material. The purpose is to establish relevancy of the lesson to the audience. The ACID BASE acronym can be used to help develop student motivation.

Attention (attract)	**B**egin
Curiosity (arouse)	**A**ssociation
Interest (create)	**S**tudents
Desire (stimulate)	**E**xperience

Cite examples or use related illustrations of near-miss incidents, injuries, or fatalities. Write this section "from the

heart." Be creative! Have fun with it or be serious, but remember the goal is to stimulate student motivation.

RETIRED CURRICULUM

PRESENTATION	APPLICATION
	SLIDE: 3-6-1
I. NOZZLE GPM	
	SLIDE: 3-6-2
A. gpm = $(29.7)(d^2 \times \sqrt{NP})$	
1. 29.7 = a constant	
2. d^2 = diameter of the nozzle orifice squared	
3. √ = square root	
4. NP = nozzle pressure	
	SLIDE: 3-6-3
	If the nozzle diameter is 2" and the NP is 80 psi, what is the gpm?
5. Example	
a) gpm = $(29.7)(2^2 \times \sqrt{80})$	
b) gpm = (29.7)(4 x 8.94)	
c) gpm = (29.7)(35.76)	
d) gpm = 1,062.072	
e) <u>gpm = 1062</u> (round off)	
	SLIDE: 3-6-4
II. HYDRANT GPM	
A. Slightly different than the formula for nozzles	
1. gpm formula for hydrants (open butts) adds a coefficient step	
2. Pressure is flow pressure (FP)	
B. gpm = $(29.7)[c \times (d^2 \times \sqrt{FP})]$	
1. 29.7 = a constant	
2. c = coefficient based on hydrant design	
3. d^2 = diameter of the discharge orifice squared	
4. √ = square root	
5. FP = flow pressure	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
	SLIDE: 3-6-5
C. Coefficient is assigned as a on the friction loss depending on the hydrant's construction type 1. .7, .8, or .9 a) .7 would denote the greatest FL b) .9 would denote the least FL c) A hydrant with no FL would have a coefficient of 1 2. Usually affected by the hydrant's configuration 3. Multiplied into the equation	
	If the coefficient is .8, the diameter of the orifice is 2.5 inches, and the FP is 30 psi, what is the gpm? **SLIDE: 3-6-6**
D. Example 1. gpm = (29.7)[.8 x (2.52 x √ 30)] 2. gpm = (29.7)[.8 x (6.25 x 5.48)] 3. gpm = (29.7)(.8 x 34.25) 4. gpm = (29.7)(27.4) 5. gpm = <u>813.78</u> **NOTE:** For calculating FL, round off to the whole number (814).	
	ACTIVITY 3-6-1: Complete the activity in the student supplement.

RETIRED CURRICULUM

SUMMARY:

The knowledge of formulas for calculating gpm is a vital part of the driver/operator's responsibilities. This knowledge can be key in testing and incident situations. The more accurate the calculations are, the more effective and efficient the overall operations will be.

EVALUATION:

The student will complete the activity and written test at a time determined by the instructor.

ASSIGNMENT:

Review your notes and read Fire Apparatus Driver/Operator Student Supplement, SFT, 2008 Edition, Pages 28-30 and Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 166 and 179 in order to prepare yourself for the upcoming test. Study for our next session.

RETIRED CURRICULUM

INDIVIDUAL ACTIVITY 3-6-1

TITLE:	Calculating Nozzle and Hydrant gpm
TIME FRAME:	0:20
MATERIALS NEEDED:	• Pen or pencil
INTRODUCTION:	This activity provides the students the opportunity to calculate gpm for nozzles and hydrants in a step-by-step format using standard formulas.
DIRECTIONS:	1. Calculate the gpm for each of the following using the appropriate formula. 2. You have 15 minutes to complete this activity. 3. Be prepared to discuss your answers with the class.

NOZZLES

1. Nozzle = 1⅛" tip and NP of 60 psi

   gpm = $(29.7)(d^2 \times \sqrt{NP})$

   gpm = **$(29.7)(1.125^2 \times \sqrt{60})$**

   gpm = **$(29.7)(1.27 \times 7.75)$**

   gpm = **$(29.7)(9.84)$**

   gpm = **292**

2. Nozzle = 1" tip and NP of 50 psi

   gpm = $(29.7)(d^2 \times \sqrt{NP})$

   gpm = **$(29.7)(1^2 \times \sqrt{50})$**

   gpm = **$(29.7)(1 \times 7.07)$**

   gpm = **$(29.7)(7.07)$**

   gpm = **210**

RETIRED CURRICULUM

3. Nozzle = 1¼" tip and NP of 50 psi

   gpm = $(29.7)(d^2 \times \sqrt{NP})$

   gpm = **$(29.7)(1.25^2 \times \sqrt{50})$**

   gpm = **$(29.7)(1.56 \times 7.07)$**

   gpm = **$(29.7)(11.03)$**

   gpm = **328**

4. Nozzle = 1½" tip and NP of 80 psi

   gpm = $(29.7)(d^2 \times \sqrt{NP})$

   gpm = **$(29.7)(1.5^2 \times \sqrt{80})$**

   gpm = **$(29.7)(2.25 \times 8.94)$**

   gpm = **$(29.7)(20.12)$**

   gpm = **598**

5. Nozzle = 1¾" tip and NP of 80 psi

   gpm = $(29.7)(d^2 \times \sqrt{NP})$

   gpm = **$(29.7)(1.75^2 \times \sqrt{80})$**

   gpm = **$(29.7)(3.06 \times 8.94)$**

   gpm = **$(29.7)(27.36)$**

   gpm = **813**

6. Nozzle = ⅞" tip and NP of 50 psi

   gpm = $(29.7)(d^2 \times \sqrt{NP})$

   gpm = **$(29.7)(.875^2 \times \sqrt{50})$**

   gpm = **$(29.7)(.77 \times 7.07)$**

   gpm = **$(29.7)(5.44)$**

   gpm = **162**

RETIRED CURRICULUM

HYDRANTS

7. Hydrant = .7 coefficient, 2½" outlet, and FP of 43 psi

   gpm = (29.7)[c x (d^2 x √ FP)]
   gpm = **(29.7)[.7 x (2.5^2 x √ 43)]**
   gpm = **(29.7)[.7 x (6.25 x 6.56)]**
   gpm = **(29.7)(.7 x 41)**
   gpm = **(29.7)(28.7)**
   gpm = **852**

8. Hydrant = .8 coefficient, 2½" outlet, and FP of 90 psi

   gpm = (29.7)[c x (d^2 x √ FP)]
   gpm = **(29.7)[.8 x (2.5^2 x √ 90)]**
   gpm = **(29.7)[.8 x (6.25 x 9.49)]**
   gpm = **(29.7)(.8 x 59.31)**
   gpm = **(29.7)(47.45)**
   gpm = **1,409**

9. Hydrant = .7 coefficient, 2½" outlet, and FP of 86 psi

   gpm = (29.7)[c x (d^2 x √ FP)]
   gpm = **(29.7)[.7 x (2.5^2 x √ 86)]**
   gpm = **(29.7)[.7 x (6.25 x 9.27)]**
   gpm = **(29.7)(.7 x 57.94)**
   gpm = **(29.7)(40.56)**
   gpm = **1205**

RETIRED CURRICULUM

10. Hydrant = .9 coefficient, 2½" outlet, and FP of 75 psi

gpm = (29.7)[c x (d^2 x √ FP)]

gpm = **(29.7)[.9 x (2.5^2 x √ 75)]**

gpm = **(29.7)[.9 x (6.25 x 8.66)]**

gpm = **(29.7)(.9 x 54.13)**

gpm = **(29.7)(48.72)**

gpm = **1,447**

RETIRED CURRICULUM

RETIRED CURRICULUM

TOPIC: 3-7: Principles Of Friction Loss

TIME FRAME: 0:15

LEVEL OF INSTRUCTION: Level II

AUTHORITY: 2009 NFPA 1002: Section 5.2

BEHAVIORAL OBJECTIVE:

Condition: Given a written test

Behavior: The student will confirm a knowledge of factors affecting friction loss by completing the written test

Standard: With a minimum 80% accuracy according to the information contained in Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 147-150

MATERIALS NEEDED:

- Writing board/pad with markers/erasers
- Appropriate audiovisual equipment
- Appropriate audiovisual materials

REFERENCES:

- Engineer Training Program, Tiburon Fire District, 2000 Edition, Pages 30-1 and 30-2
- Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 147-150

PREPARATION: Each instructor must develop a motivational statement on why the student should learn the upcoming material. The purpose is to establish relevancy of the lesson to the audience. The ACID BASE acronym can be used to help develop student motivation.

Attention (attract)	**B**egin
Curiosity (arouse)	**A**ssociation
Interest (create)	**S**tudents
Desire (stimulate)	**E**xperience

Cite examples or use related illustrations of near-miss incidents, injuries, or fatalities. Write this section "from the heart." Be creative! Have fun with it or be serious, but remember the goal is to stimulate student motivation.

PRESENTATION	APPLICATION
	SLIDE: 3-7-1
	SLIDE: 3-7-2
I. FRICTION LOSS	
A. That part of total pressure that is used to overcome friction while forcing water through pipes, fittings, fire hose and adapters	
B. The difference in pressures in a hoseline between a nozzle and a pumper is a good example for friction loss	
	What causes friction loss?
	SLIDE: 3-7-3
II. CAUSES OF FRICTION LOSS	
A. Movement of water molecules against each other	
B. Fire hose type, lining, and age	
C. Crushed couplings	
D. Sharp bends	
E. Change in size of orifice by adapters	
	SLIDE: 3-7-4
III. FOUR BASIC PRINCIPLES OF FRICTION LOSS	
A. All other conditions being the same, the loss by friction varies directly with the length of hoseline or pipe	
1. A hoseline 100 feet long and a hoseline 200 feet long, both flowing 200 gpm, have different friction loss because of their length	
B. When the same size of hoseline is used, the friction loss will vary approximately with the square of the increase in the velocity of the flow	
1. When the flow through a 3" hoseline doubles from 200 gpm to 400 gpm, the friction loss increases four times	
2. When the flow is tripled from 200 gpm to 600 gpm, the friction loss increases nine times	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
C. For the same discharge, friction loss varies inversely as the fifth power of the diameter of the hose 1. This can be illustrated by comparing the friction loss factor in a 3" hoseline and 4" hoseline 2. The 3" hoseline has four times the friction loss as the 4" hoseline D. For a given velocity of flow, the friction loss in hoseline is approximately the same, whatever the pressure on the water may be 1. A 1½" hoseline flowing 100 gpm and a PDP of 124 friction loss is 24 psi 2. When the PDP is doubled to 248 but the flow remains at 100 gpm, the friction loss does not change	
IV. CRITICAL VELOCITY A. When the velocity of a fire stream becomes so great that the entire stream is agitated by resistance, causing turbulence B. Increased friction loss	What is critical velocity? **SLIDE: 3-7-5**
V. TO REDUCE FRICTION LOSS A. Check for rough linings in old hose B. Replace crushed couplings C. Eliminate sharp bends D. Use adapters only when necessary E. Keep nozzles and valves fully open when possible F. Use gaskets of proper size G. Use shorter hose lays when at all possible H. When flow must be increased, use larger hoselines or multiple lines	How can FL be reduced? **SLIDE: 3-7-6**

RETIRED CURRICULUM

SUMMARY:

Friction loss is one of the largest factors that must be overcome when pumping hoselines. A pump operator who knows how friction loss affects pump operations will be able to overcome friction loss problems and successfully develop effective hose streams.

EVALUATION:

The student will complete the written test at a time determined by the instructor.

ASSIGNMENT:

Review your notes and read Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 147-150 in order to prepare yourself for the upcoming test. Study for our next session.

RETIRED CURRICULUM

RETIRED CURRICULUM

TOPIC: 3-8: Calculating Friction Loss In Hose Lays

TIME FRAME: 4:00

LEVEL OF INSTRUCTION: Level II

AUTHORITY: 2009 NFPA 1002: Sections 5.2.1(A) and 5.2.2(A)

BEHAVIORAL OBJECTIVE:

Condition: Given an activity and written test

Behavior: The student will confirm a knowledge of calculating friction loss in hose lays by completing the activity and written test

Standard: With a minimum 80% accuracy according to the information contained in Fire Apparatus Driver/Operator 1B Student Supplement, SFT, 2008 Edition, Pages 32-40 and Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 185-209

MATERIALS NEEDED:

- Writing board/pad with markers/erasers
- Appropriate audiovisual equipment
- Appropriate audiovisual materials
- Individual Activity 3-8-1: Calculating Friction Loss

REFERENCES:

- Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 185-209

PREPARATION: Each instructor must develop a motivational statement on why the student should learn the upcoming material. The purpose is to establish relevancy of the lesson to the audience. The ACID BASE acronym can be used to help develop student motivation.

Attention (attract)	**B**egin
Curiosity (arouse)	**A**ssociation
Interest (create)	**S**tudents
Desire (stimulate)	**E**xperience

Cite examples or use related illustrations of near-miss incidents, injuries, or fatalities. Write this section "from the heart." Be creative! Have fun with it or be serious, but remember the goal is to stimulate student motivation.

PRESENTATION	APPLICATION
	SLIDE: 3-8-1
	SLIDE: 3-8-2

I. FRICTION LOSS FORMULA

A. FL = $(C \times Q^2)(L)$

B. C = Coefficient for hose diameter

C. Q = Quantity

1. Flow rate in hundreds of gallons per minute
2. gpm/100

D. L = Length

1. Number of 100-foot lengths of hoseline
2. L/100

II. FRICTION LOSS COEFFICIENTS

What is a coefficient?

SLIDE: 3-8-3

A. C factors refer to the third principle of friction loss

1. Are the base of the friction loss equation
2. Assigned based on the diameter of the hose
   a) The larger the diameter of hose, the friction loss is greatly decreased

B. Reflects a worst-case scenario

1. Results are probably slightly higher than the actual friction loss

SLIDE: 3-8-4

C. Standard (coefficients)

1. 1" = 150
2. 1½" = 24
3. 1¾" = 10*
4. 2½" = 2
5. 3" = 0.8

* Friction loss coefficient determination from IFSTA used for 1¾" hoseline. Tests resulted in a coefficient of 9.9. Recommended FL coefficient is 10.

RETIRED CURRICULUM

PRESENTATION	APPLICATION
6. 4" = 0.2 7. 4½" = 0.1 8. 5" = 0.08	
	SLIDE: 3-8-5 **SLIDE: 3-8-6**
III. CALCULATING "Q" A. Second step of friction loss formula B. Must be calculated, then applied to friction loss formula	
	If gpm is 200, what is Q?
C. Q = 200 (gpm)/100 1. Q = 2	
	If gpm is 400, what is Q?
D. Q = 400 (gpm)/100 1. Q = 4	
IV. CALCULATING FRICTION LOSS	
	If gpm is 200 and 100-feet of 2½" hoseline is laid, what is the FL? **SLIDE: 3-8-7**
A. FL = (C x Q^2)(L) 1. FL = (2 x 2^2)(1) 2. FL = (2 x 4)(1) 3. FL = (8)(1) 4. FL = 8 psi	
V. SINGLE HOSELINE FRICTION LOSS A. Most commonly used hose lay B. Simplest friction loss calculation	
	What is the FL for a 300-foot 2½" hoseline if the gpm is 100? **SLIDE: 3-8-8**

RETIRED CURRICULUM

PRESENTATION	APPLICATION
C. Example 1. FL = $(2 \times 1^2)(3)$ 2. FL = $(2 \times 1)(3)$ 3. FL = 2×3 4. FL = <u>6 psi</u>	
	SLIDE: 3-8-9
VI. MULTIPLE HOSELINES OF EQUAL SIZE AND LENGTH A. Calculate FL for one hoseline <u>only if</u> other hoselines will have the same pressure and gpm	
	What is the friction loss of two 2½" hoselines with 400 feet of hose each and a 1" nozzle?
	SLIDE: 3-8-10
B. Example 1. Calculating Q a) gpm = $(29.7)(d^2 \times \sqrt{NP})$ b) gpm = $(29.7)(1^2 \times \sqrt{50})$ c) gpm = $(29.7)(1 \times 7.0711)$ d) gpm = $(29.7)(7.0711)$ e) gpm = 210 psi = <u>200 psi</u> 1) Round off for when calculating Q f) $Q = \frac{200}{100}$ g) Q = 2	
	SLIDE: 3-8-11
2. Calculating friction loss a) FL = $(C \times Q^2)(L)$ b) FL = $(2 \times 2^2)(4)$ c) FL = $(2 \times 4)(4)$ d) FL = $(8)(4)$ e) FL = <u>32 psi</u>	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
	SLIDE: 3-8-12
VII. WYED HOSE LAY OF EQUAL LENGTHS	
A. One hoseline supplies two other hoselines	
B. A wye appliance takes one hoseline in and splits two hoselines out	
1. Two 1½" or 1¾" attack lines wyed from a 2½" supply is common	
C. Calculate FL for supply line and one wyed hoseline, then add the two together	
D. Only one of the wyed hoselines needs to be considered when computing total FL because they both carry equal amounts of water	
	What is the correct FL? 2½" line: 200-feet 1¾" wye line: 150-feet gpm = 150 each line
	SLIDE: 3-8-13
E. Example	
1. Calculating Q for 2½" line	
a) $Q = \frac{300}{100}$	
b) Q = 3	
2. Calculating Q for 1¾" wyed hoseline	
a) $Q = \frac{150}{100}$	
b) Q = 1.5	
	SLIDE: 3-8-14
3. Calculating friction loss for 1¾" wyed hoseline	
a) $FL = (C \times Q^2)(L)$	
b) $FL = (10 \times 1.5^2)(1.5)$	
c) $FL = (10 \times 2.25)(1.5)$	
d) $FL = (22.5)(1.5)$	
e) FL = <u>34 psi</u>	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
4. Calculating friction loss for 2½" hoseline a) FL = (C x Q^2)(L) b) FL = (2 x 3^2)(2) c) FL = (2 x 9)(2) d) FL = (8)(2) e) FL = 36 psi 5. Add FL together a) 34 psi 36 psi 70 psi	
	SLIDE: 3-8-15
VIII. SIAMESE HOSELINES OF EQUAL LENGTH A. Two or more hoselines laid parallel to each other B. Divide gpm by the number of hoselines, then calculate FL for one line C. For two siamese lines of equal size and length, take ½ of the gpm flow and figure the FL for one line D. Coefficients are used in calculating FL for multiple lines	
	What is the correct FL? Siamese lines: 1,000-feet of 3" 2½" line: 300-feet" @ 300 gpm **SLIDE: 3-8-16**
E. Example 1. Calculating Q for siamese lines a) Divide gpm by 2 (number of hoselines) b) Q = 150 / 100 c) Q = 1.5 2. Calculating Q for 2½" line a) Q = 300 / 100 b) Q = 3	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
	SLIDE: 3-8-17
3. Calculating friction loss for siamese lines a) FL = $(C \times Q^2)(L)$ b) FL = $(.8 \times 1.5^2)(10)$ c) FL = (.8 x 2.25)(10) d) FL = (1.8)(10) e) FL = 18 psi	
4. Calculating friction loss for 2½" a) FL = $(C \times Q^2)(L)$ b) FL = $(2 \times 3^2)(3)$ c) FL = (2 x 9)(3) d) FL = (18)(3) e) FL = 54 psi	
	SLIDE: 3-8-18
5. Add FL together a) 54 psi 18 psi 72 psi	
	SLIDE: 3-8-19
IX. MULTIPLE HOSELINES OF UNEQUAL LENGTH A. Calculate FL for each line B. Pump for highest pressure needed C. Gate-down discharge of lines needing less pressure	
	What is the correct FL? Line 1 = 300-feet of 2½" Line 2 = 500-feet of 2½" gpm = 250 each line **SLIDE: 3-8-20**
D. Example 1. Calculating Q a) Q = $\frac{250}{100}$ b) Q = 2.5	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
	SLIDE: 3-8-21
2. Calculating friction loss for Line 1 a) FL = $(C \times Q^2)(L)$ b) FL = $(2 \times 2.5^2)(3)$ c) FL = (2 x 6.25)(3) d) FL = (12.5)(3) e) FL = 37.5 f) FL = <u>38 psi</u> (round to whole number)	
3. Calculating friction loss for Line 2 a) FL = $(C \times Q^2)(L)$ b) FL = $(2 \times 2.5^2)(5)$ c) FL = (2 x 6.25)(5) d) FL = (12.5)(5) e) FL = 62.5 f) FL = <u>63 psi</u> (round to whole number)	
	Which FL pressure would be used for PDP?
4. Use 63 psi for the most hydraulically demanding line	
	SLIDE: 3-8-22
X. WYED HOSE LAY OF UNEQUAL LENGTH A. The addition of hose lengths to an existing wyed hoseline assembly may result in unequal length attack lines B. Calculate FL for supply line and both wyed hoselines C. Pump to the highest wyed line and gate-down the other wyed line	
	What is the correct FL? 2½" line: 200-feet 1½" wye line: 150-feet 1½" wye line: 200-feet gpm = 100 each line

RETIRED CURRICULUM

PRESENTATION	APPLICATION
	SLIDE: 3-8-23
D. Example 1. Calculating Q for 2½" line a) $Q = \frac{200}{100}$ b) Q = 2 2. Calculating Q for wye line a) $Q = \frac{100}{100}$ b) Q = 1	
	SLIDE: 3-8-24
3. Calculating friction loss for 2½" line a) $FL = (C \times Q^2)(L)$ b) $FL = (2 \times 2^2)(2)$ c) FL = (2 x 4)(2) d) FL = (8)(2) e) FL = 16 psi 4. Calculating friction loss for 150-foot wye line a) $FL = (C \times Q^2)(L)$ b) $FL = (24 \times 1^2)(1.5)$ c) FL = (24 x 1)(1.5) d) FL = (24)(1.5) e) FL = 36 psi 5. Calculating friction loss for 200-foot wye line a) $FL = (C \times Q^2)(L)$ b) $FL = (24 \times 1^2)(2)$ c) FL = (24 x 1)(2) d) FL = (24)(2) e) FL = 48 psi	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
	SLIDE: 3-8-25
6. Add FL together a) 48 psi 16 psi 64 psi	
	SLIDE: 3-8-26
XI. SIAMESE HOSELINES OF UNEQUAL LENGTH A. Add the lengths of each line together, then divide by the number of lines	
	What is the correct FL? 3" siamese line: 900-feet 3" siamese line: 1,000-feet 2½" line: 100-feet @ 250 gpm
	SLIDE: 3-8-27
B. Example 1. Calculating Q for siamese lines a) Divide gpm by 2 (number of hoselines) b) Q = 125 / 100 c) Q = 1.25 2. Calculating Q for 2½" line a) Q = 250 / 100 b) Q = 2.5	
	SLIDE: 3-8-28
3. Calculate L for siamese lines a) Add the lengths of each line 1) 900 1,000 1,900 b) Divide by 2 (number of siamese lines) 2) 1,900 ÷ 2 = 950	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
c) Divide total length by 100	
3) 950 ÷ 100 = 9.5	
4) L = 9.5	
4. Calculating friction loss for siamese lines	
a) FL = (C x Q^2)(L)	
b) FL = (.8 x 1.25^2)(9.5)	
c) FL = (.8 x 1.56)(9.5)	
d) FL = (1.25)(9.5)	
e) FL = <u>12 psi</u>	
	SLIDE: 3-8-29
5. Calculating friction loss for 2½" line	
a) FL = (C x Q2)(L)	
b) FL = (2 x 2.52)(1)	
c) FL = (2 x 6.25)(1)	
d) FL = (12.5)(1)	
e) FL = <u>13 psi</u>	
6. Add FL together	
a) 13 psi <u>12 psi</u> 25 psi	

RETIRED CURRICULUM

FRICTION LOSS COEFFICIENT DETERMINATION CHART

Date: 11/06/2002 Hose Size: 1¾" Hose Construction: Double jacket rubber lined

Person(s) Conducting The Tests: R. Confer, G. Bryant, T. Hostetter, D. Ockey

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7	Column 8	Column 9
Test Run #	Pump Discharge Pressure psi	Pressure @ Gauge 1 psi	Pressure @ Gauge 2 psi	Nozzle Pressure* psi	Flow from Flow meter or by Equation**	$\left(\frac{gpm}{100}\right)^2$ or $\left(\frac{Col\ 6}{100}\right)^2$	Friction Loss per 100 feet or $\left(\frac{Col\ 3 - Col\ 4}{2}\right)$	C $\left(\frac{Col\ 8}{Col\ 7}\right)$
1	40	30	15	8	n/a	$\left(\frac{106}{100}\right)^2$ 1.12	7.5	6.29
2	180	150	50	30	n/a	$\left(\frac{205}{100}\right)^2$ 4.20	50	11.90
3	115	100	35	20	n/a	$\left(\frac{168}{100}\right)^2$ 2.82	32.5	11.52
4								

*Not necessary if flow meter is used

**gpm = $29.7\ d^2\sqrt{NP}$

Total of all Column 9 answers: ***29.71***

Average C = # of tests conducted

Average C = ***9.90***

RETIRED CURRICULUM

SUMMARY:

The theories involved in calculating friction loss are vital to the overall success of a pumping operation. The driver/operator must be able to correctly apply the proper friction loss formulas and coefficients to the related hose lays to produce an effective fire stream. Fire stream production and proper hose lays are the responsibility of the driver/operator.

EVALUATION:

The student will complete the activity and written test at a time determined by the instructor.

ASSIGNMENT:

Review your notes and read Fire Apparatus Driver/Operator 1B Student Supplement, SFT, 2008 Edition, Pages 32-40 and Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 185-209 in order to prepare yourself for the upcoming test. Study for our next session.

RETIRED CURRICULUM

INDIVIDUAL ACTIVITY 3-8-1

Title:	Calculating Friction Loss
TIME FRAME:	0:50
MATERIALS NEEDED:	• Calculator • Pen or pencil
introduction:	This activity provides the students the opportunity to strengthen their use of the friction loss formulas and sharpen their math skills.
DIRECTIONS:	1. Calculate the friction loss for each of the following. 2. Convert all letter values to number values first. 3. You have 30 minutes to complete this activity. 4. Be prepared to discuss your answers with the class.

RETIRED CURRICULUM

SECTION I: SIMPLE HOSE LAYS

1. Find the correct friction loss.

FL = $(C \times Q^2)(L)$

C = **2**

Q = **2** (200/100)

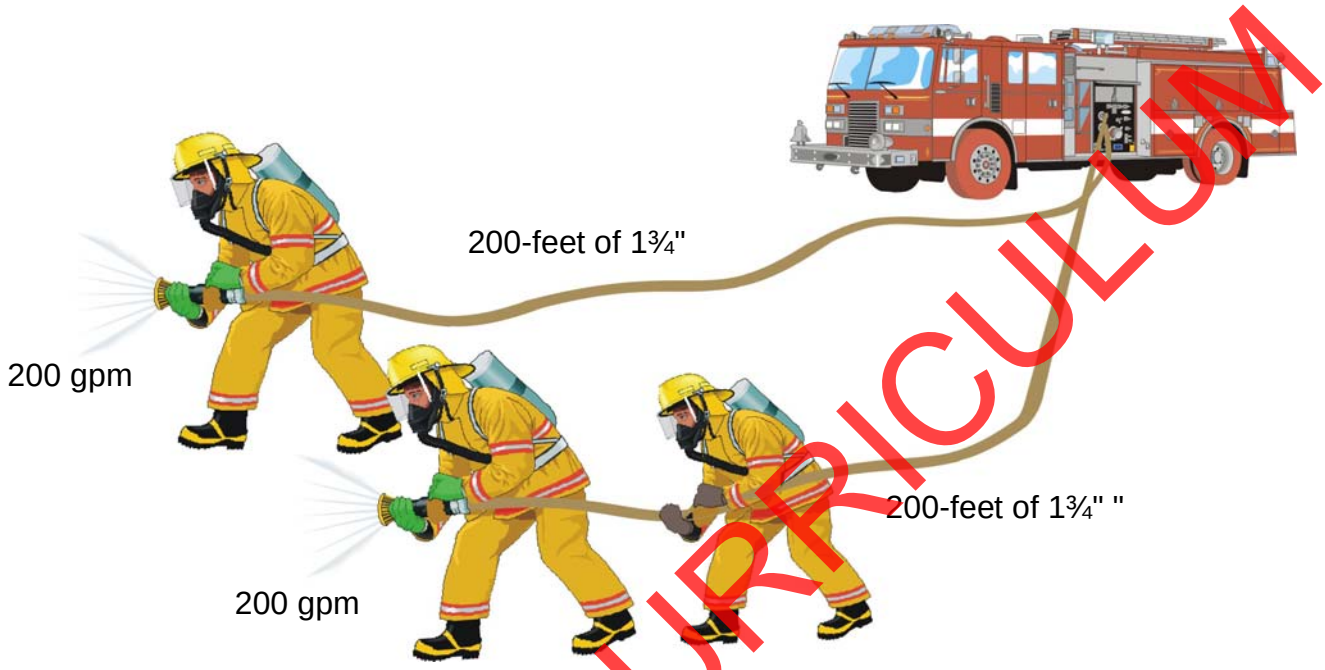
L = **3** (300/100)

FL = **$(2 \times 2^2)(3)$**

FL = **24 psi**

RETIRED CURRICULUM

2. Find the correct friction loss.



FL = $(C \times Q^2)(L)$

C = **10**

Q = **2** (200/100)

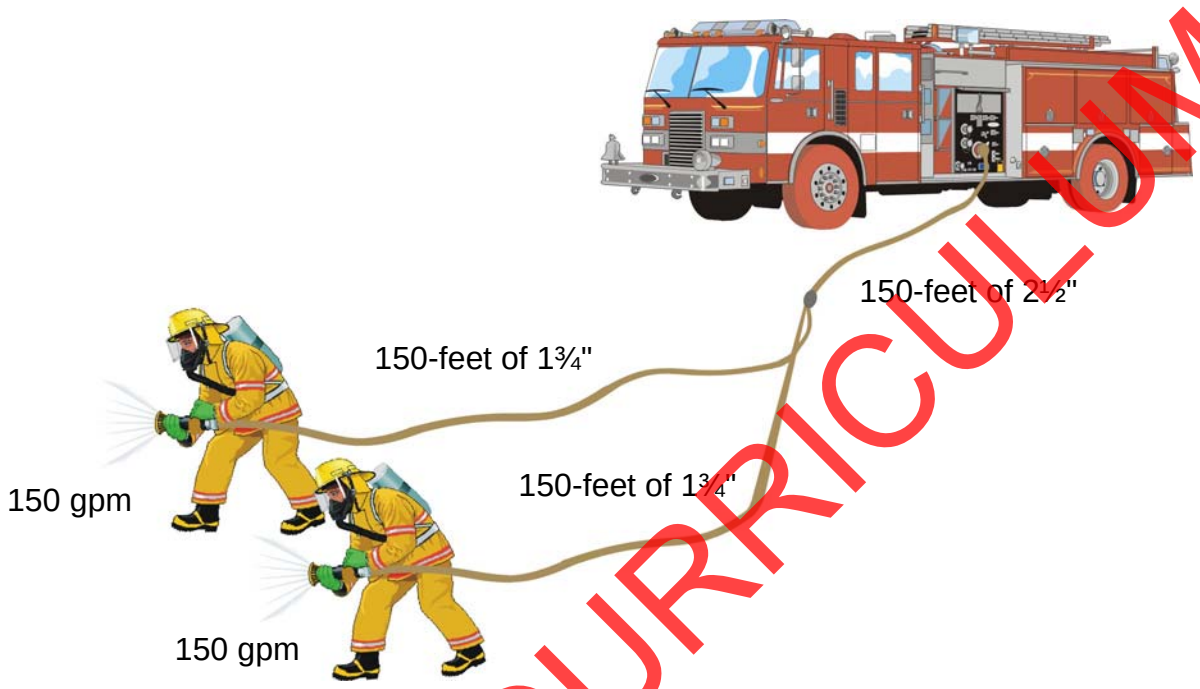
L = **2** (200/100)

FL = **$(10 \times 2^2)(2)$**

FL = **80 psi**

RETIRED CURRICULUM

3. Find the correct friction loss.



2½" Line:

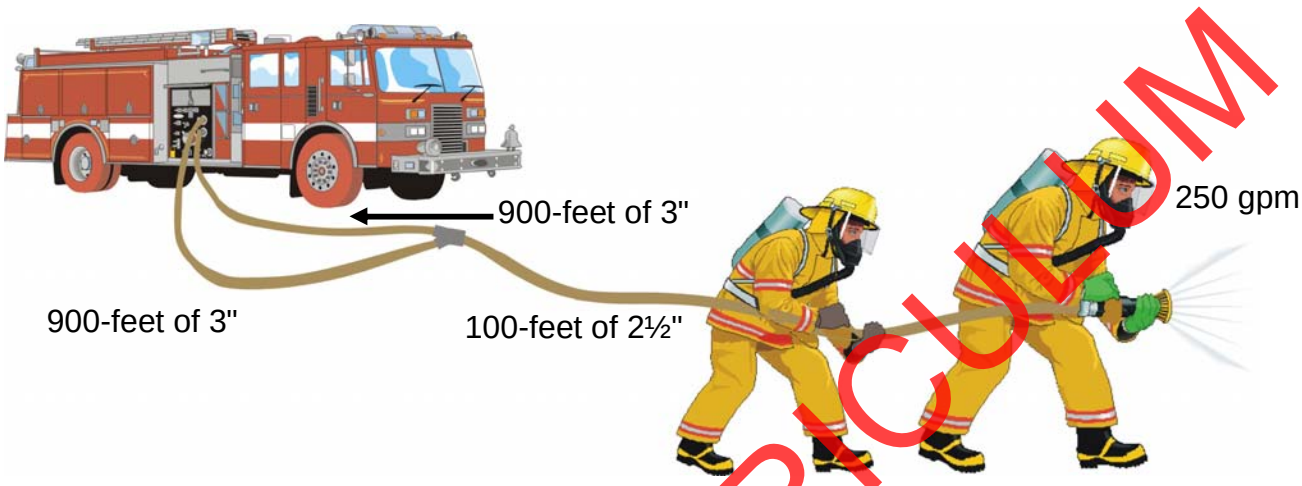
FL = $(C \times Q^2)(L)$
C = **2**
Q = **3** (300/100)
L = **1.5** (150/100)
FL = **$(2 \times 3^2)(1.5)$**
FL = **27 psi**

Wye Line:

FL = $(C \times Q^2)(L)$
C = **10**
Q = **1.5** (150/100)
L = **1** (100/100)
FL = **$(10 \times 1.5^2)(1)$**
FL = **23 psi** (22.5)

RETIRED CURRICULUM

4. Find the correct friction loss.



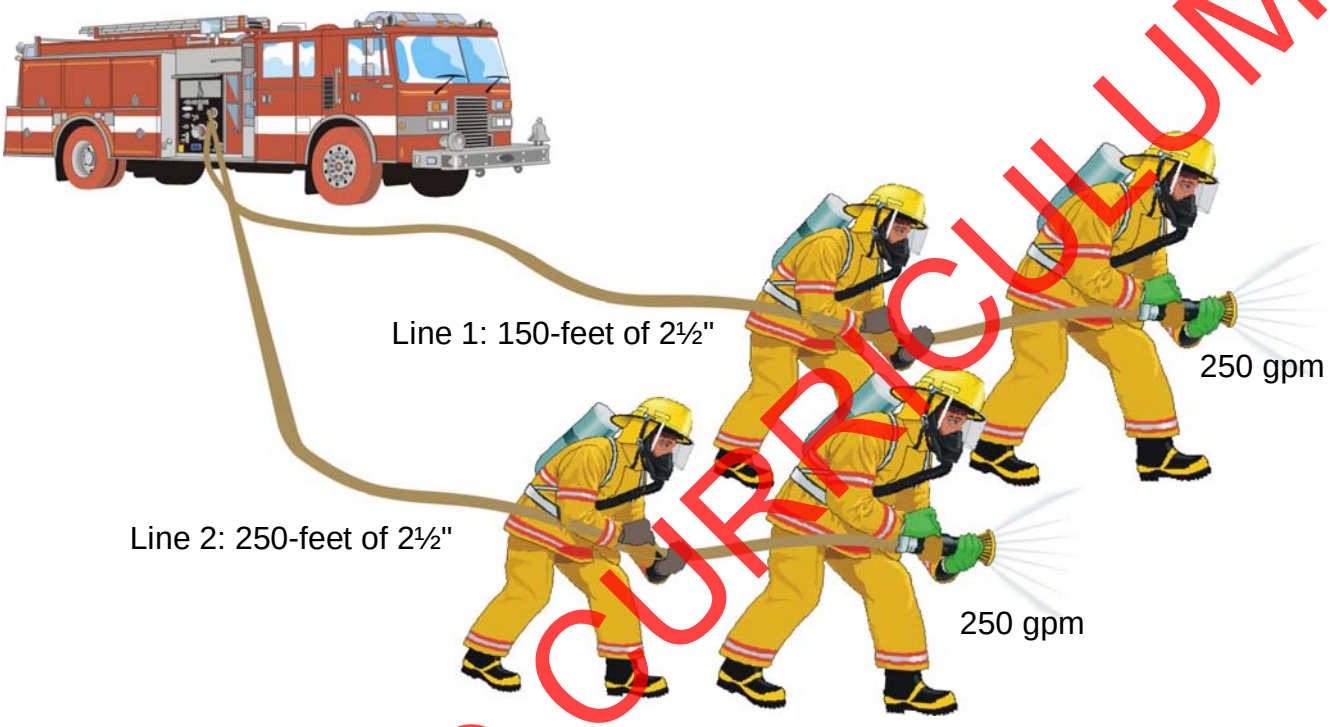
Siamese Lines:		2½" Line:	
FL =	$(C \times Q^2)(L)$	FL =	$(C \times Q^2)(L)$
C =	**.8**	C =	**2**
Q =	**1.25** (125/100)	Q =	**2.5** (250/100)
L =	**9** (900/100)	L =	**1** (100/100)
FL =	**$(.8 \times 1.25^2)(9)$**	FL =	**$(2 \times 2.5^2)(1)$**
FL =	**11 psi** (11.25)	FL =	**13 psi** (12.5)

TOTAL FL = **24 psi** (11 psi + 13 psi)

RETIRED CURRICULUM

SECTION II: COMPLEX HOSE LAYS

5. Find the correct friction loss.



Line 1:

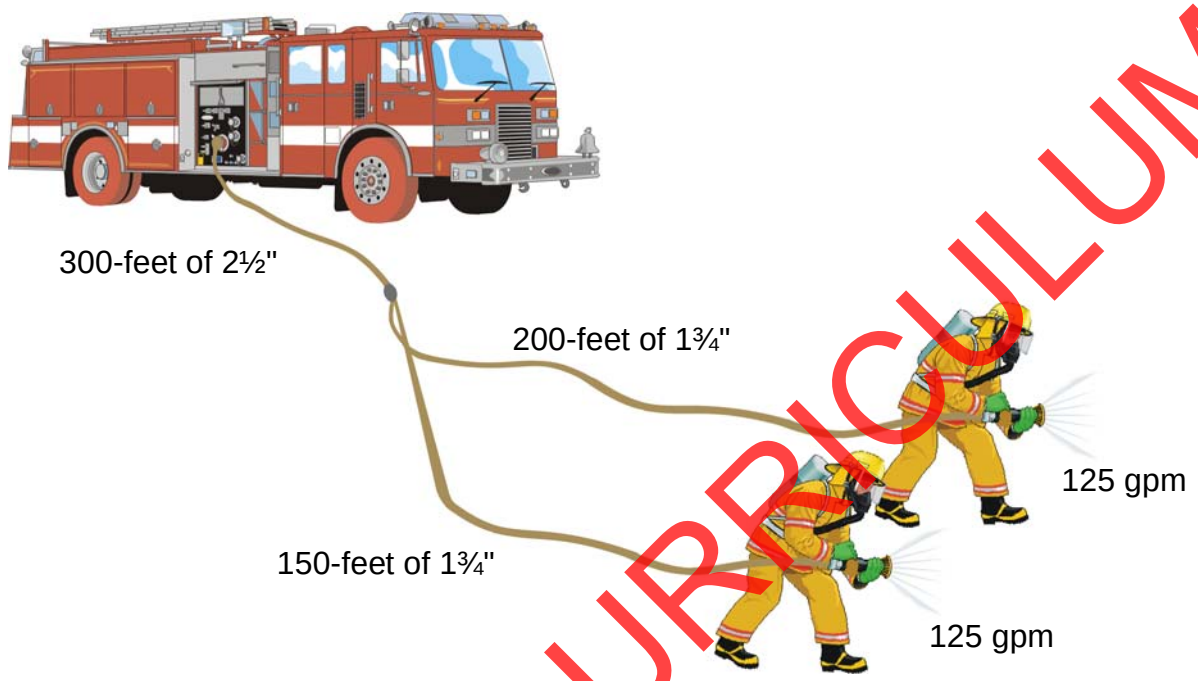
FL = $(C \times Q^2)(L)$
C = **2**
Q = **2.5** (250/100)
L = **1.5** (150/100)
FL = **$(2 \times 2.5^2)(1.5)$**
FL = **19 psi** (18.75)

Line 2:

FL = $(C \times Q^2)(L)$
C = **2**
Q = **2.5** (250/100)
L = **2.5** (250/100)
FL = **$(2 \times 2.5^2)(2.5)$**
FL = **31 psi** (31.25)

RETIRED CURRICULUM

6. Find the correct friction loss.



2½" Line:

FL = $(C \times Q^2)(L)$
C = **2**
Q = **2.5** (250/100)
L = **3** (300/100)
FL = **$(2 \times 2.5^2)(3)$**
FL = **38 psi**

150' Wye Line:

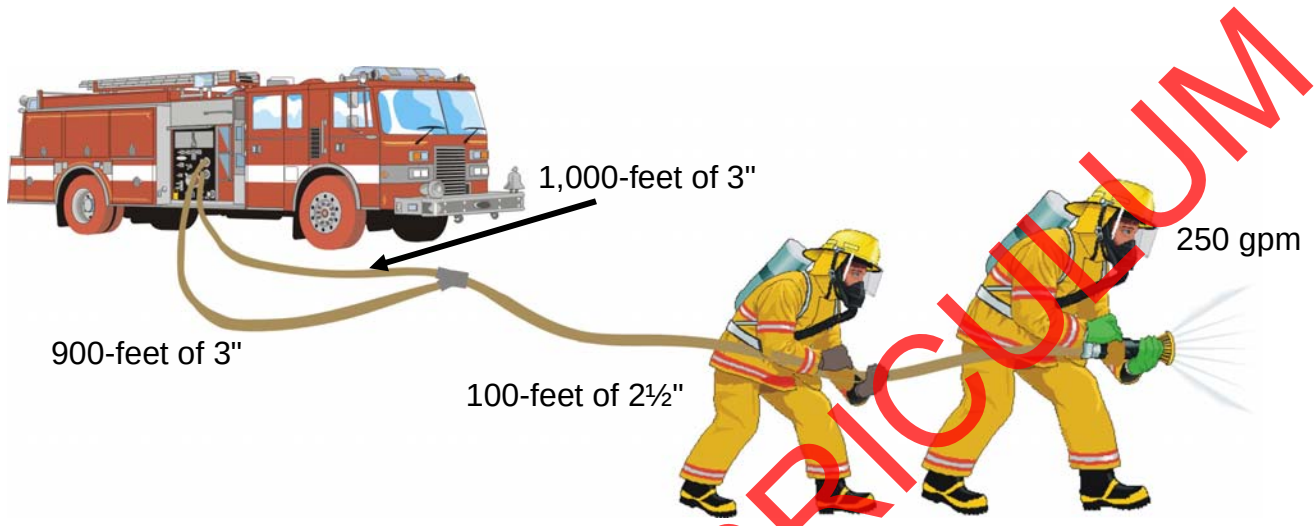
FL = $(C \times Q^2)(L)$
C = **10**
Q = **1.25** (125/100)
L = **1.5** (150/100)
FL = **$(10 \times 1.25^2)(1.5)$**
FL = **24 psi** (23.4)

200' Wye Line:

FL = $(C \times Q^2)(L)$
C = **10**
Q = **1.25** (125/100)
L = **2** (200/100)
FL = **$(10 \times 1.25^2)(2)$**
FL = **31 psi** (31.2)

RETIRED CURRICULUM

7. Find the correct friction loss.



Total length of Line 1 and Line 2 = **1,900 feet**

50% of total length = **950 feet** (1,900/2)

Siamese Lines:

FL = (C x Q^2)(L)

C = **.8**

Q = **1.25** (125/100)

L = **9.5** (950/100)

FL = **(.8 x 1.25^2)(9.5)**

FL = **12 psi** (11.87)

2½" Line:

FL = (C x Q^2)(L)

C = **2**

Q = **2.5** (250/100)

L = **1** (100/100)

FL = **(2 x 2.5^2)(1)**

FL = **13 psi** (12.5)

TOTAL FL = **25 psi** (12 psi + 13 psi)

RETIRED CURRICULUM

RETIRED CURRICULUM

TOPIC: 3-9: Pump Discharge Pressure

TIME FRAME: 0:30

LEVEL OF INSTRUCTION: Level II

AUTHORITY: 2009 NFPA 1002: Section 5.2.4(A)

BEHAVIORAL OBJECTIVE:

Condition: Given an activity and written test

Behavior: The student will confirm a knowledge of pump discharge pressure (PDP) by completing the activity and written test

Standard: With a minimum 80% accuracy according to the information contained in Fire Apparatus Driver/Operator 1B Student Supplement, SFT, 2008 Edition, Pages 41-47 and Pumping Apparatus Driver/Operator Handbook, IFSTA, First Edition, Pages 209-213

MATERIALS NEEDED:

- Writing board/pad with markers/erasers
- Appropriate audiovisual equipment
- Appropriate audiovisual materials
- Activity 3-9-1: Calculating Pump Discharge Pressure

REFERENCES:

- Engineer Training Program, Tiburon Fire District, 2000 Edition, Pages 33-4 through 33-12
- Pumping Apparatus Driver/Operator Handbook, IFSTA, First Edition, Pages 209-213

PREPARATION: Each instructor must develop a motivational statement on why the student should learn the upcoming material. The purpose is to establish relevancy of the lesson to the audience. The ACID BASE acronym can be used to help develop student motivation.

Attention (attract)	**B**egin
Curiosity (arouse)	**A**ssociation
Interest (create)	**S**tudents
Desire (stimulate)	**E**xperience

Cite examples or use related illustrations of near-miss incidents, injuries, or fatalities. Write this section "from the heart." Be creative! Have fun with it or be serious, but remember the goal is to stimulate student motivation.

PRESENTATION	APPLICATION
	SLIDE: 3-9-1
	SLIDE: 3-9-2
I. PUMP DISCHARGE PRESSURE (PDP) FORMULA	
A. Nozzle pressure plus friction loss, plus appliance friction loss, plus or minus elevation pressure loss	
	SLIDE: 3-9-3
B. PDP = Nozzle pressure plus total pressure loss	
1. PDP = NP + TPL	
C. NP = nozzle pressure	
D. TPL = Total pressure loss	
1. FL = friction loss in hose	
2. AL = appliance friction loss	
3. EP = elevation pressure (±)	
	SLIDE: 3-9-4
II. NOZZLE PRESSURE	
A. The water pressure desired at the nozzle	
B. 1½" and 1¾" hoselines	
1. NP = SOPs	
2. NP = 100 psi (rule of thumb) for fog nozzles	
3. NP = 50 psi for smooth bore tips	
4. NP = 55-75 psi for low pressure fog nozzles	
	SLIDE: 3-9-5
C. 2½" hoselines	
1. Smooth bore tip	
a) ½" through 1¼" tips considered handline use at 50 psi	
b) Should not be larger than one-half the diameter of the hoseline in order to be considered a handline	
c) 2½" hoseline = 1¼" tip	
d) Maximum use as a handline	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
2. 1" smooth tip a) 50 psi @200 gpm 3. Fog nozzle a) 100 psi @ 250 gpm 4. Monitor a) 80 psi for smooth bore b) 100 psi for fog	
	SLIDE: 3-9-6
D. Master streams 1. Any fire stream too large to be controlled without mechanical aid and above 50 psi	
	SLIDE: 3-9-7
III. APPLIANCE FRICTION LOSS A. Friction loss in fire fighting appliances due to increased turbulence of water in motion B. Standard friction loss values added to the friction loss found in hoselines 1. Wye (>350 gpm) = 10 psi 2. Siamese (>350 gpm) = 10 psi 3. Portable monitor = 25 psi 4. Standpipe = 25 psi	
	SLIDE: 3-9-8
IV. ELEVATION PRESSURE A. Gained or lost pressure due to elevation B. .434 psi per foot C. 5 psi per story minus ground floor 1. Average story = 10 feet D. Add 5 psi per 100-feet of hoseline uphill E. Subtract 5 psi per 100-feet of hoseline downhill	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
V. CALCULATING PDP	
A. PDP = NP + FL + AL $\pm$ EP	
	If NP=50, FL=10, AL=10, and EP=5, what is the PDP?
	SLIDE: 3-9-9
1. PDP = 50 + [10 + (10 + 5)]	
2. PDP = 50 + (10 + 15)	
3. PDP = 50 + 25	
4. PDP = 75 psi	

RETIRED CURRICULUM

SUMMARY:

Accurately calculating PDP will help ensure a safe and efficient operation. The pump operator's knowledge of how PDP will aid in or adversely affect the overall operation of an incident is vital.

EVALUATION:

The student will complete the activity and written test at a time determined by the instructor.

ASSIGNMENT:

Review your notes and read Fire Apparatus Driver/Operator 1B Student Supplement, SFT, 2008 Edition, Pages 41-47 and Pumping Apparatus Driver/Operator Handbook, IFSTA, First Edition, Pages 209-213 in order to prepare yourself for the upcoming test. Study for our next session.

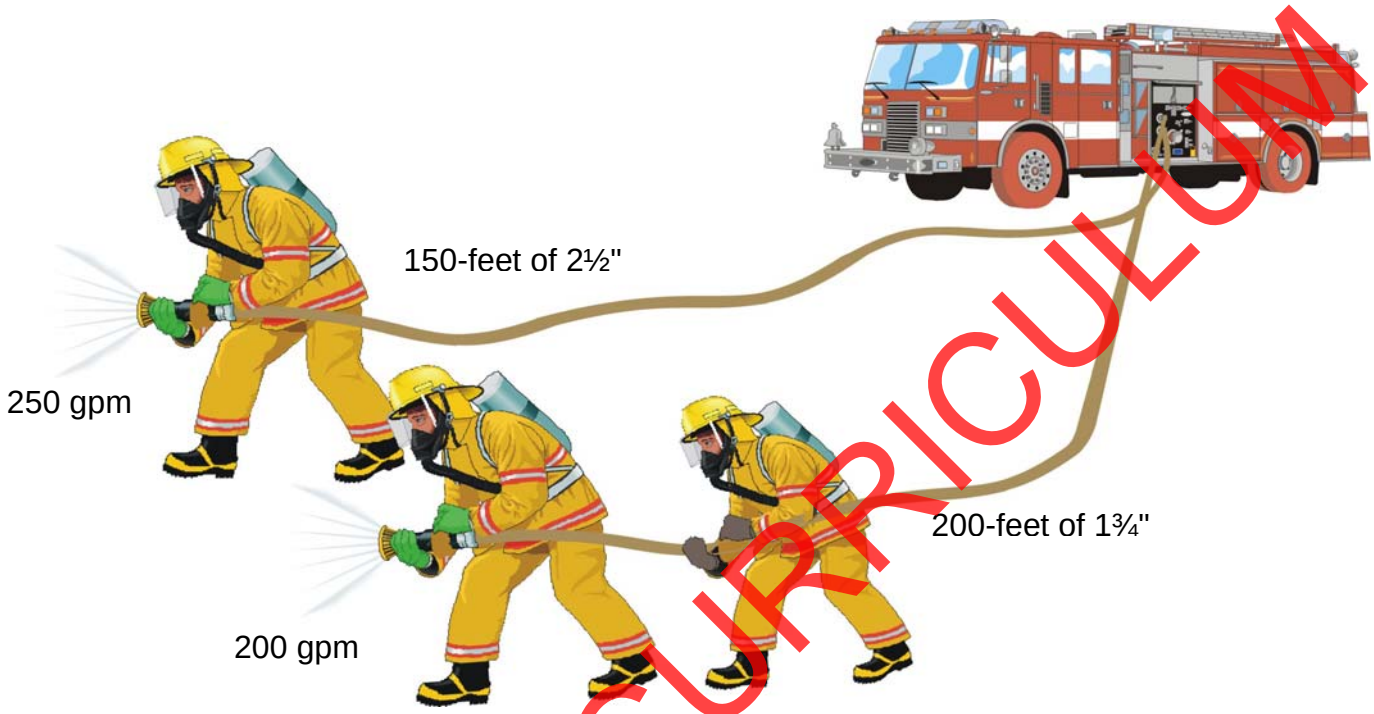
RETIRED CURRICULUM

INDIVIDUAL ACTIVITY 3-9-1

Title:	Calculating Pump Discharge Pressure
TIME FRAME:	0:20
MATERIALS NEEDED:	• Calculator • Pen or pencil
introduction:	This activity provides the students the opportunity to develop their skill to calculate PDP using the proper formula.
DIRECTIONS:	1. Complete all problems using the pump discharge pressure formula. 2. You have 15 minutes to complete this activity. 3. Be prepared to discuss your answers with the class.

RETIRED CURRICULUM

1. Calculate the correct pump discharge pressure.



2½" Line:		1¾" Line:	
PDP =	NP + [FL + (AL +/- EP)]	PDP =	NP + [FL + (AL +/- EP)]
NP =	**100 (fog)**	NP =	**100 (fog)**
FL =	**19**	FL =	**80**
AL =	**0**	AL =	**0**
EP =	**0**	EP =	**0**
PDP =	**119 psi**	PDP =	**180 psi**

Pump discharge pressure should be **180** psi. The less demanding line(s) are "gated" down to their required pressure.

RETIRED CURRICULUM

2. Calculate the correct pump discharge pressure.

Line 1:		Line 2:	
PDP	= NP + [FL + (AL +/- EP)]	PDP	= NP + [FL + (AL +/- EP)]
NP	= **100 (fog)**	NP	= **100 (fog)**
FL	= **27**	FL	= **31**
AL	= **0**	AL	= **0**
EP	= **0**	EP	= **0**
PDP	= **127 psi**	PDP	= **131 psi**

Pump discharge pressure should be **131** psi. The less demanding line(s) are "gated" down to their required pressure. In reality, the PDP would be **130** psi for both lines.

RETIRED CURRICULUM

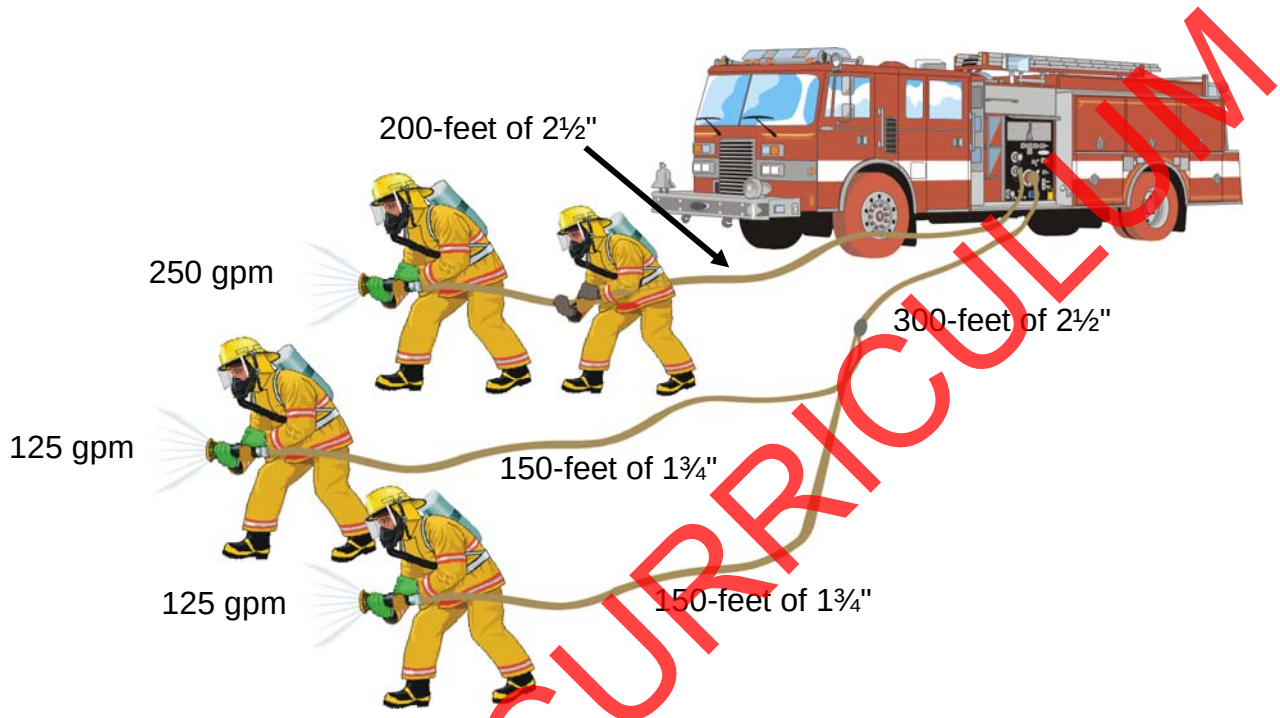
3. Calculate the correct pump discharge pressure.

2½" Line:		Wye Line:	
PDP	= NP + [FL + (AL +/- EP)]	PDP	= NP + [FL + (AL +/- EP)]
NP	= **100 (fog)**	NP	= **100**
FL	= **72**	FL	= **35 (19 +16)**
AL	= **0**	AL	= **0**
EP	= **0**	EP	= **0**
PDP	= **172 psi**	PDP	= **135 psi**

Pump discharge pressure should be **172** psi. The less demanding line is "gated" down to the required pressure.

RETIRED CURRICULUM

4. Calculate the correct pump discharge pressure.

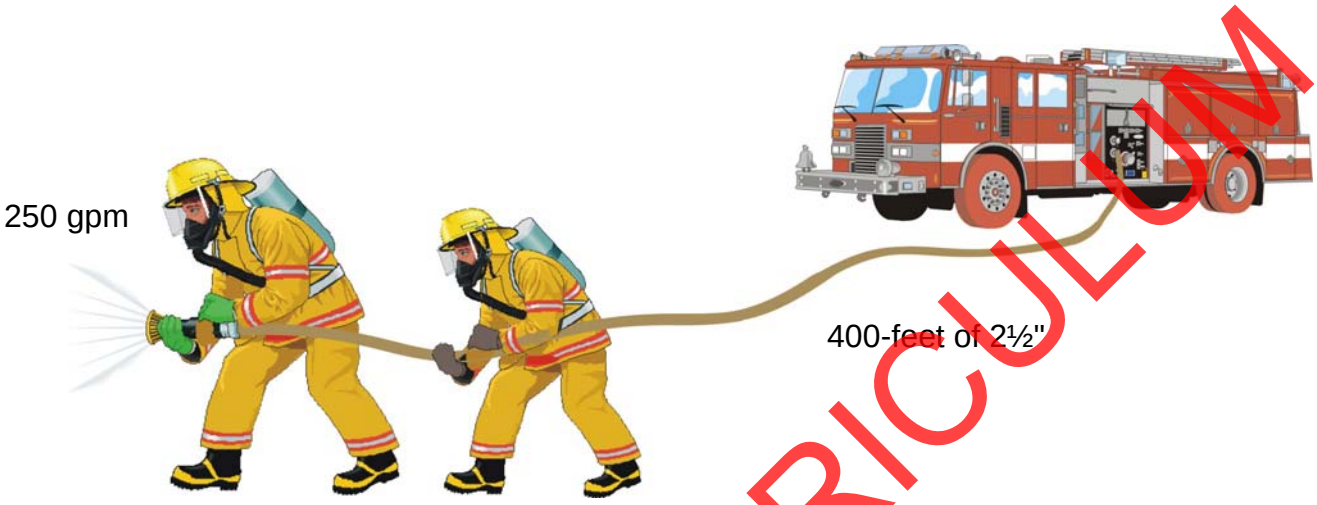


2½" Line:		Wye Line:	
PDP =	NP + [FL + (AL +/- EP)]	PDP =	NP + [FL + (AL +/- EP)]
NP =	**100 (fog)**	NP =	**100**
FL =	**25**	FL =	**61 (38 + 23)**
AL =	**0**	AL =	**0**
EP =	**0**	EP =	**0**
PDP =	**125 psi**	PDP =	**161 psi**

Pump discharge pressure should be **161** psi. The less demanding line is "gated" down to the required pressure.

RETIRED CURRICULUM

5. Calculate the correct pump discharge pressure.



PDP = NP + [FL + (AL +/- EP)]

NP = **100**

FL = **50**

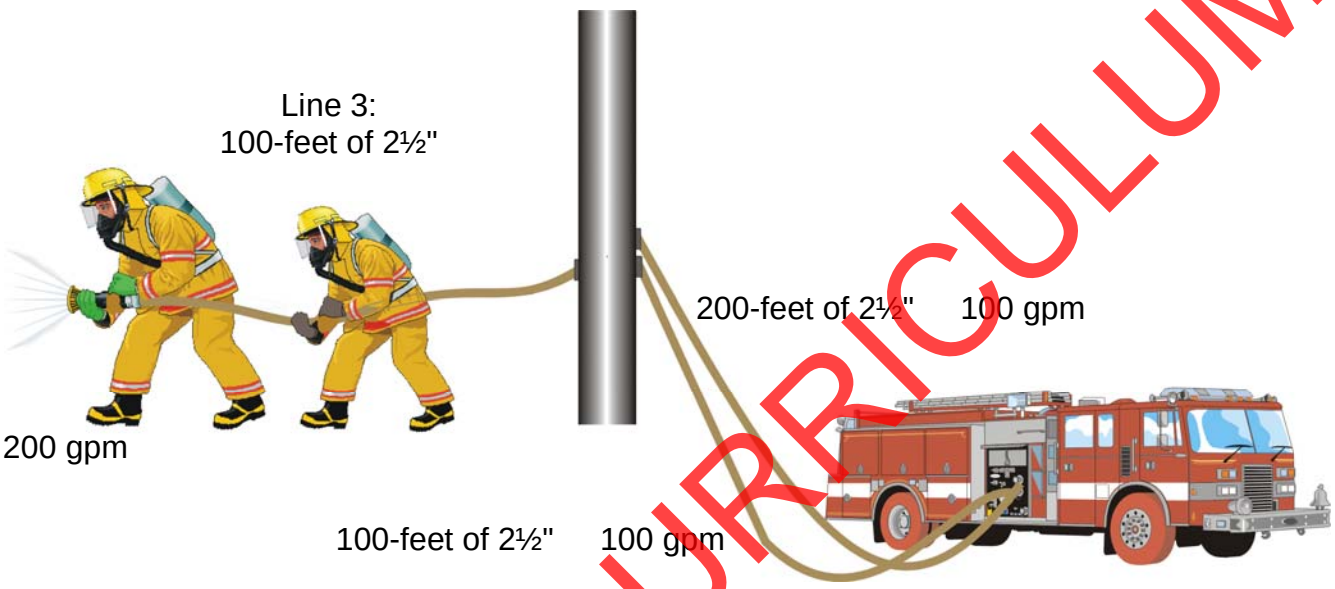
AL = **0**

EP = **0**

PDP = **150 psi**

RETIRED CURRICULUM

6. Find the correct pump discharge pressure for the hoselines connected to a standpipe, with fire floor on the third floor, and using 100-feet of 2 ½" hoseline with a fog nozzle at 200 gpm.



PDP = NP + [FL + (AL +/- EP)]

NP = **100 (fog)**

FL = **11 (3 + 8)**

AL = **25**

EP = **10**

PDP = **146 psi**

RETIRED CURRICULUM

RETIRED CURRICULUM

TOPIC: 3-10: Fireground Hydraulic Calculations

TIME FRAME: 1:00

LEVEL OF INSTRUCTION: Level II

AUTHORITY: 2009 NFPA 1002: Sections 5.2.1(A) and 5.2.2(A)

BEHAVIORAL OBJECTIVE:

Condition: Given an activity and written test

Behavior: The student will confirm a knowledge of fireground hydraulic calculations by completing the activity and written test

Standard: With a minimum 80% accuracy according to the information contained in Fire Apparatus Driver/Operator 1B Student Supplement, SFT, 2008 Edition, Pages 48-56 and Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 251-261

MATERIALS NEEDED:

- Writing board/pad with markers/erasers
- Appropriate audiovisual equipment
- Appropriate audiovisual materials
- Activity 3-10-1: Fireground Hydraulics

REFERENCES:

- Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 251-261

PREPARATION: Each instructor must develop a motivational statement on why the student should learn the upcoming material. The purpose is to establish relevancy of the lesson to the audience. The ACID BASE acronym can be used to help develop student motivation.

Attention (attract)	**B**egin
Curiosity (arouse)	**A**ssociation
Interest (create)	**S**tudents
Desire (stimulate)	**E**xperience

Cite examples or use related illustrations of near-miss incidents, injuries, or fatalities. Write this section "from the heart." Be creative! Have fun with it or be serious, but remember the goal is to stimulate student motivation.

PRESENTATION	APPLICATION
	SLIDE: 3-10-1
	SLIDE: 3-10-2
I. FIREGROUND HYDRAULICS	
A. Fire streams calculations on the fireground require a method that is easily understood and applicable to mnemonic use	
B. Memorizing a few common elements that contribute to hydraulic calculations is an effective means in determining the necessary fire stream calculations	
C. Individual departments should develop fireground hydraulic charts for their application	
	SLIDE: 3-10-3
II. RULE OF THUMB CHARTS	
A. Common nozzle pressures and flows for 2½" hoselines	
1. 1" smooth bore tip nozzle	
a) 50 psi	
b) 200 gpm	
	What is the standard pressure for fog nozzles?
2. Fog nozzles	
a) 100 psi	
b) 250 gpm	
	SLIDE: 3-10-4
3. Master stream nozzles	
a) Smooth bore tip	
1) 80 psi	
2) 1¼" tip = 400 gpm	
3) 1⅜" tip = 500 gpm	
4) 1½" tip = 600 gpm	
5) 1⅝" tip = 700 gpm	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
6) 1¾" tip = 800 gpm	
7) 2" tip = 1,000 gpm	
b) Fog	
1) 100 psi	
2) Flows can vary by manufacturer	
	SLIDE: 3-10-5
B. Common friction losses in fire hoseline	
1. 3" hoseline	
a) ⅞" tip	
1) FL = 2 psi	
2) gpm = 150	
b) 1" tip	
1) FL = 4 psi	
2) gpm = 200	
c) 1⅛" tip	
1) FL = 6 psi	
2) gpm = 250	
d) 1¼" tip	
1) FL = 8 psi	
2) gpm = 300	
e) $FL = Q^2$	
1) Flow less than 500	
	SLIDE: 3-10-6
2. 2½" hoseline	
a) ⅞" tip	
1) FL = 5 psi	
2) gpm = 150	
b) 1" tip	
1) FL = 10 psi	
2) gpm = 200	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
c) 1⅛" tip	
1) FL = 15 psi	
2) gpm = 250	
d) 1¼" tip	
1) FL = 20 psi	
2) gpm = 300	
	SLIDE: 3-10-7
C. Common friction losses in hoseline appliances	
1. Wye = 10 psi	
2. Siamese = 10 psi	
	What is the friction loss for a portable monitor?
3. Portable monitor = 25 psi	
4. Standpipe = 25 psi	
	SLIDE: 3-10-8
D. Common pressure usages	
1. Preconnect 1½" and 1¾"	
a) PDP = 135 psi	
2. PDP	
a) Do not exceed 250 psi	
3. Intake (residual pressure)	
a) Do not drop below 20 psi	
	SLIDE: 3-10-9
4. Use volume mode	
a) Two or more 2½" or larger hoselines pumping 50% or more of pump capacity	
5. Elevation	
a) PDP = 5 psi per story	
1) Minus first story	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
6. Supplying an engine a) 50 psi to start	
	What is the PDP and total gpm when pumping through 300 feet of 2½" hoseline with a 1" smooth bore tip? **SLIDE: 3-10-10**
III. RULE OF THUMB FOR 2½" HOSELINE A. Example 1. gpm = 200 2. PDP = NP + FL 3. PDP = 50 + (10 x 3) 4. PDP = 50 + 30 5. PDP = <u>80 psi</u>	
	What is the PDP and total gpm when pumping through 400 feet of 3" hoseline with a fog nozzle? **SLIDE: 3-10-11**
IV. RULE OF THUMB FOR 3" HOSELINE A. Example 1. gpm = 200 2. PDP = NP + FL 3. PDP = 100 + (4 x 4) 4. PDP = 100 + 16 5. PDP = <u>116 psi</u>	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
	What is the PDP and total gpm when pumping to 150 feet of wyed 1½" hoselines using fog nozzles through 100 feet of 2½ " hoseline? **SLIDE: 3-10-12**
V. RULE OF THUMB FOR WYED HOSELINES A. Example 1. gpm = 200 2. PDP = NP + FL + AL 3. PDP = 135 + (10 x 1) + 10 4. PDP = 135 + 20 + 10 5. PDP = 155 psi	
	What is the PDP and total gpm when pumping to a ⅞" smooth bore tip nozzle through 200 feet of 2½" hoseline up to a third floor? **SLIDE: 3-10-13**
VI. RULE OF THUMB FOR ELEVATION LOSS A. Example 1. gpm = 150 2. PDP = NP + FL +/- EL 3. PDP = 50 + (10 x 1) + 10 4. PDP = 50 + (10) + 10 5. PDP = 50 + 20 6. PDP = 70 psi	

RETIRED CURRICULUM

SUMMARY:

The driver/operator should understand and be able to calculate friction loss on the fireground. The ability to use "rule of thumb" calculations during critical periods of the incident can save time and increase efficiency.

EVALUATION:

The student will complete the activity and written test at a time determined by the instructor.

ASSIGNMENT:

Review your notes and read Fire Apparatus Driver/Operator 1B Student Supplement, SFT, 2008 Edition, Pages 48-56 and Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 251-261 in order to prepare yourself for the upcoming test. Study for our next session.

RETIRED CURRICULUM

INDIVIDUAL ACTIVITY 3-10-1

TITLE:	Fireground Hydraulics
TIME FRAME:	0:30
MATERIALS NEEDED:	• Rule of Thumb charts • Calculator • Pen or pencil
INTRODUCTION:	This activity provides the students the opportunity to become familiar with and sharpen their skills on fireground hydraulics.
DIRECTIONS:	1. Using the Rule of Thumb charts, calculate the gpm and PDP for the following scenarios. 2. You have 0:15 minutes to complete this activity. 3. Be prepared to discuss your answers with the class.

RETIRED CURRICULUM

Rule Of Thumb Charts

NOZZLE PRESSURE		
Nozzle	psi	gpm
Smooth Tip (1")	50	200
Fog Nozzles	100	200
Portable Monitor	Same as above	

FIRE HOSELINE FRICTION LOSS PER 100' OF HOSELINE			
3" FL	Tip Size	gpm	2½" FL
2	⅞"	150	5
4	1"	200	10
6	1⅛"	250	15
8	1¼"	300	20
Q^2	Flow less than 500		

APPLIANCE FRICTION LOSS	
Appliance	psi
Wye	10
Siamese	10
Portable Monitor	25
Standpipe	25

MASTER STREAM FLOWS (80 psi)	
Tip	gpm
1¼"	400
1⅜"	500
1½"	600
1⅝"	700
1¾"	800
2"	1,000

Preconnect 1½" and 1¾" ..... PDP = 135 psi

PDP ..... Do Not Exceed 250 psi

Intake (Residual Pressure) ..... Do Not Drop Below 20 psi

Use Volume Mode ..... 2 or more 2½" or larger hoselines are used pumping 50% or more than the pump capacity

Elevation ..... PDP 5 psi per story minus first story

Supplying an Engine ..... 50 psi to start

RETIRED CURRICULUM

1. Find the correct gpm and PDP for the hose lay using the information in the Rule of Thumb chart.

gpm = **200**

PDP = NP + FL

PDP = **50 + (10 x 4)**

PDP = **50 + 40**

PDP = **90**

RETIRED CURRICULUM

2. Find the correct gpm and PDP for the hose lay using the information in the Rule of Thumb chart.

gpm = **300**

PDP = NP + FL

PDP = **50 + (20 x 6)**

PDP = **50 + 120**

PDP = **170**

RETIRED CURRICULUM

3. Find the correct gpm and PDP for the hose lay using the information in the Rule of Thumb chart.

gpm = **250**

PDP = NP + FL

PDP = **50 + (6 x 8)**

PDP = **50 + 48**

PDP = **98**

RETIRED CURRICULUM

4. Find the correct gpm and PDP for the hose lay using the information in the Rule of Thumb chart.

gpm = **200**

PDP = NP + FL

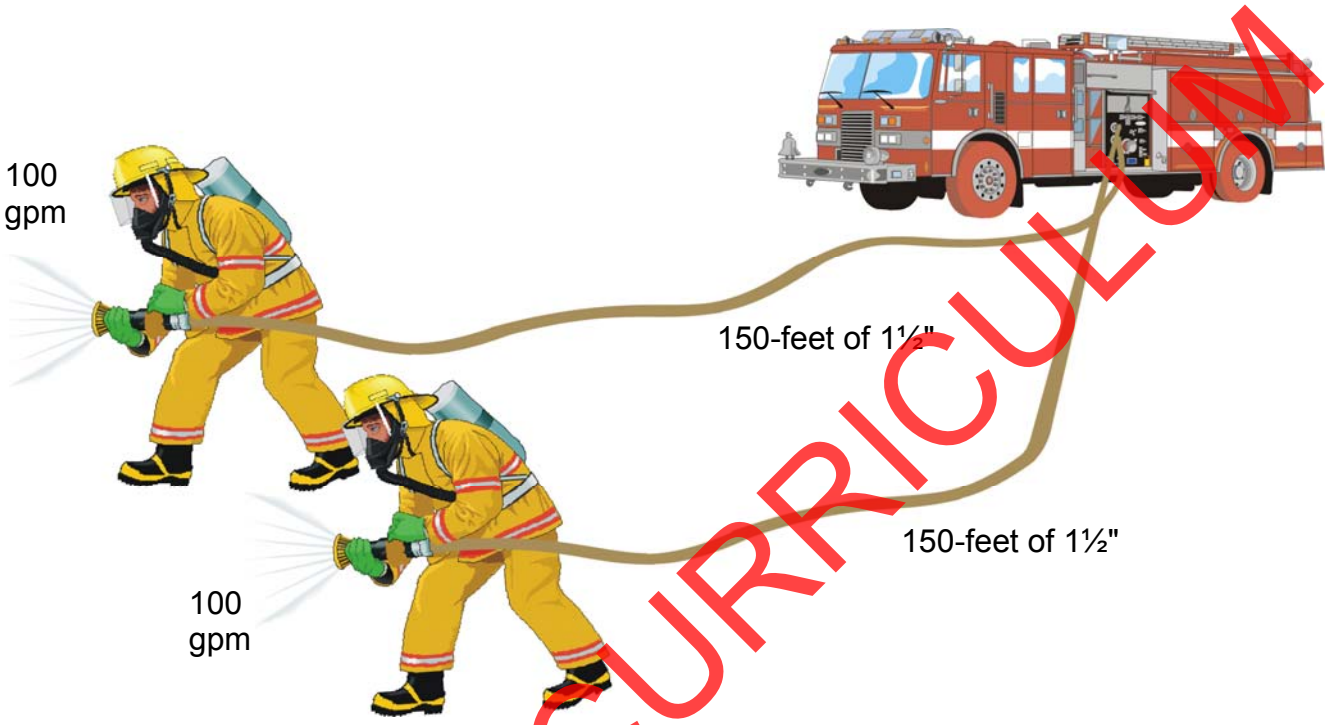
PDP = **100 + (4 x 5)**

PDP = **100 + 20**

PDP = **120**

RETIRED CURRICULUM

5. Find the correct PDP for the hose lay using the information in the Rule of Thumb chart.



PDP = NP + FL

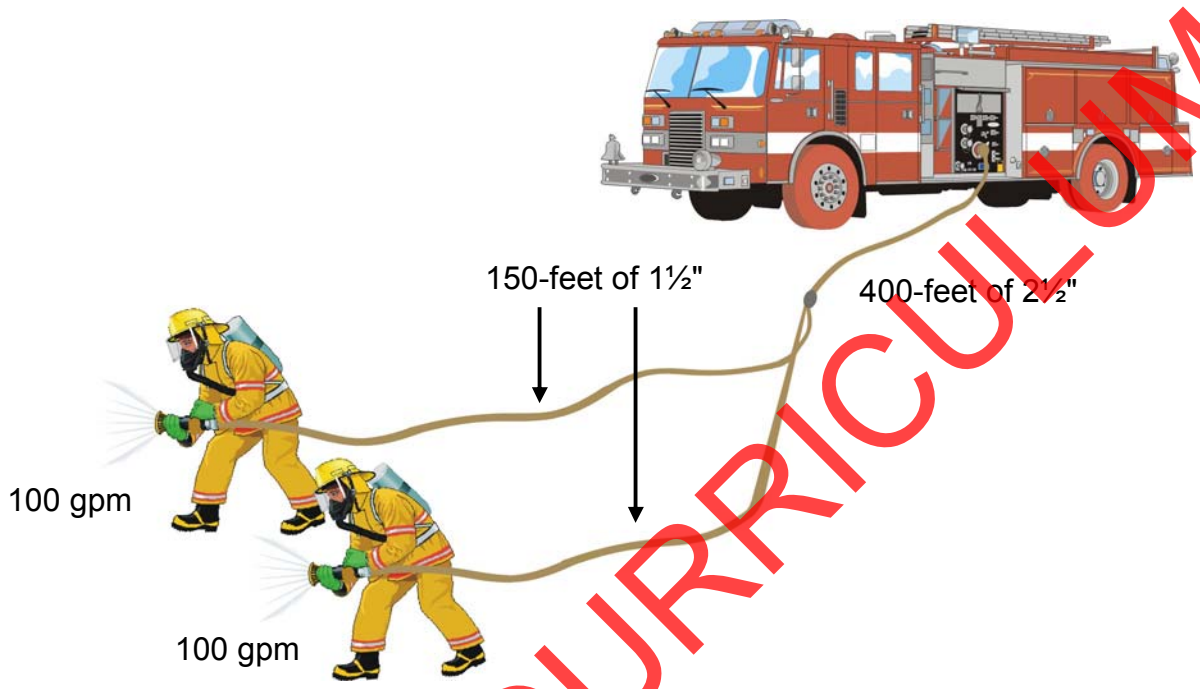
_____

_____

135

RETIRED CURRICULUM

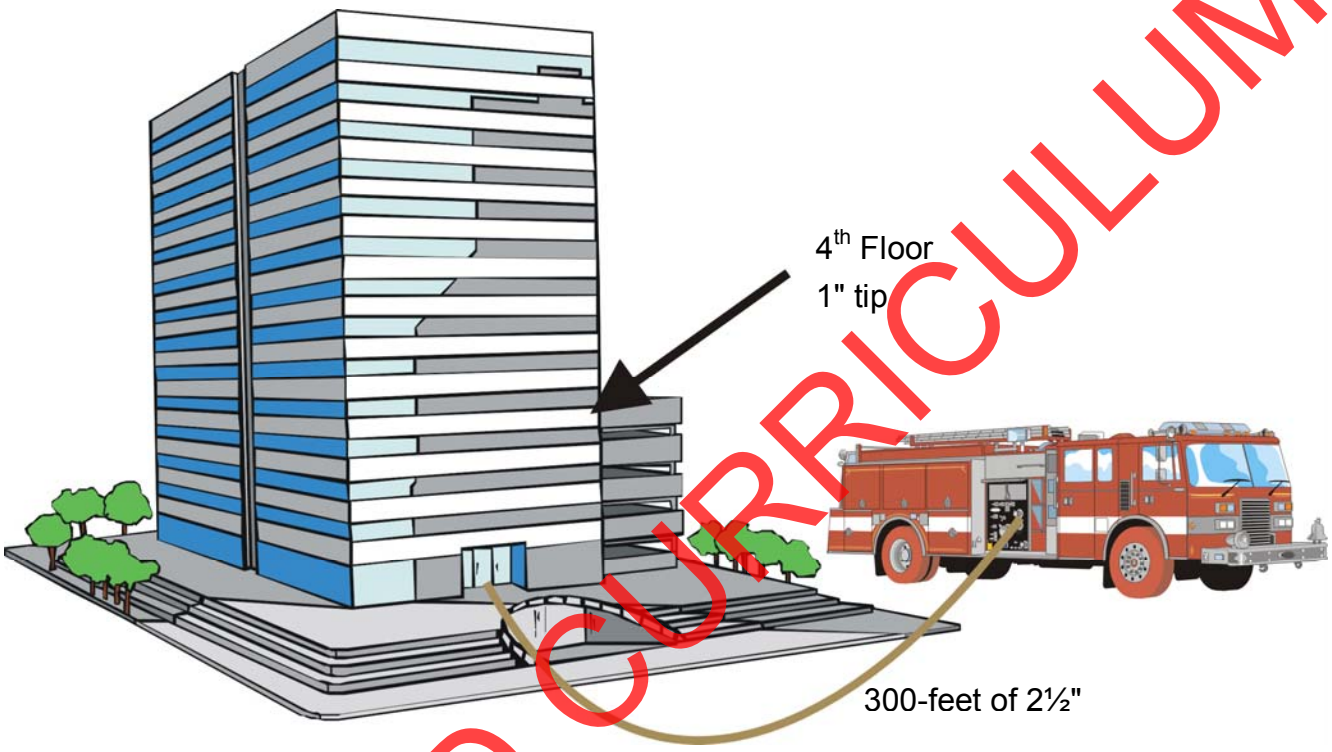
6. Find the PDP for the hose lay using the information in the Rule of Thumb chart.



Wye line:		2½" Line:		
PDP	**135**	gpm	=	**200**
		FL	=	**10 x 4**
		FL	=	**40**
		PDP	=	**175** **Wye Line PDP + 2½" Line FL**

RETIRED CURRICULUM

7. Find the correct gpm and PDP for the hose lay up to the fourth floor of a building using the information in the Rule of Thumb chart.



gpm = **200**

PDP = NP + FL + EL

PDP = **50 + (10 x 3) + 15**

PDP = **50 + 30 + 15**

PDP = **95**

RETIRED CURRICULUM

RETIRED CURRICULUM

TOPIC: 4-1: Inspecting The Pump Drive Systems

TIME FRAME: 0:15

LEVEL OF INSTRUCTION: Level II

AUTHORITY: 2009 NFPA 1002: Section 5.1.1

BEHAVIORAL OBJECTIVE:

Condition: Given a written test

Behavior: The student will confirm a knowledge of Inspecting pump drive system by completing the written test

Standard: With a minimum 80% accuracy according to the information contained in Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 51-54 and 280-285

MATERIALS NEEDED:

- Writing board/pad with markers/erasers
- Appropriate audiovisual equipment
- Appropriate audiovisual materials

REFERENCES:

- NFPA 1002: Standard for Fire Apparatus Driver/Operator Professional Qualifications, 2009 Edition, Chapter 5
- NFPA 1911: Inspection, Maintenance, Testing, and Retirement of In-Service Automotive Fire Apparatus, 2007 Edition, Chapter 6
- Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 51-54 and 280-285

PREPARATION: Each instructor must develop a motivational statement on why the student should learn the upcoming material. The purpose is to establish relevancy of the lesson to the audience. The ACID BASE acronym can be used to help develop student motivation.

Attention (attract)	**B**egin
Curiosity (arouse)	**A**ssociation
Interest (create)	**S**tudents
Desire (stimulate)	**E**xperience

Cite examples or use related illustrations of near-miss incidents, injuries, or fatalities. Write this section "from the heart." Be creative! Have fun with it or be serious, but remember the goal is to stimulate student motivation.

PRESENTATION	APPLICATION
	SLIDE: 4-1-1
I. INSPECTING PUMP DRIVE SYSTEMS AND COMPONENTS	
	SLIDE: 4-1-2
A. Auxiliary engine-driven pumps	
1. Daily inspections	
a) Operate on a daily basis	
b) Check all fluid levels	
1) Auxiliary engine oil	
2) Auxiliary fuel tank level if equipped	
c) Inspect drive belts	
	SLIDE: 4-1-3
2. Weekly inspections	
a) Check pump gear box	
1) For proper oil level	
2) For traces of water	
3) For leakage of fluids	
	SLIDE: 4-1-4
B. Power take-off (PTO)	
1. Daily inspections	
a) Operate on a daily basis	
b) Inspect drive shafts and universal joints	
1) For bent or damaged drive shafts	
2) For missing or loose retainers	
3) For leakage of fluids	
	SLIDE: 4-1-5
C. Front-mounted	
1. Daily inspections	
a) Operate on a daily basis	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
b) Inspect universal joints	
1) For missing or loose retainers	
2) For damage to clutch or universal joints	
	SLIDE: 4-1-6
2. Weekly inspections	
a) Check pump gear box	
1) For proper oil level	
2) For traces of water	
3) For leakage of fluids	
D. Midship transfer drive	
	SLIDE: 4-1-7
1. Daily inspections	
a) Operate on a daily basis	
b) Inspect drive shafts and universal joints	
1) For missing or loose retainers	
2) For bent or damaged drive shafts	
	SLIDE: 4-1-8
2. Weekly inspections	
a) Check pump gear box	
1) For proper oil level	
2) For traces of water	
3) For leakage of fluids	
	SLIDE: 4-1-9
E. Rear-mounted	
1. Daily inspections	
a) Operate on a daily basis	
b) Inspect drive shafts and universal joints	
1) For missing or loose retainers	
2) For bent or damaged drive shafts	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
	SLIDE: 4-1-10
2. Weekly inspections a) Check pump gear box or transfer case 1) For proper oil level 2) For traces of water 3) For leakage of fluids	
	SLIDE: 4-1-11
II. ADDITIONAL INSPECTION INFORMATION A. In accordance with manufacturer's recommendations and specifications B. Per department SOPs	
	SLIDE: 4-1-12
III. OUT-OF-SERVICE CRITERIA A. <u>NFPA 1911: Inspection, Maintenance, Testing, and Retirement of In-Service Automotive Fire Apparatus</u>, 2007 Edition recommendations 1. Pump will not engage 2. Pump shift indicators in cab and on operator's panel do not function properly 3. Pressure control system is not operational 4. Pump transmission components have Class 3 leakage 5. Pump operator's panel throttle is not operational 6. Pump operator's engine speed advancement interlock is not operational 7. A qualified technician shall conduct an out-of-service evaluation of the systems or components and make a written report, including recommendations to the AHJ	

RETIRED CURRICULUM

SUMMARY:

An integral part of the fire pump system is the pump drive system. Each system has certain characteristics that make it more or less adaptable to a particular fire department need. As a driver/operator, you have the responsibility to perform routine inspections of the pump drive system. Inspections will involve maintenance, troubleshooting the system and identify deficiencies to insure trouble free operation.

EVALUATION:

The student will complete the written test at a time determined by the instructor.

ASSIGNMENT:

Review your notes and read Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 51-54 and 280-285 in order to prepare yourself for the upcoming test. Study for our next session.

RETIRED CURRICULUM

RETIRED CURRICULUM

TOPIC: 4-2: Inspecting The Priming Pump Systems

TIME FRAME: 0:15

LEVEL OF INSTRUCTION: Level II

AUTHORITY: 2009 NFPA 1002: Section 5.1.1

BEHAVIORAL OBJECTIVE:

Condition: Given a written test

Behavior: The student will confirm a knowledge of inspecting the pump priming systems by completing the written test

Standard: With a minimum 80% accuracy according to the information contained in Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 51-54 and 299-301

MATERIALS NEEDED:

- Writing board/pad with markers/erasers
- Appropriate audiovisual equipment
- Appropriate audiovisual materials

REFERENCES:

- NFPA 1002: Standard for Fire Apparatus Driver/Operator Professional Qualifications, 2009 Edition, Chapter 5
- NFPA 1911: Inspection, Maintenance, Testing, and Retirement of In-Service Automotive Fire Apparatus, 2007 Edition, Chapter 6
- Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 51-54 and 299-301

PREPARATION: Each instructor must develop a motivational statement on why the student should learn the upcoming material. The purpose is to establish relevancy of the lesson to the audience. The ACID BASE acronym can be used to help develop student motivation.

Attention (attract)	**B**egin
Curiosity (arouse)	**A**ssociation
Interest (create)	**S**tudents
Desire (stimulate)	**E**xperience

Cite examples or use related illustrations of near-miss incidents, injuries, or fatalities. Write this section "from the heart." Be creative! Have fun with it or be serious, but remember the goal is to stimulate student motivation.

PRESENTATION	APPLICATION
	SLIDE: 4-2-1 How often is the priming pump inspected? **SLIDE: 4-2-2**
I. WEEKLY INSPECTIONS A. Operate the pump primer 1. With all pump valves closed B. Check level in oil/fluid reservoir 1. Proper type of oil/fluid 2. Ensure vent hole is cleaned and opened if equipped 3. Ensure anti-siphon hole (line vent) is clean and open C. Check for fluid leakage D. Security of mounting 1. Check for loose or missing fasteners	
	SLIDE: 4-2-3
II. ADDITIONAL INSPECTION INFORMATION A. In accordance with manufacturer's recommendations and specifications B. Per department SOPs	

RETIRED CURRICULUM

SUMMARY:

The ability for fire apparatus to successfully draft water, it must have several key components. One critical component is the priming pump. The driver/operator's have the responsibility to perform routine inspection of the priming pump system. This will involve maintenance, troubleshooting the system, and identifying deficiencies in the system.

EVALUATION:

The student will complete the written test at a time determined by the instructor.

ASSIGNMENT:

Review your notes and read Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 51-54 and 299-301 in order to prepare yourself for the upcoming test. Study for our next session.

RETIRED CURRICULUM

RETIRED CURRICULUM

TOPIC: 4-3: Inspecting The Pump Pressure Control Systems

TIME FRAME: 0:15

LEVEL OF INSTRUCTION: Level II

AUTHORITY: 2009 NFPA 1002: Section 5.1.1

BEHAVIORAL OBJECTIVE:

Condition: Given a written test

Behavior: The student will confirm a knowledge of inspecting the pump control pressure systems by completing the written test

Standard: With a minimum 80% accuracy according to the information contained in Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 51-54 and 293-298

MATERIALS NEEDED:

- Writing board/pad with markers/erasers
- Appropriate audiovisual equipment
- Appropriate audiovisual materials

REFERENCES:

- NFPA 1002: Standard for Fire Apparatus Driver/Operator Professional Qualifications, 2009 Edition, Chapter 5
- NFPA 1911: Inspection, Maintenance, Testing, and Retirement of In-Service Automotive Fire Apparatus, 2007 Edition, Chapter 6
- Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 51-54 and 293-298

PREPARATION: Each instructor must develop a motivational statement on why the student should learn the upcoming material. The purpose is to establish relevancy of the lesson to the audience. The ACID BASE acronym can be used to help develop student motivation.

Attention (attract)	**B**egin
Curiosity (arouse)	**A**ssociation
Interest (create)	**S**tudents
Desire (stimulate)	**E**xperience

Cite examples or use related illustrations of near-miss incidents, injuries, or fatalities. Write this section "from the heart." Be creative! Have fun with it or be serious, but remember the goal is to stimulate student motivation.

PRESENTATION	APPLICATION
	SLIDE: 4-3-1
	Why should you check the pressure control device?
	SLIDE: 4-3-2
I. PURPOSE	
A. Ensures systems are in a safe operating condition and operating within the required pressures set by the manufacturer	
	SLIDE: 4-3-3
II. INSPECTION CHECKS	
A. Operational check	
1. In accordance with	
a) Manufacturer's recommendations and specifications	
b) Department SOPs	
c) IFSTA recommends a weekly schedule	
	SLIDE: 4-3-4
2. Procedure	
a) Engage pump	
b) Open tank-to-pump valve slightly	
1) To flow water	
c) Throttle up to 150 psi	
d) Set pressure control device	
e) Throttle up	
1) Should not exceed 30 psi above the set level	
	SLIDE: 4-3-5
f) <u>NFPA 1911: Inspection, Maintenance, Testing, and Retirement of In-Service Automotive Fire Apparatus</u>, 2007 Edition	
1) System opens within 3-10 seconds	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
2) Discharge pressure shall not exceed 30 psi above the set pressure	
	SLIDE: 4-3-6
B. Visual check	
1. Confirm all components have no obvious defects	
2. Mountings secure	
3. No broken or loose lines	
4. Strainer in pilot valve control is clean	
a) If equipped	
	SLIDE: 4-3-7
III. OUT-OF-SERVICE CRITERIA	
A. NFPA 1911: Inspection, Maintenance, Testing, and Retirement of In-Service Automotive Fire Apparatus, 2007 Edition	
1. Pressure control system that is not operational	

RETIRED CURRICULUM

SUMMARY:

A critical component for safe fireground operations is the pressure control system. It is imperative that this system be inspected and maintained according to the manufacture's recommendations and department SOPs. As a driver/operator, your inspections will involve maintenance, troubleshooting and identifying deficiencies in the system.

EVALUATION:

The student will complete the written test at a time determined by the instructor.

ASSIGNMENT:

Review your notes and read Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 51-54 and 293-298 in order to prepare yourself for the upcoming test. Study for our next session.

RETIRED CURRICULUM

RETIRED CURRICULUM

TOPIC: 4-4: Pump Service Testing

TIME FRAME: 0:45

LEVEL OF INSTRUCTION: Level II

AUTHORITY: 2009 NFPA 1002: Section 5.1.1

BEHAVIORAL OBJECTIVE:

Condition: Given a written test

Behavior: The student will confirm a knowledge of pump service testing by completing the written test

Standard: With a minimum 80% accuracy according to the information contained in Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 486-505

MATERIALS NEEDED:

- Writing board/pad with markers/erasers
- Appropriate audiovisual equipment
- Appropriate audiovisual materials

REFERENCES:

- NFPA 1002: Standard for Fire Apparatus Driver/Operator Professional Qualifications, 2009 Edition, Chapter 5
- NFPA 1911: Inspection, Maintenance, Testing, and Retirement of In-Service Automotive Fire Apparatus, 2007 Edition, Chapter 18
- Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 486-505

PREPARATION: Each instructor must develop a motivational statement on why the student should learn the upcoming material. The purpose is to establish relevancy of the lesson to the audience. The ACID BASE acronym can be used to help develop student motivation.

Attention (attract)	**B**egin
Curiosity (arouse)	**A**ssociation
Interest (create)	**S**tudents
Desire (stimulate)	**E**xperience

Cite examples or use related illustrations of near-miss incidents, injuries, or fatalities. Write this section "from the heart." Be creative! Have fun with it or be serious, but remember the goal is to stimulate student motivation.

PRESENTATION	APPLICATION
	SLIDE: 4-4-1
	SLIDE: 4-4-2
	What are the three required preservice tests?
	SLIDE: 4-4-3
I. PRESERVICE TESTS	
A. Manufacturer's test	
1. Hydrostatic test	
B. Pump certification tests	
1. Pumping tests	
2. Pumping engine overload test	
3. Pressure control system test	
4. Priming device test	
5. Vacuum test	
6. Water tank-to-pump flow test	
C. Acceptance testing	
II. PUMP SERVICE TESTS	
	SLIDE: 4-4-4
A. Engine speed test	
1. Done under no load conditions	
	What is the purpose of an engine speed test?
2. Ensures that the pump engine is still running at the same governed speed that is was rated for when the apparatus was new	
	SLIDE: 4-4-5
B. Dry vacuum test	
1. Checks the priming device, pump, and hard intake hose for air leaks	
a) Pump must be dry	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
b) All intakes open and capped	
c) All discharges closed and caps removed	
2. Usually performed at the beginning of a pump service test	
	SLIDE: 4-4-6
C. Pumping test	
1. Annual test	
2. Checks the overall condition of the pump and engine	
a) Capacity test - 150 psi (net pump pressure)	
1) Twenty minute test	
2) Record reading for 20 minutes at 5 minute intervals of 100% of its rated capacity	
3) Transfer valve in VOLUME position	
b) Second test - 200 psi	
1) 10 minute test	
	During this test, what capacity should the pump deliver?
2) Pump should deliver 70% of its rated volume capacity	
• According to NFPA 1911 some pumps can run in either VOLUME (parallel) or PRESSURE (series)	
• Check data plate on pump panel	
c) Third test - 250 psi	
1) Ten minute test	
2) Pump should deliver 50% of its rated volume capacity	
3) Pump must be in PRESSURE (series) for this test	
	SLIDE: 4-4-7

RETIRED CURRICULUM

PRESENTATION	APPLICATION
D. Pressure control devices	
1. Ensures that they maintain a safe level of pressure on the pump when valves are closed	
a) Three part sequence test	
1) Test at 90, 150, and 250 psi	
b) Close valves slowly during test	
1) Valves should close within 3-10 seconds	
	During this test, the pressure should not rise more than how many psi?
c) Pressure should not rise more than 30 psi	
	SLIDE: 4-4-8
E. Discharge pressure gauge operational test	
1. Ensures that the gauges are providing accurate discharge information	
a) Test at 150, 200, and 250 psi	
b) Discharges to be capped except the one being tested	
c) Quick visual of master discharge gauge should match each individual gauge	
2. Any gauge off by more than 10% should be recalibrated, repaired, or replaced	
	SLIDE: 4-4-9
F. Flow meter operational test	
1. Ensures that the flow meter is providing accurate discharge information	
a) Not a simple test	
b) Not all discharges have to be tested at once	
c) Test at 150, 200, and 250 psi	
d) Use hoseline with a solid stream nozzle	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
	What is used to measure the flow?
e) A pitot tube is used to measure the flow	
2. Any flow meter off by more than 10% should be recalibrated, repaired, or replaced	
	SLIDE: 4-4-10
G. Tank-to-pump flow test	
1. Ensures that the piping between the water tank and pump is sufficient to supply the minimum amount of water specified by NFPA 1901	
	This test flow how many gallons per minute?
a) 500 gpm capacity or greater	
1) Test should flow at least 500 gpm	
	SLIDE: 4-4-11
III. DOCUMENTATION	
A. All calculations, figures, and pumping problems determined during the test should be recorded so that they may be filed	
1. Per department SOPs	
	SLIDE: 4-4-12
IV. POSSIBLE PROBLEMS DURING PUMP SERVICE TESTING	
A. Transmission in wrong gear	
B. High gear lockup not functioning (automatic transmission)	
C. Clutch slipping	
D. Engine overheating	
E. Muffler clogged	
F. Tachometer inaccurate	
G. Nozzle too large	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
	SLIDE: 4-4-13
H. Transfer valve in wrong position I. Intake screens clogged J. Pump impeller(s) are clogged K. Pitot tube is clogged L. Vacuum leaks M. Excessive wear on wear rings	
	SLIDE: 4-4-14
V. OUT-OF-SERVICE CRITERIA A. NFPA 1911: Inspection, Maintenance, Testing, and Retirement of In-Service Automotive Fire Apparatus, 2007 Edition 1. If the pump test indicates a deficiency, a qualified technician shall conduct an out-of-service evaluation and make a written report, including recommendations to the AHJ	

RETIRED CURRICULUM

SUMMARY:

As fire apparatus get older, it is important that fire departments do an annual pump service test and record the test data in order to determine the dependability of a fire pump. Test data can show potential problems that can be repaired before a major breakdown occurs. This can prevent costly repairs, reduce down time, or fireground tragedies.

EVALUATION:

The student will complete the written test at a time determined by the instructor.

ASSIGNMENT:

Review your notes and read Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 486-505 in order to prepare yourself for the upcoming test. Study for our next session.

RETIRED CURRICULUM

RETIRED CURRICULUM

TOPIC: 4-5: Maintenance Of The Pump And Control Systems

TIME FRAME: 1:00

LEVEL OF INSTRUCTION: Level II

AUTHORITY: 2009 NFPA 1002: Section 5.1.1

BEHAVIORAL OBJECTIVE:

Condition: Given a written test

Behavior: The student will confirm a knowledge of maintenance of the pump and control systems by completing the written test

Standard: With a minimum 80% accuracy according to the information contained in Fire Apparatus Driver/Operator 1B Student Supplement, SFT, 2008 Edition, Pages 61-64

MATERIALS NEEDED:

- Writing board/pad with markers/erasers
- Appropriate audiovisual equipment
- Appropriate audiovisual materials

REFERENCES:

- Fire Apparatus Driver/Operator 1B Student Supplement, SFT, 2008 Edition, Pages 61-64
- Fire Service Instructor's Manual, Waterous Pump Company, 1996 Edition, Form 1077
- NFPA 1911: Inspection, Maintenance, Testing, and Retirement of In-Service Automotive Fire Apparatus, 2007 Edition, Chapter 18

PREPARATION: Each instructor must develop a motivational statement on why the student should learn the upcoming material. The purpose is to establish relevancy of the lesson to the audience. The ACID BASE acronym can be used to help develop student motivation.

Attention (attract)	**B**egin
Curiosity (arouse)	**A**ssociation
Interest (create)	**S**tudents
Desire (stimulate)	**E**xperience

Cite examples or use related illustrations of near-miss incidents, injuries, or fatalities. Write this section "from the heart." Be creative! Have fun with it or be serious, but remember the goal is to stimulate student motivation.

PRESENTATION	APPLICATION
	SLIDE: 4-5-1
I. AFTER EACH OPERATION	
A. Usually operations of 1 hour or more in duration	
	What maintenance should occur after each operation of the pump?
	SLIDE: 4-5-2
B. Transfer valve	
1. If transfer valve has lubrication fitting, add grease and switch back and forth between positions	
2. Also known as a changeover valve	
C. Priming pump	
1. Operate primer	
a) Tighten all pump caps	
b) Close all pump valves	
c) Pull the primer control while watching for a below zero reading on the master intake gauge	
d) Verify that the master intake gauge readings hold for approximately 5 minutes after primer control is released	
D. Priming tank	
1. Check lubricant level; add if necessary	
	SLIDE: 4-5-3
II. WEEKLY	
A. Relief valve system or governor	
1. Test at 150, 200, 250 psi	
B. Transfer valve (if applicable)	
1. Test two-stage pumps only	
2. Manual transfer valves	
a) With the apparatus engine turned off, turn the handwheel between the volume pressure positions a few times to verify that the valve operates freely	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
b) Set for pumping, with the transfer valve in the volume position	
c) Leave the engine at idle speed	
d) Move the transfer valve to the pressure position	
e) Verify that the discharge pressure gauge readings have approximately doubled	
3. Power transfer valves	
a) With the apparatus engine turned off, follow the manufacturer's recommendations and specifications to verify that the valve operates freely	
b) Set for pumping, with the transfer valve in the volume position	
1) Note the discharge gauge readings	
c) Leave the engine at idle speed	
d) Move the transfer valve to the pressure position	
e) Verify that the master intake gauge readings have approximately doubled	
C. All valves	
1. Operational	
a) Discharge	
b) Suction	
c) Hose	
d) Drain	
e) Multi-drain	
2. Lubricate with dry molly spray	
D. Remote valve controls	
1. Clean and lubricate as necessary	
a) Do not use grease	
E. Pump shift warning indicator lights	
1. Check for operation	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
2. Move the in-cab pump shift control valve from the ROAD position to the PUMP position a) The shift warning light should light within a few seconds indicating a complete shift	How do we test the pump shift warning light?
F. Pump gear box 1. Check fluid level and add if needed a) In accordance with manufacturer's recommendations and specifications	
G. Pump packing 1. Check leakage and adjust if necessary	How many drops per minute should be coming out from the packing?
a) 8-10 drops per minute at 100-150 psi b) Adjust packing gland if necessary c) Slight leakage will lubricate and cool shaft d) Replace packing if leak cannot be stopped per manufacturer's recommendations and specifications	
H. Suction tube threads 1. Lubricate a) Do not use excessive grease	
I. Intake strainer 1. Clean 2. Check for loss of zinc anode	
J. Cap gaskets 1. Inspect and replace if cracked or hard	
K. Clapper valve 1. Check and exercise if applicable 2. In accordance with manufacturer's recommendations and specifications	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
	SLIDE: 4-5-4
III. MONTHLY	
A. Hydraulic clutch reservoir	
1. Check fluid level and add if needed	
B. Chain drive transmission	
1. Check lubricant level and add if needed	
C. Transfer valve	
1. Shift back and forth between positions	
D. Priming pump	
1. Perform vacuum test	
E. Pilot valves	
1. Check operation and clean strainer	
F. Intake screens	
1. Check condition	
	SLIDE: 4-5-5
IV. ANNUALLY	
A. Anodes	
1. Check condition	
	How often should anodes be replaced?
2. Replace when over 75% of the zinc has been consumed	
3. Performance will vary with water quality and pH	
B. Gear drive transmission	
1. Change lubricant	
C. Chain drive transmission	
1. Change lubricant	
2. Clean lubricant pump	
a) Sump strainer if provided	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
D. Impeller shaft bearing(s) 1. Add grease E. Mechanical seal 1. Flush seal chamber F. Service test 1. Perform service test according to NFPA 1911 standards G. Pump gear box 1. Drain and refill 2. Check magnetic plug 3. In accordance with manufacturer's recommendations and specifications H. Drain lines 1. Drain and purge with air to ensure they are functioning properly and are not clogged with sediment or debris I. Transfer valves 1. Lubricate a) Use white lithium grease or dry molly spray J. Pump packing 1. Recommend replacing every 2-3 years **NOTE:** Consult pump manufacturer's recommendations and specifications and your department SOPs for maintenance.	What kind of lubricant should be used on transfer valves?

RETIRED CURRICULUM

SUMMARY:

You have been shown the basics of pump maintenance. Make sure that you take the time to read and review the operator's manual for the apparatus you will be operating. In addition, adhere to your department's policies and manufacturers specifications.

EVALUATION:

The student will complete the written test at a time determined by the instructor.

ASSIGNMENT:

Review your notes and read Fire Apparatus Driver/Operator 1B Student Supplement, SFT, 2008 Edition, Pages 61-64 in order to prepare yourself for the upcoming test. Study for our next session.

RETIRED CURRICULUM

RETIRED CURRICULUM

TOPIC: 5-1: Making The Pump Operational (From Tank)

TIME FRAME: 0:30

LEVEL OF INSTRUCTION: Level II

AUTHORITY: 2009 NFPA 1002: Sections 4.2.1, 4.2.2, 5.1.1, 5.2.1, 5.2.2, 8.1.1, 8.2.1, 8.2.2, and 10.1.1

BEHAVIORAL OBJECTIVE:

Condition: Given a written test

Behavior: The student will confirm a knowledge of making the pump operational by completing the written test

Standard: With a minimum 80% accuracy according to the information contained in Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 51-54, 288-290, and 315-323

MATERIALS NEEDED:

- Writing board/pad with markers/erasers
- Appropriate audiovisual equipment
- Appropriate audiovisual materials

REFERENCES:

- Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 51-54, 288-290, and 315-323

PREPARATION: Each instructor must develop a motivational statement on why the student should learn the upcoming material. The purpose is to establish relevancy of the lesson to the audience. The ACID BASE acronym can be used to help develop student motivation.

Attention (attract)	**B**egin
Curiosity (arouse)	**A**ssociation
Interest (create)	**S**tudents
Desire (stimulate)	**E**xperience

Cite examples or use related illustrations of near-miss incidents, injuries, or fatalities. Write this section "from the heart." Be creative! Have fun with it or be serious, but remember the goal is to stimulate student motivation.

PRESENTATION	APPLICATION
	SLIDE: 5-1-1
I. PREPARATION	
	SLIDE: 5-1-2
A. Daily inspections prior to operation	
1. Operate the pump drive control and make sure that the pump can be engaged	
a) Proper positioning and safety measures must be in place prior to engaging the pump	
2. Make sure the auxiliary fuel tank is full in the case of separate engine-driven pumps	
a) For pumps with fuel supplies independent of the main apparatus fuel tank	
3. Make sure all gauges and valves on the pump panel are in working order	
4. Inspect the water and foam tanks for proper fluid level	
	SLIDE: 5-1-3
5. Check the underside of the apparatus and inside compartments for evidence of water or foam leaks	
6. Test roof and bumper turrets for proper operation and full range of motion	
7. If weather in your area is a factor, make sure that the fire pump and booster lines are completely drained of water	
a) To prevent damage from freezing	
8. Once the pump is inspected, it should be operationally tested	
a) It is not necessary to test the pump at full capacity	
	SLIDE: 5-1-4
II. INITIAL PROCEDURES	
A. Once the apparatus is in position, the parking brake must be set	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
1. IFSTA recommends that the apparatus wheels be chocked anytime the apparatus is parked	
2. For an added measure of safety	
B. Most pumps are engaged before the driver leaves the cab	
1. Varies with the type of pump drive and manufacturer	
	SLIDE: 5-1-5
2. Most operations include	
a) Placing transmission in neutral	
b) Engaging the pump control lever	
c) Placing transmission into the appropriate gear	
	Where would the driver/operator find an indication that the pump is in the proper gear?
1) Proper gear may be indicated on or near the transmission controls	
• May have a lock out device to keep it in the proper gear	
2) Some pump controls automatically go into the proper gear by selecting drive	
d) Confirm pump engagement	
1) Increase in speedometer	
• Should register 10-15	
2) Pump indicator light	
3) Audible change with engine	
	SLIDE: 5-1-6
C. Once the driver exits the cab and chocks the wheels, the driver proceeds to the pump panel	
1. Once the pump is operating, water must be moving through the pump	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
2. Sources include a) Apparatus water tank b) Pressurized source c) Static source	
	What source is predominantly used during pump operations?
D. Initiating pump operations 1. Pump operations are almost always initiated from the apparatus water supply a) Most incidents operate solely from the apparatus water tank	
	SLIDE: 5-1-7
2. The "Tank-to-Pump" valve must be opened to allow water to enter the pump a) Even if the pump is already full of water, a constant source must be established 3. At this point, the pump should be turning and building pressure	
	Where can the driver/operator check to determine if water pressure is building within the pump?
a) Determined by a quick check of the master pump discharge gauge 1) If pump is operating properly, the gauge will show a positive pressure reading 4. If the pump is a multi-stage pump, it must be placed in the proper position before pressure builds	
	SLIDE: 5-1-8
5. If hoselines are not ready to be charged, the "Tank Fill" valve can be partially opened to allow water to flow through the pump	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
a) This helps prevent the pump from over heating while not supplying hoselines	
6. At this point, barring any problems, the pump is ready to start operations	
7. The driver/operator must monitor all gauges while pumping	
a) The driver/operator must be ready to act immediately to correct any problems that may occur	
III. SETTING AUTOMATIC PRESSURE CONTROL DEVICES	
	SLIDE: 5-1-9
A. Setting the pressure relief valve	
1. Adjust the pump to the desired pressure	
2. Turn handwheel counterclockwise until relief valve opens	
a) Indicated by a sharp decrease in pressure	
b) An indicating light may also illuminate	
3. Turn handwheel clockwise, slowly, until pump returns to desired pressure	
a) A properly set relief valve will be in the closed position at the desired operating pressure	
b) NFPA 1901 requires the relief valve to open within 3-10 seconds after the discharge pressure rises 30 psi above set pressure	
4. Pressure relief valve may also include an on/off switch	
a) Normally these switches are used in case the relief valve is stuck in the "Open" position and pump pressure cannot be increased	
b) It is not recommended that pump operations be continued without a properly operating relief device	
NOTE: There are a number of pressure relief valves available. Include a review of your department specific types.	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
	SLIDE: 5-1-10
B. Setting the pressure governor	
1. Some governors need to be set with water flowing and some do not	
a) Refer to manufacturer's recommendations and specifications for department specific governors	
2. Settings for most governors include a pressure selection device and an activation switch	
a) Refer to manufacturer's recommendations and specifications	
3. Set the pressure selection device once desired pressure is determined	
4. Engage the governor activation switch	
a) Governor should now be set	
5. Shutdown	
a) Often is the reverse order	
NOTE: There are a number of pressure governors available. Include a review of your department specific types.	
	SLIDE: 5-1-11
IV. ON-GOING SAFETY PROCEDURES	
A. Water must be circulated through the pump while in operation	
1. If hoselines are used intermittently, the circulator valve or "Tank Fill" valve must be opened to circulate water through the pump	
2. If an external source is established, a waste line can be slightly opened so as not to overfill the water tank	
	SLIDE: 5-1-12
B. The driver/operator must be aware of the water tank level when operating without an external supply	
1. The driver/operator must be able to	
a) Estimate the amount of water being used	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
b) Estimate the amount of time the remaining water will last	
2. The driver/operator should warn the officer in charge as to the status of the water tank supply	
	SLIDE: 5-1-13
V. SHUTDOWN PROCEDURES	
A. Slowly close unneeded lines	
1. During partial shutdowns	
a) Monitor the engine speed and other gauges	
2. Ensure that water is moving through the pump if lines are used intermittently	
B. Reduce throttle to idle	
C. Take transmission out-of-gear	
D. Disengage pump	
1. Refill tank	
a) Unless water is contaminated source water	
	SLIDE: 5-1-14
E. Shut-off valve from external supply	
1. Refill tank first	
F. Open drain valves	
G. Disconnect lines	
H. Drain pump if necessary	
I. Make pump ready for operation	

RETIRED CURRICULUM

SUMMARY:

With a good understanding of the basics of pump operation, the driver/operator can then apply those skills in more complex situations. In fact, practice scenarios should closely resemble the real situations. This is essential for skill development. Entire operations can hinge on the driver/operator's ability to perform successfully. The driver/operator should strive for nothing less than complete competence.

EVALUATION:

The student will complete the written test at a time determined by the instructor.

ASSIGNMENT:

Review your notes and read Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 51-54, 288-290, and 315-323 in order to prepare yourself for the upcoming test. Study for our next session.

RETIRED CURRICULUM

RETIRED CURRICULUM

TOPIC: 5-2: Transitioning To An External Water Supply

TIME FRAME: 0:30

LEVEL OF INSTRUCTION: Level II

AUTHORITY: 2009 NFPA 1002: Sections 5.2.1 and 5.2.2

BEHAVIORAL OBJECTIVE:

Condition: Given a written test

Behavior: The student will confirm a knowledge of transitioning to an external water supply by completing the written test

Standard: With a minimum 80% accuracy according to the information contained in Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 320-323 and 352-356

MATERIALS NEEDED:

- Writing board/pad with markers/erasers
- Appropriate audiovisual equipment
- Appropriate audiovisual materials

REFERENCES:

- Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 320-323 and 352-356

PREPARATION: Each instructor must develop a motivational statement on why the student should learn the upcoming material. The purpose is to establish relevancy of the lesson to the audience. The ACID BASE acronym can be used to help develop student motivation.

Attention (attract)	**B**egin
Curiosity (arouse)	**A**ssociation
Interest (create)	**S**tudents
Desire (stimulate)	**E**xperience

Cite examples or use related illustrations of near-miss incidents, injuries, or fatalities. Write this section "from the heart." Be creative! Have fun with it or be serious, but remember the goal is to stimulate student motivation.

PRESENTATION	APPLICATION
	SLIDE: 5-2-1
	SLIDE: 5-2-2
I. PROCEDURE	
A. Connect supply line to apparatus	
1. Keep intake valve shut	
2. Connect hose to appropriate intake	
3. Bleed off air in supply line	
	How should the air in a supply line be purged?
a) Open bleed valve at inlet	
b) Charge line	
	SLIDE: 5-2-3
B. Open intake valve	
	When?
1. Once a continuous stream of water has been discharged from bleed valve	
2. Slowly and completely	
	SLIDE: 5-2-4
C. Pump panel adjustments	
1. Pump discharge pressure	
a) Possible increase due to incoming psi	
b) Adjust accordingly	
1) Simultaneously while opening intake valve	
2) Per department SOPs	
2. Tank-to-pump valve	
a) Leave open or close	
b) Per department SOPs	
3. Tank fill valve	
a) Refill tank if adequate water supply is available	
b) Monitor in order to close valve if necessary	

RETIRED CURRICULUM

SUMMARY:

The ability of the driver/operator to rapidly and effectively secure a continuous water supply from an external water source has prevented many emergency situations from resulting in a high loss of life and property. The skill and ability of the driver/operator to take immediate action in securing a water supply is imperative to successfully mitigating those incidents that warrant such.

EVALUATION:

The student will complete the written test at a time determined by the instructor.

ASSIGNMENT:

Review your notes and read Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 320-323 and 352-356 in order to prepare yourself for the upcoming test. Study for our next session.

RETIRED CURRICULUM

RETIRED CURRICULUM

TOPIC: 5-3: Operating From A Hydrant

TIME FRAME: 0:30

LEVEL OF INSTRUCTION: Level II

AUTHORITY: 2009 NFPA 1002: Sections: 5.2.1 and 5.2.2

BEHAVIORAL OBJECTIVE:

Condition: Given a written test

Behavior: The student will confirm a knowledge of operating from a hydrant by completing the written test

Standard: With a minimum 80% accuracy according to the information contained in Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 107-115, 323-334, and 357-361

MATERIALS NEEDED:

- Writing board/pad with markers/erasers
- Appropriate audiovisual equipment
- Appropriate audiovisual materials

REFERENCES:

- Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 107-115, 323-334, and 357-361

PREPARATION: Each instructor must develop a motivational statement on why the student should learn the upcoming material. The purpose is to establish relevancy of the lesson to the audience. The ACID BASE acronym can be used to help develop student motivation.

Attention (attract)	**B**egin
Curiosity (arouse)	**A**ssociation
Interest (create)	**S**tudents
Desire (stimulate)	**E**xperience

Cite examples or use related illustrations of near-miss incidents, injuries, or fatalities. Write this section "from the heart." Be creative! Have fun with it or be serious, but remember the goal is to stimulate student motivation.

PRESENTATION	APPLICATION
	SLIDE: 5-3-1 What is the first consideration when selecting a hydrant?
I. HYDRANT CONSIDERATIONS A. The first consideration in selecting a hydrant is to determine which hydrant is most appropriate in terms of fire fighting and safety needs	
	SLIDE: 5-3-2
B. Location 1. Safety a) Location to the incident 1) Too close to actual incident 2) Collapse zone • Falling debris 3) Radiant heat 4) Overhead wires 5) Crossing main thoroughfares • Same side of incident if possible 2. Distance to incident a) Amount of hose on apparatus b) Friction loss 3. Obstacles a) Railroad tracks b) Road barriers/closures	
C. Hydrant size and supply 1. Hydrant main size 2. Discharge diameter	
	What is the main disadvantage of connecting to a 2½" discharge?
a) Limits water flow	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
3. Grid versus dead-end main	
	Which location is less desirable?
a) Dead-end mains are less desirable	
	SLIDE: 5-3-3
II. SPOTTING THE APPARATUS	
A. At the hydrant	
1. Front/rear suction	
a) Apparatus aimed at hydrant at a 45º angle or less	
1) Eliminate kinks	
b) Distance out dependant upon length of supply line	
c) Use apparatus to block traffic if possible	
2. Side suction	
	If using the side intake, how should the front tires be positioned?
a) Front wheels at 45º angle to hydrant	
b) Distance out dependant upon length of supply line	
1) Eliminate kinks	
c) Use apparatus to block traffic if possible	
B. At the incident	
1. Per direction of Incident Commander/company officer	
	SLIDE: 5-3-4
III. HOSE EVOLUTIONS	
A. Forward lay	
1. Stopping at a hydrant, dropping the end of one or more supply lines at the hydrant, and proceeding to the fire location	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
a) May use a four-way hydrant valve	
b) Second pumper connects to second discharge of four-way	
1) No interruption of flow	
c) Second intake on four-way allows pumper connection for pressure increase	
d) Equipped with a shut-off valve	
	SLIDE: 5-3-5
B. Reverse lay	
1. Hose is laid from the fire to the water source	
2. Used when a pumper must first go to the fire location so that a size-up can be made before laying a supply line	
3. Most expedient method if apparatus must stay with water source	
4. May be used in relay operations	
5. Disadvantage	
a) Equipment must be removed from the apparatus	
	SLIDE: 5-3-6
IV. HYDRANT CAPACITIES	
A. Hydrant output capacity	
1. Outlets	
a) Number and size(s)	
NOTE: For hydrant color codes, refer to Unit 3 - Topic 4.	
2. Main size	
a) Small feeder	
b) Dead-end main	
B. A static pressure needs to be recorded from the master intake gauge prior to flowing water	
C. Pressures defined	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
	SLIDE: 5-3-7
1. Static	
a) The water pressure in the water system, which is taken when the pump is full and the system has stabilized	
b) The master intake gauge indicates the static pressure in the water system	
	What is residual pressure?
	SLIDE: 5-3-8
2. Residual	
a) Remaining pressure in the system when the apparatus is discharging water	
b) The intake gauge reading is in the residual pressure	
D. Percentage method	
1. First, calculate the drop in pressure as a percentage after the first hoseline flows water	
	SLIDE: 5-3-9
2. Formula	
a) % Drop = $\frac{(\text{Static} - \text{Residual})(100)}{\text{Static}}$	
	SLIDE: 5-3-10
3. Example	
a) % Drop = $\frac{(70 - 63)(100)}{70}$	
b) % Drop = $\frac{(7)(100)}{70}$	
c) % Drop = $\frac{700}{70}$	
d) % Drop = 10	
E. First-digit method	
1. Quicker and easier method	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
2. Steps a) Find the difference in psi between the static and residual pressures b) Multiply the first digit of the static pressure by 1, 2, or 3 to determine how many additional lines of equal flow may be added	
	SLIDE: 5-3-11
c) Additional water available at a hydrant d) Percent decrease of pumper intake pressure determines additional water available 1) 0%-10% — 3 times amount being delivered 2) 11%-15% — 2 times amount being delivered 3) 16%-25% — Same amount as being available 4) 25+% — More water might be available, but not as much as is being delivered 3. Formula a) Difference in psi 1) Static pressure – Residual pressure 4. Example a) Difference in psi = 65-58 b) Difference in psi = 7 c) First digit of static pressure x 1 d) 6 x 1 = 6 e) 7 is not less than 6 but is less than 12 (2 x 6), so two more lines at 250 gpm each can be added	
	SLIDE: 5-3-12
V. HYDRANT PUMPING OPERATIONS A. Establish a water supply 1. Flush hydrant	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
2. Connect supply line from hydrant to engine inlet	
3. Open hydrant outlet	
4. Open connected supply line intake	
B. Pump panel operations	
1. Monitoring gauges/valves	
a) Master/compound pressure gauge	
1) psi increases with incoming pressure	
b) Transfer valve	
1) In proper position prior to increasing rpm	
• Based on gpm need of the incident	
c) Pressure relief valve	
1) Set per department SOPs	
d) Tank-to-pump valve	
1) Open if valve has a clapper	
• Per department SOPs	
2. Charging the hoseline	
a) When requested	
b) Open gradually to avoid injury and water hammer	
c) Increase throttle pressure to desired psi as calculated	
VI. SHUTDOWN PROCEDURES	
	SLIDE: 5-3-13
A. Gauges/valves	
1. "Tank Fill" valve	
a) Ensure engine water tank is full	
2. Tank-to-pump valve	
a) Per department SOPs	
3. Throttle	
a) Down to idle if not pumping	
4. Intake valve closed	
a) Open bleed valve to relieve pressure	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
	SLIDE: 5-3-14
B. Hydrant	When shutting down a hydrant, what must you always be alert for?
1. Water hammer 2. Shutdown valve 3. Remove hose once pressure is relieved 4. Replace hydrant caps	
	SLIDE: 5-3-15
C. Disengage pump 1. When pumping evolution is complete 2. As directed by IC/company officer 3. Per department SOPs	
	SLIDE: 5-3-16
D. Supply hose 1. Drain water from hose as necessary 2. Wash/clean hose per department SOPs	

RETIRED CURRICULUM

SUMMARY:

Having the ability to effectively pump water into a hoseline or fire appliance by using a fire engine supplied by a fire hydrant is a critical and primary skill of any driver/operator. A key consideration all driver/operators should have is water supply, which is usually provided by the nearest available hydrant to the emergency incident.

EVALUATION:

The student will complete the written test at a time determined by the instructor.

ASSIGNMENT:

Review your notes and read Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 107-115, 323-334, and 357-361 in order to prepare yourself for the upcoming test. Study for our next session.

RETIRED CURRICULUM

RETIRED CURRICULUM

TOPIC: 5-4: Principles And Practices Of Drafting Operations

TIME FRAME: 0:30

LEVEL OF INSTRUCTION: Level II

AUTHORITY: 2009 NFPA 1002: Sections 5.2.1 and 5.2.2

BEHAVIORAL OBJECTIVE:

Condition: Given a written test

Behavior: The student will confirm a knowledge of principles and practices of drafting operations by completing the written test

Standard: With a minimum 80% accuracy according to the information contained in Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 334-346

MATERIALS NEEDED:

- Writing board/pad with markers/erasers
- Appropriate audiovisual equipment
- Appropriate audiovisual materials

REFERENCES:

- Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 334-346

PREPARATION: Each instructor must develop a motivational statement on why the student should learn the upcoming material. The purpose is to establish relevancy of the lesson to the audience. The ACID BASE acronym can be used to help develop student motivation.

Attention (attract)	**B**egin
Curiosity (arouse)	**A**ssociation
Interest (create)	**S**tudents
Desire (stimulate)	**E**xperience

Cite examples or use related illustrations of near-miss incidents, injuries, or fatalities. Write this section "from the heart." Be creative! Have fun with it or be serious, but remember the goal is to stimulate student motivation.

PRESENTATION	APPLICATION
	SLIDE: 5-4-1
	SLIDE: 5-4-2
I. PRINCIPLES OF LIFT	
A. All fire department pumpers should be capable of pumping water from a static water supply	
B. The static water supply is most often located at a lower level than the fire pump	
1. It is not possible to pull water into the pump from a lower level	
C. It is possible to evacuate some of the air inside the fire pump	
	What principle allows water to enter the pump from a lower static source?
1. A pressure differential (partial vacuum inside the pump), allows atmospheric pressure acting on the surface of the water to force water into the fire pump	
	SLIDE: 5-4-3
2. The weight of the water, combined with the reduced air pressure acting on its surface, creates a balance	
3. An airtight, non-collapsible waterway (hard intake hose) is needed between the fire pump and the body of water to be used	
	SLIDE: 5-4-4
D. Lift is affected by additional pressure losses encountered	
1. Any type of fire hose, strainer, or appliance creates a certain amount of friction loss	
a) Proportional to the amount of water moving through it	
2. The inertia of or movement of water is an additional pressure loss	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
3. The amount of energy consumed in getting the water at rest to begin to move and increase its velocity sufficiently to supply the amount of water needed	
	SLIDE: 5-4-5
4. The total pressure available to overcome all pressure losses is limited to atmospheric pressure at sea level a) 14.7 psi 1) For every 1 psi of atmospheric pressure, water can be lifted 2.3 feet b) Decreases .5 psi per 1,000 feet of elevation increase	
	SLIDE: 5-4-6
5. While the pump is moving water, the vacuum reading on the master intake gauge indicates the remaining pump capacity	
	What is the maximum amount of vacuum that most pumps develop?
a) The maximum amount of vacuum that most pumps develop is approximately 22 inches of mercury b) A reading that is approaching this amount indicates that the pump is close to the limits of its ability	
	SLIDE: 5-4-7
E. Cavitation - water being discharged from the pump faster than it is coming in 1. "The pump is running away from the water" 2. Air cavities are created in the pump or bubbles pass through the pump a) They move from the point of highest vacuum into the pressurized section where they collapse or fill with fluid	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
b) The high velocity of the water filling these cavities causes a severe shock to the pump	
c) May cause damage to the in pump	
3. Temperature of the water, the height of the lift, and the amount of water being discharged affect the point at which cavitation begins	
a) Water temperatures below 35°F or above 90°F	
b) Maximum theoretical lift is 33.9 feet in perfect conditions	
1) Realistic conditions can greatly reduce this	
	SLIDE: 5-4-8
4. Indications that a pump is cavitating	
a) Hose streams and the pressure gauge on the pump will fluctuate	
b) Sounds described as a popping or sputtering as the water leaves the nozzle	
	SLIDE: 5-4-9
c) Severe cavitation	
1) The pump itself will be noisy	
2) Sounding like gravel passing through it	
d) The best indication - the lack of reaction on the pressure gauge to changes in the setting of the throttle	
1) Increasing pump rpm will not increase discharge pressure when there is no more water available to be supplied	
	SLIDE: 5-4-10
e) Caused by	
1) Inadequate piping from the water tank	
2) While operating from a poor hydrant or supply system	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
	When is cavitation most likely to occur?
3) Most often occurs during drafting operations	
	SLIDE: 5-4-11
II. SELECTING A DRAFTING SITE	
A. Dictated by the following factors	
1. Amount of water available	
2. Type of water	
3. Accessibility of water	
	SLIDE: 5-4-12
B. Amount of water available	
1. Size of static source is important	
a) Due to the fact that there needs to be a minimum of 24 inches of water all around the strainer	
2. Types of sources such as shallow streams can be dammed to increase water depth	
a) Shallow drafting strainers are also available	
3. Bodies of water with tidal movements may not be dependable all the time	
a) Low tide can make a site unusable	
	SLIDE: 5-4-13
C. Type of water	
1. In an emergency, any water can be used	
2. Nonpotable, salt, or contaminated water can damage the pump	
	What must be done to the pump if contaminated water is used?
a) If these types of sources are used, the pump should be thoroughly flushed	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
3. Water with debris can clog suction strainers and limit the capacity that can be pumped	
4. Water with high concentrations of sand or dirt can pass into the pump and severely damage components	
a) Sand can be forced into the pump packing under discharge pressure	
b) The packing then becomes contaminated and can not be adjusted	
	SLIDE: 5-4-14
D. Accessibility	
1. Accessibility is an important factor in reducing amount of lift	
a) Atmospheric pressure has to overcome elevation and friction losses	
b) As lift increases	
1) Elevation pressure increases	
2) Less friction loss can be overcome	
3) Capacity of the pump decreases	
c) Pumpers are rated to flow their capacity at 10 feet of lift	
d) Most pumpers in good condition can lift water 23 or 24 feet	
e) Practically 20 feet is the maximum considered	
	What capacity can be expected at 20 feet of lift?
1) The pump's capacity with this amount of lift is 60%	
f) It is important to keep lift to a minimum	
	SLIDE: 5-4-15
2. Others considerations	
a) Ground stability	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
b) Time of year c) Connecting hoselines d) Safety of the driver/operator	
	SLIDE: 5-4-16
III. SPOTTING THE APPARATUS A. Once a proper site is identified, the driver/operator should move the apparatus into place 1. Sometimes can be parked and the suction hose deployed 2. Oftentimes the opposite is true a) Adequate drafting sites can have limited access b) Suction hose has to be connected or partially deployed c) The apparatus is then moved into place B. Once the apparatus is in its final position, the brake must be set and the wheel chocks in place C. The sections of hard suction and strainer are then connected 1. Make sure all gaskets are in place 2. All connection need to be air tight a) Use a rubber mallet if necessary	
	SLIDE: 5-4-17
D. Ensure that there is enough help during the connection process 1. To keep the hose out of the dirt 2. For safety of operation E. Attach strainer rope F. Ensure that no part of the suction hose is above the eye of the pump	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
	Why must the eye of the pump be the highest point in the suction hose?
1. An air pocket may form and prevent effective drafting	
G. Secure the strainer rope	
1. Strainer should be suspended off the bottom of the water source	
a) Tie rope off to the pumper, tree, or other natural object	
2. Other objects such as roof ladders or scoop shovels can be used to keep the strainer off the bottom if necessary	
	SLIDE: 5-4-18
IV. PRIMING THE PUMP AND BEGINNING OPERATIONS	
A. The first step in operation is to prime the pump	
1. If operating a two stage pump, the pump should be placed in the PARALLEL position	
	Why is PARALLEL the preferred position for the transfer valve?
a) In SERIES, air can become trapped in the pump	
2. Set engine rpms	
a) Transfer case driven primers need 1,000 to 1,200 rpms to operate optimally	
b) Electric motor primers should operate at about 1,000 to 1,200 rpms	
1) Helps ensure that the alternator is charging sufficiently	
2) Also helps to prevent the loss of prime once achieved	
c) Vacuum primers should be operated at the lowest engine rpms without stalling	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
3. Operate primer	
4. Observe the master intake gauge	
a) One inch of vacuum lift equals about one foot of lift	
5. Observe physical indicators	
a) As the hose fills, the weight of water will cause it to drop and	
b) The primer discharges water on the ground	
	How long should the priming process take?
c) Entire process normally takes 10-15 seconds, but should not take any more than 30 seconds for a 1,250 gpm pumper	
1) Up to 45 seconds for a 1,500 gpm pumper	
6. Increase engine rpms prior to opening discharge valves	
a) Pressure should be boosted to 50-100 psi	
	SLIDE: 5-4-19
7. Open valve(s) slowly	
a) Observe master intake gauge	
b) If the pressure drops below 50 psi, allow pressure to stabilize before continuing	
1) Reactivate primer if it continues to drop	
c) This helps prevent air from entering the pump	
8. If lines are not ready to be charged	
a) Discharge water through a waste line or "Tank Fill" valve	
1) Helps keep prime and pump cool	
b) Be careful as to not compromise vehicle stability	
1) By soaking the ground below	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
c) Be careful as to not compromise water source	
1) Waste line can be directed back to the source as long as it does not disrupt the water and cause air to be drawn into the suction hose	
B. Operating from draft	
1. Monitor all gauges and be prepared to correct any problem	
2. Watch for developing problems	
	SLIDE: 5-4-20
V. SHUTTING THE OPERATION DOWN	
A. Fill tank if source in not contaminated	
B. Slowly decrease rpms	
C. Take the pump out of gear	
D. Allow pump to drain	
E. Allow engine temperature to stabilize	
	SLIDE: 5-4-21
F. Shut-off engine	
G. Disconnect all hose and attachments	
H. Operate primer for a few seconds	
	Why operate the primer after operations and the pump is empty?
1. This lubricates the priming pump and helps preserve it	
I. Flush pump if unclean or contaminated water was drawn through the pump	

RETIRED CURRICULUM

SUMMARY:

Drafting, oftentimes, is rarely practiced or used. This is especially true in departments with reliable pressurized water systems. It is however, an essential skill that needs to be as polished as any other. The need for a drafting operation can occur at any time. The situation should not be further complicated by the lack of preparation.

EVALUATION:

The student will complete the written test at a time determined by the instructor.

ASSIGNMENT:

Review your notes and read Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 334-346 in order to prepare yourself for the upcoming test. Study for our next session.

RETIRED CURRICULUM

RETIRED CURRICULUM

TOPIC: 5-5: Principles Of Relay Pump Operations

TIME FRAME: 1:30

LEVEL OF INSTRUCTION: Level II

AUTHORITY: 2009 NFPA 1002: Sections 5.2.1, 5.2.2, 5.2.4, 8.2.1, and 8.2.2

BEHAVIORAL OBJECTIVE:

Condition: Given a written test

Behavior: The student will confirm a knowledge of the principles of relay pump operations by completing the written test

Standard: With a minimum 80% accuracy according to the information contained in Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 395-413 and 583

MATERIALS NEEDED:

- Writing board/pad with markers/erasers
- Appropriate audiovisual equipment
- Appropriate audiovisual materials

REFERENCES:

- Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 395-413 and 583

PREPARATION: Each instructor must develop a motivational statement on why the student should learn the upcoming material. The purpose is to establish relevancy of the lesson to the audience. The ACID BASE acronym can be used to help develop student motivation.

Attention (attract)	**B**egin
Curiosity (arouse)	**A**ssociation
Interest (create)	**S**tudents
Desire (stimulate)	**E**xperience

Cite examples or use related illustrations of near-miss incidents, injuries, or fatalities. Write this section "from the heart." Be creative! Have fun with it or be serious, but remember the goal is to stimulate student motivation.

PRESENTATION	APPLICATION
	SLIDE: 5-5-1
	SLIDE: 5-5-2
I. RELAY PUMPING PRINCIPLES	
A. Definitions	
1. Relay	
a) Using two or more pumpers to move water from distances that would require excessive pressures if only one pumper was employed	
2. Relay operation	
a) Using two or more pumpers to move water over a long distance by operating them in series	
	SLIDE: 5-5-3
b) Water discharged from one pumper flows through hoses to the inlet of the next pumper, and so on	
c) Also called relay pumping	
B. Purpose	
	What is the purpose of relay pumping?
1. To boost inadequate water pressure over an extensive distance from source to incident	
	SLIDE: 5-5-4
C. Apparatus relay principles	
1. Source pumper	
a) Apparatus connected to the actual water source	
1) Largest capacity pumper	
2) Strongest operational pumper	
2. Relay pumper (in-line pumper)	
a) Pumper(s) connected within a relay	
b) Receives water from the source pumper	
c) Boosts the water pressure and supplies water to the next in-line pumper or attack pumper	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
	SLIDE: 5-5-5
3. Attack pumper	
a) Pumper located at the incident scene	
b) Receives water from the in-line pumpers	
c) Supplies water to the appliances necessary for fire suppression	
4. Determination of maximum relay capacity	
	What is the maximum capacity of a relay operation limited to?
a) Limited to the capacity of the smallest pump	
b) Limited to the smallest hoseline used within the relay	
II. TYPES OF RELAY PUMPING OPERATIONS	
NOTE: There are two basic designs or relay pumping operations: The maximum distance relay and the constant pressure relay.	
	SLIDE: 5-5-6
A. Maximum distance relay	
1. Involves flowing a predetermined volume of water for the maximum distance	
	SLIDE: 5-5-7
2. Maximum distance relay chart	
a) Used to determine maximum pumping distance through a particular hose lay	
b) Based upon	
1) 20 psi residual pressure available at the next, in-line pumper	
2) Discharge pressure of 200 psi for 2½" and 3" hose	
3) Discharge pressure of 185 psi for 4" and 5" hose	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
NOTE: Table 13.1 on page 402 in Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition must be understood and used by the student to determine the distance that a certain flow may be pumped through the type of hose carried on the apparatus.	
	SLIDE: 5-5-8
3. Minimum pump capacities based upon maximum distance relay chart (Table 13.3) and the above criteria a) 250 and 500 gpm flows: a 750 gpm rated pumper b) 750 gpm flow: a 1,250 gpm rated pumper c) 1,000 gpm flow: a 1,500 gpm rated pumper d) 1,250 gpm flow: a 1,750 gpm rated pumper	
4. Formula to determine number of pumpers needed to relay	
	SLIDE: 5-5-9
Equation U $\frac{\text{Relay distance}}{\text{MDR}} + 1 = \text{Total number of pumpers}$ MDR = maximum distance relay lengths table	
NOTE: Tables 13.1 on page 402 in Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition.	
5. Example a) $\frac{2{,}000}{1{,}600} = 1.25 + 1 = 2.25$ or **3 pumpers** b) Always round up to the nearest whole number when using the above formula 1) If answer is 3.2, you actually need 4 pumpers to achieve the flow	
	SLIDE: 5-5-10
B. Constant pressure relay	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
1. Method establishes the maximum flow available from a particular relay setup a) By using a constant pressure in the system 2. Dependant upon a constant flow provided on the fireground 3. To maintain the flow, the driver/operator may a) Open a discharge b) Secure a waste line to handle above the fire flow	
	SLIDE: 5-5-11
4. Advantages a) Speeds relay activation b) Requires no complicated calculations c) Radio traffic reduced d) Attack pumper driver/operator able to govern hoselines with greater ease e) Driver/operator guides and adjusts pressure to one constant figure	What are some advantages of this method?
5. Constant pressure relay formation a) Position attack pumper at the fire b) Largest capacity pumper at the water source c) Lay hose from the relay pumpers according to department SOPs 1) Leave minimum of two hose lengths in bed in case of a hose failure d) Connect supply lines to the pumpers e) Driver/operators (except source pumper) open an unused discharge gate if pumper has no relay relief valve	**SLIDE: 5-5-12**

RETIRED CURRICULUM

PRESENTATION	APPLICATION
f) Pump 175 psi from the water source	
g) Driver/operator on first relay pumper closes the unused discharge gate once a steady stream of water occurs	
	SLIDE: 5-5-13
h) Relay pumper then pumps to next pumper at 175 psi	
i) Driver/operator sets the pressure regulating device	
1) Each successive driver/operator follows the same procedure	
j) Attack pumper driver/operator adjusts the discharge pressure(s) to supply the attack line(s)	
	SLIDE: 5-5-14
k) Maintain the flow from the attack pumper during temporary shutdowns	
1) One or more discharge gates as waste or dump lines	
l) For a ruptured hoseline, open a discharge gate on the relay pumper before the rupture to dump water until line is replaced	
m) For additional water on the fireground, lay additional hoselines between apparatus	
	SLIDE: 5-5-15
6. Pump discharge pressure at 175 psi until	
a) Intake pressure from pressurized sources drops below 20 psi	
	What happens if the residual does drop below 20 psi?
1) Danger of cavitation	
b) Operating hand throttle does not increase rpm	
1) Engine reached governed speed	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
7. Constant pressure of 175 psi may be modified a) Variations in relay pumper spacing 1) Increase for greater spacing 2) Decrease for lesser spacing b) Severe elevation differences 1) Decrease pumping downhill 2) Increase pumping uphill c) Increase fire flow d) Large diameter hose 1) Requires lower discharge pressure	
	SLIDE: 5-5-16
8. Relay pressure adjustment a) Increase relay pressure 1) Adjust the source pumper until the desired pressure is reached 2) Adjust successive pumper similarly b) Decrease relay pressure 1) Attack pumper throttles down • Open dump line 2) Relay pumpers toward the water source, in decreasing succession	
	SLIDE: 5-5-17
III. OPERATIONAL CONSIDERATIONS/GUIDELINES A. Basis for relay operation 1. Amount of water required at the emergency scene 2. The distance from the emergency scene to the water source B. Methods to increase flow through a relay	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
	What are some methods used to increase flow through a relay?
1. Increase size of hose a) Increase numbers of hoselines in relay 2. Increase pump discharge pressure of the pumpers used in the relay 3. Increase number of pumpers used in relay	
	SLIDE: 5-5-18
C. General rules 1. A relay operation always begins with the source pumper 2. Largest diameter hose should be used at the beginning of the relay	
	SLIDE: 5-5-19
3. Once water has been established, the source pumper opens an uncapped discharge or allows water to waste through a dump line until the first relay pumper is ready for water a) From static source, this prevents losing prime 4. Relay pressure not to exceed the maximum operating pressure rating for the hose 5. Elevation pressures a) Uphill 1) Calculate elevation pressure and friction loss b) Downhill 1) Calculate additional psi and friction loss due to lower elevation	
	SLIDE: 5-5-20
D. Placing a relay into operation	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
	At a relay operation, where should the largest capacity pumper be placed?
1. The largest capacity pumper should be at the source	
2. Source and relay pumper ready for water	
a) Discharge supply the hoseline on the source pumper is opened	
b) Valve on the dump line is closed in conjunction	
c) If only minutes before receiving water, the pump on the receiving pump may be engaged. If longer, disengage pump as not to run dry and overheat	
	At what psi should the intake pressure be maintained?
3. Maintain an intake pressure of 20 psi	
4. If relay pumper is receiving an intake pressure greater than 50 psi	
a) Adjust valve on the dump line on the relay pumper to a maximum residual of 50 psi	
	SLIDE: 5-5-21
5. Receiving water at the attack pumper	
a) Bleed out air from the supply line	
1) Open bleed valve on the intake being used	
b) Open discharge	
c) Close dump line	
E. Operating the relay	
1. Once water is flowing	
a) Driver/operators set automatic pressure control devices	
2. Attack pumper has an intake relief valve	
a) Set between 50 and 75 psi	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
3. Small variations in pressure are not significant a) Intake pressure should not drop below 20 psi nor increase above 100 psi	
	SLIDE: 5-5-22
F. Relay operation shutdown 1. Shutdown from the fire scene first 2. Driver/operators should shut down in succession a) Slowly decrease the throttle b) Open the dump line c) Take pump out of gear	

RETIRED CURRICULUM

SUMMARY:

There is a high likelihood that at some point in your career, you will be placed in a situation where the water source is at a greater distance from the emergency than a single pumper can reasonably supply. With a thorough knowledge of relay operations, you should be able to effectively deploy fire attack lines by recognizing the need and utilizing the necessary resources appropriately.

EVALUATION:

The student will complete the written test at a time determined by the instructor.

ASSIGNMENT:

Review your notes and read Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 395-413 and 583 in order to prepare yourself for the upcoming test. Study for our next session.

RETIRED CURRICULUM

RETIRED CURRICULUM

TOPIC: 5-6: Troubleshooting Pump Operations

TIME FRAME: 1:00

LEVEL OF INSTRUCTION: Level II

AUTHORITY: 2009 NFPA 1002: Sections 4.2.1, 4.2.2, 5.1.1, 5.2.1, 5.2.2, 8.1.1, 8.2.1, 8.2.2, and 10.1.1

BEHAVIORAL OBJECTIVE:

Condition: Given an activity and written test

Behavior: The student will confirm a knowledge of troubleshooting the pump by completing the activity and written test

Standard: With a minimum 80% accuracy according to the information contained in Fire Apparatus Driver/Operator 1B Student Supplement, SFT, 2008 Edition, Pages 70-75 and Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 366-373

MATERIALS NEEDED:

- Writing board/pad with markers/erasers
- Appropriate audiovisual equipment
- Appropriate audiovisual materials
- Group Activity 5-6-1: What's Wrong!

REFERENCES:

- Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 366-373

PREPARATION: Each instructor must develop a motivational statement on why the student should learn the upcoming material. The purpose is to establish relevancy of the lesson to the audience. The ACID BASE acronym can be used to help develop student motivation.

Attention (attract)	**B**egin
Curiosity (arouse)	**A**ssociation
Interest (create)	**S**tudents
Desire (stimulate)	**E**xperience

Cite examples or use related illustrations of near-miss incidents, injuries, or fatalities. Write this section "from the heart." Be creative! Have fun with it or be serious, but remember the goal is to stimulate student motivation.

PRESENTATION	APPLICATION
	ACTIVITY 5-6-1: Complete the activity in the student supplement.

NOTE: **DO NOT** lecture on this material. Activity 5-6-1 provides the opportunity for the students to learn this information in a dynamic approach. If necessary, use the information below to clarify any points of debate brought up by the students during the review of the activity.

I. TROUBLESHOOTING PROBLEMS COMMON TO ALL TYPES OF OPERATIONS

A. Unable to get a reading on the pressure gauge when the pump is put in service

1. Symptom: Green light indicating that the pump shift transfer is complete is not illuminated

   a) Probable cause

      1) Pump drive system is not fully engaged

   b) Possible corrective action

      1) Check the position of the shift transfer control

         - If it is in the proper position, release the transfer control
         - Allow the gears to turn
         - Operate shift transfer again

   c) Possible corrective action - automatic transmission

      1) Repeat pump shifting procedure to ensure power transfer to pump operation

2. Symptom: Green light is on, no mph reading registers on the speedometer

   a) Probable cause

      1) Clutch is not engaged

   b) Possible corrective action

      1) Check the remote clutch control on the driver/operator's panel

RETIRED CURRICULUM

PRESENTATION	APPLICATION
c) Probable cause 1) Road transmissions is not in the proper gear 2) Automatic transmission selector is in wrong position d) Possible corrective action 1) Check the shift lever • Lock it in the proper position for pump operation 3. Symptom: Speedometer reading is normal for pump operation, all indications are correct, and rpm reading is as specified a) Probable cause 1) No water in pump b) Possible corrective action 1) Check water supply 2) Ensure that all applicable valves are open 3) Primer pump may need to be operated • To eliminate air in the main pump c) Probable cause 1) Gauge is defective • Pressure is there but not reading on the master pressure gauge d) Possible corrective action 1) Check the shutoff (snubber) dampening valve associated with the gauge 2) Open the gate valve to one of the capped discharge outlets • Look for pressure reading on the individual line gauge 3) Open an uncapped discharge outlet from the pump • To see if water is discharged under pressure	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
B. Pump will not develop sufficient pressure 1. Symptom: The rpm reading on the tachometer is normal when compared with the UL plate a) Probable cause - two-stage pump 1) Pump transfer valve is in the wrong position b) Possible corrective action 1) Transfer valve should be in the SERIES or PRESSURE position anytime more than 200 psi is needed c) Probable cause 1) Swing check valve may be leaking if the pump is in the SERIES position d) Possible corrective action 1) Set the discharge pressure within 50 psi of compound (intake) pressure 2) Change from SERIES to PARALLEL 3) Listen for the metallic sound of the valve operating 4) If it is blocked, remove the strainer from the large intake and clear the valve seat of any debris e) Probable cause 1) Transfer valve has not completed its travel and is only partially operated f) Possible corrective action 1) Check all mechanical and electrical indicators 2) Observe pressure gauge readings as valve is operated 3) If equipped, use manual override controls to complete valve operation 4) May be possible to assist the action of the valve mechanically if the power transfer mechanism is faulty	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
g) Probable cause - automatic transmission 1) Transmission not staying in pumping gear lockup and is downshifting as load increases h) Possible corrective action 1) Remove pump from service 2) Must be adjusted or repaired i) Probable cause 1) Wear on the clearance rings inside the pump may cause excessive slippage j) Possible corrective action 1) Take out-of-service until repaired 2. Symptom: Relief valve is operating and the indicator light is on a) Probable cause 1) Relief valve pressure adjustment set too low b) Possible corrective action 1) Increase operating pressure of relief valve • By turning the adjustment control clockwise • Until it closes 3. Symptom: Indicator light shows that the relief valve is closed a) Probable cause 1) Relief valve may be stuck open or may not be properly seated • Allows water to bypass back to the intake b) Possible corrective action 1) Turn the relief valve operating control to the OFF position	

RETIRED CURRICULUM

PRESENTATION	APPLICATION

2) Increase the setting of adjustment control to maximum clockwise position

3) Exercise valve

- By rapidly turning control valve on and off or
- Alternately increasing and decreasing the pressure adjustment control
- To cause valve to operate

4. Symptom: Engine rpm cannot be raised to the level required as determined by the UL plate, even at full throttle; tachometer reading is low and pressure gauge reading is too low

a) Probable cause

1) Flow requirements may be exceeding the capacity of the pump

b) Possible corrective action

1) Capacity of pump in the SERIES or PRESSURE position is limited to 50% of its rated capacity at 250 psi

and

2) 70% at 200 psi net pump pressure

c) Probable cause

1) Throttle linkage may have slipped or be stuck

d) Possible corrective action

1) Check linkage action

2) It may be possible to override action of the throttle

- By using the accelerator or hand throttle in the cab

  or

- Manually operating the linkage at the carburetor

RETIRED CURRICULUM

PRESENTATION	APPLICATION

e) Probable cause

1) Severe engine overheating can reduce the power available to drive the pump

f) Possible corrective action

1) Check engine temperature gauge

2) Adjust auxiliary cooling valve

- To maintain proper operating temperature

3) Check level of coolant in radiator

- If it is too low and the water being pumped is clean and pure, open radiator fill valve
- To bring the coolant up to proper level

g) Probable cause

1) Reduced engine power

h) Possible corrective action

1) No field correction

2) If additional pressure is essential, use another pumper

3) Take out-of-service until repaired

C. Pump is unable to supply its rated capacity

1. Symptom: The rpm reading on the tachometer is normal when compared to the UL plate

a) Probable cause - Two-stage pump

1) Transfer valve is wrong position

b) Possible corrective action

1) Transfer valve should be in PARALLEL or VOLUME position anytime 50% or more of the capacity of the pump is needed

c) Probable cause

1) Swing check valve is not opening completely

RETIRED CURRICULUM

PRESENTATION	APPLICATION
d) Possible corrective action 1) Remove strainer from large intake opening on each side of pump 2) Make sure valve swings freely • By inserting a rod and pushing on the face of valve 2. Symptom: Intake gauge registers "0" or has a positive pressure indicated a) Intake pressure or supply is not the problem b) <u>Probable cause</u> 1) Blockage in the waterways of the pump • An object lodged inside the impeller can reduce the capacity c) Possible corrective action 1) Thoroughly back-flush the pump • In accordance with manufacturer's recommendations and specifications • By connecting a supply line to the highest discharge outlet and opening the large intake fittings d) <u>Probable cause</u> 1) Wear in the pump, usually the clearance rings or relief valve • Allowing slippage from the discharge back to the intake e) Possible corrective action 1) Take out-of-service until repaired 3. Symptom: Intake compound gauge is registering a high vacuum, and the discharge pressure gauge is fluctuating (cavitation) a) <u>Probable cause</u> 1) Blockage of strainer at the intake fitting of pump	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
b) Possible corrective action 1) Disconnect intake line 2) Clean any accumulated debris from strainer c) <u>Probable cause</u> 1) Inadequate water supply or supply lines d) Possible corrective action 1) Connect additional supply line to intake of the pump 2) Reduce the amount of discharge lines being supplied 3) Lower the discharge pressure • To reduce the amount of water flowing through the lines 4. Symptom: Unable to develop enough engine rpm at full throttle to supply the rated capacity a) <u>Probable cause</u> 1) Flow requirements may be exceeding the capacity of the pump b) Possible corrective action 1) Capacity of pump in the SERIES or PRESSURE position is limited to 50% of its rated capacity at 250 psi and 2) 70% at 200 psi net pump pressure c) <u>Probable cause</u> 1) Throttle linkage may have slipped or be stuck d) Possible corrective action 1) Check linkage action 2) It may be possible to override action of the throttle	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
• By using the accelerator or hand throttle in the cab or Manually operating the linkage at the carburetor	
e) <u>Probable cause</u>	
1) Severe engine overheating can reduce the power available to drive the pump	
f) Possible corrective action	
1) Check engine temperature gauge	
2) Adjust auxiliary cooling valve	
• To maintain proper operating temperature	
3) Check level of coolant in radiator	
• If it is too low and the water being pumped is clean and pure, open radiator fill valve	
• To bring the coolant up to proper level	
g) <u>Probable cause</u>	
1) Reduced engine power	
h) Possible corrective action	
1) No field correction	
2) If additional pressure is essential, use another pumper	
3) Take out-of-service until repaired	
D. Pump overheats while in operation	
1. Symptom: Warning light is on or seen through physical observation	
a) <u>Probable cause</u>	
1) Inadequate flow through the pump while operating under pressure	
b) Possible corrective action	
1) Open booster cooling valve	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
2) Set circulator valve to TANK or SPILL position as appropriate	
3) Open tank fill valve if it is connected to the discharge side of the pump	
4) Use the booster line to maintain a minimum flow of water while pumping	
c) Probable cause	
1) Excessive throttle on relief valve-equipped pumps	
d) Possible corrective action	
1) Reduce engine rpm	
E. Relief valve is inoperative or slow acting	
1. Symptom: Pressure surges are excessive when individual hoselines are shutdown	
a) Probable cause	
1) Strainer in the pressure line to the pilot valve is dirty	
b) Possible corrective action	
1) Open the flush line while pumping clean water to back-flush the in-line strainer	
2) Remove strainer element and wash in clear water	
c) Probable cause	
1) Relief valve is corroded or dirty	
d) Possible corrective action	
1) If relief valve is equipped with a shut-off	
• Set the discharge pressure on the pump to 150 psi	
• Set the relief valve adjustment control to minimum	
• Alternately turn the valve off and on for 60 seconds	

RETIRED CURRICULUM

PRESENTATION	APPLICATION

2) If no control is provided
   - Set the pump pressure to 150 psi
3) Operate the relief valve by cranking the adjustment control in and out rapidly

e) Probable cause
   1) Defective relief valve

f) Possible corrective action
   1) Have relief valve serviced/repaired

II. TROUBLESHOOTING TANK OPERATIONS

A. Unable to establish an adequate operating pressure or a loss of pressure occurs when the first discharge valve is opened

1. Symptom: Pressure increases with the engine rpm up to a point, then holds steady or fluctuates

a) Probable cause
   1) Trapped air in pump

b) Possible corrective action
   1) Operate priming pump
      - Per department SOPs
   2) Switch transfer valve between SERIES to PARALLEL several times
      - At low rpm
   3) Open discharge in order to "burp" out air
   4) Open pump-to-tank valve or small handlines
      - Increase water velocity through pump

c) Probable cause
   1) Automatic transmission - intermittent slippage

d) Possible corrective action
   1) Have transmission repaired or adjusted

RETIRED CURRICULUM

PRESENTATION	APPLICATION

e) Probable cause

1) Low transmission fluid level

f) Possible corrective action

1) Increase fluid level

g) Probable cause

1) Transmission not remaining in correct pumping gear

h) Possible corrective action

1) Have transmission repaired or adjusted

B. Fluctuation of the pressure gauge and a reduction of discharge pressure when additional lines are put in service

1. Symptom: High vacuum reading on intake compound gauge

a) Probable cause

1) Tank-to-pump valve partially closed

b) Possible corrective action

1) Fully open and lock if possible

c) Probable cause

1) Tank-to-pump valve piping too small to supply the amount of water required from hoselines

d) Possible corrective action

1) Shutdown hoselines

- As fire permits

2) Reduce discharge pressure until fluctuation stops and pressure gauge begins to drop

C. While pumping, the discharge pressure drops to a low value and water supply is interrupted

1. Symptom: Compound gauge on the intake reads "0" or fluctuates; engine speed increases

RETIRED CURRICULUM

PRESENTATION	APPLICATION

a) Probable cause

1) Air leak in the pump

b) Possible corrective action

1) Check caps and valves on the intake side of the pump

c) Probable cause

1) Water supply from the tank is nearly or completely exhausted

d) Possible corrective action

1) Reduce pressure until gauge becomes steady and flow resumes

2) Arrange for another water supply as soon as possible

III. TROUBLESHOOTING HYDRANT OPERATIONS

A. Suction line collapses when the discharge valve to a hoseline is opened

1. Symptom: Intake pressure drops to less than "0" and discharge pressure also drops

a) Probable cause

1) Too small of a suction line for needed water flow

b) Possible corrective action

1) For 2½" or 3" suction line, bring into the large intake through a suction siamese or bell reducer

2. Symptom: Water is coming out of the ground around the barrel of the hydrant

a) Probable cause

1) Hydrant not fully opened

b) Possible corrective action

1) Turn hydrant counterclockwise until completely opened

RETIRED CURRICULUM

PRESENTATION	APPLICATION
B. While supplying water, the suction line collapses and the pump begins to cavitate 1. Symptom: Intake pressure drops to less than "0" and discharge pressure fluctuates and decreases a) <u>Probable cause</u> 1) Greater water demand by the hoselines being supplied b) Possible corrective action 1) Reduce the number of hoselines in service 2) Reduce the flow settings on the nozzles 3) Reduce the PDP until cavitation stops c) <u>Probable cause</u> 1) Additional demands on the water system may have reduced the residual pressure in the system d) Possible corrective action 1) Decrease water use by • Changing the nozzle settings • Taking attack lines out-of-service 2) Obtain a supplementary water supply from another hydrant, relay, or water shuttle C. While supplying water, the suction line is charged and the pump begins to cavitate 1. Symptom: Intake pressure drops to less than 0; discharge pressure fluctuates and decreases a) <u>Probable cause</u> 1) Pump inlet from hydrant closed 2) Clogged strainer b) Possible corrective action 1) Open pump inlet valve fully 2) Place an additional suction line in-service 3) Inspect inlet strainer for obstructions • Clean if necessary	

RETIRED CURRICULUM

PRESENTATION	APPLICATION

IV. TROUBLESHOOTING DRAFTING OPERATIONS

A. Pump will not prime

1. Symptom: Unable to get water into the pump through the hard suction hose and no vacuum reading is registered on the intake compound gauge

a) Probable cause

1) Drain valve left open

b) Possible corrective action

1) Make sure master drain valve is fully closed

2) Check individual drain valves for governor, auxiliary cooler, and so on

c) Probable cause

1) Intake valves left open or caps not tight

d) Possible corrective action

1) Tighten caps on large suction fittings that are not being used

2) Make sure tank-to-pump valve is closed

- If tank is empty

e) Probable cause

1) Intake relief valve may be leaking

f) Possible corrective action

1) If relief valve is equipped with a shut-off valve, close it

2) If it has fire hose threads on the discharge opening, put a cap on it

g) Probable cause

1) Suction hose connections are not airtight

h) Possible corrective action

1) Listen for air leaks at each connection

2) Tighten with a rubber mallet if any connection appears to be leaking

RETIRED CURRICULUM

PRESENTATION	APPLICATION
i) <u>Probable cause</u> 1) Suction hose connection to floating strainer not airtight j) Possible corrective action 1) Tighten coupling with a rubber mallet or spanner wrench k) <u>Probable cause</u> 1) Pump packing is too loose and leaking air l) Possible corrective action 1) Take out-of-service until packing can be adjusted or pump repacked m) <u>Probable cause</u> 1) Not operating the primer long enough to get rid of air n) Possible corrective action 1) Typical pump requires 15 seconds to prime through 20 feet of suction • May take as long as 30 seconds to prime completely o) <u>Probable cause</u> 1) Tank-to-pump valve not sealing with an empty tank p) Possible corrective action 1) Temporary • Partially fill tank 2) Permanent • Repair valve 3) Engage pump • Build up 100 psi • Discharge water from booster line • While keeping end of suction hose submerged	

RETIRED CURRICULUM

PRESENTATION	APPLICATION

- Take cap off end and install strainer
- Slowly close tank-to-pump valve
- While continuing to flow water from booster line
- Pump is now primed

q) Probable cause

1) Engine rpm is too low

r) Possible corrective action

1) Engine rpm should be as specified in manufacturer's instructions
   - Usually 1,000 to 1,200 rpm

s) Probable cause

1) No oil in the reservoir for the priming pump

t) Possible corrective action

1) Supply of oil should be carried on any pumper that uses oil for priming
   - If this is the case, oil can be put in the reservoir to replenish supply
2) If regular priming oil is not available, putting water in reservoir may enable primer to operate
   - It should be thoroughly cleaned out and a supply of oil put in at the first opportunity

2. Symptom: Electric motor will not operate to drive the primer

a) Probable cause

1) Bad battery or poor connection between the cable and battery terminals

b) Possible corrective action

1) Inspect battery terminals
   - If they are corroded, may be possible to loosen the fastening and clean the terminal sufficiently to run

RETIRED CURRICULUM

PRESENTATION	APPLICATION

3. Symptom: Very little air is being discharged from the primer
   a) Probable cause
      1) Priming valve may have not opened
   b) Possible corrective action
      1) Ensure that the priming activation lever is fully engaged in order to open the valve
   c) Probable cause
      1) Defective primer
   d) Possible corrective action
      1) If primer will not operate for mechanical reasons
         - Prime the pump by connecting the hard suction hose to the pump

           and
         - Installing the cap on the end of the hose

           then
         - Submerging hose under water
         - Open tank-to-pump valve
         - Allowing suction hose to fill with water as well as the pump

B. Pump loses its prime when the first discharge valve is opened and water begins to flow
   1. Symptom: Discharge pressure gauge drops sharply
      a) Probable cause
         1) Valve may have been opened too rapidly
      b) Possible corrective action
         1) Carefully observe pressure gauge
         2) While slowly opening discharge valve
         3) If pressure begins to drop suddenly
            - Pause and allow it to stabilize before continuing

RETIRED CURRICULUM

PRESENTATION	APPLICATION
c) <u>Probable cause</u> 1) Pump not completely primed 2) Still had some air trapped in it when primer was released d) Possible corrective action 1) Allow primer to continue to operate • Until a steady stream of water is discharging from it • Before closing the priming valve 2) If pressure drops suddenly while opening a discharge valve, operate primer momentarily • To remove any remaining air from the pump e) <u>Probable cause</u> 1) Pump may not be turning fast enough to sustain the prime when water begins to flow f) Possible corrective action 1) Adjust discharge pressure to 75 psi or more 2) Before opening the discharge valve g) <u>Probable cause</u> 1) Priming valve can stick causing air to leak into pump h) Possible corrective action 1) Make sure priming valve control is in CLOSED position 2) Exercise valve • To clear any debris from valve seat i) <u>Probable cause</u> 1) Rock or debris in impeller	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
j) Possible corrective action	
1) Take out-of-service until repaired	
2. Symptom: Reading on pressure gauge drops sharply and intake gauge returns to "0" reading	
a) Probable cause	
1) High spot in suction line trapped a quantity of air when pump was primed	
2) Air drawn into pump when the water began to move through suction hose	
b) Possible corrective action	
1) Attempt to eliminate high spot, by moving suction hose	
2) Prime pump again	
3) If high spot cannot be eliminated, it may be possible to scavenge the air from the suction hose	
• By operating the primer again each time the pressure begins to drop	
C. Pump loses its prime during the course of a pumping operation	
1. Symptom: Pump loses its prime when all nozzles are closed and no water is flowing	
a) Probable cause	
1) Air leak on the intake side of pump	
b) Possible corrective action	
1) Make sure all connections are airtight	
c) Probable cause	
1) Packing may be misadjusted	
• Allowing air to break into the pump around the shaft	
d) Possible corrective action	
1) Open a discharge outlet	

RETIRED CURRICULUM

PRESENTATION	APPLICATION

2) Allow water to flow at all times
   - To maintain a higher vacuum reading in the intake side of the pump
3) If the problem becomes acute, take out-of-service until repaired

2. Symptom: Pump loses its prime when it is operating near its maximum capacity and the vacuum reading on the intake gauge is near "0" and is fluctuating
   a) Probable cause
      1) Whirlpool over strainer is allowing air to get into the pump through the suction hose
   b) Possible corrective action
      1) Put a board or other object over the whirlpool
         - To break up the whirling motion

           and
         - Stop air from getting into the suction hose
   c) Probable cause
      1) Air leak on the intake side of the pump
   d) Possible corrective action
      1) Check all connections

D. Pump goes into cavitation when the flow increases
   1. Symptom: Intake gauge registers more than 22 inches of vacuum, the pressure gauge fluctuates and decreases reading
      a) Probable cause
         1) Flow exceeds the capacity of the pump at the lift that is required
            - Capacity of pump decreases as the lift increases

RETIRED CURRICULUM

PRESENTATION	APPLICATION

b) Possible corrective action

1) Reduce flow or demand on pump

- At a 20-foot lift, the lift capacity of the pump is only 60% of what is would be with a 10-foot lift

c) Probable cause

1) Suction line may be partially blocked

d) Possible corrective action

1) Debris blocking strainer on suction hose

- Clean strainer manually

2) Debris is trapped in strainer at the pump intake

- Shutdown the pump
- Remove suction hose
- Clean the strainer

e) Probable cause

1) Inner rubber liner of suction hose has become separated from hose

2) Resulting in restriction caused by the "bubble" of inner liner

f) Possible corrective action

1) Suction hose can collapse

- Will have to be replaced if reduced capacity is unacceptable

2) Replace suction hose

V. TROUBLESHOOTING RELAY PUMP OPERATIONS

A. Intake supply line collapses when throttle setting is increased to establish initial discharge pressure as required

1. Symptom: Intake pressure gauge reading is negative, reading vacuum instead of pressure

RETIRED CURRICULUM

PRESENTATION	APPLICATION

a) Probable cause

1) Dump line or uncapped discharge used to waste water while establishing the relay may still be open

b) Possible corrective action

1) Close the valve to any uncapped discharge or dump line

2) If pumper is operating as terminal unit

- Adjust the valve on the dump line

  To bring the residual pressure at the intake of pump to 50 psi

c) Probable cause

1) Attack pumper may be attempting to take more water from the relay than it can supply

d) Possible corrective action

1) Notify water supply officer that relay is unable to supply amount of water needed

- Additional supply lines need to be put into service

2) Reduce discharge pressure

- Until intake gauge registers a positive reading

B. While the relay is operating, the intake pressure increases above 50 psi

1. Symptom: Intake pressure gauge is reading above 50 psi and discharge pressure also increases accordingly

a) Probable cause

1) Changes in flow of attack line cause friction loss to decrease and residual pressure to increase

b) Possible corrective action

1) No action is necessary unless pressure increase becomes dangerous

RETIRED CURRICULUM

PRESENTATION	APPLICATION
2) Minor variations are to be expected 3) Frequent adjustments are undesirable C. While the relay is operating, the intake pressure increases dangerously 1. Symptom: Intake pressure gauge is reading above 150 psi and discharge pressure is above 200 psi a) <u>Probable cause</u> 1) Hoselines have been shutdown with no corresponding dumping of excess water b) Possible corrective action 1) Open uncapped discharge or dump line 2) Until intake residual pressure returns to 50 psi	

RETIRED CURRICULUM

SUMMARY:

The driver/operator must be able to recognize and correct problems that may occur when pumping. Conditions that may affect pumping performance are cavitation, overheating, and inadequate water supply to name a few.

EVALUATION:

The student will complete the activity and written test at a time determined by the instructor.

ASSIGNMENT:

Review your notes and read Fire Apparatus Driver/Operator 1B Student Supplement, SFT, 2008 Edition, Pages 70-75 and Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 366-373 in order to prepare yourself for the upcoming test. Study for our next session.

RETIRED CURRICULUM

GROUP ACTIVITY 5-6-1

TITLE:	What's Wrong!
TIME FRAME:	1:00
MATERIALS NEEDED:	• Writing board/pad with markers/erasers
INTRODUCTION:	This activity provides the students the opportunity to evaluate a problem associated to a pumping operation and identify one or more probable causes and possible corrective actions. The students ***cannot*** use the Pumping Apparatus Driver/Operator Handbook to complete this activity.
DIRECTIONS:	1. Divide the students into 5 groups (1-5). 2. In your group, develop a probable cause and possible corrective action for each problem based on the symptom provided. 3. Record your responses on the writing board/pad. 4. You have 30 minutes to complete this activity. 5. Be prepared to discuss your answers with the class.

RETIRED CURRICULUM

GROUP 1

	OPERATION	PROBLEM	SYMPTOM
1	Common to all	Unable to get a reading on the pressure gauge when the pump is put in service.	Green light indicating that the pump shift transfer is complete is not illuminated.
2	Common to all	Pump will not develop sufficient pressure.	Indicator light shows that the relief valve is closed.
3	Common to all	Pump is unable to supply its rated capacity.	Unable to develop enough engine rpm at full throttle to supply the rated capacity.
4	TANK	While pumping, the discharge pressure drops to a very low value and water supply is interrupted.	Compound gauge on the intake reads "0" or fluctuates; engine speed increases.
5	DRAFT	Pump will not prime.	Electric motor will not operate to drive the primer.
6	DRAFT	Pump loses its prime during the course of a pumping operation.	Pump loses its prime when it is operating near its maximum capacity. Vacuum reading on the intake gauge is near "0" and is fluctuating.

RETIRED CURRICULUM

GROUP 2

	OPERATION	PROBLEM	SYMPTOM
1	Common to all	Unable to get a reading on the pressure gauge when the pump is put in service.	Green light is on, no mph reading registers on the speedometer.
2	Common to all	Pump will not develop sufficient pressure.	Engine rpm cannot be raised to the value required as determined by the UL plate, even at full throttle. Tachometer reading is low; pressure gauge reading is too low.
3	Common to all	Pump overheating while in operation.	Pump overheating warning light is on or by physical observation.
4	HYDRANT	Suction line collapses when the discharge valve to a hoseline is opened.	Intake pressure drops to less than "0" and the discharge pressure also drops.
5	DRAFT	Pump will not prime.	Very little air is being discharged from the primer.
6	DRAFT	Pump goes into cavitation when the flow increases.	Intake gauge registers more than 22 inches of vacuum; the pressure gauge fluctuates and decreases reading.

RETIRED CURRICULUM

GROUP 3

	OPERATION	PROBLEM	SYMPTOM
1	Common to all	Unable to get a reading on the pressure gauge when the pump is put in service.	Speedometer reading is normal for pump operation. All indications are correct and rpm reading is as specified.
2	Common to all	Pump is unable to supply its rated capacity.	The rpm reading on the tachometer is normal when compared to the UL plate.
3	Common to all	Relief valve is inoperative or slow acting.	Pressure surges are excessive when individual hoselines are shutdown.
4	HYDRANT	Suction line collapses when the discharge valve to a hoseline is opened.	Water coming out of the ground around the barrel of the hydrant.
5	DRAFT	Pump loses its prime when the first discharge valve is opened and water begins to flow.	Discharge pressure gauge drops sharply.
6	RELAY	Intake supply line collapses when the throttle setting is increased to establish the initial discharge pressure as required.	Intake pressure gauge reading is negative (reading vacuum instead of pressure).

RETIRED CURRICULUM

GROUP 4

	OPERATION	PROBLEM	SYMPTOM
1	Common to all	Pump will not develop sufficient pressure.	The rpm reading on the tachometer is normal when compared with the UL plate.
2	Common to all	Pump is unable to supply its rated capacity.	Intake gauge registers "0" or has a positive pressure indicated.
3	TANK	Unable to establish an adequate operating pressure or a loss of pressure occurs when the first discharge valve is opened.	Pressure increases with the engine rpm up to a point, then holds steady or fluctuates.
4	HYDRANT	While supplying water, the suction line collapses and the pump begins to cavitate.	Intake pressure drops to less than "0" and discharge pressure fluctuates and decreases.
5	DRAFT	Pump loses its prime when the first discharge valve is opened and water begins to flow.	Reading on the pressure gauge drops sharply and the intake gauge returns to the "0" reading.
6	RELAY	While the relay is operating, the intake pressure increases above 50 psi.	Intake pressure gauge is reading above 50 psi and the discharge pressure also increases accordingly.

RETIRED CURRICULUM

GROUP 5

	OPERATION	PROBLEM	SYMPTOM
1	Common to all	Pump will not develop sufficient pressure.	Relief valve is operating and the indicator light is on.
2	Common to all	Pump is unable to supply its rated capacity.	Intake compound gauge is registering a high vacuum and the discharge pressure gauge is fluctuating (cavitation).
3	TANK	Fluctuation of the pressure gauge and a reduction of discharge pressure when additional lines are put in service.	High vacuum reading on the intake compound gauge.
4	DRAFT	Pump will not prime.	Unable to get water into the pump through the hard suction hose. No vacuum reading is registered on the intake compound gauge.
5	DRAFT	Pump loses its prime during the course of a pumping operation.	Pump loses its prime when all nozzles are closed and no water is flowing.
6	RELAY	While the relay is operating, the intake pressure increases dangerously.	Intake pressure gauge is reading above 150 psi, the discharge pressure is above 200 psi.

RETIRED CURRICULUM

RETIRED CURRICULUM

TOPIC: 5-7: Principles Of Tandem Pumping Operations

TIME FRAME: 0:15

LEVEL OF INSTRUCTION: Level II

AUTHORITY: 2009 NFPA 1002: Sections 5.2.1 and 5.2.2

BEHAVIORAL OBJECTIVE:

Condition: Given a written test

Behavior: The student will confirm a knowledge of principles of tandem pumping operations by completing the written test

Standard: With a minimum 80% accuracy according to the information contained in Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 115 and 584-585

MATERIALS NEEDED:

- Writing board/pad with markers/erasers
- Appropriate audiovisual equipment
- Appropriate audiovisual materials

REFERENCES:

- Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 115 and 584-585

PREPARATION: Each instructor must develop a motivational statement on why the student should learn the upcoming material. The purpose is to establish relevancy of the lesson to the audience. The ACID BASE acronym can be used to help develop student motivation.

Attention (attract)	**B**egin
Curiosity (arouse)	**A**ssociation
Interest (create)	**S**tudents
Desire (stimulate)	**E**xperience

Cite examples or use related illustrations of near-miss incidents, injuries, or fatalities. Write this section "from the heart." Be creative! Have fun with it or be serious, but remember the goal is to stimulate student motivation.

PRESENTATION	APPLICATION
	SLIDE: 5-7-1
	SLIDE: 5-7-2
I. TANDEM PUMPING PRINCIPLES	
A. Definition	
1. A short relay operation in which a pumper taking water from the supply source (supply pumper) pumps into the intake of the second pumper (attack pumper)	
	SLIDE: 5-7-3
B. Purpose	
1. Used when pressures higher than the capability of a single pump are required	
2. Attack pumper boosts the pressure of the water even higher	
	What are some examples of when a higher water pressure is required?
a) Water required to supply	
1) High-rise sprinklers	
2) High-rise standpipes	
3) Long hose lays	
b) Attack pumper is close by	
1) Supply pumper is placed directly on hydrant and supports supply lines	
	SLIDE: 5-7-4
II. TANDEM PUMPING PROCEDURES	
A. Supply pumper connects to hydrant	
1. Using largest supply line	
B. Attack pumper positioned nearby	
1. No further than 300 feet away	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
C. Supply pumper connects line to attack pumper 1. Supply pumper discharge line to intake of attach pumper 2. Attack pumper is able to discharge water at a much higher pressure than a single engine could have supplied 3. Pumps are operating in series	**SLIDE: 5-7-5**

RETIRED CURRICULUM

SUMMARY:

At most incidents where pump operations are used, a single engine is able to achieve the necessary pressure required for mitigation. Yet, when the unique situation occurs where greater water pressure is required than the responding pumper can supply, a tandem pumping operation must be immediately implemented.

EVALUATION:

The student will complete the written test at a time determined by the instructor.

ASSIGNMENT:

Review your notes and read Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 115 and 584-585 in order to prepare yourself for the upcoming test. Study for our next session.

RETIRED CURRICULUM

RETIRED CURRICULUM

TOPIC: 5-8: Principles Of Dual Pumping Operations

TIME FRAME: 0:15

LEVEL OF INSTRUCTION: Level II

AUTHORITY: 2009 NFPA 1002: Sections 5.2.1 and 5.2.2

BEHAVIORAL OBJECTIVE:

Condition: Given a written test

Behavior: The student will confirm a knowledge of principles of dual pumping operations by completing the written test

Standard: With a minimum 80% accuracy according to the information contained in Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 113-115 and 575

MATERIALS NEEDED:

- Writing board/pad with markers/erasers
- Appropriate audiovisual equipment
- Appropriate audiovisual materials

REFERENCES:

- Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 113-115 and 575

PREPARATION: Each instructor must develop a motivational statement on why the student should learn the upcoming material. The purpose is to establish relevancy of the lesson to the audience. The ACID BASE acronym can be used to help develop student motivation.

Attention (attract)	**B**egin
Curiosity (arouse)	**A**ssociation
Interest (create)	**S**tudents
Desire (stimulate)	**E**xperience

Cite examples or use related illustrations of near-miss incidents, injuries, or fatalities. Write this section "from the heart." Be creative! Have fun with it or be serious, but remember the goal is to stimulate student motivation.

PRESENTATION	APPLICATION
	SLIDE: 5-8-1
	SLIDE: 5-8-2
I. DUAL PUMPING PRINCIPLES	
A. Definition	
1. An operation where a large volume hydrant is used to supply two pumpers by connecting the pumpers intake-to-intake	
2. A second pumper receives the excess water not being pumped by the first pumper, which is directly connected to the water supply source	
	SLIDE: 5-8-3
B. Purpose	
1. To provide adequate water supply and pressure	
a) May supply more than one pumper	
	What are the advantages of dual pumping operations?
	SLIDE: 5-8-4
C. Advantages	
1. Efficient water use	
2. Shorter hose lays	
3. Rapid deployment of additional hoselines	
4. Apparatus may be grouped together	
	SLIDE: 5-8-5
D. Dual pumping procedures	
1. First pumper connects to hydrant	
a) Using largest supply line	
2. Second pumper position	
a) Intake-to-intake with first pumper	
b) Dual pumping may be put into operation while first pumper is actively flowing water	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
	SLIDE: 5-8-6
3. Fire hydrant	
a) Closed until the intake gauge of first pumper reads 0 to 5 psi	
1) The throttle of first engine will need adjustment	
b) When volume of discharge and intake become equal	
1) Cap of the unused intake may now be removed	
	SLIDE: 5-8-7
c) First pumper	
1) Equipped with a keystone or gate valve on its unused intake	
• Gate valve can be used to restrict flow	
d) Second pumper	
1) Connected by intake hose to the unused large intake of first pumper	
2) Fire hydrant opened completely	
3) Pumps water to desired hoselines	
	SLIDE: 5-8-8
4) Water supply of second pumper is the water that is not being used by the first pumper, as it passes through the pump of the first pumper	

RETIRED CURRICULUM

SUMMARY:

As the driver/operator responsible for supplying water and a given emergency, it is imperative that you know your local water capabilities and unique hydrant characteristics. Armed with this knowledge, you should be able to immediately recognize and implement a dual pumping operation appropriately. The ease and efficiency of a proper dual pumping operation will significantly improve the overall mitigation by maximizing the available resources.

EVALUATION:

The student will complete the written test at a time determined by the instructor.

ASSIGNMENT:

Review your notes and read Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 113-115 and 575 in order to prepare yourself for the upcoming test Study for our next session.

RETIRED CURRICULUM

RETIRED CURRICULUM

TOPIC: 5-9: Principles And Practices Of Foam Operations

TIME FRAME: 1:00

LEVEL OF INSTRUCTION: Level II

AUTHORITY: 2009 NFPA 1002: Sections 5.2.3 and 8.2.3

BEHAVIORAL OBJECTIVE:

Condition: Given a written test

Behavior: The student will confirm a knowledge of principles and practices of foam operations by completing the written test

Standard: With a minimum 80% accuracy according to the information contained in Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 451-480

MATERIALS NEEDED:

- Writing board/pad with markers/erasers
- Appropriate audiovisual equipment
- Appropriate audiovisual materials

REFERENCES:

- Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 451-480

PREPARATION: Each instructor must develop a motivational statement on why the student should learn the upcoming material. The purpose is to establish relevancy of the lesson to the audience. The ACID BASE acronym can be used to help develop student motivation.

Attention (attract)	**B**egin
Curiosity (arouse)	**A**ssociation
Interest (create)	**S**tudents
Desire (stimulate)	**E**xperience

Cite examples or use related illustrations of near-miss incidents, injuries, or fatalities. Write this section "from the heart." Be creative! Have fun with it or be serious, but remember the goal is to stimulate student motivation.

PRESENTATION	APPLICATION
	SLIDE: 5-9-1
	SLIDE: 5-9-2
I. FOAM FIRE STREAMS	
A. Initially used for industrial and airport fire protection	
1. Now a part of municipal fire departments	
2. Due to the magnitude and frequency of hazardous materials incidents requiring foam for their control	
B. Types of foam	
	How many basic types of foam are there?
1. There are two basic types of foam	
a) Chemical	
1) Produced as a result of a reaction between two chemicals	
2) Considered obsolete and are rarely, if ever, found in use today	
b) Mechanical	
1) Mechanical foams must be proportioned, mixed with water and aerated (mixed with air) before they can be used	
2) To produce quality fire fighting foam, foam concentrate, water, air, and mechanical aeration are needed	
• Must be present and blended in the correct ratios	
	SLIDE: 5-9-3
C. Foam components	
1. Foam concentrate	
a) Raw foam liquid as it rests in its storage container before the introduction of water and air	
b) Should match the fuel to which they are applied	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
2. Foam proportioner a) The device that introduces foam concentrate into the water stream to make the foam solution 3. Foam solution a) The mixture of foam concentrate and water before the introduction of air 4. Foam a) The completed product after air is introduced into the foam solution (also known as finished foam) b) Aeration should produce an adequate amount of bubbles to form an effective foam blanket	
II. FOAM CONCENTRATES A. Class A	
	Class A foams are designed for what types of materials? **SLIDE: 5-9-4**
1. Designed for normal combustible materials a) Class A foam is the formulation of specialty hydrocarbon surfactants b) Reduces surface tension of the water in the foam solution 2. Biodegradable a) May harm wildlife b) Especially near bodies of water 3. These foams are corrosive 4. Have super cleaning ability a) Little adverse effect on equipment due to the low percentages used b) Equipment should be thoroughly flushed	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
5. Class A foams are used a) Where maximum absorption is needed b) On vertical surfaces c) Or when a combination of both are needed	
B. Class B	What types of fuels are Class B foams used for? **SLIDE: 5-9-5**
1. For flammable liquids 2. There are two types of classifications for Class B fuels - hydrocarbon and polar solvents a) Hydrocarbon fuels 1) Examples • Crude oil • Fuel oil • Gasoline • Benzene • Naphtha • Jet fuel • Kerosene, etc. 2) Hydrocarbons are petroleum based and float on water 3) Standard fire fighting foam floats on the surface of hydrocarbon fuels b) Polar solvent fuels 1) Liquids that are miscible in water or fuels that absorb water 2) Examples • Alcohol • Acetone • Lacquer	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
• Thinner • Ketones • Esters • Gasoline that contains 10% or more alcohol	
c) Improper matching of the proper foam concentrate with the fuel will result in an unsuccessful extinguishing attempt	
d) Could endanger fire fighters	
3. Types of Class B foam concentrates	
	SLIDE: 5-9-6
a) Regular protein foams	
1) Derived from naturally occurring sources of protein	
	What are some examples of protein sources used to make protein foams?
2) Examples - hoof, horn, or feather meal	
3) Rarely used in the fire service today.	
4) Very good heat stability and resists burn back	
5) Not as mobile or fluid on the fuel surface as other types of low-expansion	
	SLIDE: 5-9-7
b) Fluoroprotein foam is a combination protein-based and synthetic-based foam	
1) Derived from protein	
2) Has fluorochemical surfactants similar to those for AFFF	
3) Provides a strong "security blanket" for long-term vapor suppression	
4) Can be formulated to be alcohol resistant by adding ammonia	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
	SLIDE: 5-9-8
c) Aqueous film forming foam (AFFF)	
1) Nearly completely synthetic	
2) Has an air-/vapor-excluding film that is released ahead of the foam blanket	
3) The fast-moving foam blanket then moves across the surface and around objects	
• Adding further insulation	
4) As the aerated foam blanket continues to drain its water, more film is released	
	What ability or quality does AFFF have?
• Giving it the ability to "heal" over areas where the foam blanket is disturbed	
5) Alcohol-resistant AFFFs are available from most foam manufacturers	
• For polar solvent fuels	
	SLIDE: 5-9-9
d) Film forming fluoroprotein foam (FFFP)	
1) Fluoroprotein foam with aqueous film-forming foam (AFFF) capabilities	
	SLIDE: 5-9-10
e) High-expansion foams	
1) Special-purpose foams	
2) Detergent based	
3) They have a low water content	
• Minimizes water damage	
4) Used in concealed spaces	
• Such as basements, in coal mines, and in other subterranean spaces	
5) Used in fixed-extinguishing systems for specific industrial uses	
• Such as rolled or bulk paper storage	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
	SLIDE: 5-9-11
III. HOW FOAM WORKS	
A. Separating	
1. Creates a barrier between the fuel and the fire	
B. Cooling	
1. Lowers the temperature of the fuel and adjacent surfaces	
C. Suppressing	
	What does suppressing do?
1. Prevents the release of flammable vapors	
	SLIDE: 5-9-12
IV. PROPORTIONING	
A. Class A	
1. Normally mixed at ratios of 0.2% to 1%	
2. Manufacturer specific	
a) Can be mixed at a higher ratio for a thick blanket	
1) For exposure protection and fire breaks	
2) Can be mixed at a lower ratio	
• To allow foam to sink into fuels	
B. Class B	
	What proportioning ratios are used for hydrocarbon fuels?
1. Mixed at 1-3% for hydrocarbons	
2. Mixed at 3-6% for polar solvents	
	SLIDE: 5-9-13
C. Methods of proportioning	
1. Induction (eduction)	
a) Uses the pressure energy in the stream of water to induct (draft) foam concentrate into the fire stream	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
2. Injection	
a) The use of an external pump or head pressure to force foam concentrate into the fire stream at the correct ratio	
	SLIDE: 5-9-14
3. Batch mixing	
a) An appropriate amount of foam concentrate is poured directly into a tank of water	
b) The most simple method	
4. Premixing	
a) Premeasured portions of water and foam concentrate are mixed in a container	
V. PROPORTIONING EQUIPMENT	
A. Portable low energy systems	
	SLIDE: 5-9-15
1. In-line eductors	
a) Most common	
b) Works off of the Venturi principle	
1) Flow of water through the eductor creates a vacuum near the outlet side of the eductor	
• Over a reduced opening in the eductor	
2) This vacuum drafts solution into the water stream through a pick-up tube connected to the eductor	
	SLIDE: 5-9-16
c) Operational rules	
1) Eductor must control flow through the system	
	What should the pressure be at the eductor outlet?
2) Pressure at the eductor outlet must not exceed 65-70% of eductor inlet pressure	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
3) Foam concentration is only correct at rated eductor inlet pressures • Using lower than rated pressures results in a concentration that is too rich	
	SLIDE: 5-9-17
4) Eductors must be thoroughly flushed after each use 5) Metering valves must be set to match foam concentrate and burning fuel 6) Foam concentrate inlet to the eductor must not be more than 6 feet above the surface of the foam concentrate	
	SLIDE: 5-9-18
2. Foam nozzle eductors a) Operates on the same principles as the in-line eductor b) A major disadvantage is that the foam concentrate must be located near the nozzle 1) Cannot be moved quickly	
	SLIDE: 5-9-19
3. Self-educting master stream foam nozzles	When are these used?
a) Used for flows in excess of 350 gpm b) Designed to operate at lower pressures c) May be used with a jet ratio controller 1) Allows concentrate supply to be up to 3,000 feet away 2) Also allows for changes in elevation up to 50 feet	
	SLIDE: 5-9-20
B. Apparatus-mounted low energy systems 1. The majority of these systems can be used for Class A and Class B concentrates	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
	SLIDE: 5-9-21
2. Installed in-line eductors	
a) Operate on the same principles as the portable in-line eductor	
b) Can be supplied by pick-up tubes out of 5-gallon buckets or by on-board foam tanks	
	SLIDE: 5-9-22
3. Around-the-pump proportioners	
a) One of the most common types of built-in proportioners installed in mobile fire apparatus today	
b) Consists of a small return (bypass) water line connected from the discharge side of the pump back to the intake side of the pump	
c) An in-line eductor is positioned on this bypass line	
	SLIDE: 5-9-23
d) A valve just off the discharge controls the flow of water through the bypass line	
e) When the valve is open, a small amount of water (10-40 gpm) discharged from the pump is directed through the bypass piping	
f) Water passing through the eductor draws concentrate into the bypass piping	
	SLIDE: 5-9-24
g) The resulting foam solution is then supplied back to the intake side of the pump	
h) It is then pumped to the discharge and into the hoseline	
	What is a major disadvantage with these proportioners?
	SLIDE: 5-9-25

RETIRED CURRICULUM

PRESENTATION	APPLICATION
i) A major disadvantage of older types is that it cannot take advantage of incoming pressure 1) Inlet pressures greater than 10 psi will prevent concentrate from entering the intake 2) This can only be used when operating from the apparatus water tank 3) Newer units can handle inlet pressures up to 40 psi	
	SLIDE: 5-9-26
4. Bypass-type balanced pressure proportioners a) There is a foam concentrate line connected to each fire pump discharge outlet b) System is designed to supply foam concentrate to the outlet at the same pressure at which the fire pump is supplying water to that discharge 1) By PTO or other power source	
	SLIDE: 5-9-27
c) The pump discharge are jointly monitored by a hydraulic pressure control valve 1) It ensures that the concentrate pressure and water pressure are balanced d) The concentrate supplied is delivered by size of stream, relating to the overall discharge outlet size 1) In other words a 3% foam would have a concentrate stream that was 3% of the entire discharge stream 2) This works because the concentrate is delivered at the same pressure as water • More accurate	
	SLIDE: 5-9-28
e) Its primary advantage is that it can monitor demand and adjust accordingly	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
f) A disadvantage may be that it can cause agitation of the stream	
	SLIDE: 5-9-29
5. Variable-flow variable-rate direct injection systems	
a) This system injects concentrate directly into the water stream	
	How is the concentrate amount determined?
1) Using an electrically or hydraulically powered positive displacement pump	
b) Amount delivered into the stream is based on flow, not pressure	
1) Flow is monitored and the speed of the positive displacement pump is regulated	
	SLIDE: 5-9-30
c) Its primary advantage is that it can accurately adjust to changes within its design limits	
1) It can also be used with high energy foam systems	
d) A disadvantage is that it must be installed within the piping before any discharge manifolds	
	SLIDE: 5-9-31
6. Variable-flow demand-type balanced pressure proportioners	
a) Basically a Venturi-type system within the water line	
b) Advantages	
1) Concentrate flow and pressure match demand	
2) Does not recirculate the concentrate back to the foam tank(s)	
3) Does not require flushing after use	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
	SLIDE: 5-9-32
c) Disadvantages	
1) There are discharge ratio controllers that reduce discharge area	
2) Pressure drops across discharges are greater than on regular pumps	
	SLIDE: 5-9-33
7. Batch mixing	
a) Simplest means	
b) Amount mixed is based on tank size	
	What is a disadvantage to batch mixing?
c) Disadvantages	
1) Contaminates the water tank and pump	
• Thorough flushing is required	
2) Does not allow for continuous operation	
	SLIDE: 5-9-34
C. High energy foam systems – compressed air foam systems	
1. Compressed air is introduced into the foam solution prior to discharge into the hoseline	
a) Generated by the use of a direct-injection proportioning system and a standard centrifugal pump coupled with	
1) An air compressor	
or	
2) Stored air	
2. Turbulence of air and solution in the pipe/hoseline creates a finished foam	
a) Also allows foam to be discharged at greater distances than regular foams	
3. Used with Class A foams	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
	What are some advantages to compressed air foam systems?
	SLIDE: 5-9-35
4. Advantages	
a) Greater reach	
b) Uniform, durable bubbles	
c) Adheres to surfaces	
d) Hoselines are lighter	
5. Disadvantages	
a) Expensive	
b) Hose reaction can be erratic	
1) Especially with a hose rupture	
c) Additional training is necessary	
	SLIDE: 5-9-36
D. Foam application devices	
1. Handline nozzles	
a) Solid bore	
b) Fog	
c) Air-aspirating	
1) Introduces air by Venturi effect	
2. Master stream foam nozzles	
3. Medium and high-expansion foam generating devices	
	What applications are associated with medium and high-expansion foams?
a) Often associated with total flooding applications	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
	SLIDE: 5-9-37
E. Foam storage	
1. Pails	
2. Barrels	
3. Apparatus tanks	
a) On fire apparatus equipped with integral, onboard foam proportioning systems	
	SLIDE: 5-9-38
F. Expansion ratios	
1. Low expansion	
a) Up to 50:1	
2. Medium expansion	
a) 50:1 to 300:1	
3. High expansion	
a) 300:1 to around 1250:1	
VI. OPERATIONAL TROUBLESHOOTING	
	SLIDE: 5-9-39
A. Symptom: Failure to generate foam or generating poor quality foam	
	What is one reason for this?
1. <u>Possible cause</u>	
a) Failure to match eductor and nozzle flow	
1) No foam is in the pick-up tube	
2. Possible corrective action	
a) Check manufacturer's recommendations and specifications for eductor and nozzle	
	SLIDE: 5-9-40
3. <u>Possible cause</u>	
a) Air leaks at fittings that cause loss of suction	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
4. Possible corrective action a) Inspect and tighten all fittings b) Remove defective components from operation 1) Damaged hose 2) Broken nozzle, etc.	
	SLIDE: 5-9-41
5. <u>Possible cause</u> a) Dirty or clogged foam passages from improper cleaning 6. Possible corrective action a) Clean all proportioning equipment components after each use	
	SLIDE: 5-9-42
7. <u>Possible cause</u> a) Partially closed nozzle control that results in a higher nozzle pressure 8. Possible corrective action a) Open nozzle control completely	
	SLIDE: 5-9-43
9. <u>Possible cause</u> a) Too long a hose lay on the discharge side of the eductor 10. Possible corrective action a) Reduce hose lay to recommended length	
	SLIDE: 5-9-44
11. <u>Possible cause</u> a) Kinked hose 12. Possible corrective action a) Unkink hose	
	SLIDE: 5-9-45

RETIRED CURRICULUM

PRESENTATION	APPLICATION
13. <u>Possible cause</u> a) Nozzle too far above eductor causing excessive elevation pressure 14. Possible corrective action a) Lower nozzle b) Reposition hose configuration	
	SLIDE: 5-9-46
15. <u>Possible cause</u> a) Mixing different types of foam concentrates 1) Mixture becomes too viscous to pass through the eductor 16. Possible corrective action a) Use foam only as recommended	

RETIRED CURRICULUM

SUMMARY:

Successful foam operations are not "ready-made." They involve not only product and equipment familiarity, but also application in various settings. In other words, the driver/operator not only needs a good knowledge base, but practical reasoning and training. Foam operations should be tested and practiced in order to be successful. There are too many required elements to leave it up to chance.

EVALUATION:

The student will complete the written test at a time determined by the instructor.

ASSIGNMENT:

Review your notes and read Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 451-480 in order to prepare yourself for the upcoming test. Study for our next session.

RETIRED CURRICULUM

RETIRED CURRICULUM

TOPIC: 5-10: Sprinkler And Standpipe Support

TIME FRAME: 0:30

LEVEL OF INSTRUCTION: Level II

AUTHORITY: 2009 NFPA 1002: Section 5.2.4

BEHAVIORAL OBJECTIVE:

Condition: Given a written test

Behavior: The student will confirm a knowledge of sprinkler and standpipe support by completing the written test

Standard: With a minimum 80% accuracy according to the information contained in Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 347-348

MATERIALS NEEDED:

- Writing board/pad with markers/erasers
- Appropriate audiovisual equipment
- Appropriate audiovisual materials

REFERENCES:

- Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 347-348

PREPARATION: Each instructor must develop a motivational statement on why the student should learn the upcoming material. The purpose is to establish relevancy of the lesson to the audience. The ACID BASE acronym can be used to help develop student motivation.

Attention (attract)	**B**egin
Curiosity (arouse)	**A**ssociation
Interest (create)	**S**tudents
Desire (stimulate)	**E**xperience

Cite examples or use related illustrations of near-miss incidents, injuries, or fatalities. Write this section "from the heart." Be creative! Have fun with it or be serious, but remember the goal is to stimulate student motivation.

PRESENTATION	APPLICATION
	SLIDE: 5-10-1
	SLIDE: 5-10-2
I. SUPPORTING AUTOMATIC SPRINKLERS	
A. Water supplies for sprinkler systems are designed to supply only part of the total number of sprinklers installed on the system	
1. In the event of a large fire, the sprinkler system will need an outside source of water and pressure to be effective	
B. Pre-incident plans should identify all occupancies in the community that have automatic sprinkler systems	
	What information should be included in pre-fire plans concerning sprinkler systems?
1. Information that should be included	
a) Location(s) of the fire department connection(s) or FDC	
b) Hydrant or water supply source(s)	
1) Closest may not always be the best choice	
c) Any special requirements for pump pressure required to supply the system	
d) Location and familiarization of system pumps if equipped with such	
	SLIDE: 5-10-3
C. Connections	
1. A siamese with at least two 2½" female connections, or	
2. One large diameter sexless connection that is connected to a clappered inlet	
D. Upon arrival at a sprinklered property, preparations should be immediately made to supply the FDC	
1. The location of the FDC and the nearest suitable hydrant should be identified by the first-arriving or other first-alarm engine company	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
	SLIDE: 5-10-4
2. If there is any indication of an actual fire, such as smoke or the ringing of a sprinkler alarm	
a) A minimum of two 2½" hoselines or one 3" hoseline should be connected to the FDC	
1) Look for debris or obstruction in the FDC	
b) Supply lines should be laid to the hydrant and all appropriate connections made	
c) A determination should be made as soon as possible whether or not the sprinkler system is to be charged	
	SLIDE: 5-10-5
d) Pressure to the system should be developed slowly	
1) Follow department policies	
	What position should the pump transfer valve be in during sprinkler operations?
e) Multistage pumps should be in the VOLUME (parallel) position	
f) Pressure (supply from pumper)	
1) As a rule of thumb PDP is 150 psi at the FDC	
2) Buildings with their own fire pumps may have an operational pressure greater than 150 psi	
g) When possible, the accessible control valves should be checked and opened if necessary	
1) Except in the case where it is known that the building or area has been undergoing construction or renovation affecting the sprinklers	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
h) The fire pump on the property should be checked to ensure that the pump is running	
1) Control valves are frequently located in the pump room so that both functions can be performed	
	SLIDE: 5-10-6
II. SUPPORTING STANDPIPE SYSTEMS	
A. Standpipes are used to speed fire attack in multistory or single-story buildings with large floor areas	
1. Connections are 2½" and 1½"	
2. Standpipes may be wet or dry, depending upon owner preference or local code requirements	
B. Standpipe FDCs should be clearly identified to prevent confusion between sprinkler and standpipe connections	
	What types of hose lays should be used for standpipe operations?
1. The hose lays previously described for sprinkler system FDCs apply here as well	
C. Planned pump discharge pressures or rules of thumb for each building equipped with a standpipe should be developed	
1. Pump discharge pressures in excess of 200 psi are not encouraged unless the standpipe system has been designed to withstand higher pressures	
2. If the standpipe system is equipped with pressure-reducing valves, elevation pressure must be based on the total height of the standpipe or the zone being used	
a) Pressure-reducing valves reduce whatever pressure is presented to it	
b) If pressure is less than the valve adjustment, the result will be inadequate pressure for the hoselines	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
	SLIDE: 5-10-7

D. Hose valves in dry standpipes may be open for various reason
   1. When charged, water will be discharged on levels below the fire floor
   2. The valves must be closed

E. When dry standpipes are charged, there is a time delay before water arrives to the hose valve
   1. Air is expelled from the system when flowing
   2. Air can also be trapped and become compressed
      a) May exit under high pressure when valve is opened
      b) Open valves slowly

RETIRED CURRICULUM

SUMMARY:

Sprinkler systems and standpipes are tools that enhance fire safety. Nearly every jurisdiction has one or both. Pre-incident planning and preparation are essential to gaining full advantage afforded by these fire safety operations.

EVALUATION:

The student will complete the written test at a time determined by the instructor.

ASSIGNMENT:

Review your notes and read Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 347-348 in order to prepare yourself for the upcoming test. Study for our next session.

RETIRED CURRICULUM

RETIRED CURRICULUM

TOPIC: 6-1: Introduction To The Pumping Exercises

TIME FRAME: 0:30 (Introduction only)

LEVEL OF INSTRUCTION: Level II

AUTHORITY: 2009 NFPA 1002: Section 5.2

BEHAVIORAL OBJECTIVE:

Condition: Given an activity

Behavior: The student will demonstrate the ability to produce an effective fire stream by completing the pumping exercises

Standard: With a minimum 80% accuracy according to the information contained in Fire Apparatus Driver/Operator 1B Student Supplement, SFT, 2008 Edition, Pages 80-91

MATERIALS NEEDED:

- Writing board/pad with markers/erasers
- Appropriate audiovisual equipment
- Appropriate audiovisual materials
- Pumping Exercise 6-1-1: Operating From Draft
- Pumping Exercise 6-1-2: Operating Using a Forward Lay
- Pumping Exercise 6-1-3: Operating Using a Reverse Lay

REFERENCES:

- Fire Apparatus Driver/Operator 1B Student Supplement, SFT, 2008 Edition, Pages 80-91
- NFPA 1002: Standard for Fire Apparatus Driver/Operator Professional Qualifications, 1009 Edition, Section 5.2

PREPARATION: Each instructor must develop a motivational statement on why the student should learn the upcoming material. The purpose is to establish relevancy of the lesson to the audience. The ACID BASE acronym can be used to help develop student motivation.

Attention (attract)	**B**egin
Curiosity (arouse)	**A**ssociation
Interest (create)	**S**tudents
Desire (stimulate)	**E**xperience

Cite examples or use related illustrations of near-miss incidents, injuries, or fatalities. Write this section "from the heart." Be creative! Have fun with it or be serious, but remember the goal is to stimulate student motivation.

PRESENTATION	APPLICATION
	SLIDE: 6-1-1
	SLIDE: 6-1-2
I. PUMPING EXERCISES	
A. Designed to assist the driver/operator in becoming familiar with operating the pump controls using different sources of water	
B. Types of exercises	
1. Operating from draft	
2. Operating using a forward lay	
3. Operating using a reverse lay	
	SLIDE: 6-1-3
II. OPERATING FROM DRAFT	
	SLIDE: 6-1-4
A. Overview	
1. Using a static water source as a supply	
2. Correctly solving hydraulics problem	
3. Operating pump controls safely	
4. Maintaining an effective fire stream	
B. Exercise setup	
1. Apparatus parked and chocked next to drafting source	
a) Parking brake set	
b) Main engine shut-off	
2. Tank-to-pump valve is open	
3. Tank fill valve is closed	
4. Water tank and pump are empty	
5. Hoseline not attached, but laid out with female end near apparatus	
a) Can be directed back into the drafting source	
6. Hard suction hose not attached, but placed near the apparatus	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
7. If using a multi-stage pump, the transfer valve will be set to the volume setting	
C. Apparatus operation	
1. Make proper hose connections	
2. Develop and maintain draft	
3. Establish and maintain fire stream	
4. Set relief valve	
5. Safely shutdown all lines and disengage pump	
6. Interpret gauge readings	
7. Using the step-by-step procedure on score sheet	
D. Scoring criteria	
1. 120 points possible	
2. Time allotted to complete exercise	
a) 10:00	
3. Points deducted for each step not completed	
a) Some critical steps have an asterisk (*) must be completed	
4. Passing score is 80%	
5. Automatic failure	
a) Omitted a critical step	
1) Marked with an asterisk (*)	
b) Exceeded the allotted time	
c) Acted in a manner resulting in any personal injury	
d) Failed to engage the pump	
e) Abused the apparatus	
	SLIDE: 6-1-5
	SLIDE: 6-1-6
	SLIDE: 6-1-7

RETIRED CURRICULUM

PRESENTATION	APPLICATION
III. OPERATING USING A FORWARD LAY	
	SLIDE: 6-1-8
A. Overview	
1. Using tank water for first hoseline, then changing over to a pressurized water source and flowing a second hoseline	
2. Correctly solving hydraulics problem	
3. Operating pump controls safely	
4. Maintaining effective fire stream	
B. Exercise setup	
1. Apparatus parked at simulated fire incident	
2. Tank-to-pump valve is open	
3. Tank fill valve is closed	
4. Supply line laid out on the ground is connected to hydrant discharge and hose bed	
5. Two (2) hoselines of different sizes are laid out on the ground and connected to apparatus	
C. Apparatus operation	
1. Solve hydraulics problem for first hoseline	
a) Charge first hoseline	
2. Set relief valve	
3. Connect supply line to intake	
4. Perform changeover from tank to hydrant	
5. Solve hydraulics problem for second hoseline	
a) Charge second hoseline	
6. Determine additional line availability	
7. Safely shutdown all lines and disengage pump	
8. Using the step-by-step procedure on score sheet	
D. Scoring criteria	
1. 150 points possible	
2. Time allotted to complete exercise	
a) 10:00	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
3. Points deducted for each step not completed a) Some critical steps have an asterisk (*) must be completed 4. Passing score is 80% 5. Automatic failure a) Omitted a critical step 1) Marked with an asterisk (*) b) Exceeded the allotted time c) Acted in a manner resulting in any personal injury d) Failed to engage the pump e) Ran the pump dry (without water) f) Abused the apparatus	
	SLIDE: 6-1-9 **SLIDE: 6-1-10** **SLIDE: 6-1-11**
IV. OPERATING USING A REVERSE LAY	**SLIDE: 6-1-12**
A. Overview 1. With an appliance at the incident, drive apparatus to the water source 2. Correctly solve the hydraulics problem 3. Operate pump controls safely 4. Maintain effective fire stream B. Exercise setup 1. Monitor setup at simulated fire incident a) 500 gpm minimum 2. Tank-to-pump valve is open 3. Tank fill valve is closed 4. Hoselines connected to monitor and laid back to hydrant	

RETIRED CURRICULUM

PRESENTATION	APPLICATION
C. Apparatus operation 1. Drive apparatus and spot at hydrant 2. Connect hoselines from monitor to apparatus 3. Connect supply hose to hydrant 4. Solve hydraulics problem a) Charge hoselines 5. Set relief valve 6. Safely shutdown all lines and disengage pump 7. Using the step-by-step procedure on score sheet D. Scoring criteria 1. 150 points possible 2. Time allotted to complete exercise a) 5:00 3. Points deducted for each step not completed a) Some critical steps have an asterisk (*) must be completed 4. Passing score is 80% 5. Automatic failure a) Omitted a critical step 1) Marked with an asterisk (*) b) Exceeded the allotted time c) Acted in a manner resulting in any personal injury d) Failed to engage the pump e) Ran the pump dry (without water) f) Abused the apparatus	**SLIDE: 6-1-13** **SLIDE: 6-1-14** **SLIDE: 6-1-15**

RETIRED CURRICULUM

PRESENTATION	APPLICATION
V. SAFETY CONSIDERATIONS A. Check apparatus before operating B. Check surface conditions C. Wear appropriate PPE D. Review and follow all instructions E. Operate apparatus with due regard F. Use spotters for safety G. Check apparatus after exercise	

RETIRED CURRICULUM

SUMMARY:

Being able to produce and maintain an effective, continuous fire stream is a simple operation if you choose the best procedure to accomplish our goals. You must be capable of modifying your pumping plan as incident conditions change. You must also be aware of how your apparatus is performing and how much more is available without exceeding safe limits.

EVALUATION:

The student will complete the pumping exercises at a time determined by the instructor.

ASSIGNMENT:

Review your notes and read Fire Apparatus Driver/Operator 1B Student Supplement, SFT, 2008 Edition, Pages 80-91 in order to prepare yourself for the upcoming test. Study for our next session.

RETIRED CURRICULUM

PUMPING EXERCISE 6-1-1

EXERCISE:	Operating From Draft
	This exercise allows the driver/operator to become familiar with using a static water source as a supply while operating the pump controls safely and maintaining an effective fire stream. Fire hydrants are not always available at the scene, and the driver/operator may have to use some imagination to determine an alternate water supply. Solving a hydraulics problem is required.
TIME FRAME:	10:00 (per student)
AUTHORITY:	2009 NFPA 1002: Section 5.2
MATERIALS NEEDED:	• Fire apparatus • 2,400 square foot area (30' x 80') • Drafting source • Stopwatch • 1½" or 1¾" hoseline • Hard suction hose • Student assistant
INSTRUCTOR DIRECTIONS:	1. Demonstrate and explain each step of the exercise. 2. Students should determine hydraulic formula solutions using field hydraulics for the hoseline and nozzle being used. 3. Provide adequate space and supervision to perform the exercise safely and without risk of injury.
STUDENT DIRECTIONS:	1. Make the proper hose connections. 2. Develop and maintain draft. 3. Establish and maintain a fire stream. 4. Solve the hydraulics problem(s). 5. Set the relief valve. 6. Safely shutdown all lines and disengage the pump. 7. Continually interpret gauge readings throughout the exercise and recall those readings to the instructor. 8. Step-by-step procedures are listed on the Scoring Sheet.

RETIRED CURRICULUM

EXERCISE:	Operating From Draft
SCORING:	**120 points possible** **80% passing**

1. **Points** are deducted for each step not completed.
2. The student **fails** if a step marked with an asterisk (*) is omitted.
3. The student **fails** if the exercise is not completed within the allotted time.
4. The student **fails** if any personal injury occurs.
5. The student **fails** if he or she does not engage the pump.
6. The student **fails** there is apparatus abuse.

SITE PREPARATION:

- Apparatus is properly parked and chocked next to the drafting source.
- Parking brake is set.
- Main engine is shutoff.
- Tank-to-pump valve is open.
- Tank fill valve is closed.
- Water tank and pump in the apparatus are empty.
- Hoseline is laid out on the ground with the female end near the apparatus. This line can be directed back into the drafting source.
- Hard suction hose is placed near apparatus, but is not attached.
- If using a multi-stage pump, the transfer valve will be set to the volume setting.

RETIRED CURRICULUM

PUMPING EXERCISE 6-1-1 SCORING SHEET

STUDENT: _____ DATE: _____

6-1-1: OPERATING FROM DRAFT		Penalty points subtracted from 100 possible points.	
	Rated Component	**Value**	**120**
1.	Start engine prior to leaving cab	5	
	TIME STARTS (When student's foot touches the ground)		
2.	Connect hard suction hose to apparatus and place in drafting source	5	
3.	Connect hoseline to designated discharge	5	
4.	Close all valves and drains	5	
5.	Engage midship pump	*	
6.	Throttle engine up to 1000 – 1200 rpm	5	
7.	Engage primer for no more than 30 – 45 seconds or until water has filled hard suction hose	5	
8.	Operate pump panel throttle slowly until the PDP reads 100 psi (If prime is lost, repeat step 6)	10	
9.	Loudly state, "Water coming"	10	
10.	Slowly open designated discharge valve	5	
11.	Calculate field hydraulics for the hoseline and nozzle being used	10	
12.	Readjust the pump panel throttle slowing until the proper PDP is reached (± 5 psi)	10	
13.	Properly adjust the pressure relief valve	10	
	TIME STOPS		
14.	The student must recall and interpret the gauge readings	5	
	SHUTDOWN PROCEDURES		
1.	Loudly state, "Shutdown"	5	
2.	Slowly close discharge valve	2	
3.	Slowly reduce pump panel throttle until main engine returns to idle	2	
4.	Return to cab and disengage pump	2	
5.	Shut-off main engine	2	
6.	Open tank-to-pump valve and drain pump	2	
7.	Disconnect hoseline and hard suction hose	2	

RETIRED CURRICULUM

	MISCELLANEOUS		
1.	Dropped a brass coupling	2	
2.	Opened valves too fast	2	
3.	Left compartment door open	2	
4.	Failed to remove kinks in hose(s)	2	
5.	Failed to disengaging the pump	5	
	ITEMS THAT WILL RESULT IN AUTOMATIC FAILURE		
1.	Omitted a step marked with an asterisk (*)	☐ Yes	Failure
2.	Exceeded the allotted time	☐ Yes	Failure
3.	Acted in a manner resulting in any personal injury	☐ Yes	Failure
4.	Failed to engage the pump	☐ Yes	Failure
5.	Abused the apparatus	☐ Yes	Failure

ALLOTTED TIME: **10:00 MINUTES** **TOTAL POINTS:** _____

COMPLETION TIME: _____ **PASSING SCORE:** 96

Scorer's Name: _____

PASS/FAIL: ☐ Pass ☐ Fail ☐ Retest

Signature: _____

6-1-1 NOTES:

RETIRED CURRICULUM

PUMPING EXERCISE 6-1-2

EXERCISE:	Operating Using A Forward Lay This exercise will allow the driver/operator to become proficient at using tank water with the first attack line; then changing over to a pressurized water source and flowing a second attack line. Solving a hydraulics problem is required.
TIME FRAME:	10:00 (per student)
AUTHORITY:	2009 NFPA 1002: Section 5.2
MATERIALS NEEDED:	• Fire apparatus • 10,000 square foot area (50' x 200') • Hydrant • Stopwatch • 100-foot supply hose (minimum) • 150-foot length of 1½" or 1¾" discharge hoseline • 150-foot length of 2½" discharge hoseline • Student assistant
INSTRUCTOR DIRECTIONS:	1. Demonstrate and explain each step of the exercise. 2. The hoselines can be attached to a stable object or held by other students. 3. Hydraulics formula solutions are determined by: 1½" hoseline flowing 100 gpm (136 psi) or 1¾" hoseline flowing 150 gpm (134 psi) 2½" hoseline flowing 250 gpm (119 psi) Use the same formulas taught in the class. 4. Provide adequate space and supervision to perform the exercise safely and without risk of injury.
STUDENT DIRECTIONS:	1. Break supply line form hose bed and connect to inlet suction. 2. Solve the hydraulic problem for the first hoseline, then charge. 3. Set the relief valve. 4. Perform changeover from tank to hydrant.

RETIRED CURRICULUM

EXERCISE: Operating Using A Forward Lay

5. Solve hydraulic problem for the second hoseline, then charge.
6. Safely shutdown all lines and disengage the pump.
7. Continually interpret gauge readings throughout the exercise and recall those readings to the instructor.
8. Step-by-step procedures are listed on the Scoring Sheet.

SCORING: **120 points possible** **80% passing**

1. **Points** are deducted for each step not completed.
2. The student **fails** if a step marked with an asterisk (*) is omitted.
3. The student **fails** if the exercise is not completed within the allotted time.
4. The student **fails** if any personal injury occurs.
5. The student **fails** if he or she does not engage the pump.
6. The student **fails** if the pump is run dry.
7. The student **fails** there is apparatus abuse.

SITE PREPARATION:

- Apparatus is parked at a simulated fire incident.
- Tank-to-pump valve is open.
- Tank fill valve is closed.
- Supply line laid out on the ground and connected to hydrant discharge and hose bed.
- Two (2) hoselines of different sizes are laid out on the ground and connected to the apparatus.

RETIRED CURRICULUM

PUMPING EXERCISE 6-1-2 SCORING SHEET

STUDENT: _____ DATE: _____

6-1-2: OPERATING USING A FORWARD LAY			Penalty points subtracted from 150 possible points.
	Rated Component	**Value**	**150**
1.	Start engine and engage midship pump	5	
	TIME STARTS (When student's foot touches the ground)		
2.	Set chock blocks according to local policy	*	
3.	Break supply line apart from hose bed and attach to suction inlet	5	
4.	Call for assistant at hydrant to charge supply line	*	
5.	Loudly state "Water coming"	10	
6.	Slowly open discharge valve for the 1½" (1¾") hoseline	5	
7.	Calculate field hydraulics for the 1½" (1¾") hoseline using field hydraulic formulas	10	
8.	Operate pump panel throttle slowly until proper PDP pressure is reached (± 5 psi)	5	
9.	Properly adjust the pressure relief valve	10	
10.	Open suction inlet valve while simultaneously reducing throttle to maintain proper PDP	*	
11.	PDP should return to Step 7's calculations	10	
12.	Calculate field hydraulics for the 2 ½" hoseline using field hydraulic formulas	10	
13.	Loudly state, "Water Coming"	10	
14.	Slowly open discharge valve for 2½" hoseline until proper PDP is achieved (± 5 psi)	5	
15.	Tank-to-pump valve (Leave open or close according to local policy)	4	
16.	Open tank filler valve slightly to refill tank while keeping PDP consistent	10	
	TIME STOPS		
17.	Close tank filler valve when tank is full	5	
18.	The student must recall and interpret the gauge readings	10	
	SHUTDOWN PROCEDURES		
1.	Loudly state, "Shutdown"	5	
2.	Slowly reduce pump panel throttle until main engine returns to idle	2	
3.	Slowly close discharge valve and suction valve	2	
4.	Return to cab and disengage pump	2	
5.	Have assistant shut-off hydrant	2	
6.	Relieve pressure form suction hose	2	
7.	Close suction valve and disconnect suction hose from suction inlet	2	
8.	Open tank-to-pump valve (If closed in step 14 above)	2	
9.	Reset pressure relief valve	2	
10.	Pick up chocks and return to proper location	2	

RETIRED CURRICULUM

STUDENT: _____ DATE: _____

6-1-2: OPERATING USING A FORWARD LAY		Penalty points subtracted from 150 possible points.	
	Rated Component	**Value**	**150**
	MISCELLANEOUS		
1.	Dropped brass couplings	2	
2.	Opened valves too fast	2	
3.	Left compartment door open	2	
4.	Failed to remove kinks in hose(s)	2	
5.	Failed to disengage the pump	5	
	ITEMS THAT RESULT IN AUTOMATIC FAILURE		
1.	Omitted a step marked with an asterisk (*)	☐ Yes	Failure
2.	Exceeded the allotted time	☐ Yes	Failure
3.	Acted in a manner resulting in any personal injury	☐ Yes	Failure
4.	Failed to engage the pump	☐ Yes	Failure
5.	Ran the pump dry (without water)	☐ Yes	Failure
6.	Abused the apparatus	☐ Yes	Failure

ALLOTTED TIME: **10:00 MINUTES** **TOTAL POINTS:** _____

COMPLETION TIME: _____ **PASSING SCORE:** 120

Scorer's Name: _____

PASS/FAIL: ☐ Pass ☐ Fail ☐ Retest

Signature: _____

6-1-2 NOTES:

RETIRED CURRICULUM

PUMPING EXERCISE 6-1-3

EXERCISE:	Operating Using A Reverse Lay This exercise can be applied when the driver/operator needs to place an appliance at the incident and then drive to the water source. Solving a hydraulics problem is required.
TIME FRAME:	5:00 (per student)
AUTHORITY:	2009 NFPA 1002: Section 5.2
MATERIALS NEEDED:	• Fire apparatus • 1,000 square foot area (50' x 200') • Hydrant • Stopwatch • Monitor with 500 gpm nozzle minimum • Hose to supply monitor (Instructor choice) • 15-20 foot length of soft suction hose • Student assistant
INSTRUCTOR DIRECTIONS:	1. Demonstrate and explain each step of the exercise. 2. Hydraulics formula solutions determined using field hydraulics for the hoseline and nozzle being used. Use the same formulas taught in the class. 3. Provide adequate space and supervision to perform the exercise safely and without risk of injury.
STUDENT DIRECTIONS:	1. Drive the apparatus to the hydrant and spot. 2. Connect hoselines from the monitor to the apparatus. 3. Connect supply hose to the hydrant. 4. Solve the hydraulics problem, then charge the hoselines. 5. Set the relief valve. 6. Safely shutdown all lines and disengage pump. 7. Continually interpret gauge readings throughout the exercise and recall those readings to the instructor. 8. Step-by-step procedures are listed on the Scoring Sheet.

RETIRED CURRICULUM

EXERCISE:	Operating Using A Reverse Lay
SCORING:	**150 points possible** **80% passing**

1. **Points** are deducted for each step not completed.
2. The student **fails** if a step marked with an asterisk (*) is omitted.
3. The student **fails** if the exercise is not completed within the allotted time.
4. The student **fails** if any personal injury occurs.
5. The student **fails** if he or she does not engage the pump.
6. The student **fails** if the pump is run dry.
7. The student **fails** there is apparatus abuse.

SITE PREPARATION:

- Monitor is set-up at a simulated fire incident.
- Tank-to-pump valve is open.
- Tank fill valve is closed.
- Hoseline(s) are laid out on the ground, connected to the monitor, and laid back to the hydrant

RETIRED CURRICULUM

PUMPING EXERCISE 6-1-3 SCORING SHEET

STUDENT: _____ DATE: _____

6-1-3: OPERATING USING A REVERSE LAY		Penalty points subtracted from 150 possible points.	
	Rated Component	**Value**	**150**
1.	Start engine and drive apparatus to hydrant	5	
2.	Spot apparatus correctly at hydrant	5	
3.	Set parking brake and engage pump	*	
	TIME STARTS (When student's foot touches the ground)		
4.	Set chock blocks according to local policy	*	
5.	Connect hoseline(s) from monitor to appropriate apparatus discharge(s)	5	
6.	Rollout suction hose to hydrant	5	
7.	Connect suction hose to suction inlet	5	
8.	Flush hydrant (Engine should not be in path of water flow)	10	
9.	Connect suction hose to hydrant	5	
10.	Open hydrant (Remove kinks from supply line)	10	
11.	Open inlet suction valve	5	
12.	Tank-to-pump valve (Leave open or close according to local policy)	5	
13.	Loudly state, "Water Coming"	10	
14.	Slowly open discharge valve(s)	5	
15.	Calculate field hydraulics for the appliance using field hydraulic formulas	10	
16.	Operate pump panel throttle slowly until proper PDP is reached (± 5 psi)	5	
17.	Properly adjust the pressure relief valve	10	
	TIME STOPS		
18.	The student must recall and interpret the gauge readings	10	
	SHUTDOWN PROCEDURES		
1.	Loudly state, "Shutdown"	5	
2.	Slowly reduce pump panel throttle until main engine returns to idle	2	
3.	Slowly close discharge valve(s)	2	
4.	Return to cab and disengage pump	2	
5.	Shutoff hydrant	2	
6.	Close suction inlet valve	2	
7.	Relieve pressure from suction hose	2	
8.	Disconnect suction hose from suction inlet and hydrant	2	
9.	Replace suction hose on apparatus	2	
10.	Disconnect hoseline(s) to monitor and lay on ground at hydrant	2	
11.	Open tank-to-pump valve (If closed in step 12 above)	2	

RETIRED CURRICULUM

STUDENT: _____ DATE: _____

6-1-3: OPERATING USING A REVERSE LAY		Penalty points subtracted from 150 possible points.	
	Rated Component	**Value**	**150**
12.	Pick up chocks and return to proper location	2	
	MISCELLANEOUS		
1.	Dropped brass couplings	2	
2.	Opened valves too fast	2	
3.	Left compartment door open	2	
4.	Failed to remove kinks in hose(s)	2	
5.	Failed to disengage the pump	5	
	ITEMS THAT RESULT IN AUTOMATIC FAILURE		
1.	Omitted a step marked with an asterisk (*)	☐ Yes	Failure
2.	Exceeded the allotted time	☐ Yes	Failure
3.	Acted in a manner resulting in any personal injury	☐ Yes	Failure
4.	Failed to engage the pump	☐ Yes	Failure
5.	Ran the pump dry (without water)	☐ Yes	Failure
6.	Abused the apparatus	☐ Yes	Failure

ALLOTTED TIME: **5:00 MINUTES** **TOTAL POINTS:** _____

COMPLETION TIME: _____ **PASSING SCORE:** 120

Scorer's Name: _____

PASS/FAIL: ☐ Pass ☐ Fail ☐ Retest

Signature: _____

6-1-3 NOTES:

RETIRED CURRICULUM

Instructor Answer Key Test 1

Each answer space is worth five points. Some questions may have more than one correct answer. You have 30 minutes to complete the entire test.

INSTRUCTIONS: This is a true-false test. If the statement is true, draw a circle around the "T." If the statement is false, draw a circle around the "F."

EXAMPLE: (T) F The Incident Command System was developed by the fire service.

RETIRED CURRICULUM

T F 1. The symbol that indicates the pressure generated for hoselines during pumping operations is "PDP."

Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Page 243

T **F** 2. Water converts to vapor or steam at 200°F?

Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Page 135

T F 3. The third principle of pressure says, "Pressure applied to a confined fluid from without is transmitted equally in all directions."

Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Page 142

T F 4. Grid system piping for water distribution is comprised of primary and secondary feeders and distributors.

Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Page 156

T **F** 5. A hydrant color coded with green indicates that the hydrant will deliver between 500-999 gpm.

Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Page 325

T **F** 6. The nozzle pressure for a solid stream handline is 80 psi.

Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Page 166

T F 7. Nozzle reaction for a fog nozzle is ½ the gpm.

Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Page 178

T F 8. The formula for calculating gpm for a nozzle is $29.7 \times d^2 \times \sqrt{NP}$.

Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Page 166

T **F** 9. Fresh water weighs 8.5 lbs per gallon.

Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Page 136

RETIRED CURRICULUM

➧T	F	10.	One way to help reduce friction loss in hoselines is to make sure that you eliminate sharp bends. *Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Page 150*
T	➧F	11.	Centrifugal pumps have the ability to pump air. *Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Page 265*
➧T	F	12.	Positive displacement pumps are primarily used as priming pumps on fire apparatus. *Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Page 265*
➧T	F	13.	Multi-stage pumps have more than one impeller. *Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Page 272*
T	➧F	14.	Midship pumps are driven off the flywheel. *Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Page 283*
T	➧F	15.	The gate valve is the most commonly used valve on fire apparatus today. *Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Page 290*
➧T	F	16.	Pressure governors regulate engine throttle to maintain pump discharge pressure. *Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Page 296*
T	➧F	17.	Priming devices are designed to raise atmospheric pressure within the pump. *Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Page 298*
➧T	F	18.	A compound gauge must be able to register 30 in. Hg. *Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Page 302*
T	➧F	19.	Auxiliary coolers are used during emergency response. *Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Page 334*
➧T	F	20.	Pumping in the "pressure position" is also known as the "SERIES position." *Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Page 274*

QUIZ SCORING Each answer space is worth five points	Total Possible 100	80% Minimum 80	Score	Pass or Fail?

Instructor Answer Key Test 2

Each answer space is worth five points. Some questions may have more than one correct answer. You have 30 minutes to complete the entire test.

SECTION I

INSTRUCTIONS: Section I is a true-false test. If the statement is true, draw a circle around the "T." If the statement is false, draw a circle around the "F."

EXAMPLE: (T) F The Incident Command System was developed by the fire service.

T F 1. The friction loss coefficient for 1¾" hoseline is 10.

Fire Apparatus Driver/Operator 1B Student Supplement, SFT, 2008 Edition, Page 32

T **F** 2. The friction loss value for a wye is 25 psi.

Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Page 189

T F 3. The friction loss formula for calculating friction loss in 2½" hoselines is $2Q^2L$.

Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Page 186

T **F** 4. When calculating friction loss for multiple hoselines of equal size and length you will calculate the friction loss for all hoselines and then add them together to get your total friction loss.

Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 195-196

T **F** 5. Fireground hydraulics will get a more accurate friction loss calculation but it will take longer to calculate the formulas.

Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Page 251

T F 6. Using fireground hydraulics for a master stream using a 1¾" tip, the amount of water that it will deliver is 800 gpm.

Fire Apparatus Driver/Operator 1B Student Supplement, SFT, 2008 Edition, Page 49

T **F** 7. The elevation pressure loss that is used in fireground hydraulics is 10 psi per floor.

Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Page 225

RETIRED CURRICULUM

RETIRED CURRICULUM

➧T	F	8.	Flowmeters provide the water flow in gallons per minute. *Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Page 251*
➧T	F	9.	There are two basic concepts for pressure relief valves. *Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Page 294*
➧T	F	10.	With the engine idling and the pump engaged, most speedometers will read between 10 to 15 mph. *Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Page 283*
➧T	F	11.	On a centrifugal pump, water enters through the eye of the impeller. *Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Page 271*
T	➧F	12.	The maximum flow rating of a pump is achieved at 200 psi. *Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Page 273*
➧T	F	13.	The transfer valve is used to change the pump setting from volume to pressure. *Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 273-274*
T	➧F	14.	A centrifugal pump is a positive displacement pump. *Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 273-274*
T	➧F	15.	The tank fill valve can also be used as a relief valve. *Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Page 294*
T	➧F	16.	The compound gauge can measure only pressure. *Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 302-303*
➧T	F	17.	A positive displacement pump can pump air. *Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 266-267*
T	➧F	18.	A two-stage pump will have one impeller and two discharge outlets. *Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Page 273*
➧T	F	19.	The pump packing is used to form a semi-tight seal where the pump shaft passes through the casing. *Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 278-279*
T	➧F	20.	The most common type of valve is the piston valve. *Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 290-300*

➧T	F	21. A priming pump must have an oil or fluid source in order to establish an airtight seal. *Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 298-299*
T	➧F	22. A rotary vane pump is a type of centrifugal pump. *Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 269-270*
T	➧F	23. A front mount pump is driven by the use of a gearbox and clutch attached to the side of the transmission. *Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 281-282*
➧T	F	24. A disadvantage to the rear mount pump is that the operator is directly exposed to oncoming traffic. *Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Page 285*

Complete Section II on the next page.

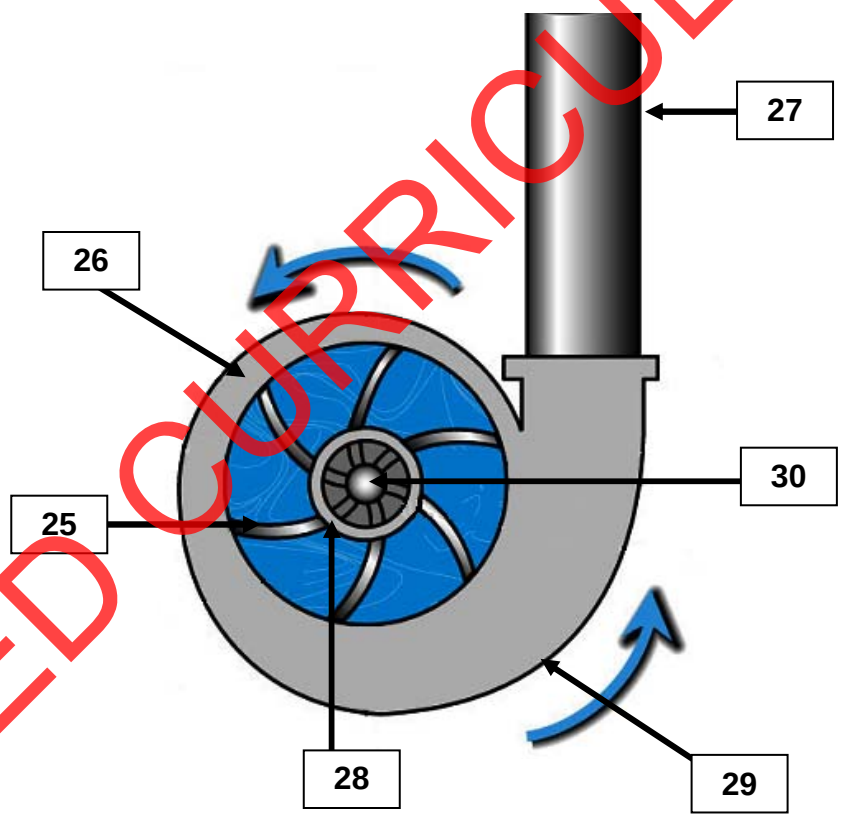
RETIRED CURRICULUM

SECTION II

INSTRUCTIONS: Section II is a matching test. Select the item in Column 1 that most closely matches the name of the component in the diagram. Write the number of the item from Column 1 in the corresponding box for the component in the diagram.

COLUMN 1

25. Vane
26. Volute
27. Discharge
28. Hub
29. Casing
30. Eye



Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Page 270

RETIRED CURRICULUM

QUIZ SCORING Each answer space is worth five points	Total Possible 150	80% Minimum 120	Score	Pass or Fail?

Instructor Answer Key Test 3

Each answer space is worth five points. Some questions may have more than one correct answer. You have 30 minutes to complete the entire test.

SECTION I

INSTRUCTIONS: Section I is a true-false test. If the statement is true, draw a circle around the "T." If the statement is false, draw a circle around the "F."

EXAMPLE: (T) F The Incident Command System was developed by the fire service.

T ➧F 1. Cavitation can be described as water entering the pump faster than it is being discharged.

Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 336-337

➧T F 2. Open drains and valves are the most common source of air leaks during priming and drafting operations

Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 343-344

➧T F 3. If no water is being discharged for an extended amount of time and discharge pressure is maintained at a relatively high level, the pump will overheat

Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 322-323

T ➧F 4. Due to the relatively low volume demands of sprinkler systems, multistage pumps should be in the PRESSURE (SERIES) position

Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Page 347

➧T F 5. As a standard practice, it is not desirable to reduce the incoming pressure from a hydrant or other supply pumper below 20 psi

Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 323-324

➧T F 6. A blockage of the strainer at the intake of the pump can cause a high vacuum reading on the compound gauge.

Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Page 368

RETIRED CURRICULUM

➧T	F	7.	A defective relief valve can cause excessive pressure surges when individual hoselines are shut down *Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Page 369*
T	➧F	8.	Pump discharge pressures in excess of 150 psi are not encouraged in standpipe systems *Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Pages 348-350*
➧T	F	9.	A low-energy foam system imparts pressure on the foam system solely by the use of a fire pump. *Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Page 463*
T	➧F	10.	The speedometer will show a reading somewhat above 0 mph when power has been transferred from the road transmission to the pump transmission, provided that the apparatus speedometer reading is taken off of the rear of the transfer case. *Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Edition, Page 317*

Complete Section II on the next page.

RETIRED CURRICULUM

SECTION II

INSTRUCTIONS: Section II is a matching test. Select the one response in Column 2 that most nearly matches an item in Column 1. Write the number of the item from Column 1 in the parenthesis that precedes the appropriate response in Column 2.

EXAMPLE:

COLUMN 1		COLUMN 2
1. hammer	(1)	Tool used to cut
2. saw	(2)	Tool used to drive nails
3. wrench		

COLUMN 1		COLUMN 2	
11. Class A foam	(17)	Detergent based	*Page 462*
12. Class B foam	(13)	Resists burnback	*Page 461*
13. Protein foam	(22)	Mixture of foam concentrate and water before introducing air	*Page 451*
14. Fluoroprotein foam	(11)	For ordinary combustibles	*Page 458*
15. Film forming fluoroprotein foam	(18)	High-energy foam	*Page 472*
16. Aqueous film forming foam	(21)	The raw foam liquid as it rests in its storage container before the introduction of water and air	*Page 451*
17. High-expansion foam	(16)	Completely synthetic	*Page 462*
18. Compressed-air foam	(12)	For flammable and combustible liquids	*Page 458*
19. Polar solvent fuels	(15)	Fast fire knock down and long-lasting heat resistance	*Page 462*
20. Hydrocarbon fuels	(19)	Miscible in water	*Page 451*
21. Foam concentrate			
22. Foam solution			

Pumping Apparatus Driver/Operator Handbook, IFSTA, Second Ed

QUIZ SCORING Each answer space is worth five points	Total Possible 100	80% Minimum 80	Score	Pass or Fail?

RETIRED CURRICULUM

Test 1

NAME: _____

DATE: _____

Each answer space is worth five points. Some questions may have more than one correct answer. You have 30 minutes to complete the entire test.

INSTRUCTIONS: This is a true-false test. If the statement is true, draw a circle around the "T." If the statement is false, draw a circle around the "F."

EXAMPLE: (T) F The Incident Command System was developed by the fire service.

T F 1. The symbol that indicates the pressure generated for hoselines during pumping operations is "PDP."

T F 2. Water converts to vapor or steam at 200°F?

T F 3. The third principle of pressure says, "Pressure applied to a confined fluid from without is transmitted equally in all directions."

T F 4. Grid system piping for water distribution is comprised of primary and secondary feeders and distributors.

T F 5. A hydrant color coded with green indicates that the hydrant will deliver between 500-999 gpm.

T F 6. The nozzle pressure for a solid stream handline is 80 psi.

T F 7. Nozzle reaction for a fog nozzle is ½ the gpm.

T F 8. The formula for calculating gpm for a nozzle is $29.7 \times d^2 \times \sqrt{NP}$.

T F 9. Fresh water weighs 8.5 lbs per gallon.

RETIRED CURRICULUM

T F 10. One way to help reduce friction loss in hoselines is to make sure that you eliminate sharp bends.

T F 11. Centrifugal pumps have the ability to pump air.

T F 12. Positive displacement pumps are primarily used as priming pumps on fire apparatus.

T F 13. Multi-stage pumps have more than one impeller.

T F 14. Midship pumps are driven off the flywheel.

T F 15. The gate valve is the most commonly used valve on fire apparatus today.

T F 16. Pressure governors regulate engine throttle to maintain pump discharge pressure.

T F 17. Priming devices are designed to raise atmospheric pressure within the pump.

T F 18. A compound gauge must be able to register 30 in. Hg.

T F 19. Auxiliary coolers are used during emergency response.

T F 20. Pumping in the "pressure position" is also known as the "SERIES position."

RETIRED CURRICULUM

QUIZ SCORING Each answer space is worth five points	Total Possible 100	80% Minimum 80	Score	Pass or Fail?

NAME: _____

DATE: _____

Test 2

Each answer space is worth five points. Some questions may have more than one correct answer. You have 30 minutes to complete the entire test.

SECTION I

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EXAMPLE: (T) F The Incident Command System was developed by the fire service.

T F 1. The friction loss coefficient for 1¾" hoseline is 10.

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T F 4. When calculating friction loss for multiple hoselines of equal size and length you will calculate the friction loss for all hoselines and then add them together to get your total friction loss.

T F 5. Fireground hydraulics will get a more accurate friction loss calculation but it will take longer to calculate the formulas.

T F 6. Using fireground hydraulics for a master stream using a 1¾" tip, the amount of water that it will deliver is 800 gpm.

T F 7. The elevation pressure loss that is used in fireground hydraulics is 10 psi per floor.

RETIRED CURRICULUM

T F 8. Flowmeters provide the water flow in gallons per minute.

T F 9. There are two basic concepts for pressure relief valves.

T F 10. With the engine idling and the pump engaged, most speedometers will read between 10 to 15 mph.

T F 11. On a centrifugal pump, water enters through the eye of the impeller.

T F 12. The maximum flow rating of a pump is achieved at 200 psi.

T F 13. The transfer valve is used to change the pump setting from volume to pressure.

T F 14. A centrifugal pump is a positive displacement pump.

T F 15. The tank fill valve can also be used as a relief valve.

T F 16. The compound gauge can measure only pressure.

T F 17. A positive displacement pump can pump air.

T F 18. A two-stage pump will have one impeller and two discharge outlets.

T F 19. The pump packing is used to form a semi-tight seal where the pump shaft passes through the casing.

T F 20. The most common type of valve is the piston valve.

RETIRED CURRICULUM

T F 21. A priming pump must have an oil or fluid source in order to establish an airtight seal.

T F 22. A rotary vane pump is a type of centrifugal pump.

T F 23. A front mount pump is driven by the use of a gearbox and clutch attached to the side of the transmission.

T F 24. A disadvantage to the rear mount pump is that the operator is directly exposed to oncoming traffic.

Complete Section II on the next page.

RETIRED CURRICULUM

SECTION II

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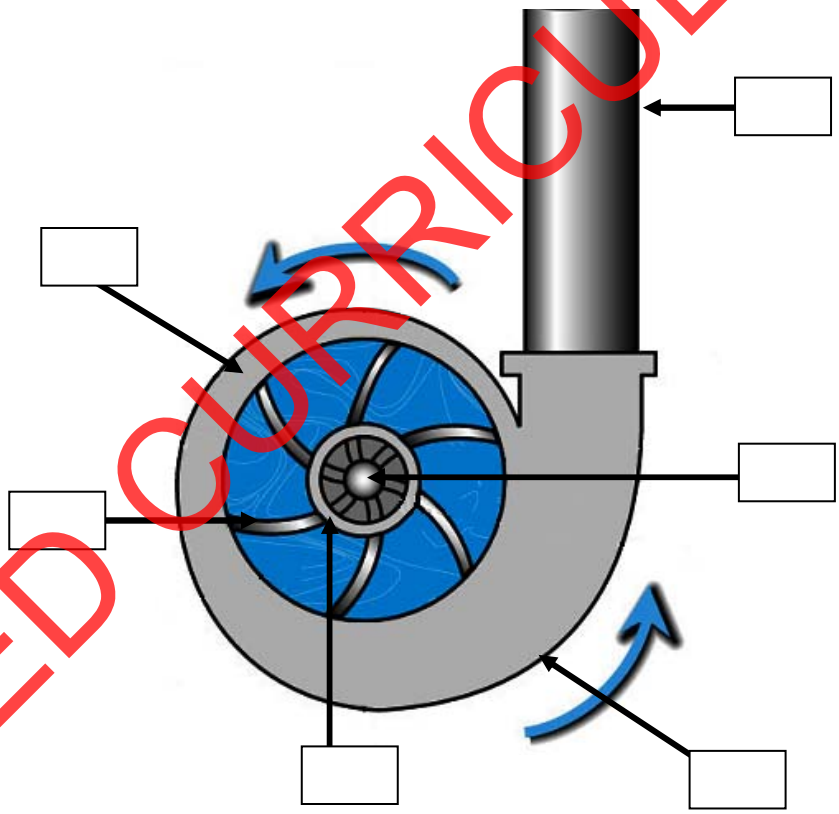
COLUMN 1

25. Vane
26. Volute
27. Discharge
28. Hub
29. Casing
30. Eye



RETIRED CURRICULUM

QUIZ SCORING Each answer space is worth five points	Total Possible 150	80% Minimum 120	Score	Pass or Fail?

Test 3

NAME: _____

DATE: _____

Each answer space is worth five points. Some questions may have more than one correct answer. You have 30 minutes to complete the entire test.

SECTION I

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EXAMPLE: (T) F The Incident Command System was developed by the fire service.

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T F 3. If no water is being discharged for an extended amount of time and discharge pressure is maintained at a relatively high level, the pump will overheat

T F 4. Due to the relatively low volume demands of sprinkler systems, multistage pumps should be in the PRESSURE (SERIES) position

T F 5. As a standard practice, it is not desirable to reduce the incoming pressure from a hydrant or other supply pumper below 20 psi

T F 6. A blockage of the strainer at the intake of the pump can cause a high vacuum reading on the compound gauge.

RETIRED CURRICULUM

T F 7. A defective relief valve can cause excessive pressure surges when individual hoselines are shut down

T F 8. Pump discharge pressures in excess of 150 psi are not encouraged in standpipe systems

T F 9. A low-energy foam system imparts pressure on the foam system solely by the use of a fire pump.

T F 10. The speedometer will show a reading somewhat above 0 mph when power has been transferred from the road transmission to the pump transmission, provided that the apparatus speedometer reading is taken off of the rear of the transfer case.

Complete Section II on the next page.

RETIRED CURRICULUM

SECTION II

INSTRUCTIONS: Section II is a matching test. Select the one response in Column 2 that most nearly matches an item in Column 1. Write the number of the item from Column 1 in the parenthesis that precedes the appropriate response in Column 2.

EXAMPLE:

COLUMN 1		COLUMN 2
1. hammer	(1)	Tool used to cut
2. saw	(2)	Tool used to drive nails
3. wrench		

COLUMN 1		COLUMN 2
11. Class A foam	(____)	Detergent based
12. Class B foam	(____)	Resists burnback
13. Protein foam	(____)	Mixture of foam concentrate and water before introducing air
14. Fluoroprotein foam	(____)	For ordinary combustibles
15. Film forming fluoroprotein foam	(____)	High-energy foam
16. Aqueous film forming foam	(____)	The raw foam liquid as it rests in its storage container before the introduction of water and air
17. High-expansion foam	(____)	Completely synthetic
18. Compressed-air foam	(____)	For flammable and combustible liquids
19. Polar solvent fuels	(____)	Fast fire knock down and long-lasting heat resistance
20. Hydrocarbon fuels	(____)	Miscible in water
21. Foam concentrate		
22. Foam solution		

QUIZ SCORING Each answer space is worth five points	Total Possible 100	80% Minimum 80	Score	Pass or Fail?

RETIRED CURRICULUM