



Western Technical College

## 10503194 Fire Protection Hydraulics

### Course Outcome Summary

#### Course Information

|                            |  |
|----------------------------|--|
| <b>Description</b>         | This course provides a foundation of theoretical knowledge in order to understand the principles of the use of water in fire protection and to apply hydraulic principles to analyze and to solve water supply problems. |
| <b>Career Cluster</b>      | Law, Public Safety, Corrections and Security   |
| <b>Instructional Level</b> | Associate Degree Courses   |
| <b>Total Credits</b>       | 3  |
| <b>Total Hours</b>         | 72   |

#### Pre/Corequisites

Prerequisite 10503110 Firefighter II

#### Textbooks

*Fire Apparatus Driver/Operator: Pump, Aerial, Tiller, and Mobile Water Supply*. 3rd Edition. Copyright 2019. International Association of Fire Chiefs. Publisher: Jones & Bartlett Learning. **ISBN-13:** 978-1-284-14761-2. Required.

#### Success Abilities

1. Cultivate Passion: Expand a Growth-Mindset
2. Live Responsibly: Develop Resilience
3. Live Responsibly: Embrace Sustainability
4. Live Responsibly: Foster Accountability
5. Refine Professionalism: Act Ethically

6. Refine Professionalism: Improve Critical Thinking
7. Refine Professionalism: Participate Collaboratively
8. Refine Professionalism: Practice Effective Communication

## Course Competencies

### 1. Apply water hydraulic principles.

#### Assessment Strategies

- 1.1. Written Objective Test
- 1.2. Demonstration

#### Criteria

*Performance will be satisfactory when:*

- 1.1. Score a minimum of 70%.
- 1.2. Complete exam within 90 minutes.
- 1.3. Complete exam without using any reference books or notes. Complete exam at prescribed time and place.
- 1.4. All pumping exercises are completed correctly.
- 1.5. All pumping exercises are completed safely.
- 1.6. Pumping theory is applied correctly during pumping exercises.
- 1.7. Pumping exercises are completed at designated time and location.

#### Learning Objectives

- 1.a. Discuss the various characteristics of water—the basic element of fire department hydraulics.
- 1.b. Explain the various effects that steam expansion has on the ability to purge an area of smoky and noxious gases.
- 1.c. Explain the four characteristics of water that affect its use in fire protection.
- 1.d. Define both force and pressure.
- 1.e. Explain the basic difference between force and pressure.
- 1.f. Understand the differences among static pressure, flow pressure, and residual pressure.
- 1.g. Explain the six basic rules governing the primary characteristics of pressure in liquids.

### 2. Apply mathematics and physics to the movement of water in fire suppression activities.

#### Assessment Strategies

- 2.1. Written Objective Test
- 2.2. Demonstration

#### Criteria

*Performance will be satisfactory when:*

- 2.1. Score a minimum of 70%.
- 2.2. Complete exam within 90 minutes.
- 2.3. Complete exam without using any reference books or notes.
- 2.4. Complete exam at prescribed time and place.
- 2.5. All pumping exercises are completed correctly.
- 2.6. All pumping exercises are completed safely.
- 2.7. Pumping theory is applied correctly during pumping exercises.
- 2.8. Pumping exercises are completed at designated time and location.

#### Learning Objectives

- 2.a. Identify the weight of 1 cubic foot of water, the number of gallons of water in 1 cubic foot, the weight of 1 gallon of water, the number of cubic inches in 1 cubic foot, the number of cubic inches in 1 gallon of water, the weight of a column of water measuring 1 inch by 1 inch in base by 1 foot high, and the weight of a column of water measuring 1 inch by 1 inch in base by 2.304 feet high.
- 2.b. Define head.
- 2.c. Determine the pressure when the head is known.
- 2.d. Determine the head when the pressure is known.
- 2.e. Understand the effect of elevation on pressure.

- 2.f. Define back pressure and forward pressure.
- 2.g. Determine the back pressure or forward pressure when lines are laid either uphill or downhill.
- 2.h. Determine the force on the base of a container.
- 2.i. Understand and work problems involving the force on clapper valves.
- 2.j. Explain the Bernoulli's Principle.
- 2.k. Explain the meaning of "conservation of energy."
- 2.l. Define energy, potential energy, and kinetic energy.
- 2.m. Illustrate a venturi in a pipe.

### **3. Identify the design principles of fire service pumping apparatus.**

#### **Assessment Strategies**

- 3.1. Written Objective Test
- 3.2. Demonstration

#### **Criteria**

*Performance will be satisfactory when:*

- 3.1. Score a minimum of 70%.
- 3.2. Complete exam within 90 minutes.
- 3.3. Complete exam without using any reference books or notes.
- 3.4. Complete exam at prescribed time and place.
- 3.5. All pumping exercises are completed correctly.
- 3.6. All pumping exercises are completed safely.
- 3.7. Pumping theory is applied correctly during pumping exercises.
- 3.8. Pumping exercises are completed at designated time and location.

#### **Learning Objectives**

- 3.a. Define a main pump.
- 3.b. Explain the various parts of the pump rating system.
- 3.c. Explain how booster pumps are used.
- 3.d. Discuss the purpose of priming pumps.
- 3.e. Explain the theory of positive displacement pumps.
- 3.f. Discuss the differences between a rotary gear, a rotary lobe, and a rotary vane pump.
- 3.g. Explain how a centrifugal pump works.
- 3.h. Explain how a multistage centrifugal pump works when in series and when in parallel.
- 3.i. Define cavitation and identify some of the signs of cavitation.
- 3.j. Demonstrate how a relief valve works.

### **4. Analyze community fire flow demand criteria.**

#### **Assessment Strategies**

- 4.1. Written Objective Test
- 4.2. Demonstration

#### **Criteria**

*Performance will be satisfactory when:*

- 4.1. Score a minimum of 70%.
- 4.2. Complete exam within 90 minutes.
- 4.3. Complete exam without using any reference books or notes.
- 4.4. Complete exam at prescribed time and place.
- 4.5. All pumping exercises are completed correctly.
- 4.6. All pumping exercises are completed safely.
- 4.7. Pumping theory is applied correctly during pumping exercises.
- 4.8. Pumping exercises are completed at designated time and location.

#### **Learning Objectives**

- 4.a. Define average daily consumption, maximum daily consumption, and peak hourly consumption.
- 4.b. Discuss needed fire flow.
- 4.c. Understand the difference between the system adequacy and the system reliability of a water system.
- 4.d. Explain the recommended markings for fire hydrants.
- 4.e. Explain the maintenance and testing procedures for fire hydrants.
- 4.f. Identify various types of emergency water supplies.

## **5. Explain the various types of fire pumps.**

### **Assessment Strategies**

- 5.1. Written Objective Test
- 5.2. Demonstration

### **Criteria**

*Performance will be satisfactory when:*

- 5.1. Score a minimum of 70%.
- 5.2. Complete exam within 90 minutes.
- 5.3. Complete exam without using any reference books or notes.
- 5.4. Complete exam at prescribed time and place.
- 5.5. All pumping exercises are completed correctly.
- 5.6. All pumping exercises are completed safely.
- 5.7. Pumping theory is applied correctly during pumping exercises.
- 5.8. Pumping exercises are completed at designated time and location.

### **Learning Objectives**

- 5.a. Explain the theory of positive displacement pumps.
- 5.b. Discuss the differences between a rotary gear, a rotary lobe, and a rotary vane pump.
- 5.c. Explain how a centrifugal pump works.

## **6. Determine the principles of forces that affect water, both at rest and in motion.**

### **Assessment Strategies**

- 6.1. Written Objective Test
- 6.2. Demonstration

### **Criteria**

*Performance will be satisfactory when:*

- 6.1. Score a minimum of 70%.
- 6.2. Complete exam within 90 minutes.
- 6.3. Complete exam without using any reference books or notes.
- 6.4. Complete exam at prescribed time and place.
- 6.5. All pumping exercises are completed correctly.
- 6.6. All pumping exercises are completed safely.
- 6.7. Pumping theory is applied correctly during pumping exercises.
- 6.8. Pumping exercises are completed at designated time and location.

### **Learning Objectives**

- 6.a. Explain the friction loss principles.
- 6.b. Recite the four fundamental rules governing friction loss in hose and pipe.
- 6.c. Apply the four fundamental rules governing friction loss to fire department hydraulics.
- 6.d. Explain the various parts of the friction loss formula.
- 6.e. Determine the friction loss in various firefighting hose configurations.
- 6.f. Explain the variables that must be considered in order to operate a pump at maximum efficiency on the fire ground.
- 6.g. Discuss the use of the required pump discharge pressure (RPDP) formula and its application to various pumping configurations.
- 6.h. Determine the RPDP for various firefighting hose configurations.