chapter 10

Ropes and Knots

Chapter Overview

Ask any experienced fire fighter to name the one tool that could support the broadest array of fire service tasks and have the greatest impact on personal life safety and that choice, most certainly, would be rope. Whether used to secure, hoist, or lower personnel and/or equipment, identify or restrict fire scene access, or serve as an emergency lifeline, rope, with its knotting capability, is one of the most useful and necessary tools in the fire service.

After students complete this chapter and the related course work, they will have an understanding of the types of ropes used in the fire service and their construction, maintenance, and application. Students will know how to appropriately select and use ropes, and they will be able to tie eight essential knots used for securing, hoisting, and lowering personnel and equipment. Students will also be able to describe how ropes are used in various rescue situations.

Objectives and Resources

Fire Fighter I

Knowledge Objectives

After studying this chapter, you will be able to:

* Describe the three primary types of fire service rope. (NFPA 5.3.20.A, p 260)
* List the two types of life safety rope. (NFPA 5.3.20.A, pp 260–261)
* Describe the characteristics of escape rope. (NFPA 5.3.20.A, p 261)
* Describe the characteristics of utility ropes. (NFPA 5.3.20.A, pp 261–262)
* List the advantages of synthetic fiber ropes. (NFPA 5.3.20.A, pp 262–263)
* List the disadvantages of synthetic fiber ropes. (NFPA 5.3.20.A, p 263)
* List the types of synthetic fibers that are used in fire service rope. (NFPA 5.3.20.A, p 263)
* Describe how twisted ropes are constructed. (NFPA 5.3.20.A, pp 263–264)
* Describe how braided ropes are constructed. (NFPA 5.3.20.A, p 264)
* Describe how kernmantle ropes are constructed. (NFPA 5.3.20.A, pp 264–265)
* Explain the differences between dynamic kernmantle rope and static kernmantle rope. (NFPA 5.3.20.A, p 265)
* List the four components of the rope maintenance formula. (NFPA 5.3.20.A, p 268)
* Describe how to preserve rope strength and integrity. (NFPA 5.3.20.A, pp 268–270)
* Describe how to clean rope. (NFPA 5.5.1, pp 268–269)
* Describe how to inspect rope. (NFPA 5.5.1, pp 269–270)
* Describe how to keep an accurate rope record. (NFPA 5.5.1, p 270)
* Describe how to store rope properly. (NFPA 5.5.1, pp 270–271)
* List the terms used to describe the parts of a rope when tying knots. (NFPA 5.3.20.A, p 271)
* List the common types of knots that are used in the fire service. (NFPA 5.3.20.A, p 272)
* Describe the characteristics of a safety knot. (NFPA 5.3.20, pp 272–273)
* Describe the characteristics of a hitch. (NFPA 5.3.20, pp 272–278)
* Describe the characteristics of a half hitch. (NFPA 5.3.20, p 272)
* Describe the characteristics of a clove hitch. (NFPA 5.3.20, pp 272–273)
* Describe the characteristics of a figure eight knot. (NFPA 5.3.20, p 279)
* Describe the characteristics of a bowline knot. (NFPA 5.3.20, p 279)
* Describe the characteristics of a bend. (NFPA 5.3.20, pp 279, 286)

Skill Objectives

After studying this chapter, you will be able to:

* Care for life safety ropes. (NFPA 5.5.1.A, 5.5.1.B, pp 268)
* Clean fire department ropes. (NFPA 5.5.1.A, pp 268–269)
* Inspect fire department ropes. (NFPA 5.5.1, p 270)
* Place a life safety rope in a rope bag. (NFPA 5.5.1, pp 270–271)
* Tie a safety knot. (NFPA 5.1.2, 5.3.20.B, pp 272–273)
* Tie a half hitch. (NFPA 5.1.2, 5.3.20.B, pp 272, 274)
* Tie a clove hitch in the open. (NFPA 5.1.2, 5.3.20.B, pp 273, 276–277)
* Tie a clove hitch around an object. (NFPA 5.1.2, 5.3.20.B, pp 273–274, 277–278)
* Tie a figure eight knot. (NFPA 5.1.2, 5.3.20.B, pp 279–280)
* Tie a figure eight on a bight. (NFPA 5.1.2, 5.3.20.B, pp 279, 281)
* Tie a figure eight with a follow-through. (NFPA 5.1.2, 5.3.20.B, pp 279, 282)
* Tie a figure eight bend. (NFPA 5.1.2, 5.3.20.B, pp 279, 283)
* Tie a bowline. (NFPA 5.1.2, 5.3.20.B, pp 279, 284)
* Tie a sheet or Becket bend. (NFPA 5.1.2, 5.3.20.B, pp 279, 285–286)
* Tie a water knot. (NFPA 5.1.2, 5.3.20.B, p 286)
* Hoist an axe. (NFPA 5.1.2, 5.3.20.B, pp 287–288)
* Hoist a pike pole. (NFPA 5.1.2, 5.3.20.B, pp 288–289)
* Hoist a ladder. (NFPA 5.1.2, 5.3.20.B, pp 289–290)
* Hoist a charged hose line. (NFPA 5.1.2, 5.3.20.B, pp 289, 291)
* Hoist an uncharged hose line. (NFPA 5.1.2, 5.3.20.B, pp 289, 292)
* Hoist an exhaust fan or power tool. (NFPA 5.1.2, 5.3.20.B, pp 290–291, 293)

Fire Fighter II

Knowledge Objectives

After studying this chapter, you will be able to:

* Describe the hardware components used during a rope rescue. (NFPA 6.4.2, pp 265–268)
* Describe the characteristics of a carabiner. (NFPA 6.4.2, pp 265–266)
* Describe the characteristics of a harness. (NFPA 6.4.2, p 266)
* List the types of incidents that might require a rope rescue. (pp 266–268)

Skill Objectives

There are no skill objectives for Fire Fighter II candidates. NFPA 1001 contains no Fire Fighter II Job Performance Requirements for this chapter.

Additional NFPA Standard

* NFPA 1983, *Standard on Life Safety Rope and Equipment for Emergency Services*

Reading and Preparation

* Review all instructional materials, including *Fundamentals of Fire Fighter Skills*, Chapter 10, and all related presentation support materials.
* Review local firefighting protocols for Chapter 10.
* Practice all the basic firefighting knots and the hoisting of selected equipment or enlist the aid of a proficient fire instructor or fire fighter for demonstrations and skills coaching.
* Review Chapter 27, Assisting Special Rescue Teams, of *Fundamentals of Fire Fighter Skills*, to provide appropriate reference and context for Fire Fighter I students.
* Familiarize yourself with the content of NFPA 1983 to be prepared to respond to student questions and/or expand on elements of the text and lesson plan.

Support Materials

* Dry erase board and markers or chalkboard and chalk
* LCD projector, slide projector, overhead projector, and projection screen
* PowerPoint presentation, overhead transparencies, or slides

Enhancements

* Direct the students to visit the Internet at www.FireFighter.jbpub.com for online activities.
* Direct the students to relevant sections in the Student Workbook for application of the content introduced in this chapter.
* Direct the students to take practice/final examinations in the Navigate Test Prep to prepare for examinations.
* Consider animations such as www.animatedknots.com or a videotaped sequence of knot tying and hoisting skills. Show in segments to confirm steps for each of the specified knots and hoisting of selected equipment, charged, and uncharged hose lines.
* If instructional media cannot be purchased or borrowed, consider the use of a digital camera to record the correct skill steps as performed by a competent instructor or fire fighter.

Teaching Tips and Activities

* Build or borrow a display board that has an assortment of correctly tied knots to assist students in identifying and tying common knots used in the fire service.
* Contact a local equipment vendor for samples or literature. Assemble an assortment of rope bags, personal escape pouches, and/or special rescue rope packets. Provide these specialized items as illustrative material for the Fire Fighter I level; consider hands-on demonstrations for the Fire Fighter II level concurrent with presentation of Chapter 27, Assisting Special Rescue Teams.
* Provide length of rope for each student; encourage students to carry rope with them to class and practice during lunch breaks, other break segments, or scheduled “down time” or skill staging.
* For simplicity, text materials refer to “right hand” and “left hand” in describing knot tying skills. For left-handed and ambidextrous students, consider using the terms “dominant hand” and “alternate hand” to clarify the skill steps if needed.
* When providing instruction and coaching for left-handed fire fighters, it may be best to stand next to the student instead of facing the student to demonstrate correct knot tying.
* For students with perceptual difficulties, consider using color-coded practice rope or speaking in metaphors for description (eg, “the rabbit comes out of the hole....” for tying a bowline).
* Consider peer instruction for knot tying and hoisting practice sessions with volunteer coaches selected from among those students with previous experience or facility in knot tying.
* If a multistory training facility is not available, position a ground ladder against the side of a building and loop rope over a high rung to simulate a roof or window.
* Advise students that detailed information on special rescue use of ropes is covered in other segments of the course.
* If instructing the Fire Fighter II level, you may want to assign a review of this chapter as homework before conducting hands-on activities to meet the requirements for assistance with special rescue (Chapter 27). Your audience assessment also would indicate the need to briefly review this lesson plan or its psychomotor skills activity component.
* Obtain a copy of NFPA 1983 and have it available on a resources table in the classroom for easy reference.

Presentation Overview

|  |  |  |  |
| --- | --- | --- | --- |
| **Total time**: 2 hours, 38 minutes  (with enhancements) | **Activity Type** | **Time** | **Level** |
| **Pre-Lecture** |  |  |  |
| **You Are the Fire Fighter** | Small Group Activity/Discussion | 5 minutes | Fire Fighter I and II |
| **Lecture** |  |  |  |
| **I. Introduction** | Lecture/Discussion | 12 minutes | Fire Fighter I and II |
| **II. Types of Rope** | Lecture/Discussion | 7.5 minutes | Fire Fighter I |
| **III. Rope Materials** | Lecture/Discussion | 7.5 minutes | Fire Fighter I |
| **IV. Rope Construction** | Lecture/Discussion | 10.5 minutes | Fire Fighter I |
| **V. Technical Rescue Hardware** | Lecture/Discussion | 10.5 minutes | Fire Fighter II |
| **VI. Rope Maintenance** | Lecture/Discussion/ Demonstration | 10.5 minutes | Fire Fighter I |
| **VII. Knots** | Lecture/Discussion/ Demonstration | 19.5 minutes | Fire Fighter I |
| **VIII. Hoisting** | Lecture/Discussion/ Demonstration | 7.5 minutes | Fire Fighter I |
| **VIX. Summary** | Lecture/Discussion | 7.5 minutes | Fire Fighter I and II |
| **Post-Lecture** |  |  |  |
| **I. Wrap-Up Activities**  **A. Fire Fighter in Action**  **B. Technology Resources** | Individual Activity/Small Group Activity/Discussion | 40 minutes | Fire Fighter I and II |
| **II. Lesson Review** | Discussion | 15 minutes | Fire Fighter I and II |
| **III. Assignments** | Lecture | 5 minutes | Fire Fighter I and II |

Pre-Lecture

* 1. I. You Are the Fire Fighter

Time: 5 Minutes

Level: Fire Fighter I and II

Small Group Activity/Discussion

Use this activity to motivate students to learn the importance of rope as an essential tool for the fire fighter and to understand its use in supporting the wide range of fire suppression and rescue activities performed in the fire service.

Purpose

To allow students an opportunity to explore the significance and concerns associated with ropes and knots.

Instructor Directions

1. Direct students to read the “You Are the Fire Fighter” scenario found in the beginning of Chapter 10.
2. You may assign students to a partner or a group. Direct them to review the discussion questions at the end of the scenario and prepare a response to each question. Facilitate a class dialogue centered on the discussion questions.
3. You may also assign this as an individual activity and ask students to turn in their comments on a separate piece of paper.

Lecture

* 1. SLIDE TEXT LECTURE NOTE
  2. I. Introduction

Time: 12 Minutes

Slides: 1–8

Level: Fire Fighter I

Lecture/Discussion

* + 1. In the fire service, ropes are widely used to hoist or lower tools, appliances, or people; to pull a person to safety; or to serve as a lifeline in an emergency.

Slide 8

Introduction

* Ropes are widely used in the fire service.
* May be your only means for rescue
* A fire fighter must be able to tie simple knots accurately and without hesitation.

Slide 1–7

CHAPTER 10: Ropes and Knots

* Chapter Objectives
  + 1. A rope may be your only means of accessing a trapped person or your only way of escaping from a fire.
    2. Learning about ropes and knots is an important part of your training as a fire fighter.
    3. You must be able to tie simple knots accurately without hesitation or delay.
  1. II. Types of Rope

Time: 7.5 Minutes

Slides: 9-13

Level: Fire Fighter I

Lecture/Discussion

* + 1. There are three primary types of rope used in the fire service, each dedicated to a distinct function.

Slide 9

Types of Rope

* Life safety
* Used solely for supporting people
* Escape Rope

Used for emergency self-rescue

* Utility
* Used in most cases when it is not necessary to support a person
  + - 1. Life safety rope is used solely for supporting people.
         1. Life safety rope must be used anytime a rope is needed to support a person, whether during training or during firefighting, rescue, or other emergency operations.
      2. Escape rope is a single-purpose, emergency self-escape, self-rescue rope.
      3. Utility rope is used in most other cases, when it is *not* necessary to support the weight of a person, such as when hoisting or lowering tools or equipment.
    1. Life Safety Rope

Slide 10

Life Safety Rope

* Never used as utility rope
* Must be used when supporting the weight of one or more persons
* NFPA 1983 specifies design, construction, and performance criteria.
  + - 1. The life safety rope is a critical tool used only for life-saving purposes.
      2. It must *never* be used for utility purposes.
      3. Life safety rope must be used in every situation where the rope must support the weight of one or more persons.
      4. In these situations rope failure could result in serious injury or death.
      5. Because a fire fighter’s equipment must be extremely reliable, the criteria for design, construction, and performance of life safety rope and related equipment are specified in the NFPA 1983, *Standard on Fire Service Life Safety Rope and System Components*.
      6. NFPA 1983 lists very specific standards for the construction of life safety rope.
         1. NFPA 1983 also requires the rope manufacturer to include detailed instructions for the proper use, maintenance, and inspection of the life safety rope, including the conditions for removing the rope from service.
         2. The manufacturer must also supply a list of criteria that must be reviewed before a life safety rope that has been used in the field can be used again.
         3. If the rope does not meet all of the criteria, it must be retired from service.
      7. The two primary types of life safety ropes are technical use life safety rope and general use life safety rope.

Slide 11

Types of Life Safety Rope

* Technical use life safety rope

3/8” (9.5 mm) or greater, but is less than 1/2” (12.5mm)in diameter

* General use life safety rope

is no larger than 5/8” (16 mm) and no smaller than 7/16” (11 mm) in diameter

* + - * 1. A technical use life safety rope is 3/8” (9.5 mm) or greater, but less than 1/2” (12.5mm), in diameter..
        2. A General use life safety rope is no larger than 5/8” (16 mm) and no smaller than 7/16” (11 mm) in diameter.
      1. After each use, these ropes must be inspected according to the criteria provided by the manufacturer before they can be used again.
      2. If a life safety rope has been damaged or overstressed or if it does not meet the inspection criteria, it cannot be reused as a life safety rope.
    1. Escape Rope

Slide 12

Escape Rope

* Used for self-rescue in extreme situations
* Designed for the weight of one person
* Should be replaced after one use
* Use the rope only as a last resort.
  + - 1. An escape rope is a special classification of life safety rope that is intended to be used by a fire fighter only for self-rescue from an extreme situation.
         1. This rope is designed to carry the weight of only one person and to be used only one time.
         2. Its purpose is to provide the fire fighter with a method of escaping from a life-threatening situation.
         3. After one use, the personal escape rope should be replaced by a new rope.
         4. When you are fighting a fire, you should always have a safe way to get out of a situation and to a safe location.
         5. You may be able to go back through the door that you entered, or you may have another exit route, such as through a different door, through a window, or down a ladder.
         6. If conditions suddenly change for the worse, having an escape route can save your life.
         7. Sometimes, however, you may find yourself in a situation where conditions deteriorate so quickly that you cannot use your planned exit route.
         8. In such a situation, you may need to take extreme measures to get out of the building.

The personal escape rope was developed specifically for this type of emergency self-rescue situation.

* + - * 1. A personal escape rope can support the weight of one person and fits easily in a small packet or pouch.
    1. Utility Rope

Slide 13

Utility Rope

* Is not used to support a person
* Used for hoisting, lowering, and securing equipment
* Requires regular inspection
  + - 1. Utility rope is used when it is *not* necessary to support the weight of a person.
      2. Fire department utility rope is used for hoisting or lowering tools or equipment, ladder halyards (rope used on extension ladders to raise a fly section), marking off areas, and stabilizing objects.
      3. Utility ropes also require regular inspection.
      4. Utility ropes must not be used in situations where life safety rope is required.
      5. Conversely, life safety rope must not be used for utility applications.
      6. A fire fighter must be able to instantly recognize the category of a rope from its appearance and markings.
  1. III. Rope Materials

Time: 7.5 Minutes

Slides: 14-18

Level: Fire Fighter I

Lecture/Discussion

* + 1. Ropes can be made from many different types of materials.

Slide 14

Rope Materials

* Ropes can be made of many types of materials.
* Earliest ropes were made from natural vines woven together.
* Now ropes are made of synthetic material.
  + - 1. The earliest ropes were made from naturally occurring vines or fibers that were woven together.
      2. Ropes are now made of synthetic materials, such as nylon or polypropylene.
      3. Because ropes have many different uses, different materials may work better than others in various situations.
    1. Natural Fibers

Slide 15

Natural Fibers

* Natural fiber ropes were often made of manila.
* Current use for utility, not life safety, tasks
  + - 1. In the past, fire departments used ropes made from natural fibers, such as manila, because there were no alternatives.
      2. The natural fibers are twisted together to form strands.
      3. A strand may contain hundreds of individual fibers of different lengths.
      4. Today, ropes made from natural fibers are still used as utility ropes but are no longer acceptable as life safety ropes.
      5. Natural fiber ropes can be weakened by mildew and deteriorate with age, even when properly stored.
      6. A wet manila rope can absorb 50 percent of its weight in water, making it very susceptible to deterioration.
      7. A wet natural fiber rope is very difficult to dry.
    1. Synthetic Fibers

Slide 16

Synthetic Fibers

* Nylon first manufactured in 1938
* Synthetic fibers have been used for ropes ever since.
  + - 1. Since nylon was first manufactured in 1938, synthetic fibers have been used to make ropes.
      2. In addition to nylon, several newer synthetic materials, such as polyester, polypropylene, and polyethylene, are used in rope construction.
      3. Synthetic fibers have several advantages over natural fibers.

Slide 17

Synthetic Fibers

**Table 10-3:** Advantages to Using Synthetic Fiber Ropes

* + - * 1. Synthetic fibers are generally stronger than natural fibers, so it may be possible to use a smaller diameter rope without sacrificing strength.
        2. Synthetic materials can also produce very long fibers that run the full length of a rope to provide greater strength and added safety.
        3. Synthetic ropes are more resistant to rotting and mildew than natural fiber ropes and do not degrade as rapidly.
        4. Depending on the material, synthetic ropes may provide more resistance to melting and burning than natural fiber ropes.
        5. They also absorb much less water when wet and can be washed and dried.
        6. Some types of synthetic rope can float on water, which is a major advantage in water rescue situations.
      1. However, ropes made from synthetic fibers do have some drawbacks.
         1. Prolonged exposure to UV light and exposure to strong acids or alkalis can damage a synthetic rope and decrease its life expectancy.
      2. Life safety ropes are always made of synthetic fibers.

Slide 18

Synthetic Fibers

* Life safety rope is always synthetic.
* Nylon
* Polyester
* Polypropylene
  + - * 1. Before any rope can be used for life safety purposes it must meet the requirements outlined in the most current version of NFPA 1983.
        2. These standards specify that life safety rope must be of block creel construction (without knots or splices in the yarns, ply yarns, strands, braids, or rope).
        3. Rope of any other material or construction may not be used as a life safety rope.
      1. The most common synthetic fiber used in life safety ropes is nylon.
         1. It has a high melting temperature with good abrasion resistance and is strong and lightweight.
         2. Nylon ropes are also resistant to most acids and alkalis.
      2. Polyester is the second most common synthetic fiber used for life safety ropes.
      3. Some life safety ropes are made of a combination of nylon and polyester or other synthetic fibers.
      4. Polypropylene is the lightest of the synthetic fibers.
         1. Because it does not absorb water and floats, polypropylene rope is often used for water rescue situations.
         2. However, it is not as suitable as nylon for fire department life safety uses because it is not as strong, is hard to knot, and has a low melting point.
  1. IV. Rope Construction

Time: 10.5 Minutes

Slides: 19-25

Level: Fire Fighter I

Lecture/Discussion

* + 1. There are several different types of rope construction.

Slide 19

Rope Construction

* There are several types of rope construction.
* The best choice depends on specific application.
  + 1. The best choice of rope construction depends on the specific application.
    2. Twisted Rope

Slide 20

Twisted Rope Construction

* Also called laid ropes
* Individual fibers twisted into strands
* Strands are twisted to make the rope.
* Both natural and synthetic fibers can be twisted.
  + - 1. Twisted ropes, which are also called laid ropes, are made of individual fibers twisted into strands.
      2. The strands are then twisted together to make the rope.
      3. This method of rope construction has been used for hundreds of years.
      4. Both natural and synthetic fibers can be used to make twisted rope.
      5. This method of construction exposes all of the fibers to the outside of the rope where they are subject to abrasion.
      6. Abrasion can damage the rope fibers and may reduce rope strength.
      7. Twisted ropes tend to stretch and are prone to unraveling when a load is applied.
    1. Braided Rope

Slide 21

Braided Rope Construction

* Strands woven like hair braiding
* Exposes all of the strands to abrasion
* Fibers stretch
* Double-braiding
  + - 1. Braided ropes are constructed by weaving or intertwining strands together in the same way that hair is braided.
      2. This method of construction also exposes all of the strands to the outside of the rope, where they are subject to abrasion.
      3. Braided rope will stretch under a load, but it is not prone to twisting.
      4. A double braided rope has an inner braided core covered by a protective braided sleeve so that only the fibers in the outer sleeve are exposed to the outside.
         1. The inner core is protected from abrasion.
    1. Kernmantle Rope

Slide 22

Kernmantle Rope Construction

* Kern is the center core and provides 70% of rope’s strength.
* Mantle is the sheath-like braided covering that protects kern from dirt and abrasion.
  + - 1. Kernmantle rope consists of two distinct parts: the kern and the mantle.
      2. The kern is the center or core of the rope.
      3. The mantle or sheath is a braided covering that protects the core from dirt and abrasion.
      4. Both parts of a kernmantle rope are made with synthetic fibers, but different fibers may be used for the kern and the mantle.

Slide 23

Kernmantle Rope Construction

* Kern and mantle are synthetic.
* Provides a very strong and flexible rope that is thin and lightweight
* Well suited for rescue work
  + - 1. Each fiber in the kern extends for the entire length of the rope without knots or splices.
      2. This block creel construction is required under NFPA 1983 for all life safety ropes.
      3. The continuous filaments produce a core that is stronger than one constructed of shorter fibers that are twisted or braided together.
      4. Kernmantle construction produces a very strong and flexible rope that is relatively thin and lightweight.
      5. This construction is well-suited for rescue work and is very popular for life safety rope.
    1. Dynamic and Static Rope

Slide 24

Dynamic and Static Rope Construction

* Dynamic
* Designed to be elastic
* Usually used by mountain climbers
* Static
* Has a limited range of elasticity
* More suitable for rescue situations
  + - 1. A rope can be either dynamic or static, depending on how it reacts to an applied load.
      2. A dynamic rope is designed to be elastic and will stretch when it is loaded.
      3. A static rope has a limited range of elasticity.
      4. The differences between dynamic and static ropes result from both the fibers used and the construction method.
      5. Dynamic rope is usually used in safety lines for mountain climbing because it will stretch and cushion the shock if a climber falls a long distance.
      6. A static rope is more suitable for most fire rescue situations, where falls from great heights are not anticipated.
      7. Teams that specialize in rope rescue often carry both static and dynamic ropes for use in different situations.
    1. Dynamic and Static Kernmantle Ropes

Slide 25

Dynamic and Static Kernmantle Rope Construction

* Dynamic
* Constructed with overlapping or woven fibers
* When loaded, the fibers pull tighter.
* Static
* Constructed with fibers parallel to each other
* Little elasticity and limited elongation
  + - 1. Kernmantle ropes can be either dynamic or static.
         1. A dynamic kernmantle rope is constructed with overlapping or woven fibers in the core.

When the rope is loaded, the core fibers are pulled tighter, which gives the rope its elasticity.

* + - * 1. The core of a static kernmantle rope has all of the fibers laid parallel to each other.

A static kernmantle rope has very little elasticity and limited elongation under an applied load.

Most fire department life safety ropes use static kernmantle construction.

It is well suited for lowering a person and can be used with a pulley system for lifting individuals.

It can also be used to create a bridge between two structures.

* 1. V. Technical Rescue Hardware

Time: 10.5 Minutes

Slides: 26-32

Level: Fire Fighter II

Lecture/Discussion

* + 1. During technical rescue incidents, ropes are often used to access and extricate individuals.

Slide 26

Technical Rescue Hardware

* Ropes often used to access and extricate individuals
* Several hardware components may also be needed.
* Carabiner secures and connects lines.

**FF II**

* + 1. In addition to the rope itself, several hardware components may also be used.
    2. The one most commonly used by fire fighters is a carabiner or a snap link.
       1. This device is used to connect one rope to another rope, to a harness, or to itself.
       2. There are different types of carabiners, and you should know how to operate the type used by your department.
    3. Harnesses

Slide 27

Harnesses

* Secures person to a rope or object
* Class II (Seat harness)
* Class III (Chest harness)
  + - 1. A harness is a piece of rescue or safety equipment made of webbing and worn by a person.
      2. It is used to secure the person to a rope or to a solid object.
      3. Two different types of harnesses—Class II and Class III—are used by rescuers, depending on the type of circumstances encountered.
         1. Class II harness (seat harness) fastens around the rescuer's waist and legs and has a design load of 600 lbs. It is used to support a fire fighter, particularly in rescue situations.
         2. Class III harness (chest harness) fastens around the rescuer's waist and thighs as well as secures the rescuer's waist and shoulders. It is the most secure type of harness and is often used to support a fire fighter who is being raised or lowered on a life safety rope.
      4. Harnesses need to be cleaned and inspected regularly, just as you do for life safety ropes.
         1. Follow the manufacturer’s instructions for cleaning and inspecting harnesses.
    1. Rope Rescue

Slide 28

Rope Rescue

* Raising and lowering rescuers to access injured or trapped individuals
* Rope rescue courses cover the technical skills needed to raise or lower people.
  + - 1. Rope rescue involves raising and lowering rescuers to access injured or trapped individuals, as well as raising or lowering victims who are rescued so they can be given appropriate medical treatment.
      2. An approved rope rescue course is required to attain proficiency in rope rescue skills.
      3. Rope rescue courses cover the technical skills needed to raise or lower people using mechanical advantage systems and to remove someone from a rock ledge or a confined space.
      4. They also cover the equipment and skills needed to accomplish these rescues safely.
    1. Rope Rescue Incidents

Slide 29

Rope Rescue Incidents

* Rescuers often have to lower themselves and determine how to get victim to safety.
* Extreme cases could involve a helicopter.
* The type and number of ropes will depend on the situation.
  + - 1. Most rope rescue incidents involve people who are trapped in normally inaccessible locations, such as a mountainside or the outside of a building.
      2. Rescuers often have to lower themselves using a system of anchors, webbing, ropes, carabiners, and other devices to reach the trapped person.
      3. Once rescuers reach the person, they then have to stabilize him or her and determine how to get the person to safety.
      4. Sometimes the person will have to be lowered or raised to a safe location.
      5. Extreme cases could involve more complicated operations, such as transporting the person in a basket lowered by a helicopter.
      6. The type and number of ropes used in a rope rescue will depend on the situation.
         1. There is almost always a primary rope that will bear the weight of the rescuer (or rescuers) while he or she reaches the person.
         2. The rescuers will often have a second line attached to them, known as a belay line, which serves as a backup if the main line fails.
         3. Additional lines may be needed to raise or lower the trapped individual, depending on the circumstances.
    1. Trench Rescue

Slide 30

Trench Rescues

* Often are complicated and require a number of skills
* Shoring
* Air-quality monitoring
* Confined space operations
* Ropes
  + - 1. Rescues in collapsed trenches often are complicated and involve a number of different skills, such as shoring, air quality monitoring, confined space operations, and rope rescue.
         1. Ropes are often used to remove the trapped person.
         2. After the rescuers shore the walls of the trench and remove the dirt covering the person, they will place the person in a Stokes basket or on a backboard and lift him or her to the surface.
         3. If the trench is deep, ropes may be used to raise the patient to the surface.
    1. Confined-Space Rescue

Slide 31

Confined-Space Rescue

* Often difficult to extricate victim due to poor ventilation and limited entry/exit
* Often very complex
  + - 1. A confined space rescue can take place in locations such as tanks, silos, underground electrical vaults, storm drains, and similar structures.
         1. It is often very difficult to extricate an unconscious or injured person from these locations because of the poor ventilation and limited entry or exit area.
         2. For this reason, ropes are often used to remove an injured or unconscious person.
    1. Water Rescue

Slide 32

Water Rescue

* The simplest situation may involve throwing a rope to a person in the water.
* Complex situations may require ropes stretched across the stream with a tethered boat.
  + - 1. Ropes can be used in a variety of ways during water rescue operations.
         1. The simplest situation involves a rescuer on the shore throwing a rope to a person in the water and pulling the person to shore.
         2. A more complicated situation may involve a rope stretched across a stream or river.

A boat is tethered to the rope, and rescuers on shore maneuver the boat using a series of ropes and pulleys.

* 1. VI. Rope Maintenance

Time: 10.5 Minutes

Slides: 33-39

Level: Fire Fighter I

Lecture/Discussion/Demonstration

* + 1. All ropes, especially life safety ropes, need proper care to perform in an optimal manner.

Slide 33

Rope Maintenance

* All ropes require proper care.
* Four parts to maintenance:
* Care
* Clean
* Inspect
* Store
  + 1. Maintenance is necessary for all kinds of equipment and all types of rope, and it is absolutely essential for life safety ropes.
    2. Your life and the lives of others depend on the proper maintenance of your life safety ropes.
    3. There are four parts to the maintenance formula:
       1. Care
       2. Clean
       3. Inspect
       4. Store
    4. Care for the Rope

Slide 34

Care for the Rope

Table 10-4: Principles to Preserve Strength and Integhrity of Rope

* + - 1. You must follow certain principles to preserve the strength and integrity of rope:
         1. Protect the rope from sharp and abrasive surfaces.

Use edge protectors when the rope must pass over a sharp or unpadded surface.

* + - * 1. Protect the rope from rubbing against another rope or webbing.

Friction generates heat, which can damage or destroy the rope.

* + - * 1. Protect the rope from heat, chemicals, and flames.
        2. Protect the rope from prolonged exposure to sunlight. UV radiation can damage rope.
        3. Never step on a rope!

Your footstep could force shards of glass, splinters, or abrasive particles into the core of the rope, damaging the rope fibers.

* + - 1. Follow the manufacturer’s recommendations for rope care. Skill Drill 10-1 reviews the steps for proper care for life safety ropes.
    1. Clean the Rope

Slide 35

Clean the Rope

* Use mild soap and water for synthetic fibers.
* Do not use bleach.
* Follow manufacturer’s recommendations.
* Do not pack or store wet or damp rope.
  + - 1. Many ropes made from synthetic fibers can be washed with a mild soap and water.
      2. A special rope washer can be attached to a garden hose.
      3. Some manufacturers recommend placing the rope in a mesh bag and washing it in a frontloading washing machine.
      4. Always use a mild detergent.
      5. Do not use bleach because it can damage rope fibers.
      6. Follow the manufacturer’s recommendations for specific care of your rope.
      7. Do not pack or store wet or damp rope.
         1. Air-drying is usually recommended.
         2. The use of mechanical drying devices is not usually recommended.
         3. Never dry or store rope in direct sunlight.
      8. Skill Drill 10-2 explains how to clean fire department ropes.
    1. Inspect the Rope

Slide 36

Inspect the Rope

* Inspect life safety rope after each use and on a regular schedule when unused.
* Look for cuts and damage as you run it through your fingers.
  + - 1. Life safety ropes must be inspected after each use, whether the rope was used for an emergency incident or in a training exercise.
      2. Unused rope should be inspected on a regular schedule.
      3. Some departments inspect all rope, including life safety and utility ropes, every 3 months.
      4. Obtain the inspection criteria from the rope manufacturer.
      5. Inspect the rope visually, looking for cuts, frays, or other damage as you run it through your fingers.
      6. Because you cannot see the inner core of a kernmantle rope, feel for any depressions (flat spots or lumps on the inside).
      7. Examine the sheath for any discolorations, abrasions, or flat spots.
      8. If you have any doubt about whether the rope has been damaged, consult with your company officer.
      9. A life safety rope that is no longer usable must be pulled from service and either destroyed or marked as a utility rope..

Slide 37

Inspect the Rope

* A life safety rope that is no longer usable must be pulled from service and either destroyed or marked as a utility rope.
* **Table 10-6**: Signs of Possible Rope Deterioration
  + - * 1. A downgraded rope must be clearly marked so that it cannot be confused with a life safety rope.
      1. Skill Drill 10-3 reviews steps for inspecting fire department ropes.
      2. Rope record
         1. Each piece of rope must be marked for identification and a paper or computer rope record must be kept for each piece of life safety rope.

This record should include a history of when the rope was purchased, each time it was used, how it was used, and the types of loads applied to it.

* + - * 1. Each inspection should also be recorded.
        2. Many fire departments maintain records for both utility ropes and life safety ropes.
    1. Store the Rope

Slide 38

Store the Rope

* Avoid temperature extremes and keep out of sunlight and away from fumes of gasoline, oils, and hydraulic fluids.
* Use a separate apparatus compartment.
  + - 1. Proper care will ensure a long life for your rope and reduce the chance of equipment failure.
      2. Store ropes away from temperature extremes, out of sunlight, and in areas where there is some air circulation.
      3. Avoid placing ropes where fumes from gasoline, oils, or hydraulic fluids can damage the rope.
      4. Apparatus compartments used to store ropes should be separated from compartments used to store any oil-based products or machinery powered by gasoline or diesel fuel.
      5. Do not place any heavy objects on top of the rope.

Slide 39

Store the Rope

* Do not place heavy objects on the rope.
* Rope bags may be used or rope may be coiled.
* If shock loaded, inspect and consider removing from service.
  + - 1. Rope bags are used to protect and store ropes.
         1. Each bag should contain only one rope. Skill Drill 10-4 reviews the steps for placing a life safety rope into a rope bag.
      2. Rope may also be coiled for storage.
      3. Very long pieces of rope are sometimes stored on spools.
      4. Any rope that has been shock loaded should be inspected and may have to be removed from service.
         1. Although there may not be any visible damage, shock loading may cause damage that is not immediately apparent.
         2. Repeated shock loads can severely weaken a rope so that it can no longer be used safely.
      5. Accurate rope records will help identify potentially damaged rope.
  1. VII. Knots

Time: 19.5 Minutes

Slides: 40-52

Level: Fire Fighter I

Lecture/Discussion/Demonstration

* + 1. Knots are prescribed ways of fastening lengths of rope or webbing to objects or to each other.

Slide 40

Knots

* Ways of fastening ropes and webbing to objects or each other.
* Fire fighters must know how and when to use knots.
* Knots are used for multiple purposes.
* Knots reduce rope load-carrying capability.
  + 1. As a fire fighter, you must know how to tie and when to use certain knots.
    2. Knots can be used for one or more particular purposes.
       1. Hitches, such as the clove hitch, are used to attach a rope around an object.
       2. Knots, such as the figure eight and the bowline, are used to form loops.
       3. Bends, such as the sheet bend or Becket bend, are used to join two ropes together.
       4. Safety knots, such as the overhand knot, are used to secure the ends of ropes to prevent them from coming untied.
    3. Any knot will reduce the load-carrying capacity of the rope by a certain percentage.
       1. You can avoid an unnecessary reduction in rope strength if you know what type of knot to use and how to tie it correctly.
    4. Terminology

Slide 42

Knot Terms

* Bight
* Reverse direction to form U-bend
* Loop
* Makes a circle in the rope
* Round turn
* Makes a loop with parallel ends

Slide 43

Basic Fire Service Knots

* Safety knot (overhand knot)
* Half hitch
* Clove hitch
* Figure eight
* Figure eight on a bight
* Figure eight follow-through
* Figure eight bend
* Bowline
* Bend (sheet or Becket bend)

Slide 41

Knot Terms

* Working end
* Used in forming knots
* Running end
* Used in lifting or hoisting
* Standing part
* Between the working and the running end
  + - 1. Specific terms are used to refer to the parts of a rope in describing how to tie knots.
      2. The working end is the part of the rope used for forming the knot.
      3. The running end is the part of the rope used for lifting or hoisting.
      4. The standing part is the rope between the working end and the running end.
      5. A bight is formed by reversing the direction of the rope to form a *U*-bend with two parallel ends.
      6. A loop is formed by making a circle in the rope.
      7. A round turn is formed by making a loop and then bringing the two ends of the rope parallel to each other.
    1. A fire fighter must know how to tie these simple knots and how to use them properly.
       1. Safety knot (overhand knot)
       2. Half hitch
       3. Clove hitch
       4. Figure eight
       5. Figure eight on a bight
       6. Figure eight follow-through
       7. Figure eight bend
       8. Bowline
       9. Bend (sheet or Becket bend)
    2. Safety Knot

Slide 44

Safety Knot

* Secures the leftover working end of the rope to the standing part of the rope.
* Ensures primary knot will not become undone
* To test, try sliding it on the standing part of the rope.
* A knot that is tied correctly will slide.
  + - 1. A safety knot (also referred to as an overhand knot or a keeper knot) is used to secure the leftover working end of the rope to the standing part of the rope.
      2. It provides a degree of safety to ensure that the primary knot will not become undone.
      3. A safety knot should always be used to finish the other basic knots.
      4. A safety knot is simply an overhand knot in the loose end of the rope that is made around the standing part of the rope.
      5. This secures the loose end and prevents it from slipping back through the primary knot.
      6. Skill Drill 10-5 reviews the steps to tie a safety knot.
      7. To test whether you’ve tied a safety knot correctly, try sliding it on the standing part of the rope.
         1. A knot that is tied correctly will slide.
    1. Hitches

Slide 45

Hitches

* Wrap around an object
* Used to secure working end to a solid object or to tie a rope to an object before hoisting it
  + - 1. Hitches are knots that wrap around an object, such as a pike pole or a fencepost.
      2. They are used to secure the working end of a rope to a solid object or to tie a rope to an object before hoisting it.
      3. The half hitch is not a secure knot by itself.

Slide 46

Hitches

* Half hitch
* Not secure by itself
* Used only in conjunction with other knots.
* Long objects may need several half hitches.
* Clove hitch
* Used to attach rope to a round object
* Will hold if tension is applied
  + - * 1. It is used only in conjunction with other knots.

For example, when hoisting an axe or pike pole, you will use the half hitch to keep the hoisting rope aligned with the handle.

* + - * 1. On long objects, you may need to use several half hitches.
        2. Skill Drill 10-6 reviews the steps to tie a half hitch.
      1. A clove hitch is used to attach a rope firmly to a round object, such as a tree or a fence post.
         1. It can also be used to tie a hoisting rope around an axe or pike pole.
         2. A clove hitch can be tied anywhere in a rope and will hold equally well if tension is applied to either end of the rope or both ends simultaneously.
         3. There are two different methods of tying this knot.

A clove hitch tied in the open is used when the knot can be formed and then slipped over the end of an object, such as an axe or pike pole. Skill Drill 10-7 reviews the steps to tie a clove hitch in the open.

If the object is too large or too long to slip the clove hitch over one end, the same knot can be tied around the object. Skill Drill 10-8 reviews the steps to tie a clove hitch around an object.

* + 1. Loop Knots

Slide 47

Loop Knots

* Used to form a loop in the end of a rope
* May be used for hoisting tools, securing a person, or identifying the end of a stored rope.
* Will not slip easily but are easy to untie
  + - 1. Used to form a loop in the end of a rope.
         1. These loops may be used for hoisting tools, for securing a person during a rescue, for securing a rope to a fixed object, or for identifying the end of a rope stored in a rope bag.
         2. When tied properly, these knots will not slip and are easy to untie.
      2. A figure eight is a basic knot used to produce a family of other knots, including the figure eight on a bight and the figure eight with a follow-through.

Slide 48

Loop Knots

* Figure eight knot
* Used to produce a family of other knots
* Seldom used alone
* Figure eight on a bight
* Secures loop at the working end
* Can be used to attach rope to fixed object or a piece of equipment
  + - * 1. Skill Drill 10-9 reviews the steps to tie a figure eight knot.
      1. The figure eight on a bight knot creates a secure loop at the working end of a rope.
         1. The loop can be used to attach the end of the rope to a fixed object or a piece of equipment or to tie a life safety rope around a person.
         2. The figure eight on a bight is tied in a section of the rope that has been doubled over to form a bight.
         3. Skill Drill 10-10 reviews the steps to tie a figure eight on a bight.
      2. A figure eight follow-through knot creates a secure loop at the end of a rope when the working end must be wrapped around an object or passed through an opening before the loop can be formed.

Slide 49

Loop Knots

* Figure eight follow-through
* Useful for attaching a rope to a fixed ring or a solid object with an “eye”
* Figure eight bend
* Used to join two ropes together
* Bowline
* Used to secure a rope to an object or anchor point
  + - * 1. It is very useful for attaching a rope to a fixed ring or a solid object with an “eye.”
        2. Skill Drill 10-11 reviews the steps to tie a figure eight with a follow-through.
      1. A figure eight bend or tracer 8 is used to join two ropes together.
         1. Skill Drill 10-12 reviews the steps to tie a figure eight bend.
      2. A bowline knot also can be used to form a loop.
         1. It is frequently used to secure the end of a rope to an object or anchor point.
         2. Skill Drill 10-13 reviews the steps to tie a bowline.
    1. Bends

Slide 50

Bends

* Used to join two ropes together
* The sheet bend or Becket bend can be used to join two ropes of unequal size.
* The water knot or ring bend is used to join webbing of the same or different sizes together.
  + - 1. Used to join two ropes together.
         1. The sheet bend or Becket bend can be used to join two ropes of unequal size.
         2. A sheet bend knot also can be used to join rope to a chain.
         3. This knot is tied by forming a bight in the end of one rope.
         4. If the ropes are of unequal size, the bend should be made in the larger rope.
         5. Skill Drill 10-14 reviews the steps to tie a sheet or Becket bend.
      2. The water knot or ring bend is used to join webbing of the same or different sizes together.
         1. A sling knot is created when a single piece of webbing is used to tie opposite ends together.
         2. Skill Drill 10-15 reviews the steps to tie a water knot.
    1. There are many ways to tie each of these knots.

Slide 51

Methods of Knot Tying

* Find a method and use it all the time.
* Your department may require a specific method.
* You should be able to tie knots while wearing gloves, in the dark, and behind your back.
  + - 1. Find one method that works for you and use it all the time.
      2. In addition, your department may require that you learn how to tie other knots.
      3. It is important to become proficient in tying knots.
      4. With practice, you should be able to tie these knots in the dark, with heavy gloves on, and behind your back.
    1. A knot should be properly “dressed” by tightening and removing twists, kinks and slack from the rope.

Slide 52

“Dressing” a Knot

* Knots should be “dressed” by tightening and removing twists, kinks, and slack.
* Always secure loose ends.
* Knot-tying should be practiced.
  + - 1. The finished knot is firmly fixed in position.
      2. The configuration of a properly dressed knot should be evident so that it can be easily inspected.
    1. Knot-tying skills can be quickly lost without practice.
       1. Practice tying knots while you are on the telephone or watching television.
       2. For added practice, try tying these knots with your gloves on or in the darkness.
  1. VIII. Hoisting

Time: 7.5 Minutes

Slides: 53-57

Level: Fire Fighter I

Lecture/Discussion/Demonstration

* + 1. Tying knots is not an idle exercise but a practical skill that you will use on the job.

Slide 53

Hoisting

* In an emergency, you may have to raise or lower tools and equipment.
* Important that the object is properly secured.
* Coworkers must be able to quickly remove the object.
* When lowering, be sure no one is under the object.
  + - 1. In emergency situations, you may have to raise or lower a tool to other fire fighters.
         1. It is important for you to learn how to raise and lower an axe, a pike pole, a ladder, a hose line, and an exhaust fan.
      2. You must ensure that the rope is tied securely to the object being hoisted so the tool does not fall.
      3. In addition, your coworkers must be able to remove and place the tool into service quickly.
      4. When you are hoisting or lowering a tool, make sure no one is standing under the object.
    1. An axe should be hoisted in a vertical position with the head of the axe down.

Slide 54

Hoisting

* An axe should be hoisted in a vertical position with the head of the axe down.
* A pike pole should be hoisted in a vertical position with the head at the top.
* A ladder should be hoisted in a vertical position.
  + - 1. Skill Drill 10-16 reviews the steps to hoist an axe.
    1. A pike pole should be hoisted in a vertical position with the head at the top, so it can be used immediately.
       1. Skill Drill 10-17 reviews the steps to hoist a pike pole.
    2. A ladder should be hoisted in a vertical position.
       1. A tag line should be attached to the bottom to keep it under control as it is hoisted.
       2. If it is roof ladder, the hooks should be in the retracted position.
       3. Skill Drill 10-18 reviews the steps to hoist a ladder.
    3. It is almost always preferable to hoist a dry hose line because water adds considerable weight to a charged line.

Slide 55

Hoisting

* It is almost always preferable to hoist a dry hose line.
* Water adds considerable weight.
* Fold the hose back on itself and place the nozzle on top of the hose.
  + - 1. Water weighs 3.7 kg per gallon, which can make hoisting much more difficult.
      2. Skill Drill 10-19 reviews the steps to hoist a charged hose line.
      3. The knot can be released after the line is hoisted by removing the tension from the rope and slipping the bight back over the end of the nozzle.
    1. Before hoisting a dry hose line, you should fold the hose back on itself and place the nozzle on top of the hose.
       1. This ensures that water will not reach the nozzle if the hose is unintentionally charged while being hoisted.
       2. It also eliminates any unnecessary stress on the couplings by ensuring that the rope pulls on the hose and not directly on the nozzle.
       3. Skill Drill 10-20 reviews the steps to hoist an uncharged hose line.
    2. Several different types of tools and equipment, including an exhaust fan, a chain saw or circular saw, or any other object that has a strong closed handle, can be hoisted using the same technique.

Slide 56

Hoisting

* Several types of tools and equipment can be hoisted using the same technique.
* Rope is secured to the object.
* A figure eight closes the loop.
* Practice hoisting the actual tools and equipment used in your department.
  + - 1. The hoisting rope is secured to the object by passing the rope through the opening in the handle.
      2. A figure eight with a follow-through knot is used to close the loop.
      3. Some types of equipment require that you use additional half hitches to balance the object in a particular position while it is being hoisted.
         1. Power saws are hoisted in a level position to prevent the fuel from leaking out.
      4. You should practice hoisting the actual tools and equipment used in your department.
         1. You should be able to hoist them automatically and in adverse conditions.
      5. Remember, you always use utility rope for hoisting tools.

Slide 57

Hoisting

* Always use utility rope for hoisting tools and equipment.
* If a life safety rope gets oily or greasy, it should be taken out of service and destroyed.
  + - * 1. You do not want to get oil or grease on designated life safety ropes.
        2. If a life safety rope gets oily or greasy, it should be taken out of service and destroyed so that it will not be mistakenly used again as a life safety rope.

It can be cut into short lengths and used for utility rope.

* + - 1. Skill Drill 10-21 reviews the steps to hoist an exhaust fan.
  1. VIX. Summary

Time: 7.5 Minutes

Slides: 58-62

Level: Fire Fighter I and II

Lecture/Discussion

* + 1. There are three primary types of rope used in the fire service:

Slide 58

Summary

* Three primary types of fire service rope:
* Life safety
* Escape
* Utility
* Life safety ropes are rated as technical use life safety rope or general use life safety rope.
* An escape rope is designed to be used once by one fire fighter.
  + - 1. Life safety rope
      2. Escape rope
      3. Utility rope
    1. Life safety ropes are rated as technical use life safety rope or general use life safety rope.
    2. An escape rope is designed to be used once by one fire fighter.
    3. Ropes can be made of natural or synthetic fiber.

Slide 59

Summary

* Ropes can be made of natural or synthetic fiber.
* Three common rope construction types:
* Twisted rope
* Braided rope
* Kernmantle rope
  + 1. Synthetic fiber can be damaged by UV light .
    2. Nylon is the most common synthetic fiber used.
    3. Three common rope constructions are:
       1. Twisted rope
       2. Braided rope
       3. Kernmantle rope
    4. Two hardware pieces are used in rescue incidents:

Slide 60

Summary

* Two hardware pieces are used in rescue incidents:
* Carabiner
* Harness
* Rope rescues involve people trapped in inaccessible locations.
* All ropes need proper care to perform in an optimal manner.
  + - 1. Carabiner
      2. Harness
    1. Rope rescues involve people trapped in inaccessible locations.
    2. All ropes, especially life safety ropes, need proper care to perform in an optimal manner.
    3. There are four principles to care for a rope:

Slide 61

Summary

* There are four principles to caring for a rope.
* There are five questions to ask when inspecting a safety rope.
* A rope record for a life safety rope includes many important details.
* Ropes should be protected.
  + - 1. Protect the rope from sharp and abrasive surfaces.
      2. Protect the rope from rubbing against another rope or webbing.
      3. Protect the rope from heat, chemicals, and flames.
    1. Protect the rope from prolonged exposure to sunlight There are five questions to consider when inspecting a safety rope:
       1. Has the rope been exposed to heat or flame?
       2. Has the rope been exposed to abrasion?
       3. Has the rope been exposed to chemicals?
       4. Has the rope been exposed to shock loads?
       5. Are there any depressions, discolorations, or lumps in the rope?
    2. A rope record for a life safety rope includes many important details.
    3. Ropes can be protected and stored in rope bags.
    4. Knots are prescribed ways of fastening lengths of rope or webbing to objects or to each other.

Slide 62

Summary

* Knots are prescribed ways of fastening lengths of rope or webbing to objects or to each other.
* It is important to learn the terms used to refer to parts of a rope.
* A fire fighter should know the nine ways to tie a knot.
  + 1. It is important to learn the terms used to refer to parts of a rope.
    2. A fire fighter should know the ways to tie a knot:
       1. Safety knot
       2. Half hitch
       3. Clove hitch
       4. Figure eight
       5. Figure eight on a bight
       6. Figure eight follow-through
       7. Bowline
       8. Bend (sheet or Becket bend)
       9. Water knot

Post-Lecture

* 1. I. Wrap-Up Activities

Time: 40 Minutes

Level: Fire Fighter I and II

Small Group Activity/Individual Activity/Discussion

Fire Fighter in Action and/or Fire Fighter II in Action

This activity is designed to assist the student in gaining a further understanding of ropes and knots. The activity incorporates both critical thinking and the application of fire fighter knowledge.

Purpose

This activity allows students an opportunity to analyze a firefighting scenario and develop responses to critical thinking questions.

Instructor Directions

1. Direct students to read the “Fire Fighter in Action” and/or “Fire Fighter II in Action” scenario located in the Wrap-Up section at the end of Chapter 10.
2. Direct students to read and individually answer the quiz questions at the end of the scenario. Allow approximately 10 minutes for this part of the activity. Facilitate a class review and dialogue of the answers, allowing students to correct responses as needed. Use the answers noted below to assist in building this review. Allow approximately 10 minutes for this part of the activity.
3. You may also assign these as individual activities and ask students to turn in their comments on a separate piece of paper.

Answers to Multiple Choice Questions

1. C
2. B
3. A
4. D
5. B
6. A
7. C

Technology Resources

This activity requires students to have access to the Internet. This may be accomplished through personal access, employer access, or a local educational institution. Some community colleges, universities, or adult education centers may have classrooms with Internet capability that will allow for this activity to be completed in class. Check out local access points and encourage students to complete this activity as part of their ongoing reinforcement of firefighting knowledge and skills.

Purpose

To provide students an opportunity to reinforce chapter material through use of online Internet activities.

Instructor Directions

1. Use the Internet and go to www.FireFighter.jbpub.com. Follow the directions on the Web site to access the exercises for Chapter 10.
2. Review the chapter activities and take note of desired or correct student responses.
3. As time allows, conduct an in-class review of the Internet activities and provide feedback to students as needed.
4. Be sure to check the Web site before assigning these activities because specific chapter-related activities may change from time to time.
   1. II. Lesson Review

Time: 15 Minutes

Level: Fire Fighter I and II

Discussion

Note: Facilitate the review of this lesson’s major topics using the review questions as direct questions or overhead transparencies. Answers are found throughout this lesson plan.

Fire Fighter I

* + 1. What are the major differences between life safety and utility ropes?
    2. What are the different types of life safety ropes?
    3. What is the purpose of an escape rope?
    4. Why are natural fiber ropes no longer acceptable for life safety?
    5. How are fire service ropes constructed?
    6. What is the difference between dynamic and static ropes?
    7. What are the four parts to the maintenance formula?
    8. Are inspection records required for ropes? Why or why not?
    9. Which end of the rope is the working end? Which is the running end?
    10. What knots are considered hitches, and how can they be used?
    11. Name the different types of loop knots used in the fire service, and explain their use.

Fire Fighter II

* + 1. Describe the between Class II, and III harnesses.

**FF II**

* + 1. What is involved in rope rescue?
    2. Name three types of rescue operations that might require rope rescue.
  1. III. Assignments

Time: 5 Minutes

Level: Fire Fighter I and II

Lecture

* + 1. Advise students to review materials for a quiz (determine date/time)
    2. Direct students to read the next chapter in *Fundamentals of Fire Fighter Skills* as listed in your syllabus (or reading assignment sheet) to prepare for the next class session.