TOPIC: Fire Service Rope Construction and Use

TIME FRAME: 1 Hour

LEVEL OF INSTRUCTION:

BEHAVIORAL OBJECTIVE:

Condition: A written quiz

Behavior: The student will list and describe the types of rope used in the fire service, comparing fibers utilized, color coding, construction and characteristics of each.

Standard: With a minimum of 70% accuracy

MATERIALS NEEDED:

- Appropriate visual aids
- Rope samples
- Audio visual equipment

REFERENCES:

- IFSTA, Essentials of Fire Fighting, 2nd Edition, Chapter 3

PREPARATION: Rope is one of the most versatile tools used in the fire service. It can be used to raise, lower and secure equipment. It is used extensively in life rescue. It is essential that all firefighters recognize the different types of rope and be able to identify their proper use.

PRESENTATION	APPLICATION

I. ROPE CLASSIFICATIONS

Ropes fall into what two categories?

A. CDF Ropes or "Lines" Fall Into Two Categories

1. Life lines or rescue lines
2. Equipment or utility lines

B. Lifelines or Rescue Lines

1. Color coded green
2. Used for supporting human life
    a. Rappelling
    b. Rescue
3. Used exclusively for life safety operations and identified for this use only
4. Used for rescue or when the failure of the rope will result in death or injury
5. Are made of nylon static kernmantle
6. Minimum NFPA Standard
    a. Minimum breaking strength of 9000 lbs.
    b. 1/2" diameter
    c. Sufficient strength to support two people

C. Utility or Equipment Lines

1. Color coded red
2. Used for pulling, lifting, hoisting, hauling, and tying off equipment or objects

PRESENTATION	APPLICATION
3. Less reliable than lifelines and should not be used where human life is endangered	
4. Often equipment lines are downgraded lifelines	
5. Can be of smaller diameter than lifeline for example - 1/4", but usually 1/2" - 5/8"	
II. ROPE PROPERTIES	
	What is tensile strength?
A. Tensile Strength	
1. A measure of the static or unmoving force or load required to break a rope	
a. NFPA Standard - 9000 lb rating for lifeline	
B. Working Strength	
	What percentage of tensile strength is a ropes working strength?
1. For safety reasons, the amount of weight or load allowed to be applied to a rope	
2. 20 % of current tensile strength	
3. Each use decreases strength	
a. Rope strength is never constant	
C. Energy Absorption	
1. Measure of the shock absorbing quality of rope	
2. Total dynamic load or force applied should not exceed the ropes working strength	

PRESENTATION	APPLICATION
D. Safe Life	
	What is safe life?
1. A measurement of how long it is safe to use a piece of rope and is affected by:	
a. Ultraviolet radiation (sunlight)	
b. Moisture/caustics	
c. Abrasion	
d. Number of days in use	
e. Age	
f. Number and size of loads applied	
2. Abrasion is the most important factor in a ropes safe life. The more abrasion it has experienced, the shorter the life of the rope	
3. Natural fiber rope deteriorates rapidly in direct proportion to its age	
a. 10% loss in strength per year whether used or not	
b. Should not be used as life or rescue lines	
4. Nylon deteriorates in direct proportion to:	
a. The number of times it is used	
b. The amount of abrasion that it is subject to	
E. Strength of Application	
1. A measure of whether rope can be safely used in a specific configuration for a specific load	

PRESENTATION	APPLICATION

2. Tensile strength is lessened by the number of knots and bends along its length

3. Every bend and knot potentially weakens the rope

III. MATERIALS USED IN ROPE CONSTRUCTION

A. Natural Fiber

1. Natural fibers are all vegetable products that have been cut from stems of plants

   a. Manila

   b. Cotton

   c. Hemp/sisal

2. Natural fibers will degrade with age as they slowly decompose

3. Natural fibers are subject to mildew and rot

4. Natural rope should not be utilized in rescue operations or as lifelines

B. Synthetic Fiber

1. Nylon/Dacron

   a. Most common fiber found in fire service rope today

   b. Has a high tensile strength - approximately twice that of the same diameter manila rope

   c. Has good heat and chemical resistance when compared to manila rope

PRESENTATION	APPLICATION

d. Can stretch considerably under load depending upon how the rope is constructed

e. Dacron has less abrasion resistance and energy absorption than nylon

2. Polyethylene/Polypropelene

a. Not desirable for rescue rope due to low strength, high stretch, and low heat resistance.

b. Found in blended ropes used in water rescue because of floating characteristics

IV. ROPE CONSTRUCTION

A. Laid Rope

1. Traditional method of building ropes.

2. Fibers are twisted into strands and strands are twisted in the opposite direction into the completed rope.

3. Vulnerable to abrasion and cutting as 80-90% of the fibers come to the surface of the rope at some point.

4. On 3 strand rope, the failure of 1 strand will result in the loss of 2/3rds of the ropes total strength.

5. Since laid rope is twisted during manufacture, it will untwist when loaded.

a. Do not use in devices which tend to twist further such as lifebelts and carabiniers.

6. Kinks easily

B. Braided Rope

PRESENTATION	APPLICATION

1. Manufactured by weaving 12 or more substrands into a solid braid.
    a. Finished rope is in a loose weave
    b. Susceptible to abrasion -100% of fibers come to surface at some point
    c. Dirt enters rope weave easily
    d. Rope elongates excessively

C. Braid - On - Braid

1. Two unconnected braids - one inside the other
2. Less susceptible to abrasion - only 50% of fibers come to the outside of the rope at some point
3. Used by a number of agencies for rescue or other applications

D. Kernmantle - Static & Dynamic

1. Static kernmantle is a tight mass of synthetic fibers that are placed under tension in a woven jacket or sheath of like synthetic fiber.
    a. This construction creates a rope which:
        (1) Will not stretch more than 2%
        (2) Will not kink
        (3) Has 75% of its fibers protected by a woven sheath and is therefore abrasive resistant
        (4) Has a central core which comprises 75% of the ropes strength

PRESENTATION	APPLICATION

2. Dynamic kernmantle is similar in construction to static kernmantle but with 15-20% stretch

    a. Poorly suited for most rescue applications due to extreme stretch

3. Kernmantle rope, is also difficult to inspect due to the nature of construction.

SUMMARY:

Ropes are important tools in the fire service. It is important that we recognize and identify the different types of rope construction and the application for which each rope is best suited.

EVALUATION:

A written quiz.

ASSIGNMENT:

As determined by instructor(s).