Department of Fire Services

Massachusetts Firefighting Academy

Technical Rescue Programs



ROPE RESCUE:
Operational

STUDENT GUIDE

08/30/2018

NFPA 1983



Standard for fire service life safety rope, harnesses and hardware (2017 edition)

Chapter 4 – certification
Chapter 5 – labeling and information
Chapter 6 – design and construction requirements
Chapter 7 – performance requirements
Chapter 8 – test methods

NFPA 1670

Standard on operations and training for technical search and rescue incidents (2017 edition)

4.1.4 (1) – _____

This level represents the minimum capability of organizations that provide response to technical search and rescue incidents

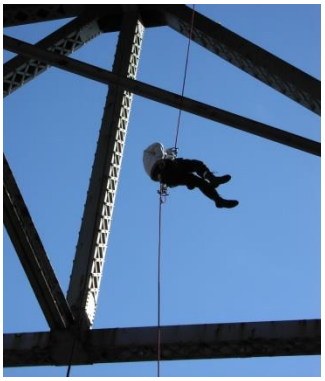
4.1.4 (2) – _____

This level represents the capability of organizations to respond to technical search and rescue incidents and to identify hazards, use equipment, and apply limited techniques specified in this standard to support and participate in technical search and rescue incidents

4.1.4 (3) - _____

This level represents the capability of organizations to respond to technical search and rescue incidents, and to identify hazards, use equipment, and apply advanced techniques specified in this standard necessary to coordinate, perform and supervise technical search and rescue incidents

NFPA 1006



Standard for rescue technician professional qualifications (2017 edition)

Chapter 5 – Rope Rescue

Awareness Level

5.1.1 Recognize the need for support resources
5.1.2 Recognize incident hazards and initiate isolation procedures
5.1.3 Recognize needed resources for a rescue incident
5.1.4 Initiate a discipline-specific search
5.1.5 Perform ground support operations for helicopter operations
5.1.6 Initiate triage of victims
5.1.7 Assist a team in operation of a haul line of a rope mechanical advantage system raising operation

Operations Level

5.2.1 Perform size-up a rescue incident
5.2.2 Inspect and maintain hazard-specific PPE
5.2.3 Inspect and maintain rescue equipment
5.2.4 Demonstrate knots, bends and hitches
5.2.5 Construct a single-point anchor system
5.2.6 Construct a multiple-point anchor system
5.2.7 Conduct a system safety check
5.2.8 Place edge protection
5.2.9 Construct a belay system

5.2.10 Operate a belay system during a lowering or raising operation in a high-angle environment
5.2.11 Belay a falling load in a high-angle environment
5.2.12 Construct a fixed rope system
5.2.13 Ascend a fixed rope in a high-angle environment
5.2.14 Descend a fixed rope in a high-angle environment
5.2.15 Demonstrate the ability to escape from a jammed or malfunctioning device during a fixed rope descent in a high-angle environment
5.2.16 Construct a lowering system
5.2.17 Direct a lowering operation in a high-angle environment
5.2.18 Construct a simple rope mechanical advantage system
5.2.19 Direct a team in the operation of simple rope mechanical advantage system in a high-angle raising environment
5.2.20 Construct a compound rope mechanical advantage system
5.2.21 Direct the operation of a compound rope mechanical advantage system in a high-angle environment
5.2.22 Negotiate an edge while attached to a rope rescue system during a hog-angle lowering and raising operation
5.2.23 Access, assess, stabilize, package, and transfer victims
5.2.24 Direct a litter lowering and litter raising operation in a low-angle environment
5.2.25 Operate as a litter tender in a low-angle lowering or raising operation
5.2.26 Direct a litter lowering and litter raising operation in a high-angle environment
5.2.27 Terminate a technical rescue operation

Rope is often used as a tool in many technical rescue disciplines including;

- High Angle
- Water Rescue
- Low Angle or Slope Evacuation
- Confined Space
- Search an area (in wilderness)
- Trench Rescue



Identify Needed Support Resources

- Equipment cache
- Scene lighting
- Environmental concerns
- Personnel rehab

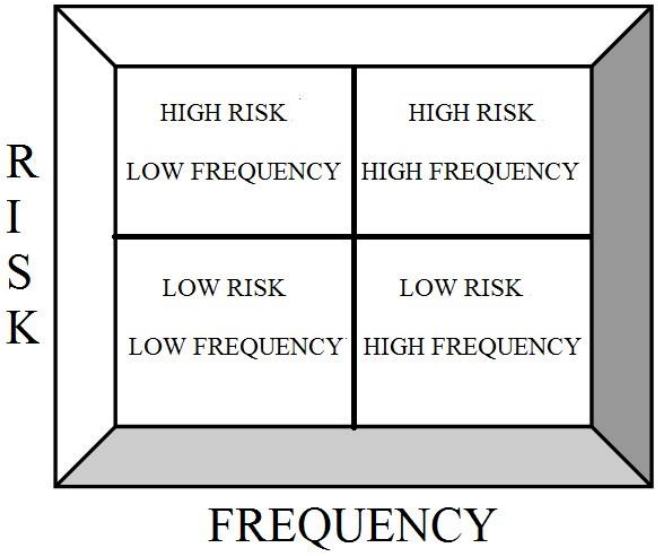
Size Up

- Distinction between rescue and recovery
- Scope and Magnitude
- Additional Resources
- Location and Number of Victims
- Risk benefit analysis
- Hazards-utilities, mechanical, hazmat

- Access to Scene
- Environmental Factors
- Separation, isolation, interviewing, security of witnesses

Risk vs. Benefit Analysis

- High frequency/high risk
- High frequency/low risk
- Low frequency/high risk
- Low frequency/low risk



Rescue vs. Recovery

- Based on Risk/Benefit Analysis
- Duration of the operations
- Mechanism of Injury
- Environmental conditions
- Victim access

Managing Incident Hazards

- Scene control barriers
- PPE
- Specialized equipment and resources

Conducting a Search

- Search specific PPE - hearing protection, fall protection, PFD
- Pertinent search equipment - GPS, helicopters, ATV's
- Victim information - Age, last seen point, Number of victims,
- Accountability - Personnel assignments match their expertise

Helicopter – ground support operations

- 100' X 100' Landing Zone
- Slope of ground & type of ground
- Obstructions/Hazards – Trees, wires, light poles, and antennas.
- Hazardous Materials
- Crowds
- Communication



Termination of the Operations

- Most Dangerous Point
- Accountability
- Demobilization Plan
- Documentation
- Consider CISD

Time Constraints

- Is EMS with you?
- Do you have firefighter/paramedics?
- Consider – "suspension trauma"
- We are still dealing with the "golden hour"

EMS

- Access the victim - "given tool kits, personal protective equipment and other equipment designed to allow for physical approach to the victim…."
- Assess and Stabilize – "given personal protective equipment to include protection from airborne and blood borne pathogens and a basic first aid kit…. treatment priorities are established."
- Triage the victim – "given triage tags and local protocol, so that rescue versus recovery factors are assessed…."
- Package the victim – "an ill or injured victim, given basic first aid kit and other specialized equipment…illness or injuries are managed, and potential for further injury is minimized."
- Transfer patient to EMS – "to EMS, given local medical protocols, so all pertinent information is passed from rescuer to EMS, and the victim can be transported to a medical care facility"

Personal Protective Equipment

- Helmet
- Gloves
- Eye Protection
- Ear Protection
    - For both Rescuer and Victim
- Footwear

Personal Protective Equipment – Inspection and Maintenance

- Cleaning
- Inspection
- Maintenance
- Sanitization
- *Follow Manufacturer Recommendations*

Equipment -Inspection and Maintenance

- Clean, Wash or dry equipment
- Proper inspection after each use - identify wear and damage
- Log equipment use
- Record time and date of usage
- Replace equipment when needed
- Proper disposal methods

Rope – Care and Maintenance

DO NOT

- Step on the rope
- Drag rope on ground
- Leave rope under tension
- Smoke around ropes
- Store a rope in a poorly vented area
- Store in direct sunlight
- Expose a rope to high temperature
- Run nylon over nylon
- Subject rope to chemicals, oils, acids, etc.
- Use life safety rope for towing
- Cause undo abrasion to rope
- Do not shock load the rope

DO

- Inspect a rope for damage
- Clean a rope after each use if necessary
- Use edge protection
- Bag rope, ready for use
- Remove knot as soon as possible



Anchor Point - A single, structural component used either alone or in combination with other components to create an anchor system capable of sustaining the actual and potential load on the rope rescue system (*NFPA 1006 3.3.3*)



Anchors Points –

Solid
Bomb proof
Critical angle
- Less than 120^0
- Under 90^0 preferred

SeRENE –
S - solid (bomb proof)
R - redundant
E – equalized
NE - non-expanding

Examples of good anchors:

a. _____

b. _____

c. _____

d. _____

Examples of bad anchors:

a. _____

b. _____

c. _____

Edge Protection

- Used to protect rope and webbing from sharp or abrasive edges
- Types of edge protection
  - Software when rope is not moving under load
  - Hardware when rope is moving under load

Two Important Causes of Rope Failure:

- Unprotected Edges
  - _____
  - _____
- Shock Load

Belay a Falling Load:

- Only have 8-12" of slack in system at a time
- Use the "Z" system of pulling slack out of the tandem prusik belay
- IF A SHOCK LOAD SHOULD HAPPEN:
  - ***Let go and set the second prusik!***

Conducting a Systems Safety Check

- Start at one end, work your way through the entire system
- Never safety check something that you built

The Rescuer Must be Capable of:

The ability to move up and down the rope

To move side to side on rope

Engineer lowering systems

Descend

Ascend

Life safety rope is made in accordance with NFPA 1983, 2012 edition. This standard considers the following to be appropriate working loads:

1 – Person Working Load equals _____ lbs.

2 – Person Working Load equals _____ lbs.

Minimum breaking strength for 1-person load _____lbs

Minimum breaking strength for 2-person load _____lbs

Another NFPA requirement is that the fibers be of _____ material and _____ _____in length.

The two main types of rope used in the technical rescue are _____Kernmantle and _____ Kernmantle.

Static Kernmantle has an elongation (stretch) less than 6% with a 10% load. Static Kernmantle (low stretch) has an elongation of 10% or less with a 10% load. Both will stretch approximately 20% at their break point. This is the preferred rope in most areas of rope rescue.

Dynamic Kernmantle has an elongation of 8-12% and breaks at approximately 60%. This is the type of rope used by rock climbers and in tower rescue where the rescuer climbs ABOVE their anchor point.

_____ rope is used in water rescue. It floats and is made in bright colors to increase visibility. This rope must NOT be used when committing weight to gravity.

Accessory cord is usually 9mm or less in diameter with strength of approximately 3000lbs. It is used in situations requiring a "rope grab". It is also used when building systems to introduce adjustability into the system.

Webbing – lightweight and inexpensive

1-inch tubular, military specification has a load rating of 4000lbs.

1-inch flat webbing has a rating of 6000lbs but is slightly more difficult to tie knots with.

Harness

Class 2 _____

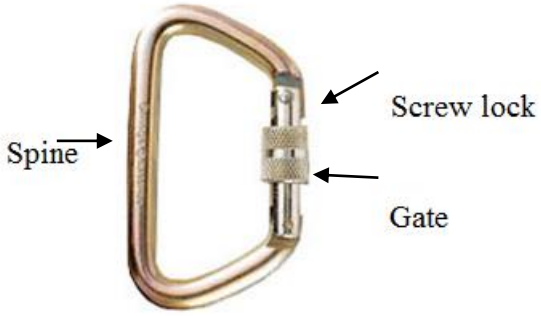
Class 3 _____

HARDWARE

Carabiners – NFPA rated

- "G" – general use
  - MBS of 40kN (8992 lbs)
- "T" – Technical use
  - MBS of 27kN (6069 lbs)

MBS = minimum breaking strength



Always load along the major axis or spine

Always lock the gate and safety check BEFORE placing under any load

Pulleys – NFPA rated

- "G" – general use
  - MBS of 36 kN (8093 lbs)
- "T" – technical use
  - MBS of 22 kN (4946 lbs)

Types:

Single sheath
Double sheath becketed
Knot passing
Prusik minding



Must be at least 4 times the diameter of the rope

Moving pulleys provide mechanical advantage

Change of direction pulleys act as force multipliers



Ascenders –

They were originally designed to travel up a rope.
We now use them as rope grab devices, to allow movement up
a rope or as a device to grab the rope to allow us to haul or pull on the rope

Descenders – (decent control device)

Figure 8 with ears – NFPA rated - 22 kN (4946 lbs)

Bar rack – NFPA rated - 22 kN (4946 lbs)



Both devices may be used for rappelling and/or lowering

Edge protection –

- Hardware – when moving under load
  - Edge rollers
  - Roof rollers
- Software – when line is static
  - fire hose
  - garden hose
  - salvage covers, etc.





Reasons For Failure Of Technical Rescue Operations

Acronym: ***FAILURE***

F – Failure to understand or underestimating the environment

A – Additional medical implications not considered

I – Inadequate rescue skills

L – Lack of teamwork and experience

U – Underestimating the logistical needs of the operation

R – Rescue versus recovery mode not being considered

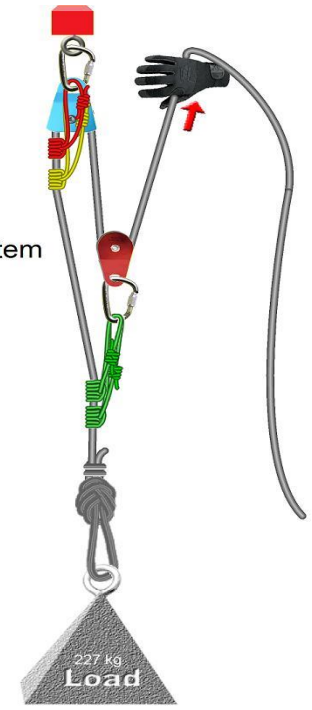
E – Equipment not mastered

_____- this line carries the load. It should tie directly into the rescuers main attachment point. Avoid having slack in this line.

_____- this line is the safety. It should be tied into the rescuer at some secure point other than the main attachment point. Avoid having this line under tension

Mechanical Advantage;

Definition – a force created through mechanical means, including but not limited to, a system of ropes and pulleys usually creating an output force greater than the input force.



3:1 System

Simple Mechanical Advantage:

- Single Rope Mechanical Advantage System. A rope mechanical advantage system containing a single rope and one or more moving pulleys (or similar devices), all traveling at the same speed and in the same direction, attached directly or indirectly to the load mass; and may contain one or more stationary pulleys (or similar devices), so that the force on the system is distributed approximately evenly among its supporting rope segments.
- One or more moving pulleys
- Both traveling at the same speed and direction
- Forces are evenly distributed throughout the system
- Examples. – 2:1. 3:1. 4:1 rescuemate

COMMANDS:

- ***SLACK*** -- let out more rope, introduce slack into the system. ex. “Slack on blue line”
- ***UP ROPE*** -- take up the slack in the line. ex. “Up rope on red line”
- ***TENSION*** -- remove all slack and put some load on the line. ex. “Tension on blue belay”
- ***STOP*** -- this can be called out by anyone, anytime. If you see an unsafe situation or what you think is an unsafe situation call out STOP! With this everything stops immediately.

- ***ON BELAY?*** -- This is a question the rappeller asks the edge manager before approaching the edge/window. He is asking if everyone is ready for him to approach the edge.
- ***BELAY IS ON*** -- the edge manager answers him, acknowledging that they are ready.
- ***ON RAPPEL?*** -- Done after tensioning the system, the rappeller asking the edge manager if he's ready for him to exit the window/edge.
- ***RAPPEL AWAY*** -- the edge manager's answer that he is ready for the rappeller to exit.

COMMANDS WHILE ON ROPE:

- ***STOP*** -- the rappeller telling the edge manager he's stopping.
- ***WHY STOP?*** -- The edge manager asking why the rappeller is stopping. ex. Locking off, adjusting my harness, etc.
- ***UNLOCKING*** -- the rappeller telling the edge manager he is unlocking.
- ***UNLOCKING*** -- the edge manager acknowledging the unlocking and that he's ready for it.
- ***ON RAPPEL?*** -- The rappeller asking the edge manager if he's ready for him to continue.
- ***RAPPEL AWAY*** -- edge manager to rappeller -- ready for you to continue
- ***SAFE ON BLUE*** -- rappeller to edge manager -- I am on the blue line and I'm safely on the ground, not off belay at this time.
- ***OFF BLUE BELAY*** -- rappeller to edge manager -- I am safely off the blue line's belay.

PERSONAL EQUIPMENT NEEDED FOR CLASS

leather work gloves -
non-firefighting type
non-lined
clean

boots –
over the ankle
firefighting type boots are ok

dress appropriate –
cold / warm weather
rain / snow

water for rehydration



Figure of Eight



Figure of Eight on a Bight



Figure of Eight Bend



Figure of Eight Follow Through



Barrel Knot



Water Knot



Over Hand Safety