Massachusetts Firefighting Academy

Department of Fire Services

Rope Rescue Technician

Student Guide

07-2024

Students will be able to:

- Review and expand operational skills
- Learn and develop individual rope skills
- Discuss system safety factors and strengths and weaknesses
- Implement twin tensioned rope systems (TTRS)
- Construct artificial high directionals in multiple configurations.
- Move a rescue package horizontally in various means.

Notes:

Regulations

National Fire Protection Association (NFPA)

NFPA 1006: Standard for Technical Rescue Personnel

Awareness - Recognize, non entry, assist, call resources

Operations - Anchors, belays, lower/haul, mechanical advantage, slope, litter with tag lines

Technician - Rappel, ascend, litter tender, perform rescue on rope, tensioned line systems, lead climbing

NFPA 2500: Standard for Operations and Training for Technical Search and Rescue Incidents and Life Safety Rope and Equipment for Emergency Services

Encompasses:

NFPA 1670 Training for departments and teams

NFPA 1983 Equipment manufactures

NFPA 1858 Selection, care, and maintenance of gear and PPE for Tech Rescue

American National Standards Institute (ANSI) Z87.1 and Z359.1 - Z359.7

Occupational Safety andHealth Administration (OSHA) 29 CFR 1910 & 29 CFR 1926

European Standards (EN)

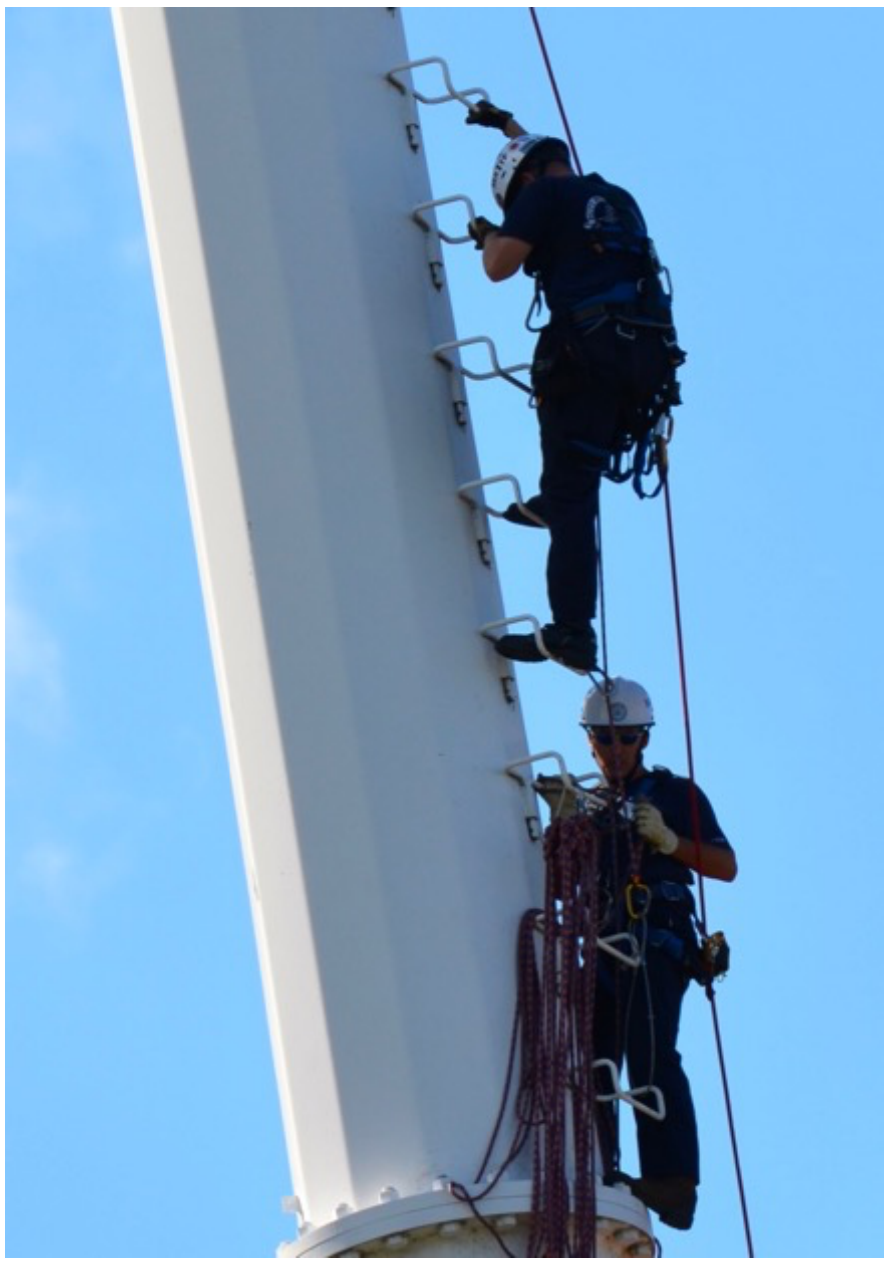
European Conformity (EC)

Types of Systems:

- Fixed lines
- Lowering
- Lead Climbing
- DMDB
- TTRS

Lead Climbing

- Climb vertical or near-vertical paths while maintaining two points of contact
- Use of climbing aids and /or positioning equipment to support the weight of the rescuer in a vertical or near vertical environment



TTRS

Twin Tensioned Rope System

Maintains a Two Rope System

Each rope shares an almost equal portion of the load

No dedicated Main and Belay

One person operation (can have a person stand back and ”tail” the lines)

DEPARTMENT OF FIRE SERVICES
Massachusetts Firefighting Academy

Rope Rescue Equipment Review

Equipment:

Software

Hardware

PPE

Patient Packaging

Artificial High Directionals

Anchors

SERENE

Single Point

Multi Point

Straights

Forces

Anchor Forces

Figure 6

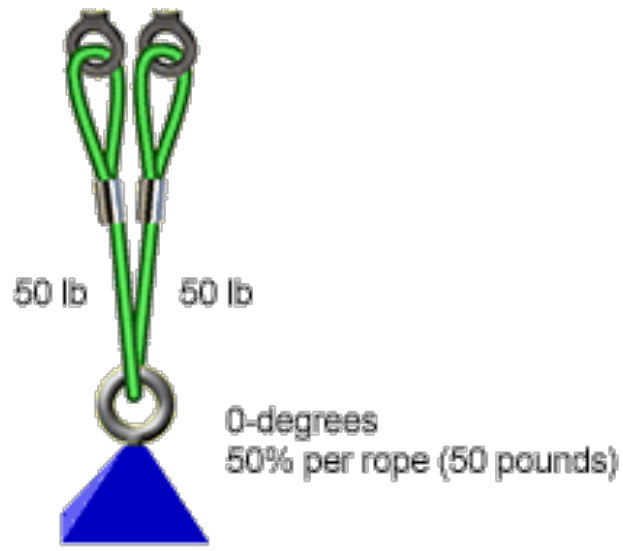


Figure 7

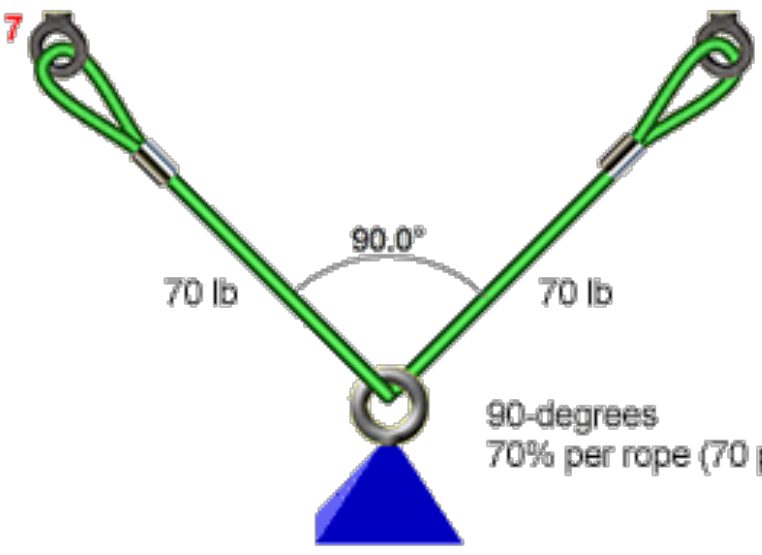
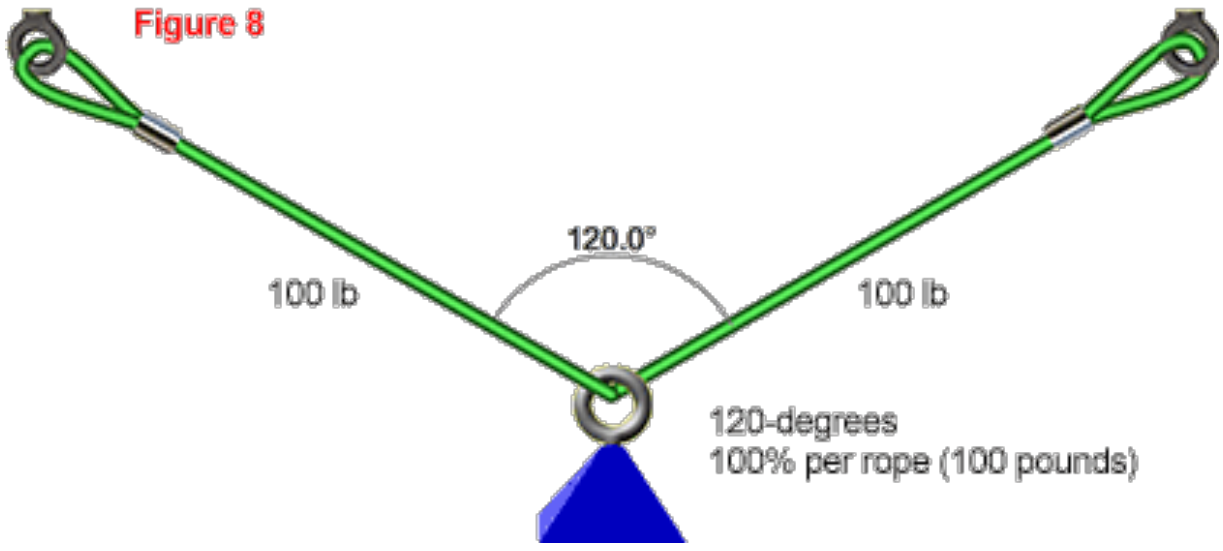
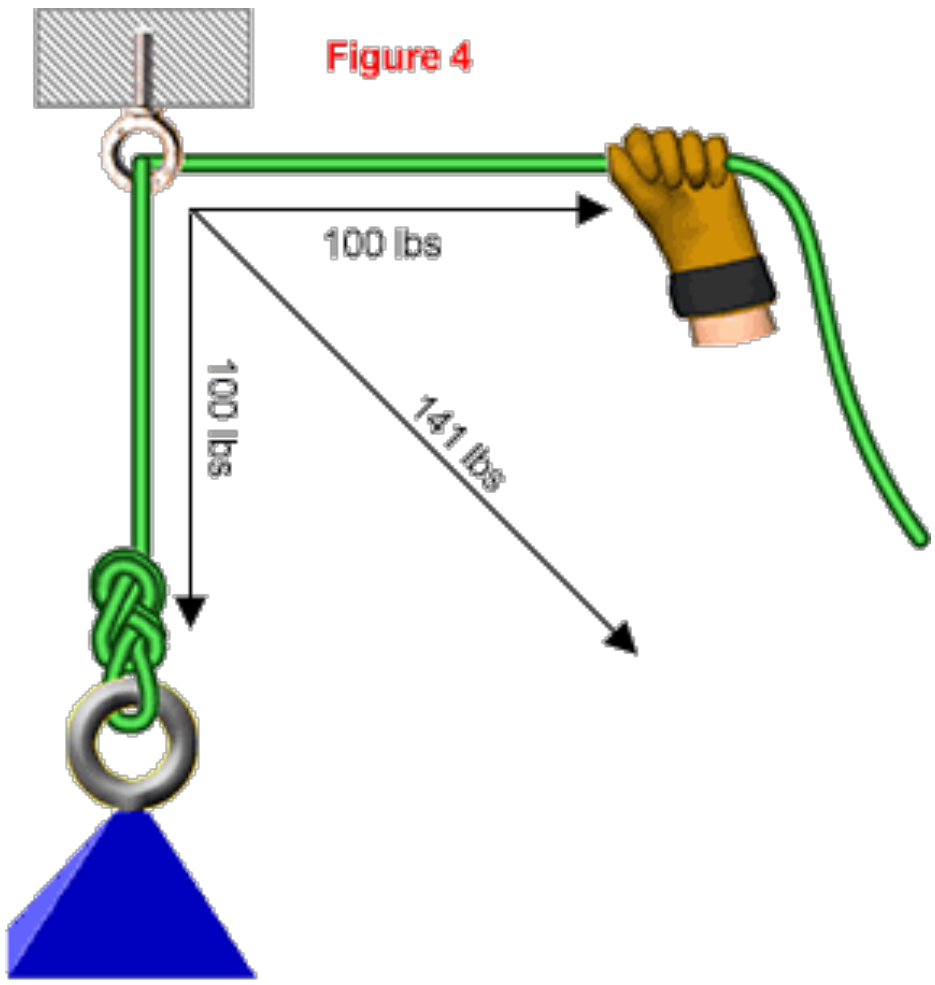


Figure 8



Change of direction = Force Multiplier



Wide angle = less force on COD

Narrow angle = more force on COD

Picket Anchor Systems

- Should be 4 ’1” duplex head
- Driven 2/3’s into the ground at a 15˚
- Multiple configurations and strength ratings

Tie-Back Anchors

- Used when strength of an anchor is questionable
- Technique used to increase an anchor's strength

Mechanical Advantage Review

- Simple
- Compound
- Complex
- Hauling

“T” method

Artificial High Directionals

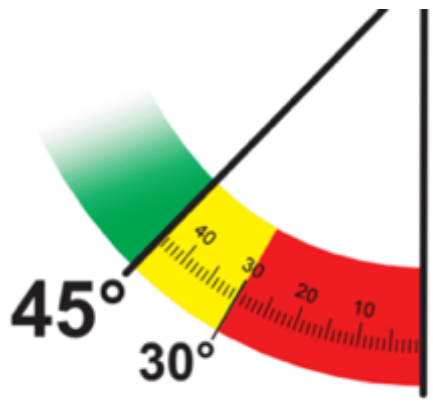
- CMC NFPA G
  - Tripod
  - Easel A Tripod
    - 2 outer 1 inner on blue, 90 degrees

Arizona Vortex Non-NFPA configurations

- Easel A (head beyond 90°)
- A-Frame/Sideways A
- Mono/Gin Pole
- Floating Head

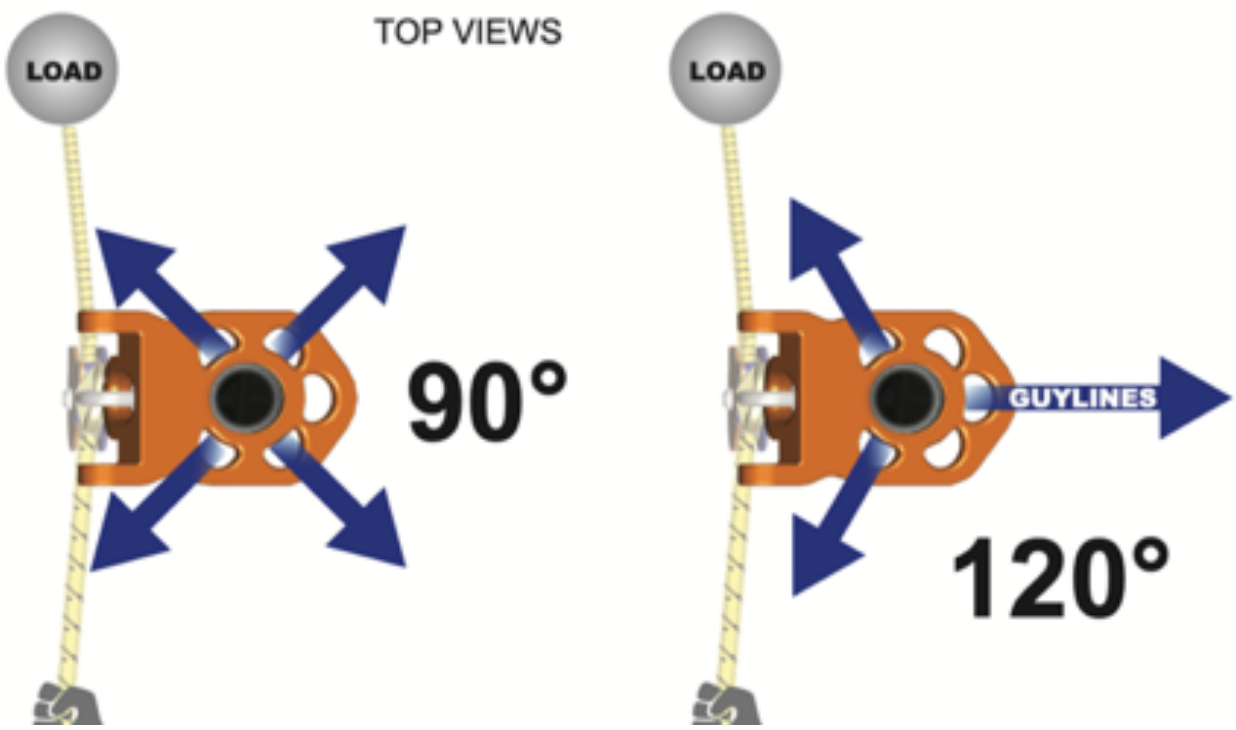
Vortex Guy Angles

1. Guy Angle should not be less than 30°, ideally not less than 45°.



2. Guy Angle not less than the Applied Force Angle

Guy Angle > **Applied Force Angle**



Horizontal Movement

- Horizontal or Sloping Highline
- Skate Block Systems
- Offset Systems

Horizontal or Sloping Highline

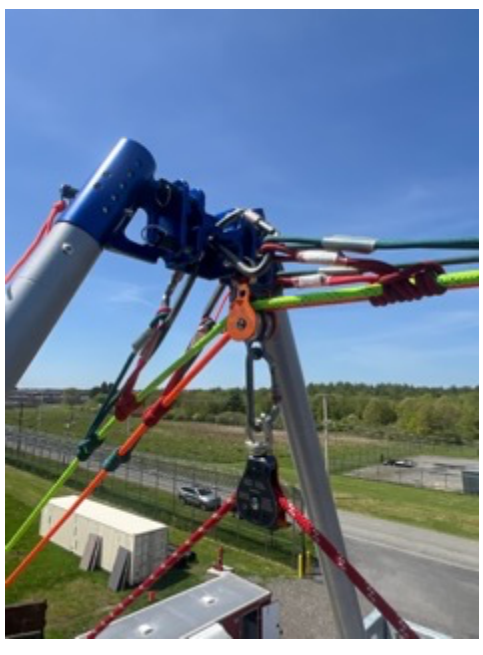
- Implemented when natural and/or man-made features prevent vertical movement of the rescue package
    - Rivers, mountainous areas, building to building
- Must have a solid understanding of angles and forces in rope systems

Highline Components

3:1 Tensioning System

Trolley/Connection Points

Dead-ended Anchor



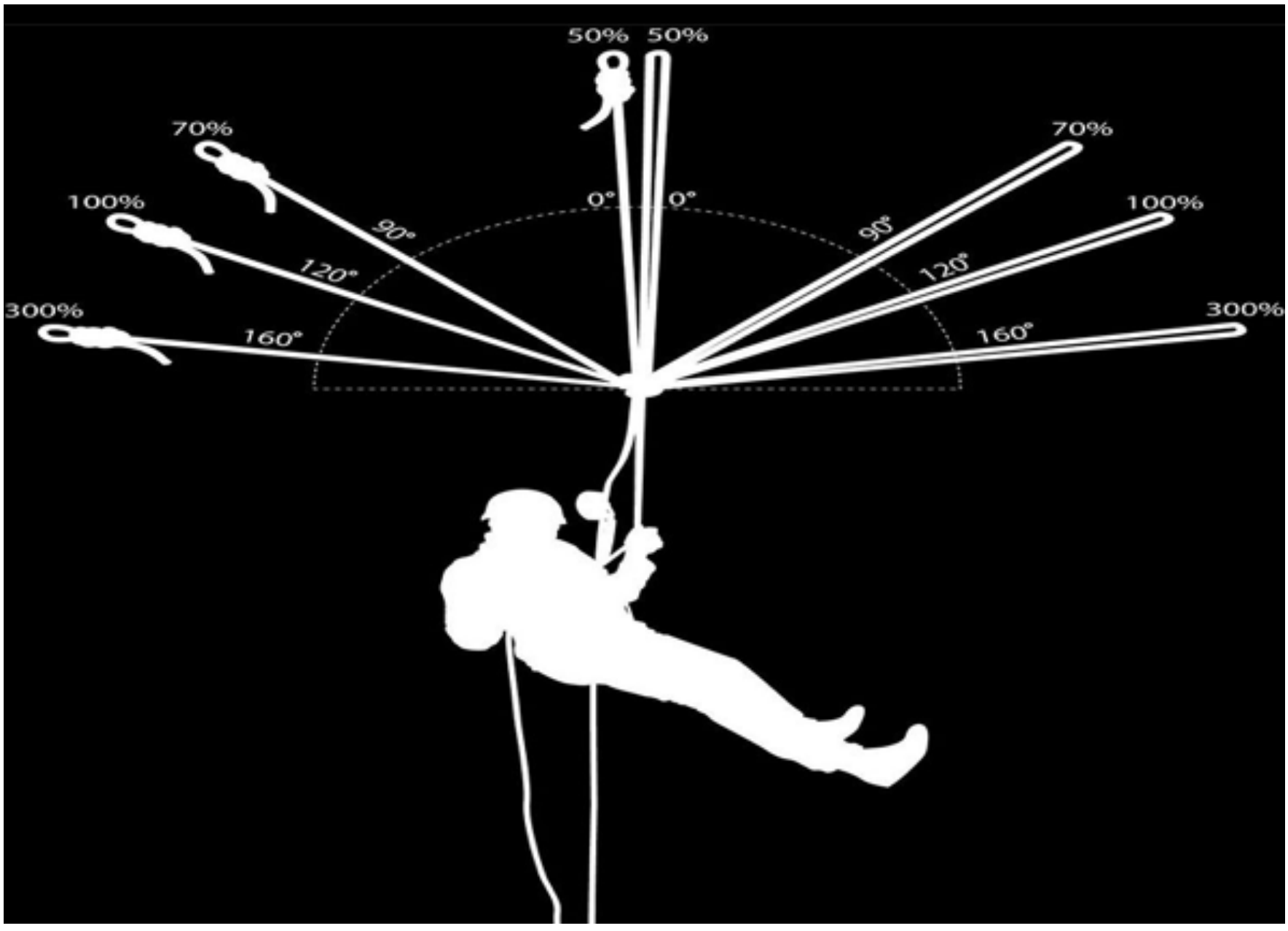
AHD w/track and control lines

Reeve Systems

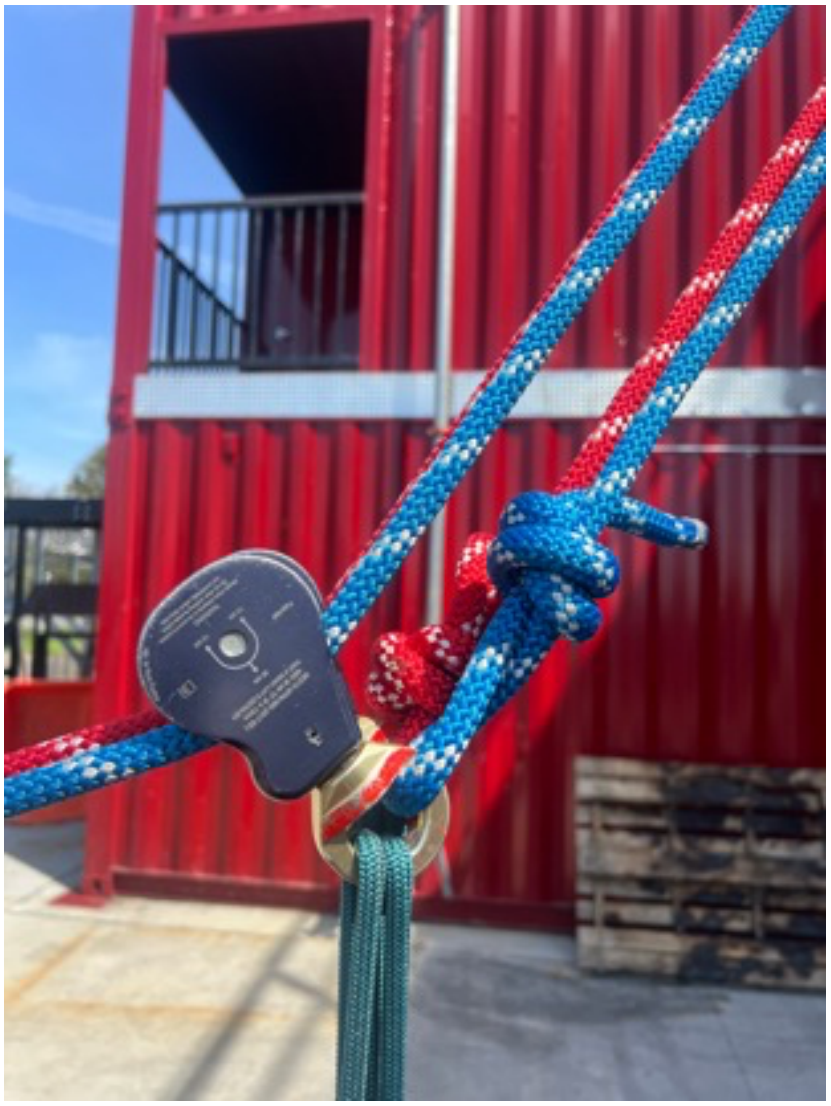
Norwegian Reeve

English Reeve

Angles and Forces in Highline Systems

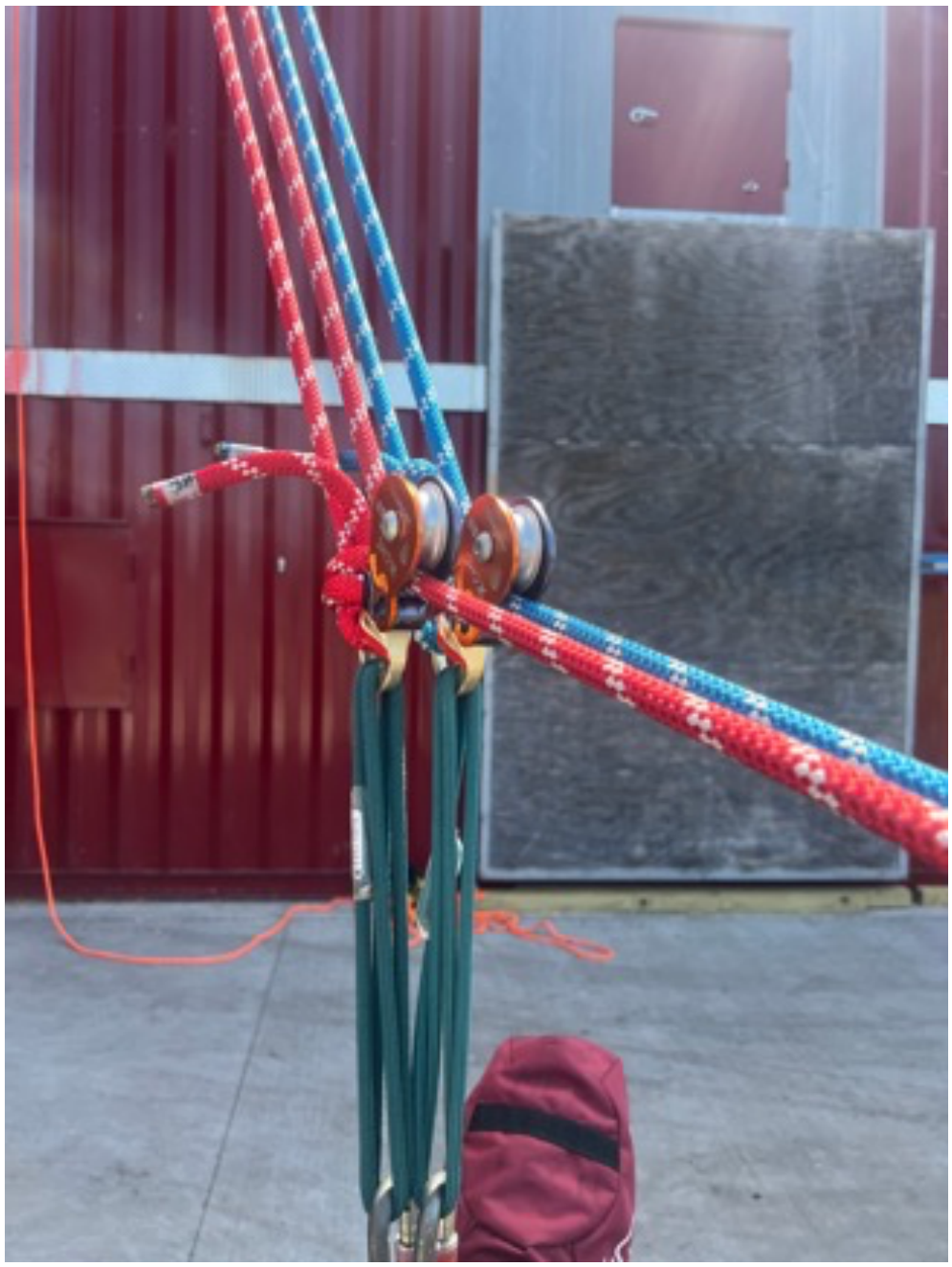


Skate Block Systems



Lowering system where the rope is run through a DCD at ground level up to a change of direction pulley and attached to a pulley. That pulley rides on the side of the rope coming up from the DCD.

Mirrored Skate Block



A doubled skate block system operated via TTRS

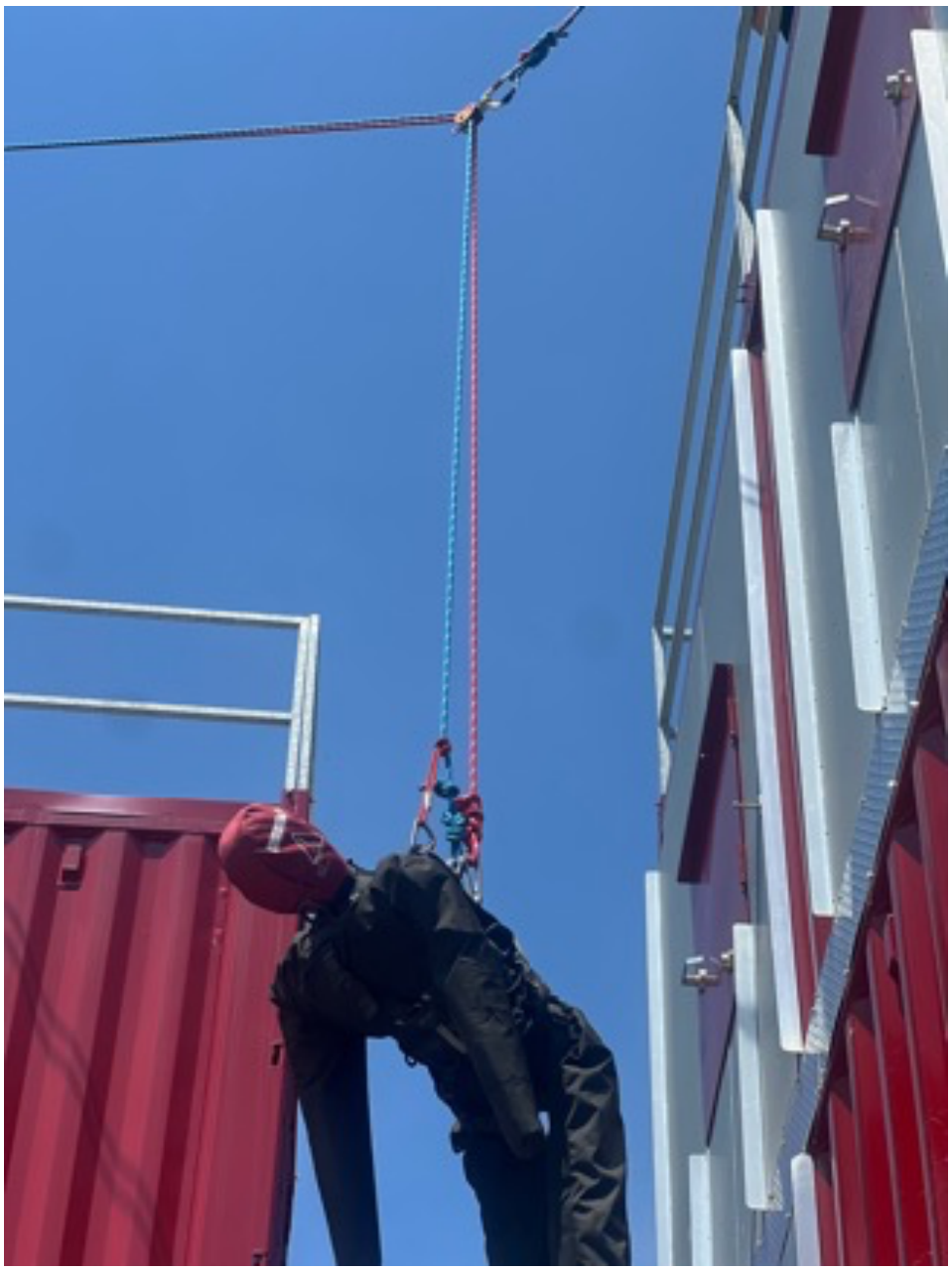
Hybrid Skate Block

- System uses one half skate block one half tensioned track line
- Allows for more control of where the rescue package lands

Offset System

- Opposing Raise/Lower systems brought to a collection point for moving a rescue package.
- Used when there are severe obstacles that a litter attendant would not be able to maneuver the rescue package around.

Dynamic Deflection



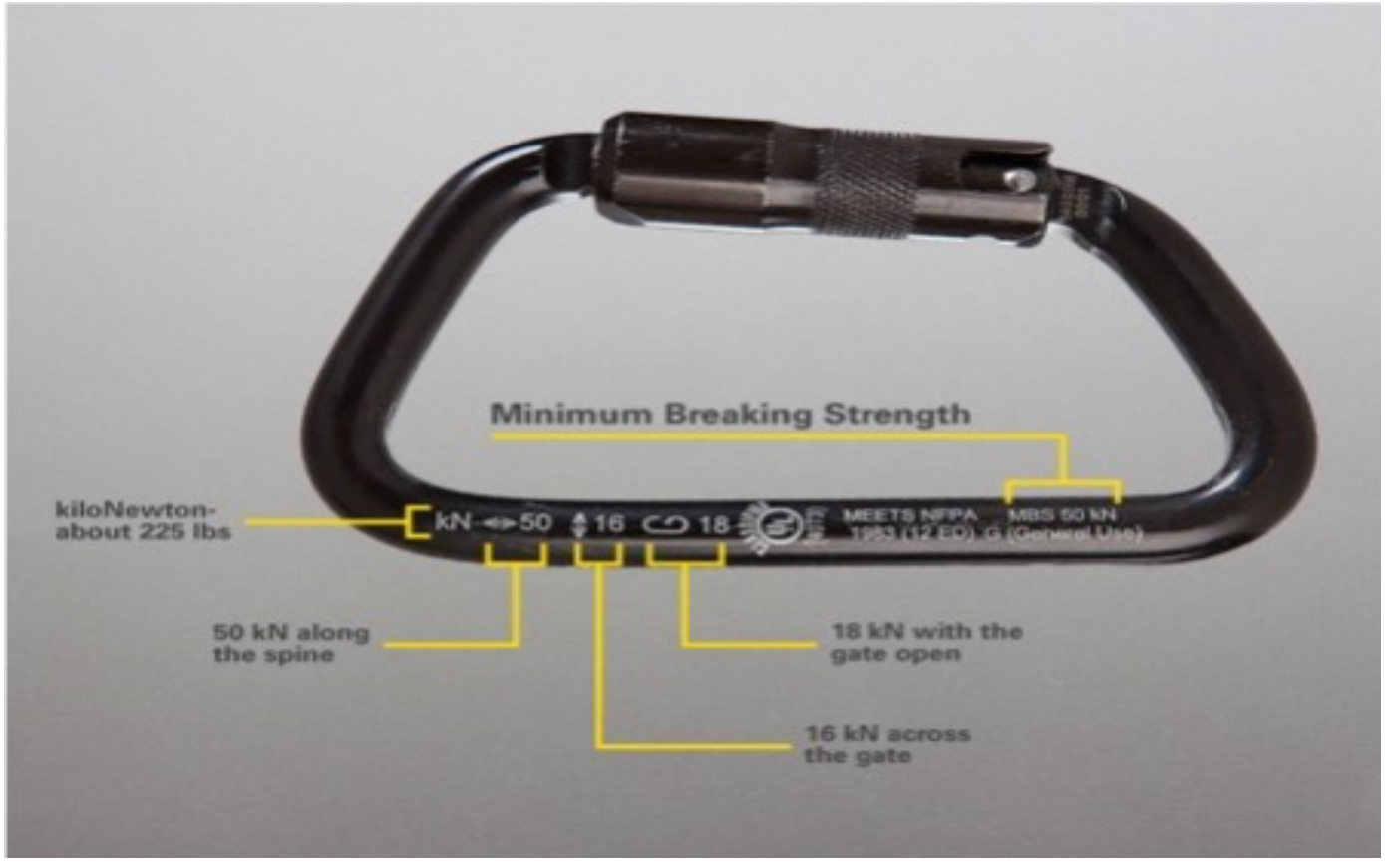
Two-rope system with a double pulley at the end, the pulley is connected to another two-rope system.

Safety Checks

ABCDE

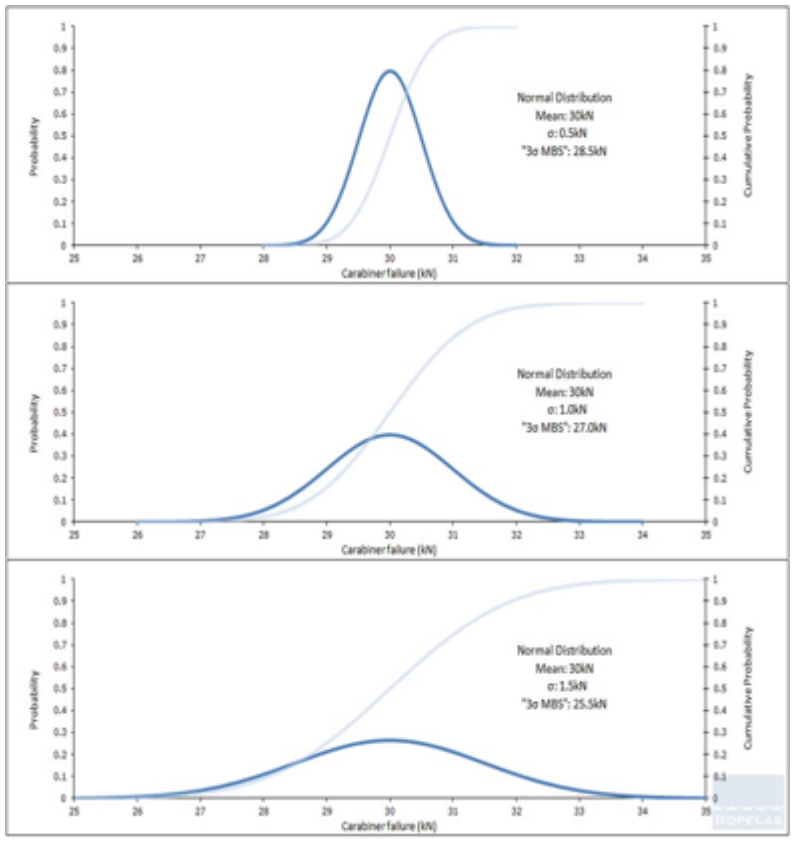
FAILURE

Kilonewton



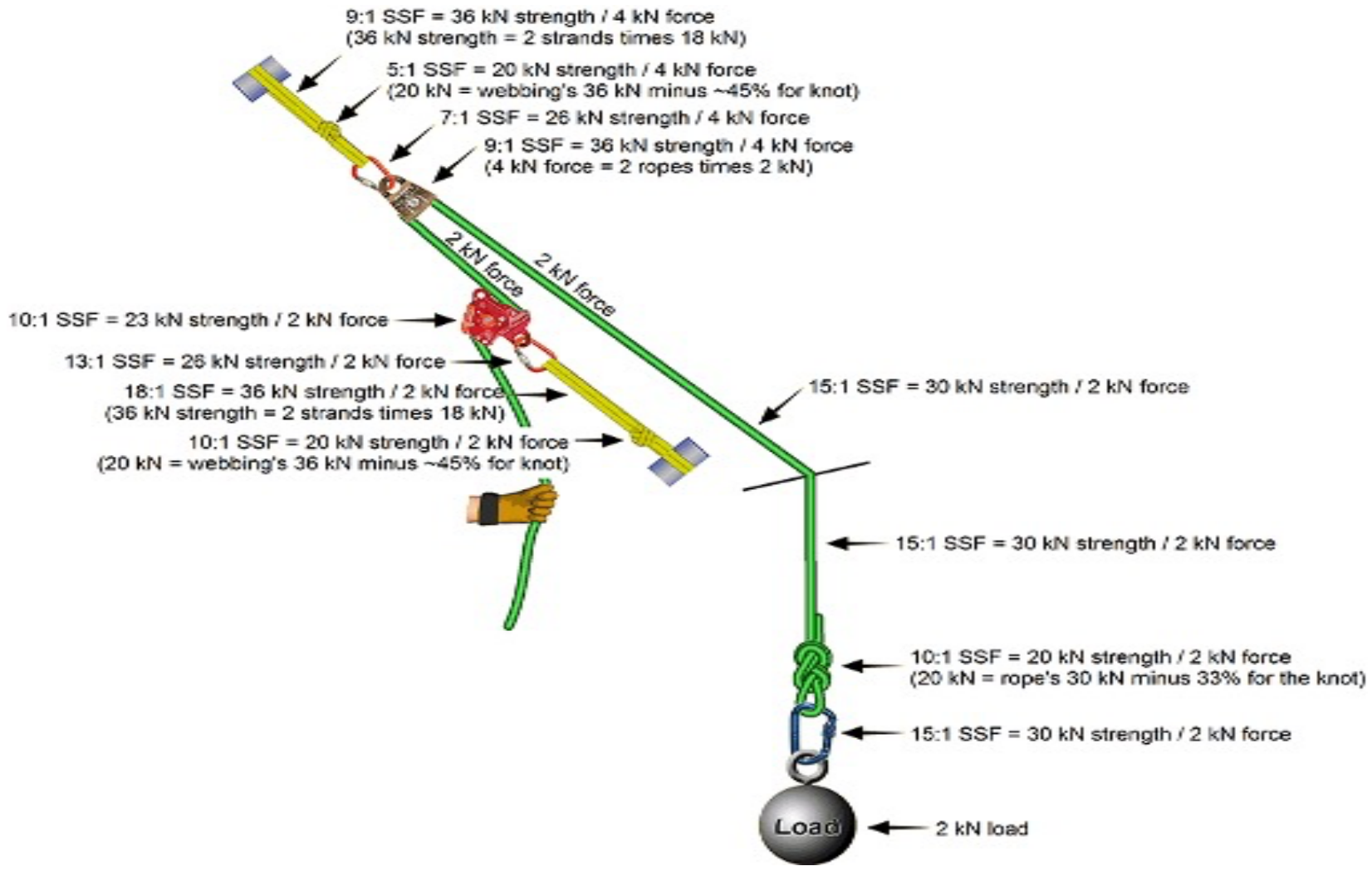
- Kilonewton (kN) is a unit of force
- 1 kN is equal to 225 lbs.
- Rating found on all equipment

MBS & 3 Sigma



- Width of the curve is the standard deviation.
  - 99.7% should be above this with a good manufacturing.
  - Poor process covered by 3 sigma
- MBS= mean -3sigma

Static System Safety Factor (SSSF)



- The rating applied to the entire system based on its lowest component safety factor
- ”Weakest Link”
- Will change and decrease when system becomes Dynamic

Summary

- Technician Level skills vs Operational Level
- Individual Rope Skills
- TTRS
- Horizontal Movement
- System Safety