B01
FALL PROTECTION • RESCUE

Wednesday 10:00 – 5:30

Course Introduction

• Instructor(s)
• Classroom Rules
• Restrooms
• Breaks
• Emergency Procedures
  • Emergency Exits
  • Severe Weather Shelter
  • Evacuation Wardens

Hennepin Technical College

She didn’t silence her phone!
Make sure you do.
Disclaimer

• Hennepin Technical College and the North Dakota Safety Council are NOT endorsing any of the products shown in this training program. They are used for demonstration purposes, ONLY.

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Fall Protection - Rescue

**Classroom**

- OSHA Standards for Fall Protection
- Ropes and Knots
- Mechanical Advantage Systems
- Rescue From Heights

**Hands-On**

- Self-Rescue
  - Stirrups / Straps
  - Self-lowering devices
- Retrieval Rescue
  - Hauling systems
  - Fall arrest w/winch
  - Piggyback hauling
  - "Reach" rescue tools
- Technical (Rope) Rescue
  - Victim pick-off

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FALL PROTECTION STANDARDS
General Duty Clause

• (a) Each **employer**
  – (1) shall furnish to each of his employees employment and a place of employment which are free from **recognized hazards** that are causing or are likely to cause death or serious physical harm to his employees;
  – (2) shall comply with occupational safety and health standards promulgated under this Act.

General Duty Clause

• (b) Each **employee** shall comply with occupational safety and health standards and all rules, regulations, and orders issued pursuant to this Act which are applicable to his own actions and conduct.
1910 vs. 1926

- Although 29 CFR 1910 and 1926 are separate standards, there are notable differences.
- Some standards are covered in duplicate, and some go into more depth than the other.
- Although both 1926 & 1910 have versions of the fall protection standard, the construction industry standard is far more detailed than the General Industry standard.

Fall Protection Standards

- 29 CFR 1910
  - Subpart D
  - Walking-Working Surfaces
  - Subpart F
  - Powered Platforms, Manlifts and Vehicle-Mounted Work Platforms

- 29 CFR 1926
  - Subpart M
  - Fall Protection
  - Subpart X
  - Stairways and Ladders

“*I’ve fallen, and I can’t get down!”*
Deer Stand Accident

Retrieval

• 1926.502(d)(20), when personal fall arrest systems are used, the employer must assure that employees can be promptly rescued or can rescue themselves should a fall occur.

Retrieval

• In some situations, equipment which allows employees to rescue themselves after the fall has been arrested may be desirable, such as devices which have descent capability.
Prolonged, Upright Suspension

• In 29 CFR 1926.502, OSHA requires employers to "provide for prompt rescue of employees in the event of a fall,"

• Research indicates that "suspension in a fall arrest device can result in unconsciousness, followed by death, in less than 30 minutes."

Prolonged, Upright Suspension

• The risk of "orthostatic intolerance" and "suspension trauma," which refer to some of the potential health hazards – death being the chief one – experienced by workers who are suspended upright by fall arrest equipment after a fall.

Prolonged, Upright Suspension

• Injuries suffered during the fall, or the shock resulting from the experience of the fall, "can increase the onset and severity" of venous pooling and orthostatic intolerance.
Prolonged, Upright Suspension

• Other physical and environmental factors such as:
  • Fatigue,
  • Dehydration,
  • Hypothermia,
  • Cardiovascular disease,
  • Respiratory disease and
  • Blood loss

Suspension Trauma
Prolonged, Upright Suspension

"Unless the worker is rescued promptly using established safe procedures, venous pooling and orthostatic intolerance could result in serious or fatal injury, as the brain, kidneys and other organs are deprived of oxygen,"
How Prompt is Prompt?

• Just how long a worker can remain suspended upright and motionless before suffering health consequences is a matter of some debate.

• An Air Force study in which volunteers suspended in harnesses experienced adverse health effects in as little as **12 to 15 minutes**.
  – "The volunteers passed out, their vital signs went south and they had to be medically rescued."

How Prompt is Prompt?

• Paul A. Satti, technical director of the Construction Safety Council believes OSHA’s confined space standard for exposure to atmospheric hazards that could cause oxygen deficiency provides some guidance.
  – "Anything more than 4, 5, 6 minutes and you’re risking irreversible health effects," Satti said. "I would say to have somebody suspended no more than 3 to 5 minutes would be a responsible time for rescue."

How Prompt is Prompt?

• But Satti also acknowledges that the 3-to-5-minute window is "a tough time to meet" for employers without a rescue plan in place.
  – "You'll take 3 to 5 minutes just looking at the guy trying to plan what to do," Satti said.
How Prompt is Prompt?

- The revised ANSI Z359.1 standard for fall protection in general industry, expected to be published in 2006, suggests that 6 minutes "may be an appropriate time to look at," according to Wingfield.

How Prompt is Prompt?

- **IF YOU'RE NOT GOING TO GIVE YOUR EMPLOYEES THE SKILLS TO PERFORM RESCUE," SATTI ASSERTED, "THEN YOU MIGHT AS WELL NOT EVEN PUT THEM IN THE HARNESS AT ALL.**
KNOT APPLICATIONS

Stopper / Keeper is used to keep the end of the rope from passing through hardware... and hands!

Did you hear that, Dave? Sounded like a scream...

Hitch - A "hitch" is a knot which is used when fastening a rope to something.

A stricter definition is that a hitch has the ability to conform to the size and shape of the object to which it's tied.
Knot Applications

- Loops - create a fixed point along, or at either end of a rope which allows the rescue to attach hardware to the rope, or the rope to an object.

Knot Applications

- Joins (or Bends) connect ropes end-for-end creating a continuous length of rope.

FIGURE '8' KNOTS
Figure '8' Knots

- Figure 8
- Figure 8 on-a-bight
- Inline 8
- Figure 8 follow-thru
- Figure 8 join
- Rescue 8

The BASIC knot for tying all other Figure '8' knots.
Functions as a stopper/keeper knot.

Figure 8

- The BASIC knot for tying all other Figure '8' knots.
- Functions as a stopper/keeper knot.

Figure 8 on-a-bight

- Creates a single loop anywhere along the length of the rope.
- Used for supporting single person loads and equipment.
Inline 8

- Forms a single loop which can be loaded up to 45° from the rope centerline.
- Used for direction changes and inline loading.

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Figure 8 follow-thru

- Attaches the end of the rope by forming a loop around or through an object.

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Figure 8 join (bend)

- Joins two ropes together to form a continuous length.
Rescue 8

- Forms two loops anywhere along the length of the rope.
- Used for rigging two-person loads.
- Can be used as a rescue harness.
- Can be used to form a self-equalizing anchor loop.

Rescue 8 follow-thru

- Attaches the end of the rope by forming two loops around or through an object.
SPECIAL KNOTS

- Safety / Keeper Knots
  - Fisherman / Grapevine
- Hitches
  - Prusik
  - Kleinheist
  - Muentner Hitch
  - Handcuff Hitch
- Non-linear Loop
  - Butterfly

**Fisherman**

- Used primarily as a safety / keeper knot behind other rescue knots.
- Can be used to form a Prusik loop (Double Fisherman)
Prusik Knots
• The Prusik loop is applied as a friction hitch (portable knot) on a loaded line.
• Easily repositioned when tension is released.
• Can be loaded in either direction.

Kleimheist Knot
• Similar to the Prusik except single direction loading.

Muënter Hitch
• Running friction knot that can change direction without re-rigging.
• Used for belay and lowering systems.
**Handcuff (Clove) Hitch**

- Forms a single loop which can be loaded from 45° to 90° from the rope centerline.
- Used for direction changes and moving control points.
- Tying methods:
  - Coil
  - Alpine
  - Over-the-hand

**Butterfly**

- Forms a single loop which can be loaded from 45° to 90° from the rope centerline.
- Used for direction changes and moving control points.
- Tying methods:
  - Coil
  - Alpine
  - Over-the-hand

**Double Butterfly**

- Forms two loops which can be loaded from 45° to 90° from the rope centerline.
WEBBING KNOTS AND HARNESSES

Webbing Knots

- Water Knot
- Frost Knot
- Mariner Hitch
  - Load Release Hitch

Water Knot

- Joins the ends of webbing to form a continuous length / loop.
- A.K.A. Overhand Join
- Applications include
  - Anchoring
  - ‘Hasty’ harnesses
  - Litter lashing
Water Knot

- Used in anchoring rope systems to reduce damage to life safety ropes and distribute load move effectively.
- *Wrap 3 – Pull 2* takes the strain off the knot, thus retaining webbings strength.

Water Knot

- Webbing shortening (adjustment) technique.

Frost Knot

- Forms a single loop at the end of a webbing loop, which is sized for the distance between two objects.
- Application as a pick-off strap.
TONKA TRUCKS CONTINUE TO BE MANUFACTURED DESPITE THE THOUSANDS OF GI JOE DOLLS KILLED BY THEM ANNUALLY IN ROLLOVER ACCIDENTS. NO AIRBAGS, NO SEAT BELTS. THESE THINGS ARE DEATHTRAPS, I TELL YA!

HAULING SYSTEMS

‘Armstrong’ Systems

- Force are generated by the number and strength of the rescuers pulling on the load line.
- NO M.A. is gained
Block and Tackle Systems

- Increase mechanical advantage by redirecting hauling forces between a stationary [fixed] pulley and a traveling [load] pulley.
- Linear increase in M.A.
3:1 Block and Tackle

4:1 Block and Tackle

5:1 Block and Tackle
Compound Systems

- Increase the mechanical advantage by utilizing hauling system force applied to another hauling systems.
- M.A. is multiplied by compounding.

Z-Drag (Z-Rig) Systems

- Adds a 2:1 simple pulley system to a 1:1 rope system to create a 3:1 M.A.

3:1 Z-Drag

- $2:1 + 1:1 = 3:1$
3:1 Z-Drag

2:1 + 1:1 = 3:1

Hauling Cam
Pre Tension Pulley w/Rope Clamp

3:1 Z-Drag w/Petzl Id

01:58

4:1 Compound

2:1 x 2:1 = 4:1
Piggyback Systems

- Allow the rescuers to apply hauling forces to an existing system, even if the system is under tension.
- M.A. can be by block-and-tackle or compound system.

3:1 Z-Drag Piggyback System

4:1 Compound Piggyback System
Pre-Rigging

Take the time – when there is no pressure – to pre-rig as much equipment as possible; it takes some of the pressure off when an emergency situation takes place.

Pre-Rigging

Rather than spending some of the “Golden Hour” building an anchor plate with all of the tools (bar rack, pulley, load release, etc.), having it pre-rigged speeds up the rescue. The same holds true with storing the M/A pulleys with a carabiner and prusik attached; have it all in one package.
Pre-Rigging

This is not rope rescue for dummies, rather it is thinking ahead toward the solution – solving the problem as it is presented. It gives a better opportunity to size up the situation and come up with a plan which (hopefully) leads to a successful outcome.

LeRoy Harbach
Senior Instructor
CMC Rescue School

Self-Rescue

- Self-rescue stirrups allow fall victim to extend rescue time by alternating sit/stand to reduce effect of suspension trauma.
• Self-rescue stirrups allow fall victim to extend rescue time by alternating sit/stand to reduce effect of suspension trauma.

• **BUT...**
  – How do you get down, or back up?

• **AND...**
  – You need to be conscious and relatively uninjured to use them.
RETRIEVAL RESCUE

Retrieval Rescue

- Pre-rigged
- Anchor above victim
- Attach victim using rescue pole with carabiner clip
- Raise victim to release PFAS device
- Raise/lower victim to safety

Miller QuickPick Rescue Kit shown for demonstration – This is NOT a product endorsement

Retrieval Rescue - Lowering

- If victim is suspended from a self-retracting lifeline [SRL].
  - Attach piggyback hauling system to victim.
  - Raise victim enough to release the SRL.
  - Lower the victim slowly to prevent re-engagement of the SRL.
Retrieval Rescue - Lowering

- Rig hauling system with lowering device.
- Attach retrieval line to victim.
- Use hauling system to transfer victim to lowering system.

Retrieval Rescue - Lowering

- Release fall arrest device from anchoring system.
- Lower victim.
Inline Transfer
Attended Descent

• Rescuer attaches victim with a pick-off strap.
• Rescuer uses piggyback to transfer victim to descent system.

• Rescuer releases victim fall arrest system.
• Rescuer descends with victim.
questions?

HANDS-ON RESCUE SKILLS
It's not if. It's when and how bad.