

# Ice Rescue Technician Student Manual



## Disclaimer

This manual is intended as a supplement for students who are enrolled or have taken our Ice Rescue courses. The information within is not all encompassing and should never be used without proper instruction from Capital Technical Rescue and Safety Consultants, LLC instructors.

In most instances we do not get into the specific operation, use, limitations, warnings, or dangers of pieces of equipment. Even when we do, you should always consult with the latest version of the manual directly from the manufacturer of the product and contact Capital Technical Rescue and Safety Consultants, LLC to receive the proper hands-on training of that device.

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For additional information or questions please contact us at [info@capitaltechrescue.com](mailto:info@capitaltechrescue.com) or by phone at 518-930-4500.

The latest version of this manual may always be obtained at:



[www.capitaltechrescue.com/icerescue-student-manual.pdf](http://www.capitaltechrescue.com/icerescue-student-manual.pdf)



## Table of Contents

<b>Disclaimer.....</b>	<b>2</b>
<b>Pre-Course Information.....</b>	<b>5</b>
<b>What to Expect.....</b>	<b>5</b>
What to Bring.....	5
<b>Class at our Training Facility .....</b>	<b>5</b>
Address .....	5
Directions .....	5
Parking.....	6
Facility Rules.....	6
<b>Pre-Course Study Material .....</b>	<b>7</b>
<b>Introduction.....</b>	<b>8</b>
<b>CTR Background .....</b>	<b>9</b>
<b>Standards .....</b>	<b>12</b>
<b>NFPA.....</b>	<b>12</b>
1006 - Standard for Technical Rescue Personnel Professional Qualifications .....	12
1670 - Standard on Operations and Training for Technical Search and Rescue Incidents.....	12
1983 - Standard on Life Safety Rope and Equipment for Emergency Services .....	12
1858 - Standard on Selection, Care, and Maintenance of Life Safety Rope and Equipment for Emergency Services.....	12
2500 - Standards for Operations and Training for Technical Search and Rescue Incidents and Life Safety Rope and Equipment for Emergency Services.....	13
<b>Water Rescue Disciplines .....</b>	<b>14</b>
<b>Environmental and Physiological Factors.....</b>	<b>14</b>
Ice Formation.....	14
Environmental Effects on Ice .....	15
Ice Types .....	16
Hypothermia .....	16
Methods of Heat Loss.....	17
Cold Water Survival.....	18
Drowning .....	19
Victim Considerations .....	20
<b>Water &amp; Ice Rescue Equipment.....</b>	<b>21</b>
PPE.....	21
Ice Rescue Equipment .....	23
Ice Rescue Craft .....	26
NFPA 1983 Overview.....	28
Definitions .....	28
<b>Rope / cordage construction &amp; features.....</b>	<b>29</b>
<b>Knots / Bends / Hitches .....</b>	<b>32</b>
<b>Ice Rescue .....</b>	<b>37</b>



Rescue Sequence .....	37
Self Rescue.....	37
Reach Rescue .....	38
Throw Rescue .....	38
Row Rescue.....	39
Go Rescue.....	39
Helo Rescue .....	41
Ice Rescue Communications .....	42
<b>Recommended Training / Continuing Education .....</b>	<b>44</b>
Weekly.....	44
Monthly.....	44
Quarterly.....	45
Annual .....	45
Other recommended training courses available .....	46
<b>Definitions.....</b>	<b>48</b>
PFD (Personal Flotation Device) .....	48
Ice Rescue Suit.....	48
Ice Awls / Picks.....	48
Throw Bag.....	48
RDC (Rapid Deployment Craft).....	48
HELP Position (Heat Escape Lessening Posture) .....	48
1-10-1 Rule .....	48
Hypothermia.....	49
Frazil Ice.....	49
Rotten Ice.....	49
Candle Ice.....	49
Rescue Sequence .....	49
Tether Line.....	49
Victim Sling.....	49
Rescue Sled / Board.....	50
Crampons.....	50
<b>Appendix.....</b>	<b>51</b>
<b>Appendix A – Reference Materials / Apps.....</b>	<b>51</b>

## Pre-Course Information

### What to Expect

#### What to Bring

- PPE
  - Helmet with chinstrap
  - Gloves: Leather / mechanic style
  - Ice Rescue Suit or Dry Suit
  - Appropriate layers / under garments
- Personal Items (optional)
  - Towel
  - Change of Clothes (recommended)
  - Poly / Wool Insulation Layers (no cotton clothing)
  - Refillable water bottle
  - Snacks / Lunch
- Notify Us
  - Any medical problems
  - Any allergies – food, bees etc.
  - Any concerns you may have
- Training Weather
  - Be prepared to be working in the water and in cold air temperatures
  - Heavy downpours and/or lighting will stop outdoor training, you will be contacted if the course is re-located or re-scheduled.

### Class at our Training Facility

#### Address

22 Mill Street, Unit 2  
Albany, NY 12204

#### Directions

Directions via Google Maps: <https://goo.gl/maps/r2BDuJtPeRR2>

## Parking

Do not block the gates at the end of the road.

Parking is limited and we try to be good neighbors to a few businesses, so please do not block the dumpster or the loading dock as it is actively used throughout the day.

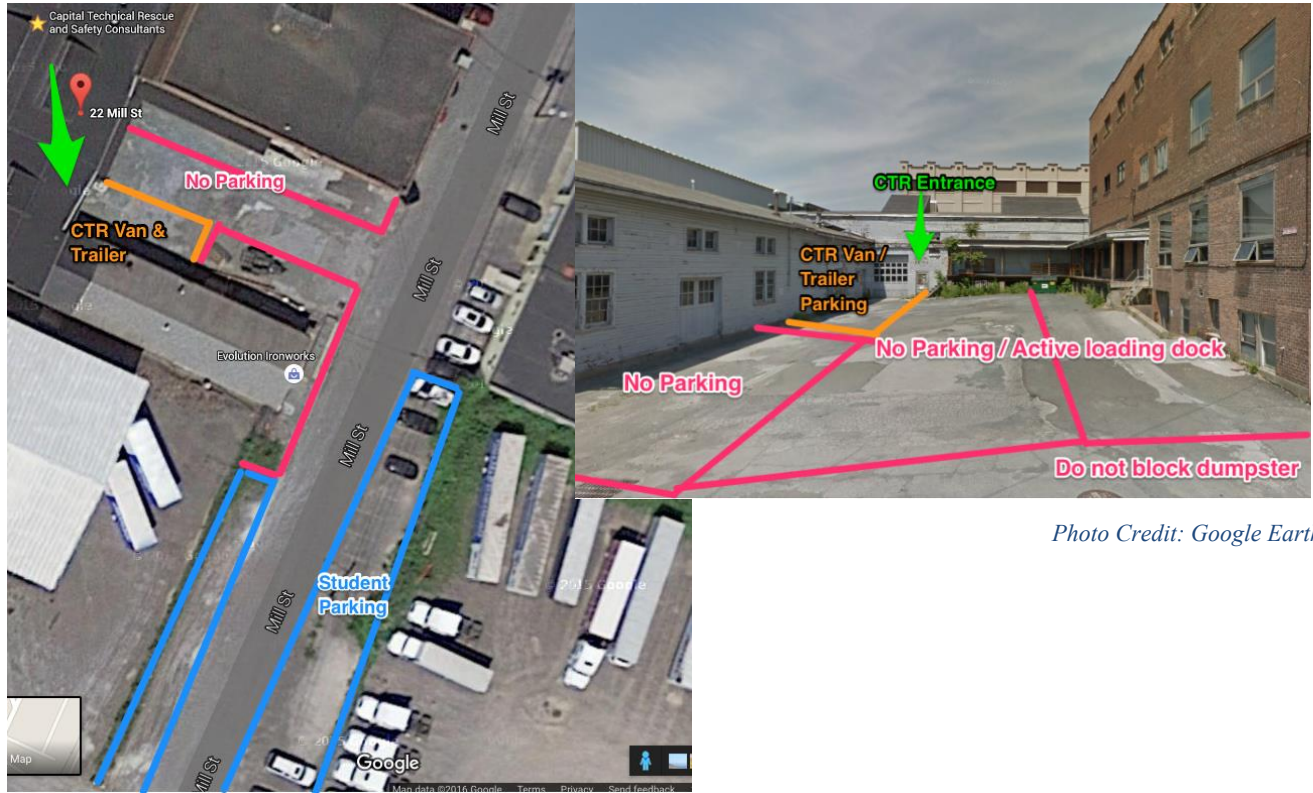


Photo Credit: Google Earth

Photo Credit: Google Earth

## Facility Rules

- Tobacco / Vape Free
  - Our facility is 100% Tobacco Free
  - This includes use of smokeless tobacco





## Pre-Course Study Material

- Prior to Day 1 read the following sections:
  - Introduction
  - Standards
  - Water Rescue Disciplines
  - Environmental and Physiological Factors
  - Water & Rescue Equipment
  - Ice Rescue
- Begin learning the knots, bends and hitches from the Equipment Section. Each knot has its own information and link to videos.



## Introduction

Ponds, lakes, rivers and other bodies of water are sources of winter recreation for adults, children and wandering pets. Not everyone heeds the warnings or understands that the ice may be unstable.

Facts: drowning is the second leading cause of accidental death in the US. Over 1/2 the victims are children. There is a very small window for successful intervention. Over 60% of ice incidents also involve vehicles.

Rescuers drown because they wear PPE improperly or fail to wear adequate PPE at all. Overestimate abilities, inadequate training, lack of proper equipment, or backup and they can underestimate effects of cold water.

This course is designed to address the needs of most teams to perform rescues at the operations and technician level based upon the job performance requirements of the NFPA 1006 standard.

Regardless of where you work and the territory you respond to, this course is an introduction into ice rescue and begins your lifelong journey and commitment into becoming a well-rounded technical rescuer. You must realize that like all technical rescue skills, these are perishable, and you must train and practice regularly to be effective and efficient. The recommended training and continuing education sections of this manual will help guide you throughout the course of your journey. Please remember that once you have begun the journey with us, we are always here to help you with any questions or problems you may have. Do not hesitate to send us an email or give us a call whenever you need.



## CTR Background

Capital Technical Rescue and Safety Consultants, LLC (CTR) was formed in 2006 to serve the needs of emergency response personnel whose job duties specifically task them with performing a variety of technical rescue disciplines. These responders have come from a variety of agency types including federal and municipal public sector emergency services as well as private industry emergency response teams and fire brigades.

The primary staff of CTR has been working and teaching together for over 10 years, prior to the formation of the company. Their backgrounds vary from volunteer to career firefighters and fire officers, emergency medical technicians to paramedics, and emergency responses from the smallest local incident to natural disasters and terrorist attacks that have had a global impact.

Previous and current CTR contracts have included teaching technical rescue courses from 6 to over 350 students, with scheduled completion ranging from a single day to over the course of several months. This flexibility has allowed our clients to minimize overtime expenses and ensure that production or response is negligibly impacted. This is also true for our industrial clients and has led us to be one of the most experienced groups of standby rescuers.

Capital Technical Rescue and Safety Consultants, LLC is a proud [Petzl Technical Partner](#) (PTP).

### What is a Petzl Technical Partner (PTP)?

A PTP is a recognized expert company or individual in a vertical environment that demonstrates a thorough understanding of their respective industry, contributes to the development of best practices, and meaningfully integrates Petzl into their systems and curriculum. In return for this promotional support, Petzl endeavors to share our information, our products, our time, and our resources to ensure mutual success and sustainable growth.

### Who is a Petzl Technical Partner?

Trainers & Training Organizations  
Industry Leaders & Influencers  
Consultants & Field Experts



### PTP Mission Statement:

The Petzl Technical Partner (PTP) Program's mission is to develop a diverse network of training company partners and recognized leaders who can help Petzl promote our products and solutions to a wide variety of industries and end-users. Whereas Petzl is an expert in our products and services, we believe that front line, subject-matter experts are the best bridge to the industries we ultimately serve.

As a Petzl Technical Partner, we are part of a network of subject matter experts. There are technical partners located in 5 continents and in over 18 countries.

Capital Technical Rescue and Safety Consultants, LLC serves clients from a variety of industries. These include:

Food Service

- Ingredient Facilities
- Food processing and packaging

Paper Mills

- Fine Papers
- Recycled Paper
- Tissue Paper

Nuclear Facilities

- Nuclear research
- Nuclear training facilities

Chemical Plants

- Silicones
- Formaldehyde
- Methanol
- Pharmaceutical research and development
- Pharmaceutical production
- Biotechnology research and development, production

Industrial Plants

- Nanotechnology production
- Nanotechnology research and development
- Packaging production
- Personal Protective Equipment manufacturing
- Armament Production

Mining Operations

Cement Plants

Research Facilities

Environmental Services

Power Generation – Hydroelectric, Coal

Fire Academies

Municipal Services

Airports

Construction

CTR has a warehouse full of rescue equipment, including multiple rescue boats. Depending on the needs of the client and our hazard surveys will depend on what equipment is required.

Typical CTR Confined Space Rescue Equipment list:

Atmospheric Monitors, RAE Systems	Ventilation Fan (for actual emergencies only)
Rescue Rope, variety of lengths	Supplied Air Systems (SAR) and SCBA
Mechanical Advantage Rope Systems	Pulley systems
Anchor straps	Rope winch system
Tripods, bipods and monopods	Fall arrest rescue equipment
Patient packaging gear, SKED, SPEC PAK	Intrinsically safe radios and lighting
Edge protection	Reference material, iPads, onsite phone
Ascenders & Descenders	Additional hardware and software as needed

In addition to the rescue equipment, we have our own indoor training facility for rope and confined space rescue. Our props are utilized in clients' courses as well as in testing out new and prototype equipment and techniques as well as keeping our staff up to date.

The confined space rescue simulator has multiple levels, opening types, dimensions and space configurations. These include both vertical and horizontal access points, vessels with bottom openings, top openings and more. The simulator is also located in doors and allows us to train throughout the year, regardless of weather conditions.

We are also located just minutes away from the Hudson River and the Corning Preserve boat launch. This allows us to get out on the water and train, test new equipment and get it all back in service quickly.

There are also various other training props, including cell towers, firefighter survival, and lock out tag out in house. Our warehouse area stages equipment we utilize for HAZ-MAT, trench and collapse rescue courses, as well as rigging equipment for heavy duty operations.

As this space continues to evolve, we imagine many more possibilities. These include the capability to evaluate client's issue on site and re-create it in house, so we can practice performing a potentially difficult rescue within a safe area.

You can learn more about our site at the following links:

<https://www.capitaltechrescue.com/post/indoor-training-facility>

<https://www.firehouse.com/rescue/article/12146756/technical-rescue-training-facility-profile-capital-technical-rescue-safety>

## Standards

### NFPA

#### **1006 - Standard for Technical Rescue Personnel Professional Qualifications**

This standard identifies the minimum job performance requirements (JPRs) for fire service and other emergency response personnel who perform technical rescue operations. We utilize this standard to ensure that our training programs provide you with the knowledge and skills to meet current national standards. This standard applies directly to you, the individual rescuer.

#### **1670 - Standard on Operations and Training for Technical Search and Rescue Incidents**

This standard identifies and establishes levels of functional capability for efficiently and effectively conducting operations at technical search and rescue incidents while minimizing threats to rescuers. It is intended to help the authority having jurisdiction (AHJ) assess a technical search and rescue hazard within the response area, identify the level of operational capability, and establish operational criteria. This is known as an “organizational” standard and specifies what your organization should do and know for technical rescue incidents.

#### **1983 - Standard on Life Safety Rope and Equipment for Emergency Services**

This standard specifies requirements for life safety rope and associated equipment used to support emergency services personnel and civilians during rescue, firefighting, or other emergency operations, or during training. It is imperative to understand that this is not a “use” standard. This standard is known as a “manufacturers standard” as it defines how equipment should be made, tested, labeled and documented. Within NFPA 1983 come the terms “General Use” and “Technical Use” which relate to ratings of the specific equipment.

#### **1858 - Standard on Selection, Care, and Maintenance of Life Safety Rope and Equipment for Emergency Services**

NFPA 1858 is written for organizations that evaluate the risks faced by emergency responders and their particular needs for life safety rope and equipment. It is also written for users of life safety rope and equipment to enable them to inspect, maintain, and care for the life safety rope and equipment they use during rescue and training operations that is compliant with NFPA 1983, *Standard on Life Safety Rope and Equipment for Emergency Services*.

NFPA 1858 applies to life safety rope, escape rope, fire escape rope, fire escape webbing, escape webbing, throwlines, moderate elongation laid lifesaving rope, life safety harnesses, belts, auxiliary equipment, litters, and victim extrication devices certified as compliant with NFPA 1983.



## **2500 - Standards for Operations and Training for Technical Search and Rescue Incidents and Life Safety Rope and Equipment for Emergency Services**

This standard is a consolidation of NFPA 1670, 1983 and 1858, and was released at the end of 2021.

## Water Rescue Disciplines

Each type of water rescue has its own characteristics, hazards, and “personality”. What works in one discipline may get you killed in another. As an example, SCUBA divers are used to be harnessed and tethered into a rope system, however using tethers in swift water rescue could force a rescuer underwater and cause them to drown.

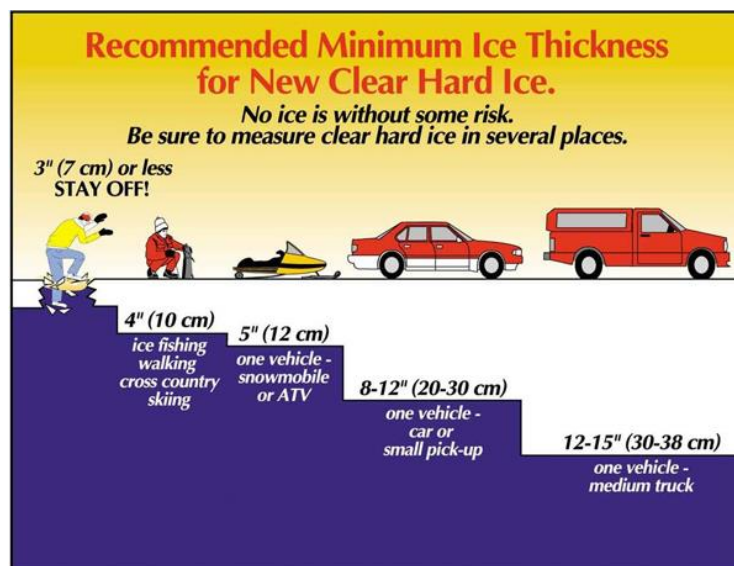
Five main areas of water rescue per NFPA 1006 & 1670

- Surface water rescue
- Swift water rescue
- Ice water rescue
- Surf water rescue
- Dive rescue

## Environmental and Physiological Factors

### Ice Formation

Cold air cools the water on the surface. The cold water then sinks and is replaced by warm water that rises from the bottom, and the cycle continues. Once all of the water in the body is the same temperature (Isothermic), the process stops and ice begins to form. There are various factors that affect the quality of ice formation, including depth of the water, air temperature, wind and any other ice or snow buildup.



Ice thickness, as shown in the diagram, are general guidelines only, and ice may fail at any time. There is no such thing as “safe” ice. Ice that was good yesterday, may not hold today.

### **Environmental Effects on Ice**

Temperatures, weather, conduction, vegetation, wind, human touch, run off, springs, recirculation, moving water, discharges, chemicals, obstructions, and water fowl can all effect ice quality.



Typically, the faster a freeze, the stronger the ice. This ice will appear “clear”. Ice that is cloudy or discolored is likely weaker ice and may have been caused by snow or rain. Snow that sits on top of the ice will create a blanket and produce a warming effect between the snow and ice, which will degrade the ice.

As the ice melts, the surface will become even more slippery, increasing the chance of injury to rescuers. Some teams will require that rescuers wear thermal hoods and a water rescue style helmet that covers the ears as well. While this level of protection may be necessary, we must also realize that the addition of hoods and coverings over our ears hinders communication, adding complexity to the rescue. Rescue ropes may soak up water as the ice melts and become heavy or even freeze to the surface, making them difficult to use.

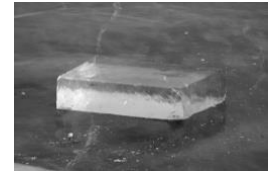


## Ice Types

- Frazil ice: initial freezing action of water
- Clear ice: strongest ice that can form
- Rotten ice: thawed slowly and is very weak
- River ice: currents erode from underneath
- Drift ice: large piece not attached to shore
- Snow ice: ice with a layer of frozen snow on top
- Fast / Shore Ice: Thin and hollow
- Candle Ice: cracks in ice that have been frozen over
- Puddle Ice: Water pooling on top of ice



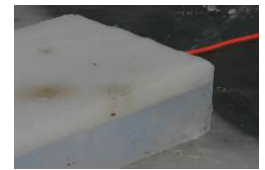
Frazil Ice



Clear Ice



River ice



Rotten ice

## Hypothermia

Victims who have fallen through the ice and are in the water are certainly prone to hypothermia, but we must also realize that rescuers will also face the potential for hypothermia.

Hypothermia is defined as the lowering of the body core temperature below 95° F.

There are 3 types of hypothermia:

- Chronic - underlying disease
- Acute - matter of seconds or minutes
- Sub-acute - hours by remaining in cold environment

Video:

[Cold Water Boot Camp USA](#)

By: Cold Water Boot Camp  
Dr. Gordon Giesbrecht  
(Professor Popsicle)

Stage	Core Temperature	Signs & Symptoms
Mild Hypothermia	99° - 97°F	Normal, shivering can begin
	97° - 95°F	Cold sensation, goose bumps, unable to perform complex tasks with hands, shiver can be mild to severe, hands numb
Moderate Hypothermia	95° - 93°F	Shivering, intense, decreased muscle coordination becomes apparent, movements slow and labored, stumbling pace, mild confusion, may appear alert
	93° - 90°F	Violent shivering persists, difficulty speaking, sluggish thinking, amnesia starts to appear, gross muscle movements sluggish, unable to use hands, difficulty speaking, signs of depression
Severe Hypothermia	90° - 86°F	Shivering stops, exposed skin blue or puffy, muscle coordination very poor, confusion, incoherent/irrational behavior, but may be able to maintain posture and appearance of awareness
	86° - 82°F	Muscle rigidity, semiconscious, stupor, loss of awareness of others, pulse and respiration rate decrease, possible heart fibrillation
	82° - 78°F	Unconscious, heart beat and respiration erratic, pulse may not be palpable
	78° - 75°F	Pulmonary edema, cardiac and respiratory failure, death. Death may occur before this temperature is reached



## Methods of Heat Loss

Water conducts heat away from the body 25 times faster than air of the same temperature. When someone is already wet and then exposed to the air they lose heat 35 times faster, so it is very important to prevent further heat loss once we remove victims from the water.

Conduction, convection, radiation (up to 80% from head), evaporation and respiration all play a part in our body losing heat. Age, body build, movement, medications, alcohol, and sudden immersion in cold water all affect heat loss. The use of a PFD and the HELP position also help ensure a good chance for survival.

## Cold Water Survival

Proper clothing and PPE can attribute to cold water survival, but a PFD is clearly the most important piece of PPE we can put on.

### 1 – 10 – 1 Principle From Cold Water Boot Camp

**1-10-1** is a simple way to remember the first three phases of cold water immersion and the approximate time each phase takes.

#### **1 – Cold Shock:**

An initial deep and sudden gasp followed by hyperventilation that can be as much as 600-1000% greater than normal breathing. You must keep your airway clear or run the risk of drowning. Cold Shock will pass in about 1 minute. During that time concentrate on avoiding panic and getting control of your breathing. Wearing a lifejacket during this phase is critically important to keep you afloat and breathing.

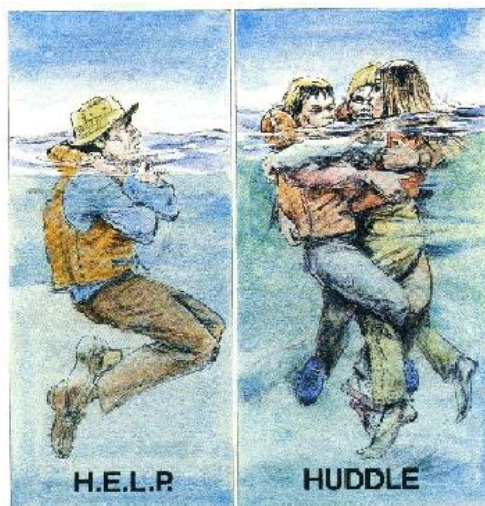
#### **10 – Cold Incapacitation:**

Over approximately the next 10 minutes you will lose the effective use of your fingers, arms, and legs for any meaningful movement. Concentrate on self rescue initially, and if that isn't possible, prepare to have a way to keep your airway clear to wait for rescue. Swim failure will occur within these critical minutes and if you are in the water without a lifejacket, drowning will likely occur.

#### **1 – Hypothermia:**

Even in ice water it could take approximately 1 hour before becoming unconscious due to Hypothermia. If you understand the aspects of hypothermia, techniques of how to delay it, self-rescue, and calling for help, your chances of survival and rescue will be dramatically increased.

- Wear a personal flotation device
- Keep clothes on
- In most cases, do not try to swim
- Get out of the water as soon as possible
- Assume the Heat Escape Lessening Posture (HELP) or Huddle



#### Cold Water Survival Factors

- Age
- Length of submersion
- Water temperature
- CPR quality
- Victim struggle
- Physical condition of the victim
- Individuals have been successfully revived after being under water for over one hour

#### Drowning

Drowning is defined as: suffocation in a liquid.

#### Three types

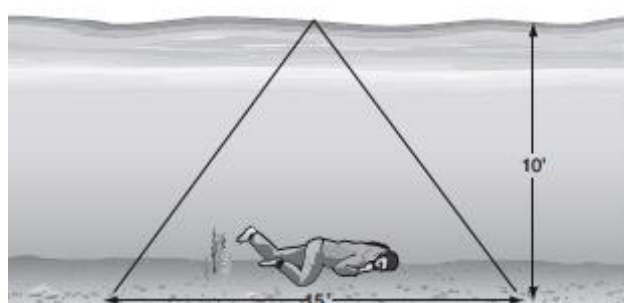
- Dry - no significant fluid in lungs (traumatic asphyxiation)
- Wet - aspiration of fluid into the lungs and causes pulmonary damage
- Secondary - Pulmonary problems such as ARDS / long term infections.

#### Care for drowning victims

- Remove from water
- Ensure ABC's and initiate CPR as required
- Prevent further heat loss
- Handle gently
- Administer 100% oxygen
- Transport to nearest medical facility which can handle these types of emergencies
- Follow local protocol

## Victim Considerations

Generally, a person submerged in calm water, or water with no current will be in an area about one and one half times the depth of the water they were in when they went under. For example, in water 10 feet deep, and with no current the victim will most likely be found in a 15 foot wide circle directly underneath the entry point.



### Multiple victims

- Many well-meaning people will complicate missions
- Additional victims may be hard to spot

Victims may be trapped under an ice sheet

### Searching / Witness Interviews

- Clues – fishing poles, tackle boxes, foot prints etc
- PLS – Point Last Seen

## Water & Ice Rescue Equipment

### PPE

#### PFDs

Personal Floatation Devices (PFDs) were traditionally broken up into 5 different types based on the US Coast Guard ratings. In 2014 the USCG adopted a final rule that changed the way PFDs are labeled.

*"The Coast Guard is issuing this final rule to remove references to type codes in its regulations on the carriage and labeling of Coast Guard-approved personal flotation devices (PFDs). Removing these type codes from our regulations will facilitate future incorporation by reference of new industry consensus standards for PFD labeling that more effectively convey safety information and is a step toward harmonization of our regulations with PFD requirements in Canada and in other countries."*

#### USCG Type 1 – 5 PFDs

- Type 1 & 2 are bulky and are for commercial or recreational boating
- Type 3 work vests are typically what we use
- Type 4 is throwable, such as ring buoys
- Type 5 is specialty, like swift water rescue vests or full body work suits.

#### New PFD Labeling & Standards

### CHOOSE THE DEVICE YOU WILL WANT TO WEAR


**SIZE & FIT**

- Check label for user weight and chest size.
- Different body types float differently.
- Try your device on in the water to ensure your airway is clear.
- A good fit is secure, comfortable, and adjustable.

TRY IT ON

**PERFORMANCE**

- Lower level number generally offers greater mobility, comfort, and style with good flotation for most people.
- Higher level number generally offers greater flotation, turning, and stability in the water.



50 70 100 150

Near Shore (Calm) (Waves) Offshore

Increasing time to rescue

Me Turn Turns Most

CONSIDER YOUR ACTIVITY & ENVIRONMENT

**WATER SAFETY INFO**

- In over 80% of boating fatalities the person was not wearing flotation.
- Most of these are sudden falls overboard or capsizing of a small boat.
- The first moments in the water are critical, even for experienced swimmers.
- Cold water shock causes involuntary gasping, loss of muscle control and swim failure.
- Long term immersion in cold water causes hypothermia and requires thermal protection and flotation in the HELP position to conserve energy.

FLOTATION DEVICES SAVE LIVES

**DESIGN TYPES**

- **INHERENT** – built-in flotation (always buoyant).
- **INFLATABLE** – activator gas canister inflates chamber(s) (no buoyancy until time of inflation, requires canister replacement, may be manual, may require secondary action to don).
- **HYBRID** – combination of flotation and inflation (some immediate buoyancy and supplemental when inflated, may require canister replacement).
- **SPECIAL PURPOSE** – your activity may require special features (safety color, harness, straps, etc.) and accessories (whistle, lights, reflectors, etc.) for certain conditions.

YOUR DEVICE ONLY WORKS WHEN WORN


**MAINTENANCE**

- Over time, exposure to sun, salt, fuel, and mildew can damage device.
- Allow to air dry. Inspect and test regularly.
- Inflatables require replacement rearming, repacking and regular servicing.

READ, SAVE AND FOLLOW INSTRUCTIONS

**WARNINGS**

- Children should have adult supervision when on or near the water.
- Devices must be fastened correctly and securely.
- Some devices were not designed for certain activities or conditions such as water skiing, towed sports, personal watercraft (PWC) or whitewater paddling.



CHECK LABEL FOR LIMITATIONS OF USE

**APPROVAL**

- Some devices are approved only when worn.
- Check federal, state/provincial and local requirements for carriage, use and wear.

☒

US Coast Guard

☒

Transport Canada

WEAR IT

For more info on the right choices for yourself, your family and friends...  
Visit [www.wearitlifejacket.org](http://www.wearitlifejacket.org)

Credit: [www.wearitlifejacket.org](http://www.wearitlifejacket.org)



Example of a label under the new USCG ruling:



*Credit: USCG*

### Ice Rescue Suits

Made from either neoprene or coated nylon. Neoprene may absorb petroleum products and is easy to repair with products such as Aquaseal. Coated nylon suits are more modern, do not absorb petroleum, and are easier to clean / decontaminate.



*Left: Coated Nylon Suit / Right: Neoprene Suit*

Both types of suits go on over your clothing and have integrated boots and gloves. They are not for use in swiftwater, as swimming in these suits is difficult. Suits provide their own



buoyancy but are not rated as PFDs. Each suit should be outfitted with ice awls and a pea-less whistle.

Ice rescue suits offer thermal protection, but the one size boots and gloves built into the suits won't fit all rescuers well. Rescuers must remember that these suits are very buoyant, including the legs. Some rescuers will put ankle weights on to help prevent inverting in the water.

Zipppers for both styles should be kept clean and waxed after every use.

### *Helmets*

Helmets should be available to all rescuers working on the ice and at the shore. They should be a lightweight rescue style helmet that has drain holes for water and can fit over the insulated hood for the ice rescue suits and still allow a chin strap to be worn.



## **Ice Rescue Equipment**

### *Ice Awls / Picks*

Ice awls or picks should be a part of every ice rescue suit. When driven into the ice, these picks allow the rescuer to self-rescue by creating something they can grip on to help pull and kick themselves to safety. Ice awls are commercially available and typically float, but many people have made their own from screwdrivers, wooden dowels with nails and other items available to them. The ice awls should have a tether to keep the two of them together as a pair or be separated and tethered into each arm of an ice rescue suit.



*Using Ice Picks to attempt a self-rescue*

Spare ice awls should also be available to throw to a victim who may be able to self-rescue or at least stabilize themselves prior to a rescue team being dressed and ready to perform a rescue.

#### *Throw bags*

Throw bags are typically 50 – 75' of polypropylene rope. They can be thrown to a victim to try to pull them out of the water and up onto the ice or shore. Other uses are to tether rescuers together, or for utility purposes. This rope is specific to water rescue and will float on water.



### *Rope Reels / Tether Lines*

Rope reels are typically available in lengths from 300' – 900', while tether lines are typically bagged rope in either 200' or 300' lengths. Both styles are used to tether rescuers to a shore based crew for when rescuers must travel a long distance to get to victims.



*Stock Photo Credit: marsars.com*

### *Reach Devices*

Reach devices may be a homemade ice staff from wooden dowels to commercially available poles with integrated slings. Other options include using inflated fire hose, which can provide buoyance for multiple victims very quickly.



These devices allow rescuers to potentially operate from a safe area, without having to enter the water with the victim, and possibly retrieve them from the water.

### *Victim Slings*

Slings are designed to provide victims with buoyancy, attach the victims into a rope system and to secure a victim under their arms and assist in extricating them out of the water. Slings may be used on their own, attached to the rope system and rescuer, or with reach devices or ice rescue sleds and craft.



## **Ice Rescue Craft**

### *Rescue Boards / Sleds*

Commercially available ice rescue boards and sleds are available to assist in removing victims from the water and being able to move them longer distances without dragging their bodies on the ice. Some boards are inflatable, while others are rigid high-density polyethylene with integrated straps and slings designed to assist in removal of a victim. Both styles of boards are buoyant and provide floatation and protection to the victim.

Larger sleds are also available and can be paddled through open water, and potentially have a litter placed in the center for longer transports. They may also be towed behind vehicles on the snow and ice.



*Various Commercial Sleds*

### *Inflatable Boats*

Inflatable boats are popular because of rapid deployment, weight, and space they take up. Commonly used inflatable boats include styles such as the RDC – Rapid Deployment Craft which can be used for ice rescue and swiftwater rescue. By design, there is no true bow or stern and can be used in any direction. Two rescuers can deploy the RDC and bring a victim on board, without the need for a rescuer entering the water, and then be hauled back to safety by shore-based crews.



### *Boats*

Other boats may also be a viable option, especially when there may be a fair amount of open water. These may include additional inflatable boats, hover craft, or airboats. Each of them has a place in various ice rescue scenarios but hover craft and airboats are typically very specialized pieces of equipment and require a lot of training.





## NFPA 1983 Overview

As mentioned earlier, this is a manufacturing standard and not a use standard, however understanding what the certifications of NFPA 1983 mean helps guide us in the purchasing of quality products.

- NFPA G Rating - General Rating - Minimum breaking strength of 9,000 lbs
- NFPA T Rating - Technical Rating - Minimum breaking strength of 6,000 lbs
- Most hardware is good as long as it passes inspection, which should also include function tests where applicable.
- Most software is good for up to 10 years from the date of manufacture.
- NFPA 1983 also addresses:
  - Labeling on equipment
  - Record keeping and requirements

## Definitions

kN – Kilonewton – The Newton is a measure of force

1 kN = 1000 Newtons

1 kN = 224.8 lbf (pounds of force)

Often, we consider 1 kN to equal the weight of 1 average person. Certainly, that can fluctuate, but in simple terms when considering how much weight or force a rope or piece of equipment can handle, if it is rated at 10 kN (2,224 lbf), that is approximately the weight of 10 people.

MBS – Minimum Breaking Strength

Carrier Count - This refers to the number of different yarns that are braided around the core of the rope to form the sheath.

Hand - The “hand” of the rope is a reference to how soft or supple the rope is. Typically, a supple rope will be considered to have a soft hand, versus a stiff rope that has a hard hand.

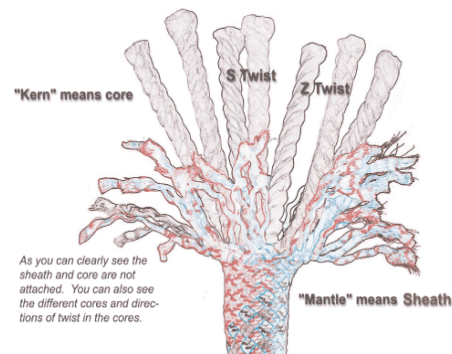


Photo Credit: NRS.com article - [Know the Ropes](#)

Kernmantle – The construction style of the rope where the “Kern” is the core, while the “Mantle” is the sheath. The core typically supports the major portion of the load, while the sheath primarily protects the core and supports a portion of the load.

Static Kernmantle Rope – A life safety rope with a maximum elongation of 6% at 10% of its minimum breaking strength. It is the primary type of rope used in technical rescue due to its low elongation, making it efficient for use in lowering and raising systems.

Dynamic Kernmantle Rope – A life safety rope with an elongation greater than 25% at 10% of the minimum breaking strength. These ropes are typically used by climbers since they help absorb the shock of a fall with their high elongation. Technical rescue teams specially trained in lead climbing, tower rescue and rescue from other structures may choose a dynamic rope over a static because they anticipate the potential of a fall.<sup>1</sup>

## Rope / cordage construction & features

### Suppleness vs. durability

The softer the hand of a rope the easier it is to knot typically. A stiff rope that has a hard hand, will be more difficult to work with and tie knots. Think about how difficult it would be to tie a knot in cable versus a softer rope. Typically, the more supple the rope the less durable it may be. A stiffer rope will be more like cable and therefore will be more durable. Manufacturers all try to balance this with different techniques in making the ropes including coatings, treatments, fiber tensions, directions of the twists and more.

### High carrier count vs. low carrier count

Ropes with a higher carrier count will typically have a softer hand, while a lower carrier count will have a harder hand. Carrier counts in Static Kernmantle ropes typically range from 16 - 48 carriers. This means that there could be anywhere from 16 to 48 different yarns braided around the core of the rope to make the sheath. This will also affect how smooth or flat the surface of the rope is. The last video link below has the most in-depth explanation of all the factors of how ropes are made.



*Each bobbin is a yarn that is being braided around the core of the rope to form a sheath.*

The 2 main construction characteristics that affect the performance characteristics are the number of carriers in the sheath and how much twist is in the bundles that make up the sheath and the core.

A rope with a high carrier count will have a thinner sheath and larger core, lending itself to a less durable rope with low stretch. The opposite being true of a low carrier count rope with a thicker sheath, more durability with a thinner core and more stretch. This primarily the result of a larger portion of the mass of the rope running straight in a high carrier count rope, transferring the energy in a straight line through the mass of the rope.

<sup>1</sup> Cordage Institute, Terminology for Fiber Rope



With a low carrier count rope there is more mass running at angles to the transfer of energy and those fibers need to straighten and bind on other fibers before holding the load, leading to more elongation.

Twisting the bundles that make up the sheath and the core adds structure, a firmness, to the body of the rope. Less twisting will typically result in a very low stretch rope, but it will feel “mushy” and tend to flatten over edges and through devices.

The amount of twisting of these fibers also imparts some stretch to the rope. Adding a lot of twists to these bundles is how a dynamic rope functions as the materials are the same as the fibers used in static ropes.

#### Common Materials

- Nylon
  - Loses strength in water.
  - More stretch compared to polyester and aramid fibers
- Polyester
  - Unaffected by water
  - Low stretch
- Polypropylene
  - Floats
  - Typically water rescue rope, not life safety
  - Classified as NFPA Throwline
- Aramid (i.e. Technora)
  - Unaffected by water
  - Low Stretch
  - High Abrasion/Heat resistance
  - High strength fibers
    - 3 times stronger than nylon / polyester
  - Low resistance to shock

#### Common Diameters / Sizes & Uses

- 10.5 – 11.5mm (7/16”) Static Kernmantle Rope
  - May be NFPA T rated at 20kN – some are G rated depending on construction
  - Primarily used in industry, technical rescue teams and gaining popularity within the fire service

#### Videos:

[How Ropes are Made](#)

By: BlueWater Ropes

[How Climbing Ropes are Made](#)

New England Ropes

[How is Climbing Rope Made?](#)

By: Sterling Ropes

[How Climbing Ropes are Made:](#)

[Inside / Out](#)

By: WeighMyRack - @Edelrid Ropes

- 12.5mm (1/2") Static Kernmantle Rope – NFPA G rated at 40 kN – common rope diameter used in fire service.
- 6mm technora cord – used for tiebacks – rated for 21kN
- 8mm prusik cords – used as rope grabs, mini-haul systems, accessory cord, sewn cord used as anchors
  - Rated at 15 kN as a single part
  - Cords tied into a prusik loop with a double fisherman's have a theoretical rating of up to 50% less than 15 kN
  - Sewn cords in a bound prusik loop rated at 20 kN
- 1" Tubular Webbing – rated at approximately 19kN<sup>2</sup>
- 1" Flat Webbing – rated at approximately 26kN<sup>3</sup>

The practice of tying prusiks should be eliminated completely. Sewn bound loop prusiks offer a level of safety that far exceeds the cost savings of making your own.

Rated sewn terminations can be used as anchor straps with a degree of certainty that unaccounted for hand tied prusiks cannot.

Sewn anchor slings should be used wherever possible for the same reasons.

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<sup>2</sup> CMC Rescue

<sup>3</sup> CMC Rescue

## Knots / Bends / Hitches

These knots, bends, and hitches, are the common ones we utilize in rope, water, and confined space rescue. There are many ways to tie each of these, and it is always good to know several ways to tie each.

A knot has many definitions, but for our purposes, it is an intentional complication in rope, cordage or webbing, which has a practical application. A bend is a type of knot that ties 2 ropes ends together, while a hitch is a knot which secures a rope, cord or webbing to another object.

A bight is a fold in a piece of rope so that the two parts lay alongside each other. This is often used to form a loop, as when we tie the “figure 8 on a bight.” We make this bight, or loop, sized appropriately for the task. We refer to the size of the loop or bight, as the “gain” of the knot. The gain is the overall size of the knot. The larger the gain, the larger the loop. In confined space rescue we often try to tie our knots so the gain of the knot is small enough to just clip in two carabiners. This allows us to maximize our lifting height, because if we had a knot with a large gain, and our overhead clearance was low, we could potentially not be able to get a rescuer or victim out of that space.

The working end of the rope refers to the “short” end, the part doing the knotting or the work, or the part under load. It is also referred to by some as the “running end”.

The standing end of the rope is the long part of the rope, or the part not knotted, or the “free” end of the rope.













The bitter end refers to the tail end of the standing end of the rope.













Typically, regardless of the knot, bend, or hitch, we de-rate the breaking strength of the rope a minimum of 30% but more often de-rate it at 50%. This is because there is such a variation in the materials used in rope construction, strength loss of various knots, and condition of the rope itself – new versus used. De-rating the rope at 50% ensures that we have considered all of these factors.










Anything we tie must be easily identifiable by everyone involved. Clean and well-dressed knots, bends, and hitches help us quickly inspected our system and ensure we are ready to proceed. Unless noted in the table below, we do not use “safety” knots when tying the majority of these. Instead, we follow a few rules:





- Tails in rope should be 6” or length of hand
- Tails in webbing should be 4” or width of hand
- Knots should be well dressed, set and easily identifiable

Scan the QR codes below with your camera app, or just tap on the QR Code on your mobile device and it will bring you to a video on how to tie that knot.

Rescue Knots / Bends / Hitches and their uses		
Photo / Name	QR / Alternate Names	Uses
		Stopper knot, used in the terminal end of a rope
<b>Figure 8</b>	Figure 8 Stopper, Flemish Knot	
		Creates a loop to anchor the end of a rope. Loop typically should only be large enough to accommodate 2 carabiners. Tail should be the length of your hand, if it is longer you can tie it off.
<b>Figure 8 on a bight</b>		
		Creates a loop in the end of a rope going through a ring, carabiner, harness, object, anchor point etc. Tail should be the length of your hand, if it is longer you can tie it off.
<b>Figure 8 Follow Through</b>		
		Joins two ropes together Tails should be the length of your hand, if it is longer you can tie it off.
<b>Figure 8 Bend</b>	Flemish Bend	
		Creates a loop / attachment point in the middle of a rope. Can also isolate a damaged section of rope.
<b>Butterfly</b>	Alpine Butterfly	
		Join two ends of ropes together. Binding knot, often used in the terminal end of patient packaging devices. It is imperative that a safety knot is tied on either side of the knot, right up against it.
<b>Square Knot</b>	Reef Knot	

Rescue Knots / Bends / Hitches and their uses		
Photo / Name	QR / Alternate Names	Uses
		Stopper knot, typically used up against another knot, such as the square knot.
Overhand Knot		
		Stopper knot, used in the terminal end of a rope. It is also the basis for several other knots and is used as a safety in conjunction with other knots.
Double Overhand Stopper		
		Used to place limbs as wristlets, must be backed up to ensure locking action. This knot can cause potential trauma and only should be used when other methods are not available/practical.
Handcuff Knot	Texas/California Love Knot, Hobble Knot	
		Joins two ropes of similar size together, often used to create Prusik loops.
Double Fisherman's Bend	Grapevine Bend	
		Typically a temporary holding hitch, easily adjustable. This hitch does slip and should be backed up.
Clove Hitch – Rope End		
		Two opposite hitches are created and dropped over an object to create this hitch. Typically a temporary holding hitch, easily adjustable. This hitch does slip and should be backed up.
Clove Hitch – Half Hitches	Drop Over Clove	

Rescue Knots / Bends / Hitches and their uses		
Photo / Name	QR / Alternate Names	Uses
		Anchor around a post or tree for a static rope, can be used for rappelling or a static safety line. No strength degradation of rope. Post diameter should be at least 8 times the diameter of the rope, typically at least 3 full turns around the post. Can be secured with a carabiner or a figure 8 follow through.
Tensionless Hitch		
		Can be used to tie off descenders. Attention must be paid to the tail strand to be pulled on is away from the device.
Slip Knot	Slipped Overhand Knot	
		Triple wrapped loop of cord for system loads, this creates friction on a rope and can be used as a rope grab. Double wrapped are only suitable for a single person load such as ascending, and should never be used in systems.
Prusik Knot	Triple Sliding Hitch, Prusik Hitch	
		Utility knot creating a loop in rope or webbing, either in the end or the middle. No life loads in rescue.
Overhand Knot on a Bight		
		Forms a bight in the end of the rope that will cinch down the bight. This is useful when you need a carabiner to be loaded upon the spine to keep it from easily side loading the gate or to the bucket of a double pulley when using it at the dead end of a mechanical advantage system.
Poachers Knot / Double Overhand Knot	Strangle Snare	Triple wrap is known as a Scaffold Knot

Rescue Knots / Bends / Hitches and their uses		
Photo / Name	QR / Alternate Names	Uses
		Used with webbing or rope to attach a sling or loop around a bar, ring, or other attachment point. This hitch significantly weakens slings. If using to join two slings together, it may be better to use a carabiner.
Girth Hitch		
		Attaches two ends of webbing together by rethreading one end through an overhand tied in the other side. Tails should be at least the width of your hand.
Water Knot	Ring Bend, Tape Knot, Overhand Follow Through	
Photo / Video Credits: <a href="http://AnimatedKnots.com">AnimatedKnots.com</a> , <a href="http://REI.com">REI.com</a> , <a href="http://CMC.com">CMC.com</a>		



## Ice Rescue

### Rescue Sequence

Start at the lowest risk to rescuers and our risk increases with each advancement through the sequence.

Sequence	Action
Self-Rescue	Talk to the victim – give PFD / picks
Reach	To the victim with a pole, hook, paddle, etc
Throw	Shore based rescue – Throw bag / buoy
Row	Boat based rescue
Go	Contact Rescue
Helo	Helicopter Rescue

### Self Rescue

Spread your weight out on the ice and stay low. Use the ice awls and kick your way onto the ice and then roll away from the hole. You can throw a PFD and ice awls to a victim and have them try to self-rescue themselves.



## Reach Rescue

Use a pike pole, ice rescue staff, paddle, or inflated hose line to reach out to the victim. Have them grab on and pull them out of the water if possible.



## Throw Rescue

Any flotation with a water rescue throw rope attached or just a water rescue throw rope. Aim your throw past the victim, but over their shoulder / arms. Have victim wrap rope around their forearm multiple times and then try to pull them out of the water while coaching them to kick their feet.



## Row Rescue

If trained and equipped, use a boat to perform the rescue. This gives rescuers a stable platform to operate from and potentially not have to enter the water, decreasing the risk to the rescuer and keeping them safe.



## Go Rescue

Moving on the ice can be challenging. Walking upright could result in breaking the ice and a rescuer falling through. Using the proper PPE, crawl out on the ice, staying low at all times, spreading your weight out on the ice.

Rescuers should be tethered to shore or to other rescuers and the line tended.

**Never attach a line to a rescuer in moving water without a quick release system!**

To help in moving on the ice you can attach metal spikes, called crampons, to the rescuers feet and use the ice awls to provide traction to propel yourself along the ice.

Attach the victim to a rescue sling and help them up and out of the hole while members from shore begin to haul.



If you need to swim while in an ice rescue suit, it is usually best to lay on your back and perform a backstroke, sweeping your arms from up around your shoulders down to your hips and glide. If there is a lot of open water between you and the victim, then fins may be of assistance.

Approach victim from the side or behind so they can't pull you in and so you don't break the ice shelf they may be hanging on to.



Attach the victim to the tether line by passing the rescue collar or cinch rope under the victim's arm pits. Rescuer gets into the water behind the victim if possible and grabs the victim down low and tries to get the victim horizontal so they will come out of the water and onto the ice easier. Once the rescuer is in position, they give the signal to the shore crew to pull on the tether line.

If a rescue sled / board is available they may be used with or without the rescue collar. The rescue sled will offer victims floatation and protect them from being dragged directly on the ice.



## Helo Rescue

Helicopter rescue requires specially trained rescuers and likely may only be available from the US Coast Guard. People trapped on large sections of drift ice and on large bodies of water could require such a rescue. This is one of the most complex and high-risk rescues and should only be utilized if other options are not available or viable.

Not all helicopters are setup for rescue. They all have different sizes and capabilities. Most medevac helicopters do not have the equipment, training, or personnel to perform such rescues. It is important to understand that often we will not have communications with the aircraft unless we have pre-arranged that with them.

Additional factors to consider are the weather, and if they aircraft will need a landing zone near your rescue area.



*Credit: Andy Bernos, Irish Coast Guard*

## Ice Rescue Communications

Communications during a water and / or ice rescue can be challenging. Portable radios often will not work if submerged and are not easily carried with some of the PPE being worn. Often rescues may be far enough away from shore, or where the sound of water may make verbal communication very difficult. Therefore, we must learn to communicate with other methods to include whistle blasts, hand signals and tugging on our rope tether lines.

Any set designation of commands can be used as long as they are known to the entire team.

Any member can call "Stop" for any recognized safety issue.

In situations where radios or direct verbal communication cannot be used, a different system must be utilized.

Commands	
STOP	1 Whistle Blast
UP	2 Whistle Blasts
DOWN	3 Whistle blasts
SLOW	SLOW UP / SLOW Down
TENSION	Tension by Hand
SLACK	Make Soft / Slack the line
FLOAT	Lift Up 1 meter (off ground)
AT WILL	Your discretion
RIG FOR	"Rig for raise" - next step
<b>REPEAT COMMAND BACK</b> <b>Ensures they know you heard correctly</b>	

Another method is the OATH System, which has different meaning depending on who initiates the communication.

OATH can be used for communication across rope tugs, pulls, whistle blasts or light flashes.



# OF TUGS	ATTENDANT / Technical Rescue Officer	ENTRANT / Rescuer
1 – Ok:	All OK? OK / Attention / Stop	All is OK / Attention / Stop
2 – Advance:	Advance / Lower	Give More / Lower
3 – Take up:	Turn Back / Tension / Haul	Backing Out / Tension / Haul
4 – Help:	Get Out	Send Help



**OK! / GO! Signal**



**Stop! Signal**



**Help! Signal**

All operators on the team must be familiar with the signals to remain safe and effective.

## Recommended Training / Continuing Education

Technical rescue, regardless of the discipline, is a perishable skill set. Without regular and consistent training, the skills taught will diminish to a point that could be harmful to yourself and your team members. This includes but is not limited to severe injuries or death due to human errors in not operating or rigging equipment properly.

We can assist in any of these skills sets, and have clients who we work with monthly, quarterly and annually to ensure they stay sharp on their skill sets.

### Weekly

Recommended Minimum Time Commitment: 1 Hour

It is recommended that team members practice some type of skill at least weekly. This can be a self-guided focused review or lead by a team member who has proficiency in that particular skill.

Example topics:

- Knots
- Donning PPE
- Victim / Patient Care
- New Equipment Review
- Equipment Inspections

### Monthly

Recommended Minimum Time Commitment: 1 - 4 Hours

It is recommended that team members meet and practice some type of skill at least monthly. This can be a self-guided focused review or lead by a team member who has proficiency in that skill.

Example topics:

- Knots
- Patient Packaging / Rescue Connections
- Basic Rope Rescue Setups
- Pre-Planning
- Equipment Inspections

Monthly training may take place at your location or CTR's indoor training facility in Albany, NY.

## Quarterly

Recommended Minimum Time Commitment: 4 Hours

It is recommended that team members meet and practice some type of simple rescue scenario at least quarterly. This should not be too complicated of a scenario but rather focus on overall team dynamics and putting together all the topics they have worked on over the past few monthly drills.

These scenarios can be guided by CTR or a team member who has shown proficiency in all systems the team uses. These should be low risk scenarios that have been pre-planned and well thought out by the team member to ensure that no one can get hurt during training.

Quarterly training may take place at your location or CTR's indoor training facility in Albany, NY.

## Annual

Recommended Minimum Time Commitment: 8 - 24 Hours

Annual training is not only a great time for refresher training but also to introduce new equipment, techniques, and advancements. The minimum time is typically 8 hours, however if your team does not partake in weekly, monthly and/or quarterly training than you may need up to 24 hours of refresher training.

We recommend that you bring in a trainer such as CTR to perform this refresher training. This will allow for an independent evaluation of your team as well as ensuring that the latest techniques and/or equipment can be taught.

Our most popular option for rope and confined space rescue teams that train regularly is for a 16-hour refresher annually. This allows for time to review equipment and techniques and introduce new techniques and equipment, while still allowing plenty of time for OSHA and NFPA recommended scenarios. For water and ice rescue teams this may vary from 8 hours to 24 hours, depending on the departments response levels and equipment.

Example topics:

- Knot Review
- Equipment Review
- New Equipment
- New Techniques
- Simple and more complicated scenarios

Annual training may take place at your location or CTR's indoor training facility in Albany, NY.

### Other recommended training courses available

CTR has many other training courses and topics that may interest you and / or your team depending on your needs. See our website for the most up to date information.

[www.capitaltechrescue.com](http://www.capitaltechrescue.com)

Initial and refresher training available. Some programs have a train the trainer course available.

- Emergency Response Team Training
  - Team Evaluations
  - Site-Specific Rescue Operations
  - Stop the Bleed / Trauma Response
  - Fire Extinguisher Training
  - Structural and Industrial Live Fire Training
  - Rescue from fall protection
- Rope Rescue
  - Operations
  - Technician
  - Refresher
  - Artificial High Directional
  - Lead Climbing
  - Tower Rescue
- Firefighting
  - Firefighter Survival / MAYDAY
  - Firefighter Escape Systems
  - Fire Boat Operations
  - Engine & Truck Company Operations
- Industrial Training
  - Industrial Escape Systems
  - HAZWOPER
  - Rescue Boat Operator for OSHA for OSHA 1926.106 Rescue Skiff
- Confined Space
  - Entry
  - Awareness
  - Operations (non-IDLH)
  - Operations (IDLH)
  - Technician
  - Rigging Challenges
  - Small Team Operations
- sUAS (Drones)
  - Specific programs for industry, firefighters and emergency response
- Water Rescue
  - Rescue Boat Operator for Water and Swiftwater Rescue
  - Ice Rescue
  - Water Rescue
  - Flood Rescue Awareness
  - Swiftwater Rescue



## Definitions

This section provides standardized terminology used throughout ice rescue operations. Definitions are drawn from Capital Technical Rescue's curriculum, NFPA standards (1006, 1670, 1983, 2500), USCG regulations, and industry best practices.

### PFD (Personal Flotation Device)

A life-saving device designed to keep a person afloat in water. Classified by the USCG into Types I–V, with Type V including specialized rescue vests and suits.

**Reference:** USCG, OSHA 1910.126

### Ice Rescue Suit

A thermal protective suit made of neoprene or coated nylon, designed to keep rescuers dry and insulated during ice rescues. Includes integrated boots, gloves, and often a whistle and ice awls.

### Ice Awls / Picks

Handheld tools used to self-rescue by gripping the ice and pulling oneself out of the water. Typically tethered and stored in the sleeves of ice rescue suits.

### Throw Bag

A rescue tool containing floating rope, typically 50–75 feet, used to reach and pull a victim to safety.

### RDC (Rapid Deployment Craft)

An inflatable rescue boat used for ice and swiftwater rescues. Allows rescuers to reach victims without entering the water.

### HELP Position (Heat Escape Lessening Posture)

A body position used in cold water to reduce heat loss and delay hypothermia. Involves crossing arms and legs while floating upright.

## 1-10-1 Rule

Cold water survival guideline:

- **1 minute** to control breathing (cold shock)
- **10 minutes** of meaningful movement (cold incapacitation)
- **1 hour** before unconsciousness due to hypothermia



## Hypothermia

A medical emergency where body temperature drops below 95°F. Can affect both victims and rescuers.

**Types:** Chronic, Acute, Sub-acute

**Reference:** Cold Water Boot Camp, NFPA 1006

## Frazil Ice

The first stage of ice formation, consisting of loose, slushy ice crystals. Weak and dangerous to walk on.

## Rotten Ice

Ice that has thawed and refrozen, often appearing cloudy or honeycombed. Structurally weak and unpredictable.

## Candle Ice

Ice that has vertical cracks and appears to be made of long, thin columns. Very weak and prone to collapse.

## Rescue Sequence

The rescue sequence from lowest to highest risk:

- **Reach:** Extend a pole or object.
- **Throw:** Use a throw bag or flotation device.
- **Row:** Deploy a boat.
- **Go:** Enter the water for direct contact.
- **Helo:** Use helicopter-based rescue.

## Tether Line

A rope used to connect a rescuer to shore or a team for safety and retrieval.

## Victim Sling

A flotation and lifting device placed under a victim's arms to aid in water rescue and extrication.



### **Rescue Sled / Board**

A rigid or inflatable platform used to transport victims across ice or water. Provides flotation and protection during extrication.

### **Crampons**

Spiked attachments worn on boots to provide traction on ice during rescue operations.

## Appendix

### Appendix A – Reference Materials / Apps

*Title: **Technical Rescue Field Operations Guide***

*Publisher:* Desert Rescue Research

*Author:* Tom Pendley

*Notes:* App or Paper guide. Covers rope rescue, confined space rescue, swiftwater rescue, trench rescue, structural collapse and helicopter operations

*Link:* <https://www.desertrescue.com>

*Title: **CMC Field Guide App***

*Publisher:* CMC

*Author:* CMC

*Notes:* App with charts, diagrams, videos but heavily leans towards CMC products.

*Link:* <https://www.cmcpro.com/app/>

*Title: **Animated Knots by Grog (Grog Knots)***

*Publisher:* Animated Knots

*Author:* Animated Knots

*Notes:* Easy to follow, no internet required.

*Link:* <https://www.animatedknots.com/shop>