DEPARTMENT OF FIRE SERVICES
Massachusetts Firefighting Academy

SURFACE WATER RESCUE

TECHNICIAN LEVEL

STUDENT GUIDE

6/1/2019

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Objectives

- Provide critical safety information to protect firefighters when operating in or near the water
- Understand the NFPA standards as they relate to the water rescue environment
- Recognize and identify specific hazards unique to the swift water, surf, dive, flood, surface water, and ice rescue environments
- Understand the minimum personal protective equipment requirements especially as they pertain to the surface water rescue environments
- Understand the pathophysiology of cold water hydrology
- Understand the Incident Command System (ICS) considerations for Water Rescue Operations
- Demonstrate the knowledge, skills, and ability to execute a water using a variety of techniques
- Understand the victim care considerations in the Cold Water rescue environments
- Understand survival techniques if an unplanned or inadvertent water entry occurs while wearing turnout gear and SCBA

References

NFPA 1670
Standard on Operations and Training for Technical Rescue Incidents

NFPA 1006
Standard for Rescue Technician Professional Qualifications

- NFPA 1670 establishes seven water rescue disciplines:
  - Surface Water
  - Swift Water
  - Surf
  - Dive
  - Flood
  - Ice
  - Watercraft
- This program will only focus on Surface and Swift water rescue

Levels of Operation

Awareness NFPA 1670 4.1.4(1)
This level represents the minimum capability of organizations that provide response to technical search and rescue operations.

Operations NFPA 1670 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.

Technician NFPA 1670 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.

In any area of technical rescue the **safety of the rescuer** comes first. Without this, the rescue itself might become impossible.

A _____ _____ is one who is capable of identifying existing and predictable conditions in the surroundings or working conditions that are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

For any rescue to be successful, emergency services personnel need to have an understanding of the basic principles that will lead to a SAFE RESCUE.

S _____

A _____

F _____

E _____

R _____

E _____

S _____

C _____

U _____

E _____

Civilians **DROWN** because:

- Use of alcohol or drugs while involved in water sports
- Overestimating ones ability in the water
- Failure to wear a PFD while boating
- Driving across flooded areas
- Wading across a swift moving stream
- Underestimating the effects of cold water

Rescue Personnel **DROWN** because:

- Overestimating skill and ability
- Underestimating power and dynamics of water
- Inadequate training
- Lack of equipment
- Insufficient backup available
- Underestimating the effects of cold water

Planning for the Water Rescue

PLANNING CONSIDERATIONS

- Personnel
- Equipment
- Training
- Survey waterways (evaluate areas of past accidents first)
- Seasonal and environmental changes
- Site access
- Agency cooperation
- Community education
- Standard operational guidelines
- Other

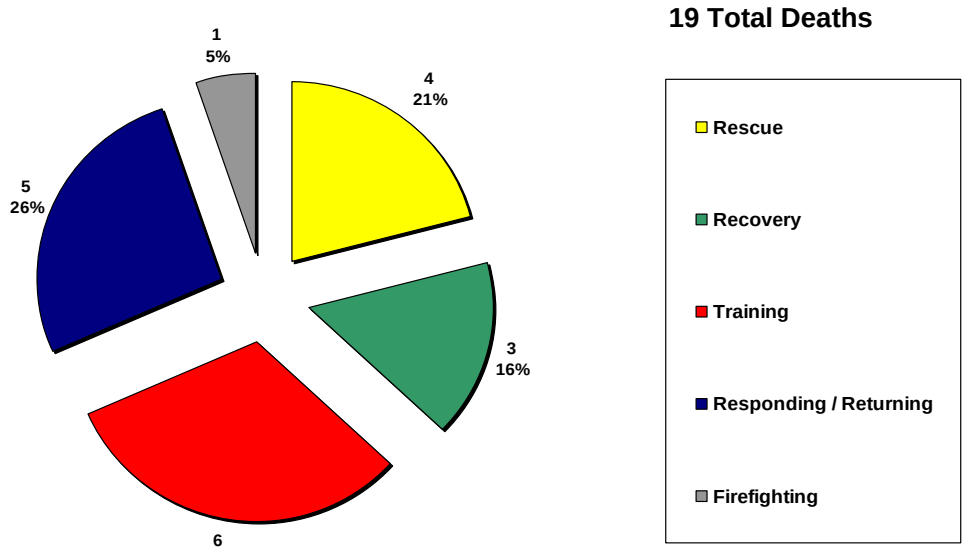
PROPER PLANNING WILL ULTIMATELY SAVE

_____ _____ _____

Drowning Facts

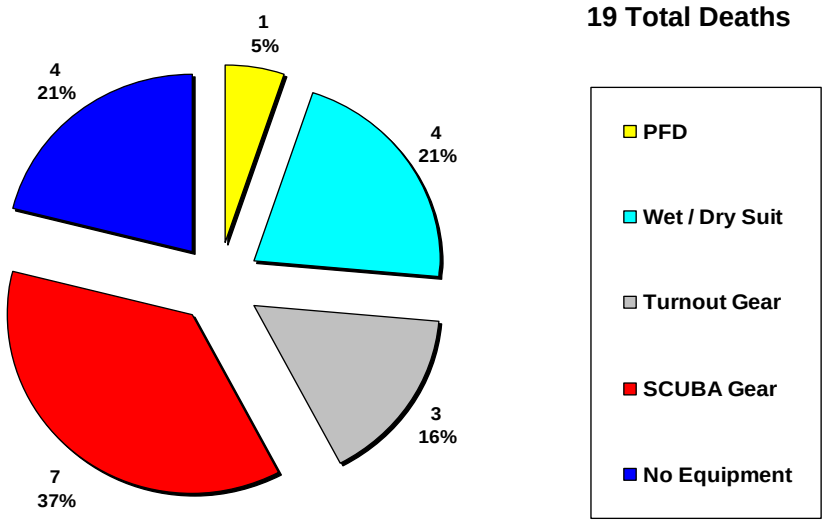
- Drowning is the _____ leading cause of accidental death in America (under the age of 44)
- 13% of drowning victims are 4 years old or younger
- Estimates of alcohol involvement in drowning incidents is as high as 2/3
- 2 out of 3 drowning victims are non-swimmers, fully clothed, and usually have no intention of entering the water
- Most drowning incidents occur within 10 feet from safety and 50 feet from shore
- 89% of people who drowned would have survived with a PFD on

On-Duty U.S. Firefighter Deaths Due to Drowning
1996-2005
By Type of Activity



Source: NFPA, Quincy MA, January 2007

On-Duty U.S. Firefighter Deaths Due to Drowning
1996-2005
By Type of Equipment Worn



Source: NFPA, Quincy MA, January 2007

On-Duty U.S. Firefighter Deaths Due to Drowning, 1996 - 2005

Year	Circumstances
1996	A firefighter responding in his personal vehicle to a fire drowned when he suffered a seizure; and the vehicle left the road and went into a lake.
1997	A firefighter (along with a sheriff's department diver) drowned while attempting to rescue two irrigation canal divers who disappeared while looking for submerged vehicles. The victim was wearing SCUBA gear.
	A firefighter wearing a wet suit and swim fins drowned while attempting to rescue a person caught in ocean surf.
	While operating in a flash flood condition, a firefighter in bunker gear drowned when he went to the aid of a fellow firefighter who had become trapped in the flood. The victim had no swift water training.
	A firefighter wearing full protective gear fell through the floor while exiting a fire-involved structure and drowned in accumulated water in the basement.
1998	The victim was swimming out to a boat during body recovery efforts on a river when he drowned. He had removed his SCUBA gear and was wearing a dry suit, a weight belt and using a 50-foot long, 4-inch flotation line and buoyancy control device for the free float to the boat. When he lost his grip on his gear, he went under water due to the 30-pound weight belt. This incident was investigated by NIOSH (www.cdc.gov/niosh/fire/reports/face9816.html).
1999	During SCUBA training at a lake, a firefighter, acting as pivot diver while practicing a boat-based circular pattern search, drowned. The incident was investigated by NIOSH (www.cdc.gov/niosh/fire/reports/face9929.html).
	A firefighter was found, drowned, in a pond after a nearby wild land fire was contained. The victim was apparently on his way to the fire and was intoxicated when he walked into the pond.
2000	A firefighter dressed in full protective clothing drowned when the current pulled him into a culvert while he and another firefighter were trying to rescue a woman who had fallen into a ditch during a flash flood. The victim, who had no water rescue training, was wearing his bunker coat, pants, boots and helmet at the time. The incident was investigated by NIOSH (www.cdc.gov/niosh/fire/reports/face200102.html).
	A firefighter drowned during a dry-suit certification training dive. The incident was investigated by NIOSH (www.cdc.gov/niosh/fire/reports/face200011.html).

Year	Circumstances
2001	A fire chief and a firefighter drowned when they attempted to recover the body of a kayaker. Investigators believe that their safety line became entangled with the victim or his kayak in the swift water. The victims were wearing wetsuits, dive boots and masks, and buoyancy compensators on their backs, but no air tanks, trim weights or cutting tools.
	A firefighter died during rescue dive training when he did not surface for some unknown reason. The victim was wearing SCUBA gear but did not have any underwater communications equipment. The incident was investigated by NIOSH (www.cdc.gov/niosh/fire/reports/face200135.html).
2002	A firefighter in SCUBA gear drowned during dive training. The victim's underwater communication system was not working properly and he was not able to send transmissions. He attempted to surface by releasing his weight belt. His body was found with his lanyard attached to the concrete weight used in the exercise. The incident was investigated by NIOSH (www.cdc.gov/niosh/fire/reports/face200215.html).
2003	A firefighter riding as passenger in a tanker responding to a wild land fire drowned in water from the tank after the vehicle overturned, ejecting her. The only protective clothing the victim was reportedly wearing was boots and a helmet. The driver was intoxicated. This incident was investigated by NIOSH (www.cdc.gov/niosh/fire/reports/face200320.html).
2004	A firefighter responding in a brush truck to a controlled burn drowned when a tire blew, causing the vehicle to go off the road and overturn, landing on its roof in two feet of water in a culvert. The victim was wearing his seatbelt. This incident was investigated by NIOSH (www.cdc.gov/niosh/fire/reports/face200415.html).
	A firefighter testing out new dry suit dive equipment became trapped under ice and drowned. He was wearing SCUBA gear. This incident was investigated by NIOSH (www.cdc.gov/niosh/fire/reports/face200436.html).
2005	A firefighter participating in a night dive training exercise at a quarry became unconscious. He was rescued and transported to the hospital, where he died the next day. The victim was wearing SCUBA gear. This incident was investigated by NIOSH (www.cdc.gov/niosh/fire/reports/face200529.html).
	A firefighter drowned when the rescue boat she was riding in crashed head-on into another boat while returning from a boat parade. The victim, wearing a jumpsuit, boots and a personal flotation device, was ejected from the boat.

Rescue Team Development

A properly trained water rescue team will be more efficient, able to respond faster, and know the skills and limitations of each member.

The roles assumed during a water rescue incident will depend on the situation. Each member may be asked to assume a different role and should be trained to handle various roles. Training and practice are essential to build the team's confidence and skill level.

The Rescue Team should establish these positions:

Rescue Team Leader (RTL)
Observes and directs the overall rescue. The RTL should not become involved in the actual rescue

Rescuers
Follow the direction of the RTL. Sets up the rescue and communicates directly with the victim.

Boat Operators
Operates the rescue water craft. The operators must understand the boat's operation, limitations and understand how to read moving water.

Backup
Means of safety control should something go wrong downstream. They may supply equipment and/or medical support.

Hand Signals

OK or Ready

Stop

Direction

Near Shore

Hand Signals

Far Shore

Help

Hand Signals

Let Out

Take Up

Communication

- Whistle
- Air Horn
- 1 Long Blast = _____
- 2 Short Blasts = _____

The Dynamics of Moving Water

Laminar Flow
Water flowing down the center of a slow, moving river which moves at different velocities depending upon the depth.

Helical Flow
Spiral flowing action of a river which occurs along the banks of a river.

River Current
Directional movement of water.

Strainer
Obstructions such as trees, in the water that allows water to pass through, but stops and holds objects such as boats and people.

Eddy
An upstream current created by a large rock or other obstruction.

Eddy Line
The line which separates the eddy from the main current.

Pillow
Elevation of the water surface caused on the upstream side of an obstruction below the surface.

Upstream "V"
Formed by an obstruction in the water that forms a "V" which points upstream.

Downstream "V"
Formed when there are two obstructions and water passes between both to form a "V" which points downstream.

Hydraulic / Hole
Formed on the downstream side of an obstruction. Similar features as the Low-Head Dam however victims trapped do not get recirculated.

Standing Wave
Waves caused by the convergence of the main current, underwater obstructions or an increase in the river speed.

Low-Head Dam
Fixed obstruction across a stream or river in which water drops over the crest creating a hydraulic that can trap and recirculate objects.

- Referred to as _____ _____
- Identified upstream by a _____ _____ going across the river
- Backwash, Outwash, Boil Line

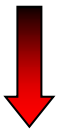
Accident Scene Considerations

Factors to Consider

- Scope, magnitude, and nature of the incident
- Condition of the Victim
- Environmental Conditions
- Available Equipment
- Available Manpower
- Safest and Most Efficient Rescue Technique

Rescue Sequence

Low Risk



High Risk

- _____
- _____
- _____
- _____
  - **most *dangerous* rescue**
  - **never perform without a *PFD* and *helmet***

Line Systems

Support: Used to keep the upper body of a victim up and out of the water.
Foot Entrapment: Used to free the victims foot from debris on the river bottom.
Tether: Attaches to a swimming rescuer, managed from the shore.
Double Line Floating Tether: Used to move floatation across moving water or an inlet to aid a waterbound victim.
Zip-Line: A very effective method as long as it is done correctly. It can be used to shuttle rescuers or victims one side to the next.
Moving Control: Similar to High Line in Rope. Used to move Rescuers or Boat across, stop, lower downstream and hold.

Accident Scene Considerations

Witness Interview

- Establish last seen point (LSP)
- Description of victim
- Number of victims
- Any other pertinent information
- Separate from other witnesses
- Bring to spot where they were
- Use boat or Firefighter in water as a landmark
- Keep them at the scene or get contact info

Don't allow people to leave the scene until you have talked to them.
Last seen point is usually the most difficult part of the rescue effort. To determine where exactly the victim is. Separating the witnesses prevents people with stronger personalities from coercing the others into the same story.

Types of Boats

Inflatable Boat

Flat bottom Jon Boat

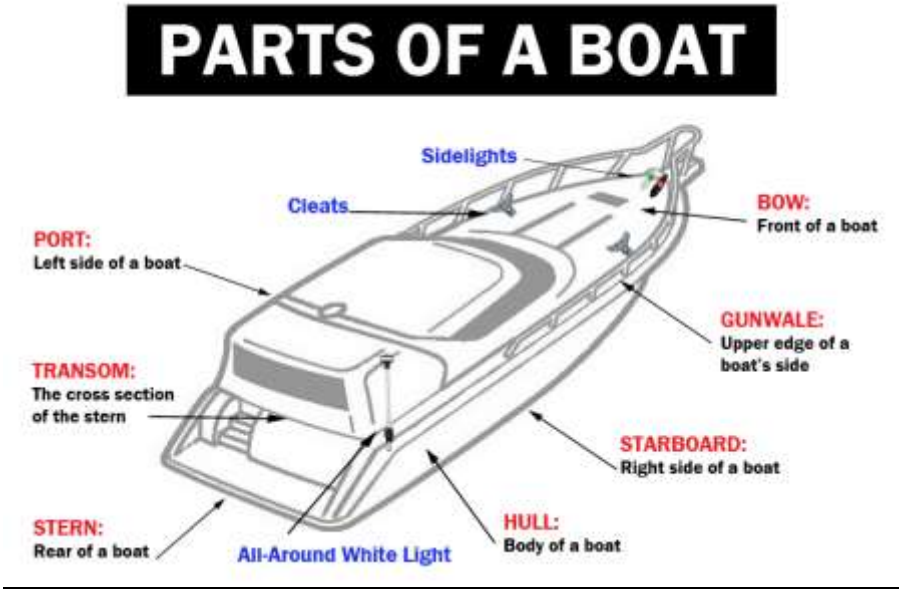
Rigid-Hull Inflatable Boat - R.I.B.

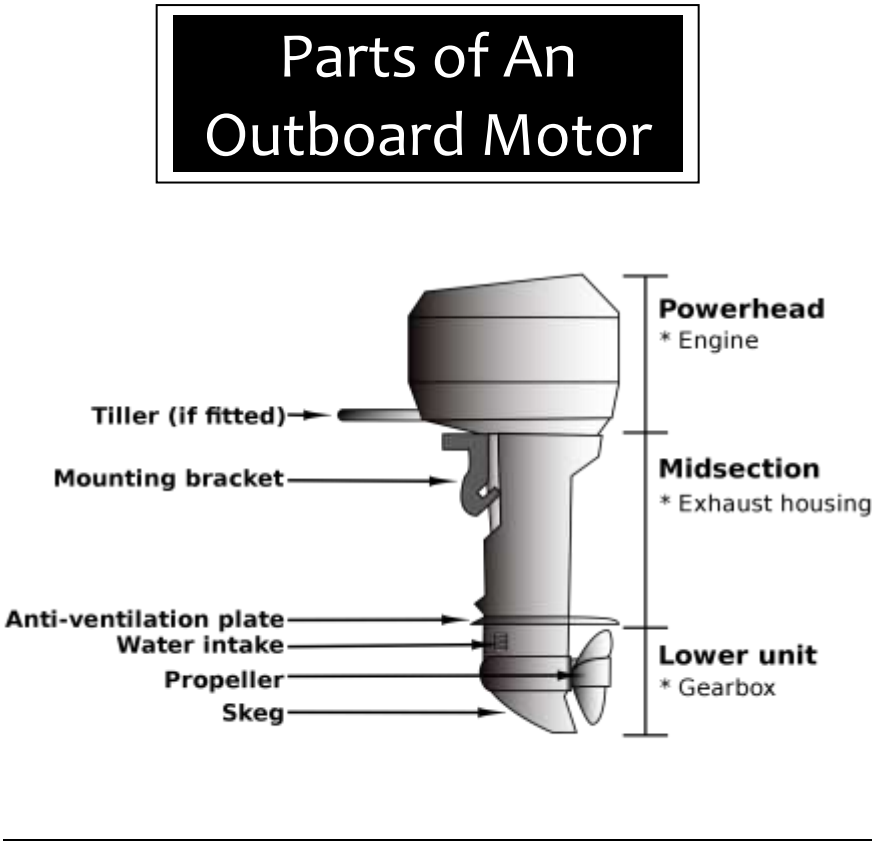
Boston Whaler

Larger Boats

Safeboat

Amphibious Boat


PARTS OF A BOAT
Sidelights
Cleats
BOW:
Front of a boat
PORT:
Left side of a boat
GUNWALE:
Upper edge of a boat's side
TRANSOM:
The cross section of the stern
STARBOARD:
Right side of a boat
STERN:
Rear of a boat
All-Around White Light
HULL:
Body of a boat


Parts of An Outboard Motor
Powerhead
* Engine
Tiller (if fitted)
Mounting bracket
Midsection
* Exhaust housing
Anti-ventilation plate
Water intake
Propeller
Skeg
Lower unit
* Gearbox

Motor Safety

- Most propeller strike accidents result from operator error. Victims include swimmers, scuba divers, fallen water-skiers, and boat operators or passengers. Most propeller accidents can be prevented by following basic safe boating practices.
- Maintain a proper lookout
- Make sure the engine is off so that the propeller is not rotating when passengers are boarding or leaving a boat.
- Never start a boat with the engine in gear.
- Slow down when approaching congested areas and always be alert for swimmers and divers.

Boat Based Operations

- Operator must be extremely experienced
- Requires extensive training to become proficient
- Before incorporating any boat operations into your response plans, attendance in a boating safety course is strongly recommended!

Boating Safety Course

- Safe, trailering, launching, docking, and retrieval of your boat
- Required Equipment
    - PFD's
    - Fire Extinguishers
    - Signaling Device
    - Proper Navigation Lighting
        - Red, port side
        - Green, starboard side
        - White, stern or all-round
- Navigation rules
- Procedures for encountering other vessels
- _____ The vessel that should maintain its course and speed
- _____ The vessel that must take early and substantial action to avoid collision by stopping, slowing down, or changing course
- Buoys and Markers
    - Types
    - Colors
    - Lateral System
    - "Red Right Returning"
- **Red Right Returning** is a reminder of the correct course when returning from open waters or heading upstream.
- Divers Flag
    - A rectangular red flag with a white diagonal stripe, at least 12 x 15 inches in size and constructed of rigidly supported material. This flag must be displayed on a vessel or surface float and must extend a minimum distance of three feet up from the surface of the water.
- Alpha Flag
    - A blue and white International Code Flag A (or Alpha flag), flown from a vessel restricted in its ability to maneuver. This flag indicates that a vessel is involved in a diving activity. The Alfa flag may be displayed in addition to the divers flag but does not replace the divers flag.

Accident Scene Considerations

Helicopter Operations

- 100’ X 100’ landing zone
- Slope of ground and type of ground
- Operating on or over water
- Hazardous materials
- Crowds
- Communication
- Obstructions / Hazards?
  - Trees
  - Wires
  - Light poles
  - Antennas

Contact the United States Coast Guard for helicopter operations involving waterways in Massachusetts.

Hypothermia and Drowning

Drowning

- Aspects of Drowning
  - Laryngeal Spasm
  - Wet
  - Dry
  - Freshwater vs Saltwater
  - Mammalian Diving Reflex
  - Torso Reflex (aka Inhalation Reflex)
- The Process
  - Struggle leading to panic
  - Ingestion of water into stomach
  - Aspiration of water into the airway
  - Laryngospasm leading to hypoxia
  - Aspirate water into lungs (wet drowning)
  - Respiratory arrest leading to cardiac arrest
- Laryngospasm
  - Victim tries to cough up water which has entered the airway
  - Leads to involuntarily ingesting more water
  - Larynx and/or vocal cords constrict and seal trachea
  - A small percentage of victims maintain this condition until cardiac arrest

Types of Drowning

- Dry: 10-15% of all drownings
  - Little to no water in lungs
- Wet: 85-90% of al drownings
  - Aspiration of water into the lungs
- Secondary:

Successfully revived but dies later due to complications

Hypothermia

- Begins when the core body temperature falls below 95 degrees Fahrenheit
- Mammalian Diving Reflex involves:
  - instinctive breath holding
  - vital function slowdown
  - blood shunting to the body's core

Types of Hypothermia
- Chronic
  - Prolonged exposure
- Acute
  - Sudden immersion

Heat Loss
- Conduction - One body to the next
- Convection - Water or wind going by
- Radiation - Heat radiates away from the body
- Evaporation - Perspiration
- Respiration - Breathing

Response to Immersion
- Involuntary Gasp
  - Covering mouth and nose will reduce the chance of inhaling water
  - Do this every time you enter the water.

Stage	Core Temperature	Signs & Symptoms
Mild Hypothermia	99º - 97ºF	Normal, shivering can begin
	97º - 95ºF	Cold sensation, goose bumps, unable to perform complex tasks with hands, shiver can be mild to severe, hands numb
Moderate Hypothermia	95º - 93ºF	Shivering, intense, muscle incoordination becomes apparent, movements slow and labored, stumbling pace, mild confusion, may appear alert. Use sobriety test, if unable to walk a 30 foot straight line, the person is hypothermic.
	93º - 90ºF	Violent shivering persists, difficulty speaking, sluggish thinking, amnesia starts to appear, gross muscle movements sluggish, unable to use hands, stumbles frequently, difficulty speaking, signs of depression, withdrawn.
Severe Hypothermia	90º - 86ºF	Shivering stops, exposed skin blue of puffy, muscle coordination very poor, inability to walk, confusion, incoherent/irrational behavior, but may be able to maintain posture and appearance of awareness
	86º - 82ºF	Muscle rigidity, semiconscious, stupor, loss of awareness of others, pulse and respiration rate decrease, possible heart fibrillation
	82º - 78ºF	Unconscious, heart beat and respiration erractic, pulse may not be palpable
	78º - 75ºF	Pulmonary edema, cardiac and respiratory failure,death. Death may occur before this temperature is reached.

Cold Water

- Average adult male in 50 degree water for 50 minutes has 50% chance of survival
- Water will conduct heat away from the body _____ faster than air at the same temperature.
- Core temp drops within 10 – 15 minutes
- Arms and legs become numb
- Confusion, loss of consciousness, and drowning

Estimated Survival Times

Temp	Exhaustion	Incapacitation
32	< 15M	30-45M
40	15-30M	30-90M
50	30-60M	1-3H
60	1-2H	1-6H
70	2-7H	2-40H
80	Indefinite	

Patient Handling

- Careful handling is crucial
  - As the body rewarms, it initially becomes colder (After Drop)
  - Rough handling can cause life-threatening rhythm disturbances.

Remember that a person should never be considered dead until they are _____ and _____.

Follow all local and regional EMS protocols!

Survival Factors

- Age
  - The Younger the better
- Length of Submersion
  - The Shorter the better
- Water Temperature
  - The Colder the better
- Water Quality
  - The Cleaner the better
- Victim Struggle
  - The Less the better
- CPR Quality
  - Aggressive
- Physical Condition of the Victim
  - Other injuries can complicate the chance for survival

Self Rescue

Personal Equipment

- ***Durable*** and provide maximum ***protection***
- Dress in ***layers***
- Withstand ***weather*** conditions
- Not restrict ***performance***
- Inner (***silk*** or ***polypro***)
- Middle (***wool*** or ***polyester***)
- Outer (***coated nylon*** or ***breathable*** fabric)
- Wet suits
  - provides ***short*** term protection
- Dry suits
  - variety of types
  - ***may*** insulate
- Exposure/immersion or ice rescue suits
  - ***not recommended for moving water***
- Helmet
  - protection ***top, back,*** and ***sides***
- Hands - gloves
- Feet - foot wear
- Personal Flotation Devices (PFD's)
- Five different types
  - ***USCG*** Approved
  - ***III*** and ***V***
  - Inflatable ***not appropriate***
  - Design considerations
  - proper size
  - visibility
  - pockets
  - ***whistle, knife, carabineer***

It is important to dress in _____**.** It will make it easier to regulate body temperature.

The primary heat loss area of the body is the _____**.** Over 50% of our body heat loss occurs here. The other areas that need protection and special clothing considerations are the _____ and _____

TYPE I
Off Shore P.F.D.

Type one PFD gives you 20 lbs. buoyancy – Designed to turn unconscious person from downward position to vertical or slightly backward position.

TYPE II
Near Shore P.F.D.

Type two PFD gives you 15.5 lbs. buoyancy - Designed to turn unconscious person from downward position to vertical or slightly backward position.

TYPE III
Flotation Aid

Type three PFD gives you 15.5 lbs. buoyancy – Not designed to turn an unconscious person from a downward position. More comfortable for water sports.

TYPE IV
Throwable Device

Type four PFD gives you 16.5 lbs. buoyancy – Designed to be grasped not worn. Must be readily accessible. There must still be an approved, wearable PFD for each occupant.

TYPE V
Special Use Devices

Type five PFD gives you 15.5 lbs. buoyancy – Approved only for certain activities and conditions. The label will list its approved uses and limitations.

Self Rescue

A PFD needs to be sized to the individual wearer. It is important to learn how it feels in moving water. When swimming in moving water, strokes are performed underwater. Out of water strokes may make the PFD "ride up" and become less buoyant.

The most common strokes used when wearing a PFD are the *modified* _____,
_____ *and* _____.

The most common types of wearable PFDs used in water rescue are Types III and V.

A water rescue helmet that provides protection to the _____,
_____ and _____ of the head is essential.

Moving Water

Self Rescue

- Proper position
  - Float on _____
  - _____ pointed ***downstream***
  - ***Strainer*** exception
- Never attempt to _____
  - possible _____ entrapment
- _____ to shore

Cold Water

Cold water will conduct heat away from the body 25 times faster than cold air.

- Need to adopt the _____ position if alone.
- Need to adopt the _____ position with two or more people.

Do not use the H.E.L.P. or Huddle position in moving water!

H.E.L.P. **Huddle**

Rescue Equipment

Equipment

- Ring buoy
- Throw bags
- Drop bags
- Aluminum carabiners
- Fire Brigade carabiners
- Inflatable hose device
- Other equipment specific to local needs

You can not conduct a water rescue operation without the proper equipment.

Cold Water Rescue Suits

When the combined water and air temperature is less than **120 degrees**, an exposure suit should be worn.

Ex. Air Temp. 40 deg. + Water Temp. 39 deg. = 79 deg. Exposure suit is needed.

Survival Suit

- For off shore riggers, fisherman
- Hands are lobster claw
- Feet are like Gumby, (Gumby suit)
- If no harness - Need to put one on

Cold Water Rescue Suit

- Stearns Surface Dry suit
- Gives 22-27lbs. of buoyancy
- 5 fingered dexterity
- Boots built into suit
- Harness built into suit
- Do not wear shoes
- Any time combined water and air temperature is below 120° F an exposure suit must be worn!

Cold Water Rescue Suits

Ocean Commander

- Lighter than the Neoprene Suits
- Flotation and thermal protection in-liner
- Detachable gloves for improved dexterity

Ice Commander

- Yellow in color
- 30lb. Buoyancy
- Built-in ice picks
- Chest harness with shoulder straps
- Flotation and thermal protection in-liner

Cold Water Survival Suits cannot be worn for surface water rescue in moving water!

Sudden In Water Immersion

- REMAIN CALM!
  - Hold breath, float to surface and stabilize.
- Remove Helmet
  - Traps air to increase buoyancy.
- Draw Knees to Chest
  - Traps air in boots and pants.
- Grasp Collar
  - Traps air in coat.
- Elementary Backstroke
  - Usually no more that 10 feet from safety.

If Wearing an SCBA!

- Not rated for underwater use.
- Three Possible Conditions

_____

_____

_____

As long as the firefighter is receiving air, continue to wear the face piece