



LIFTING, WINCHING, AND MOVING

UNDERSTANDING THE BASICS

Eric J. Rickenbach

GOAL

To introduce the operations-level rescuer to the basic principles, tool knowledge and use, and safety practices related to winching, moving, and lifting in the vehicle extrication environment, so that rescuer safety is maintained, timely and effective extrication operations are completed, and patient care is expedited or enhanced throughout the operation.



OBJECTIVES

1. Review case studies of fire-service related incidents where rigging or moving has caused firefighter injury or death.
2. Understand the changes in patient care and extrication principles and concepts as they relate to patient and vehicle movement.



OBJECTIVES

3. Identify tools that can be utilized in winching, moving, and lifting operations and some of the variations related to tool design and construction.
4. Define the concepts of working load limits, ultimate loads, and break strength for winching, moving, and lifting tools.
5. Discuss considerations for safe operations of the winching, moving, and lifting tools.





WHY WE NEED TO TALK ABOUT THIS?

How often have you heard this statement?

“Never move a vehicle with a victim inside.”

WHY WE NEED TO TALK ABOUT THIS?

**“Never move a
vehicle with a victim
inside.”**

Why do we say this?









WHY WE NEED TO TALK ABOUT THIS?

Why would we want to move a vehicle with a victim?

- ✓ **Create a potentially safer extrication (for rescuers and victim).**
- ✓ **Create needed space.**
- ✓ **Expedite the patient extrication.**

WHY WE NEED TO TALK ABOUT THIS?



WHY WE NEED TO TALK ABOUT THIS?

Volunteer Fire Fighter Dies After Being Struck by a Shackle on a Recoiling Tow Rope



WHY WE NEED TO TALK ABOUT THIS?

NIOSH investigators concluded that, to minimize the risk of similar occurrences, fire departments should:

- › utilize a heavy towing service for apparatus and revise standard operating guidelines (SOGs) accordingly
- › develop and implement SOGs and safe work practices for the selection and proper use of tow ropes and shackles, and for other rigging fixtures to prevent loading beyond their structural capacity
- › ensure that fire fighters and/or other onlookers are removed from the hazard area when towing operations are performed in the event of rigging failure
- › ensure that apparatus used at an incident scene is positioned in a safe location.



WHY WE NEED TO TALK ABOUT THIS?

31 Year-old Fire Chief Electrocuted in North Carolina

- › Vehicle accident with overturned vehicle and numerous high voltage wires knocked off pole.
- › Power company was enroute to de-energize the power line.
- › In an effort to stabilize the accident vehicle and prevent it from turning over, a steel cable attached to a winch mounted on the rescue vehicle was extended to a length of 47 feet.
- › Passed between the conductor on the ground and the sagging conductors, and was attached to the luggage rack of the accident vehicle.



WHY WE NEED TO TALK ABOUT THIS?

31 Year-old Fire Chief Electrocuted in North Carolina

- › 8 personnel & 1 bystander were all holding on to the steel cable.
- › The luggage rack then pulled loose and the rack and cable contacted the energized lines.
- › A fire chief (killed) and a bystander (severe injuries) were both electrocuted.
- › Other personnel received electrical burns.



WHY WE NEED TO TALK ABOUT THIS?

31 Year-old Fire Chief Electrocuted in North Carolina

- › Recommendation #1: Electrical sources that pose an imminent danger to rescue personnel should be de-energized prior to any initial rescue attempt.
- › Recommendation #2: Fire department standard operating procedures should require the wearing of personal protective equipment for all fire department rescue personnel responding to the scene of an emergency.
- › Recommendation #3: Only authorized rescue personnel should assist in rescue procedures.
- › Recommendation #4: Firemen should be trained in recognition and appreciation of hazards, preventive measures for personal safety during rescue operations, and safe rescue techniques.
- › Recommendation #5: Personnel assigned responsibility to coordinate activities at an accident site (i.e. fire ground commander) should not become involved in the rescue effort, if an adequate number of personnel are available.





WHY WE NEED TO TALK ABOUT THIS?

What you need to know?

- › What are you lifting and/or moving?
- › How big is it?
- › How do you want to lift/move it?
- › Do you have the training and practice to safely and effectively move it?
- › Do you have the tools to safely and effectively lift/move it?
- › Will you need help to lift/move it?

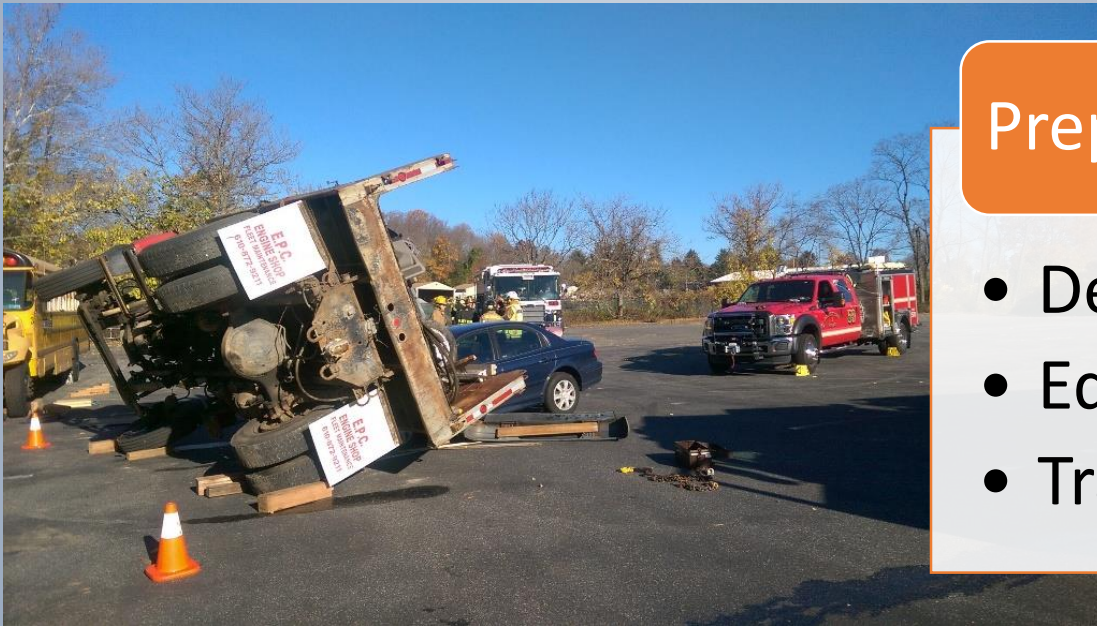
WHY WE NEED TO TALK ABOUT THIS?

How well do you know your tools?

- › Do you have the tools to do the job?
- › What are the ratings or working load limits of your lifting and moving tools?
- › Do you know how to correctly use the tools?



MAKING THE DECISION TO LIFT, WINCH, OR MOVE



Preparation

- Decision
- Equipment
- Training

DEFINITIONS

ULTIMATE LOAD

The ultimate load is a statistical figure used in calculations, and should (hopefully) never actually occur. Strength requirements are specified in terms of limit loads (the maximum loads to be expected in service) and ultimate loads (limit loads multiplied by prescribed factors of safety).

Wikipedia



DEFINITIONS

WORKING LOAD LIMIT

Safe **Working Load** (SWL) sometimes stated as the Normal Working Load (NWL) is the mass or force that a piece of lifting equipment, lifting device or accessory can safely utilize to lift, suspend, or lower a mass without fear of breaking.

Wikipedia



DEFINITIONS

CRITICAL ANGLE

CRITICAL ANGLE is the outside angle formed between the legs of rigging material within an anchor system. The angles can be used as an advantage as they help to distribute the load. However, by increasing the angle more weight will be added to the system.



DEFINITIONS

CRITICAL ANGLE

<90 degrees =
force minimizer

GOOD

>90 degrees =
force multiplier

BAD



PREPARATION - EQUIPMENT

- › Understanding what tools you have.
- › Working load limits, capacities, etc.
- › Understanding safe operations.



PREPARATION - EQUIPMENT

How well do
you know your
rescue truck?



PREPARATION - EQUIPMENT



Cribbing

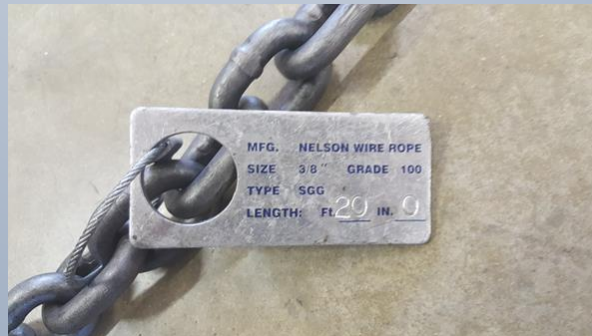
First rule of
cribbing:

**You never have
enough!**

PREPARATION - EQUIPMENT

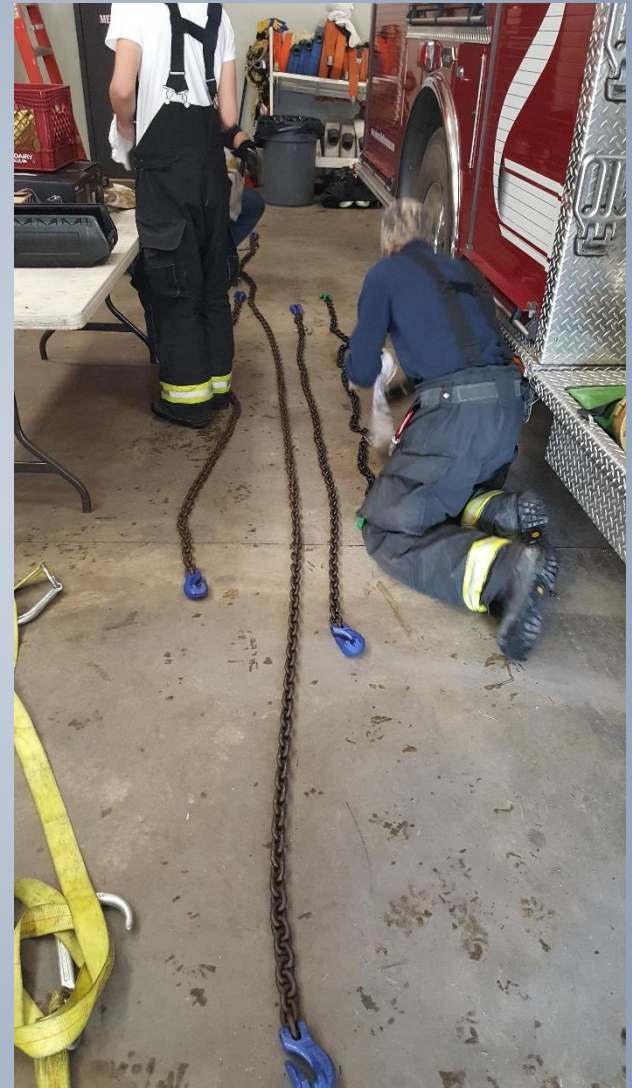
CHAINS

- › Chain should be a minimum of 3/8 inch diameter grade 8/80.
- › NACM recognizes grade 8/80 and above as overhead lifting chain.
- › Grade 8 and 10 are rated on a 4:1 Safety factor.
- › Chains MUST be inspected regularly!



PREPARATION – EQUIPMENT CHAINS

CHAINS



PREPARATION – EQUIPMENT CHAINS

CHAINS



PREPARATION - EQUIPMENT



Winches

PREPARATION - EQUIPMENT

Winches



WINCHES

1. Physics of The Pulling Power Zone™

How the Laws of Physics govern winch performance.

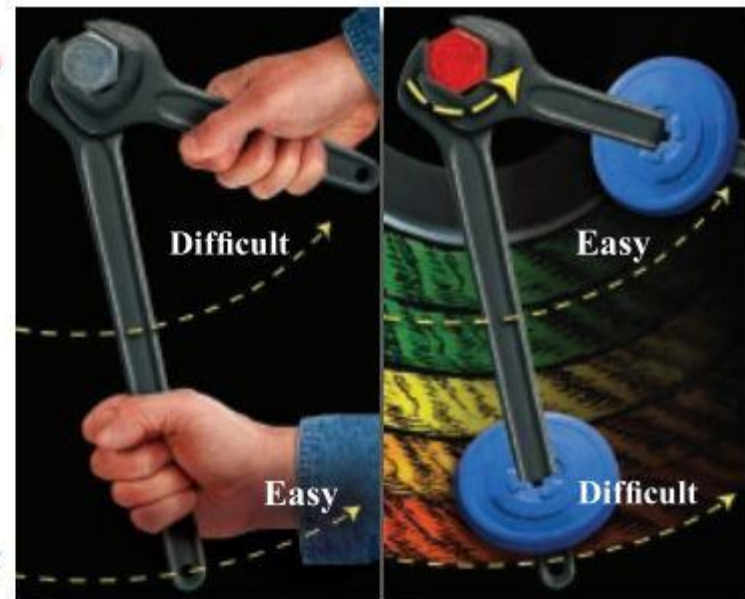
We know that using a long-handled wrench makes a job easier. You pull further away from the bolt – a longer turning radius.

WHAT IF THE BOLT WAS DOING THE PULLING?

Then the opposite is true. It's easier for the bolt to turn the same weight when it's closer to the bolt – a shorter turning radius.

Just like the drum on a winch.

As layers of rope build up, pulling the same weight requires greater force, robbing your winch of power. The first 2 layers of rope on the drum we call the Pulling Power Zone. Beyond 2 layers, pulling capacity can be reduced as much as 42%.



Get the most from your winch. Extra layers cut pulling power. Stay in The Pulling Power Zone.

Start each pull with a minimum of **5 wraps*** around the drum.

From the minimum 5 wraps of rope, to the maximum of **2 layers**** on the drum, you are working in the **Pulling Power Zone**.

* The industry safety standard. The rope fastener alone cannot support a heavy load.

** Pulling capacity is determined by the load a winch can pull with only the bottom layer of rope on the drum. For practical purposes, full capacity is retained with up to 2 layers.

- 5 Layers: Power drops 42%
- 4 Layers: Power drops 32%
- 3 Layers: Power drops 19%
- 2 Layers | **The Pulling Power Zone™**
- 1 Layer

The power loss percentages above are approximate.

WINCHES

2. Use a pulley block and double the capacity of your winch.

Another Law of Physics: double the line with a pulley block and you double the pulling capacity of your winch. Removing extra rope from the drum also allows you to work in the Pulling Power Zone.

Some typical pulls: a single-line, straight pull.

A typical double-line winch and pulley arrangement doubles winch capacity.

A redirected pull. If there's no straight, clear line to the anchor point, use a pulley block.



3. Keep the rope feeding through the fairlead as straight as possible.

This will help keep the rope wrapping smoothly across the drum. Rope feeding through the fairlead at a sharp angle will bunch up.



WINCHES

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Educational material from Superwinch, Inc.



PREPARATION - EQUIPMENT

OTHER RIGGING...





Supplying the Towing & Auto Transport Industries Since 1978

www.baproducts.com

PRODUCTS CO.

B/A Synthetic Rope WLL (In Lbs.)

Rope Size	Color	WLL
3/8"	Orange	4,100
7/16"	Yellow	5,200
1/2"	Green	7,600

B/A Chain Work Load Limits (In Lbs.)

Chain Size	Grade 40	Grade 70	Grade 80	Grade 100	Grade 120
1/4" - 9/32"	2,600	3,150	3,500	4,300	5,200
5/16"	3,900	4,700	5,300	5,700	
3/8"	5,400	6,600	7,100	8,800	10,600
1/2"	9,200	11,300	12,000	15,000	17,900
5/8"	13,000	15,800	18,100	22,600	
3/4"			28,300	35,300	

B/A Roundslings WLL (In Lbs.)

Color	Vertical	Choker	Basket
Purple	2,600	2,100	5,200
Green	5,300	4,200	10,600
Yellow	8,400	6,700	16,800
Red	13,200	10,600	26,400
Blue	21,200	17,000	42,400
Orange-10	40,000	32,000	80,000

PREPARATION - EQUIPMENT

OTHER RIGGING...



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3/8"	5,400	6,600	7,100	8,800	10,600	Yellow	8,400	6,700	16,800
1/2"	9,200	11,300	12,000	15,000	17,900	Red	13,200	10,600	26,400
5/8"	13,000	15,800	18,100	22,600		Blue	21,200	17,000	42,400
3/4"			28,300	35,300		Orange-10	40,000	32,000	80,000

PREPARATION - EQUIPMENT

› Lifting Bags – NFPA 1936



PREPARATION - EQUIPMENT

Lifting Bags —NFPA 1936



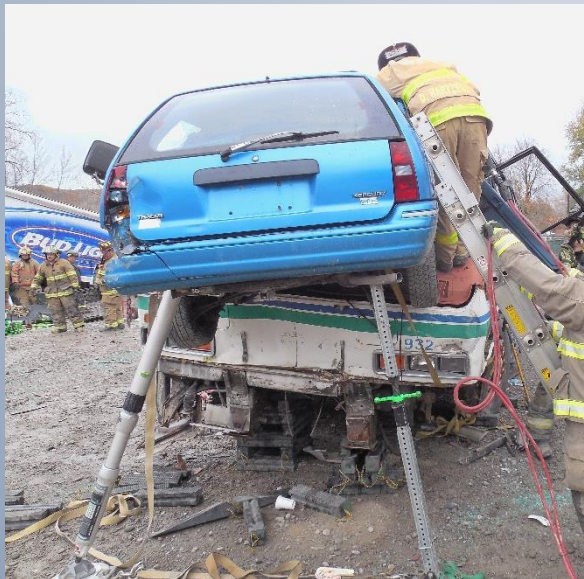
***What is the age
and condition of
your lifting bags?***

PREPARATION - EQUIPMENT



PREPARATION - EQUIPMENT

Tension Buttress Systems “Struts”



PREPARATION - EQUIPMENT

Hydraulic Bottle Jacks



PREPARATION – EQUIPMENT

HEAVY/RECOVERY WRECKER SERVICES

Can assist rescuers in managing incidents involving large vehicles/loads and effecting rescue in several ways:

- › Stabilization
- › Lifting
- › Pulling
- › Managing loads with high centers of gravity.
- › Creating access/extrication openings and space.



Photo: Null's Towing

PREPARATION – EQUIPMENT

HEAVY/RECOVERY WRECKER SERVICES

Equipment available:

- › General:
 - Will vary from service-to-service.
 - Operators know/understand their equipment and capabilities.
- › Wreckers
 - Working capacities up to 65 US tons available.
 - › Position, extension, rotation, etc. will all affect the capacity.
 - Some have booms that slide forward/rearward on body.
 - Some equipped with 360° rotation capability.
- › Rollbacks
 - Semi-detachable sliding bed with winch.
- › Cushion airbag units
 - Low pressure high-lift airbags



PREPARATION – EQUIPMENT

HEAVY/RECOVERY WRECKER SERVICES



General considerations:

- › Location of service?
- › Phone numbers (24/7/365)?
- › Availability of service?
- › Are service personnel trained/certified (ex: WreckMasters, etc.)
- › Has there been any joint training with the rescue service?

PREPARATION – EQUIPMENT

HEAVY/RECOVERY WRECKER SERVICES

Scene considerations:

- › Accessibility?
 - Can the wrecker get to your call?
- › Assign a rescue liaison to the wrecker service...
 - Sometimes what we call something is not what they call it.
 - Serves as the communications go-between.



PREPARATION – EQUIPMENT

HEAVY/RECOVERY WRECKER SERVICES

Scene considerations:

- › Allow wrecker personnel to conduct their own size-up activities.
 - They need to get a good look at what they are up against.
 - They need to know your action plan priorities and concerns.
- › Positioning?
 - Not only the incident, but also the size, type, and capability of the wrecker will dictate position.
 - May need to move apparatus and equipment.



PREPARATION – EQUIPMENT

HEAVY/RECOVERY WRECKER SERVICES

WHEN WORKING WITH HEAVY WRECKER SERVICES IN A RESCUE SCENARIO...

NEVER tell a recovery wrecker operator what they are going to do with their equipment. Some large tow trucks cost more than a fire truck, and they are the livelihood of the owners/operators...

ALWAYS discuss what your intended action plan and goals are with the operator and allow the wrecker operator to determine if his equipment and personnel are capable of fulfilling your intended plan. He may suggest an alternate plan that is safer for all involved.



PREPARATION – STANDARDS AND TRAINING

NFPA 1006-2017

– Chapter 8 – Vehicle Rescue

Training and operations should include things like:

- › Chain assemblies
- › Pneumatic high-, medium-, and low-pressure lifting bags
- › Wire rope and its associated equipment
- › Large and heavy object weight estimation
- › Steps necessary to lift or move large objects
- › Use of cribbing and chocks with large and heavy objects
- › Use of commercial heavy wreckers and recovery services to assist at incidents involving large transportation vehicles
- › Use, care, and maintenance of both manual and power winches
- › Types and examples of lifting devices that use mechanical advantage principles



PREPARATION – STANDARDS AND TRAINING

NFPA 1670-2017

– Technician Level Training

Training and operations should include things like:

- › Chain assemblies
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PREPARATION - TRAINING

Other Applicable Standards/References:

- › NFPA 1936 – Standard for Rescue Tools
- › National Association of Chain Manufacturers – Welded Steel Chain Specifications
- › Occupational Safety and Health Administration – Rigging, Hoisting, Slings
- › Society of Automotive Engineers
- › Associated Wire Rope Fabricators
- › Wreckmasters



MAKING THE DECISION TO LIFT, WINCH, OR MOVE



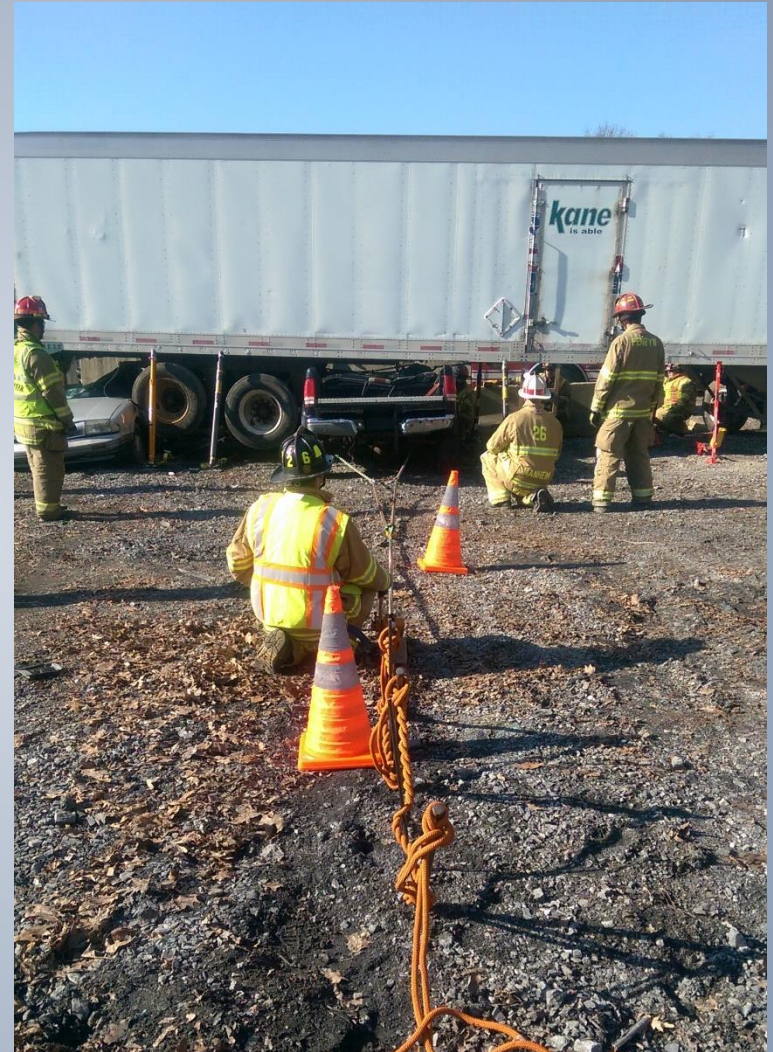
Execution

- Decision
- Operations
- Safety

EXECUTION - DECISION

Have you trained to make the lift and/or move?

This is not a first (or even second) day on the job skill.



CONSIDERATIONS FOR LIFTING

- › How much weight?
- › How high must you lift?
- › What lifting tools do you have?
- › Which tool will work the best for the particular scenario?
- › Level surface? Can you make it level?
- › Solid surface? Can you make it solid?
- › Can you follow the lift with cribbing or other stabilization devices? “Capture”





CONSIDERATIONS FOR LIFTING

- › How much does it weigh?
- › How high must you lift?
- › What lifting tools do you have?
- › Which tool will work the best for the particular scenario?
- › Level surface? Can you make it level?
- › Solid surface? Can you make it solid?
- › Can you follow the lift with cribbing or other stabilization devices? “Capture”
- › All of these need to be factored into making the decision to move or lift something.



MAKING THE DECISION TO LIFT, WINCH, OR MOVE

- › What are you trying to move?
- › How much does it weigh?
- › Appropriate anchor point?
- › Solid connection to vehicle being moved?
- › Damage – wheels move or don't move?
- › Grade – uphill or downhill?
- › Surface – solid concrete or mud?
- › Ability to move “in-line” or need for “change of direction”?
- › Clear patch of movement?
- › All of these need to be factored into making the decision to move or lift something.











CONSIDER THE 5000 POUND THEORY FOR WINCHING?

› Typical rescue companies have enough equipment and with some simple training can move a vehicle that weighs up to 5000 pounds.

- Level ground
- Solid surface
- Good/solid anchor point
- Simple commonly carried rigging equipment
- Clear path of movement
- 2:1 “in-line / straight” pull



CONSIDER THE 5000 POUND THEORY FOR WINCHING?

› OVER 5000 pounds...

- Some departments may be able to do this, however this needs to be decided before the incident.
- Request additional appropriate resources and equipment.



SAFETY

**EVERYONE AND
EVERYTHING GOES
HOME IN ONE PIECE.**





PRACTICE
PRACTICE
PRACTICE

TRAIN AT A HIGH LEVEL IN ANTICIPATION OF THE COMPLEX RESCUE!





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