

# Welcome to Heavy Duty Towing & Recovery Class



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# Attitude

“The longer I live, the more I realize the impact of attitude on life. Attitude, to me, is more important than facts. It is more important than the past, than education, than money, than circumstances, than failures, than successes, than what other people think or say or do.

It is more important than appearance, giftedness, or skill. It will make or break a company, a church, a home. The remarkable thing is we have a choice everyday regarding which attitude we will embrace for that day.

We cannot change our past...we cannot change the fact that people will act in a certain way. We cannot change the inevitable. The only thing we can do is play on the one thing we have, and that's our attitude.

I am convinced that life is 10% what happens to me and 90% how I react to it.

And so it is with you, we are in charge of our attitudes.”

CHARLES SWINDOLL

There is Never any reason for a towing & recovery instructor to say  
“THIS is the ONLY WAY to handle a towing-recovery job.”

However, there are several ways to do the same job; if the casualty is taken out in a timely manner, with little to no further damage being done.

So, lets learn from each other and have fun in doing so.

THANK YOU FOR ATTENDING



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# Interim Guidance for Electric and Hybrid-Electric Vehicles Equipped With High-Voltage Batteries

(Law Enforcement/Emergency Medical Services/Fire Department)

## Electric and Hybrid-Electric Vehicle Considerations

In the event of damage, fire, or flooding involving an electric vehicle (EV) or hybrid-electric vehicle (HEV):

- Always assume the high-voltage (HV) battery and associated components are energized and fully charged.
- Exposed electrical components, wires, and HV batteries present potential HV shock hazards.
- Venting/off-gassing HV battery vapors are potentially toxic and flammable.
- Physical damage to the vehicle or HV battery may result in immediate or delayed release of toxic and/or flammable gases and fire.
- A HV battery in a flooded vehicle may have high voltage and short circuits that can shock and cause fires.

**DETERMINE IF THE VEHICLE IS AN ELECTRIC OR HYBRID-ELECTRIC VEHICLE, and if it is, advise Dispatch and all responders that an electric or hybrid-electric vehicle is involved.**

**IF YOUR LOCAL STANDARD OPERATING PROCEDURES (SOPs) ALLOW IT AND YOU ARE PROPERLY TRAINED AND EQUIPPED, which includes using personal protective equipment, then consider the following:**

### Vehicle Shutdown and High-Voltage System Disabling

#### IMMOBILIZE VEHICLE

- Always approach vehicle from the sides to stay out of potential travel path. It may be difficult to determine if the vehicle is running due to lack of engine noise.
- If possible, chock the tires, place the vehicle in Park, and set the parking brake.

#### DISABLE VEHICLE

- Turn off the vehicle, activate hazard lights, and move vehicle keys at least 10 feet away from the vehicle.
- Disconnect the vehicle's 12-volt battery.
- CAUTION: Safety restraints, air bags, and other safety systems may be active for up to 5 minutes after disconnecting the 12-volt battery.



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## Law Enforcement and Emergency Medical Services

## Fire Department

### CRASHES DAMAGING THE AREA OF THE HV BATTERY

**NOTE:** Follow local standard operating procedures (SOPs) for personal protection and safety.

- If you detect leaking fluids, sparks, smoke, flames, increased temperature, gurgling, popping, or hissing noises from the HV battery compartment, ventilate passenger area (i.e., roll-down windows or open doors) and request fire department response.
- If you detect any unusual odors or experience eye, nose, or throat irritation, move away from the vehicle and evacuate others from the immediate area. Rapid extrication may be needed for injured or trapped occupants.
- Remain a safe distance upwind and uphill from the vehicle and out of the way of oncoming traffic until other appropriately equipped emergency responders arrive.
- Avoid contact with orange high-voltage cabling and areas identified as high-voltage risk by warning labels.

**NOTE:** Follow local standard operating procedures (SOPs) for personal protection and safety.

- If you detect leaking fluids, sparks, smoke, flames, increased temperature, gurgling, or bubbling sounds from the HV battery compartment, assume there is a battery fire and ventilate the passenger area (i.e., roll-down windows or open doors).
- Move away from the vehicle and evacuate others from the immediate area if you detect any unusual odors or experience eye, nose, or throat irritation. Wear full Personal Protective Equipment (PPE) and Self-Contained Breathing Apparatus (SCBA).
- Be alert. There is a potential for delayed fire with damaged lithium-ion batteries.

### FIRES INVOLVING OR EXPOSING THE HV BATTERY

- If you are unable to quickly remove the occupants, use a fire extinguisher to protect them from the flames.
- As with any vehicle fire, the byproducts of combustion can be toxic and all individuals should be directed to move to a safe distance upwind and uphill from the vehicle fire and out of the way of oncoming traffic.

**NOTE:** If the fire involves a lithium-ion battery, it will require large, sustained volumes of water for extinguishment. Consider defensive tactics and allow fire to burn out.

- If there is active fire, follow local standard operating procedures (SOPs) for vehicle fires. Wear appropriate Personal Protective Equipment (PPE) and Self-Contained Breathing Apparatus (SCBA).
- If occupants are still inside the vehicle or trapped, a fire extinguisher may be used to protect the occupants until a hose line is available or the occupants are removed. Consider establishing a water supply to support long-term operation.
- Use a hose line to apply water to extinguish the fire while continuing to cool the HV battery and its casing. **Never attempt to penetrate the HV battery or its casing to apply water.**
- Avoid contact with orange high-voltage cabling and areas identified as high-voltage risk by warning labels.
- Be alert. There is a potential for delayed ignition or re-ignition of a lithium-ion battery fire even after it is believed to be extinguished. This may remain an issue until the lithium-ion battery is properly discharged.
- As with any vehicle fire, the byproducts of combustion can be toxic and all individuals should be directed to move to a safe distance upwind and uphill from the vehicle fire and out of the way of oncoming traffic.

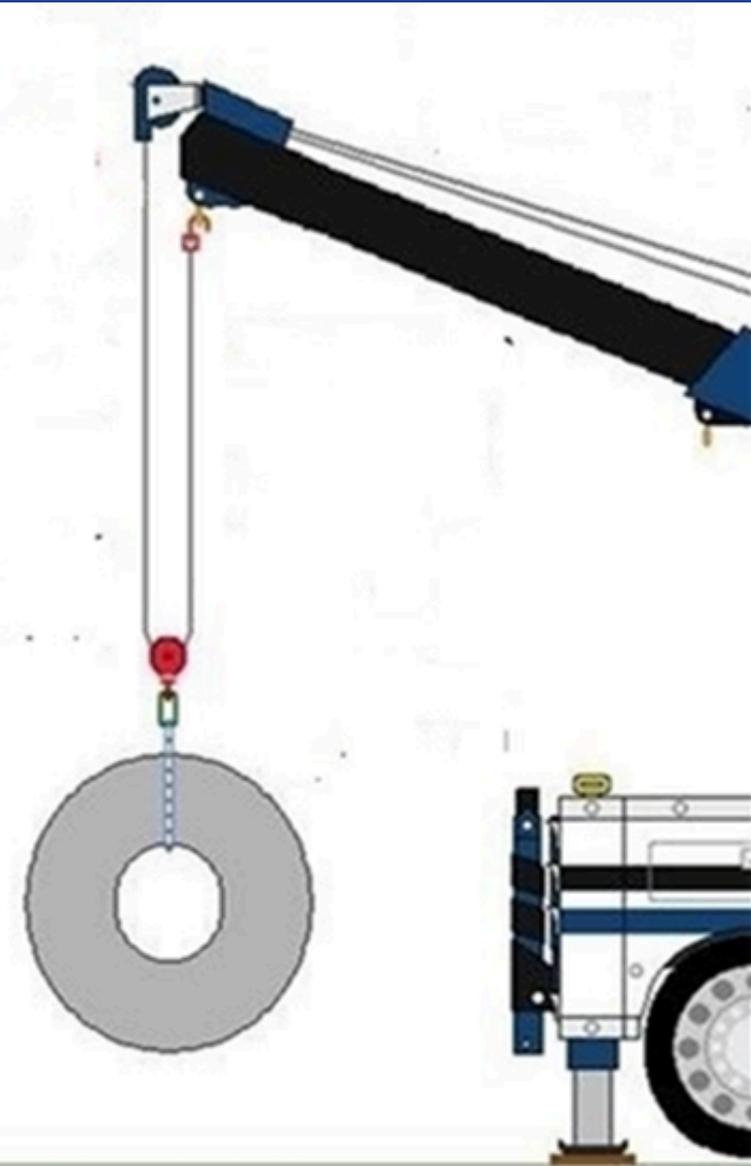
## Post-Incident

- Always assume the HV battery and associated components are energized and fully charged.
- Ensure that passenger and cargo compartments remain ventilated (i.e., open window, door, or trunk).
- Notify an authorized service center or vehicle manufacturer representative as soon as possible as there may be other steps they can take to secure and discharge the HV battery.
- Do not store a severely damaged vehicle with a lithium-ion battery inside a structure or within 50 feet of any structure, vehicle, or combustibles.
- Request fire department (if appropriate) if you observe leaking fluids, sparks, smoke, flames, or hear gurgling or bubbling from the HV battery.



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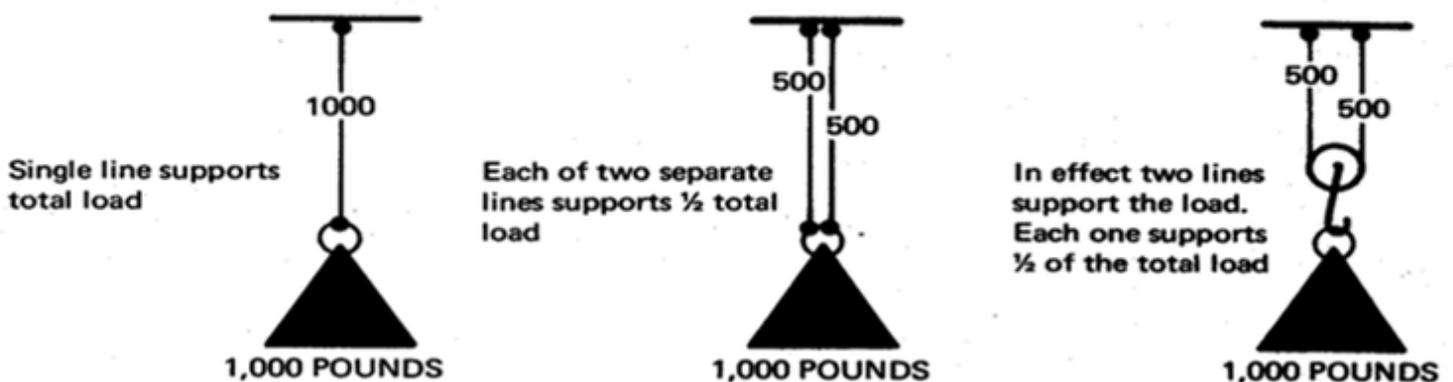
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Why Use Snatch Blocks – You can significantly increase the capacity of your wrecker by using snatch blocks. You should always use them for loads that would exceed the recommended working limits of your wrecker cables.

How a Snatch Block Reduces Line Tension – A single snatch block used to its best advantage would give the effect of connecting two lines to the load. Hence, we say the line has two parts or is a two-part line. Each of those two parts would share the load equally. Hence, tension on each part would be reduced to  $\frac{1}{2}$  the tension of a single line. The use of additional snatch blocks would further divide and reduce the tensions when properly used.

FIGURE 1. SNATCH BLOCKS GIVE EFFECT OF ADDITIONAL LINES



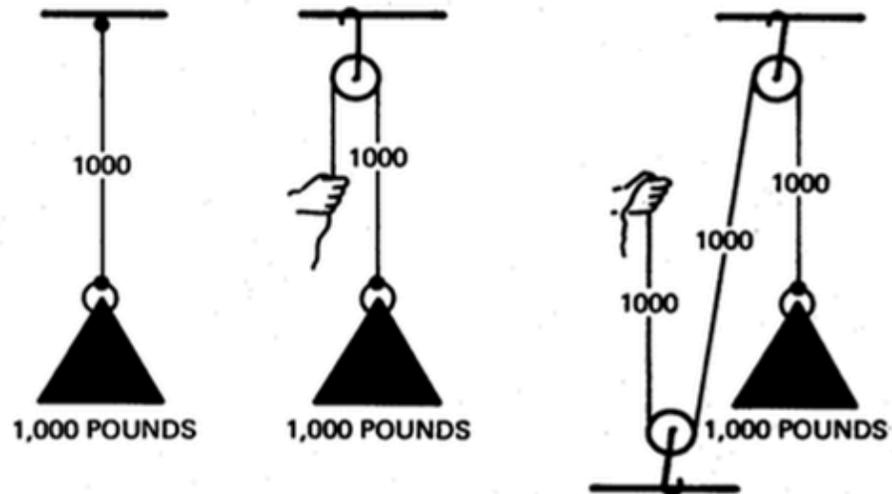
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# Using Snatch Blocks with Wreckers: Theory & Practice

**FIGURE 2. SNATCH BLOCK USAGE THAT ONLY CHANGES DIRECTION OF PULL**

In all cases shown here the entire length of line is subjected to the same tension which is at least as great as the load. Hence, these snatch blocks have not reduced line tensions.



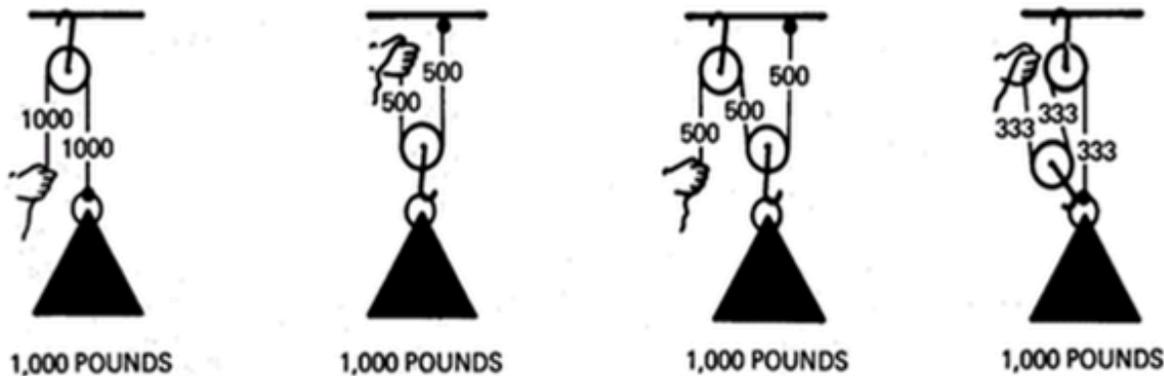
**FIGURE 3. ONLY LINES CONNECTED TO LOAD REDUCE TENSION**

One snatch block used. But only one line is connected to the load. The tension thruout the line is as great as the total load.

Again only one snatch block used. But now two lines are connected to the load. Each line shares only  $\frac{1}{2}$  the total load.

Two snatch blocks used. But only two lines are connected to the load. Each of the two lines shares  $\frac{1}{2}$  of the total load.

Again only two snatch blocks used. But now three lines are connected to the load. Each of the three lines shares  $\frac{1}{3}$  of the total load.

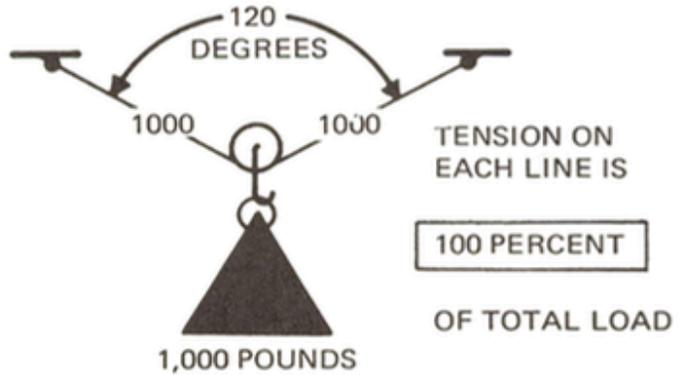
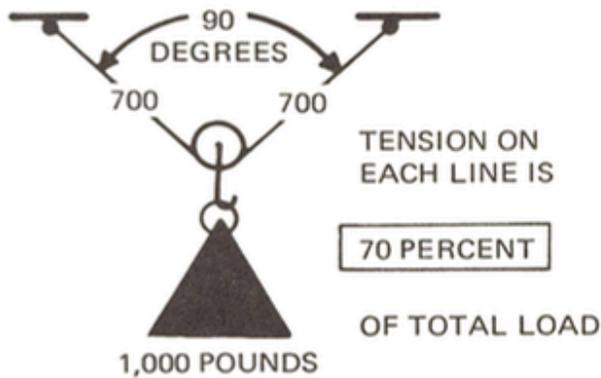
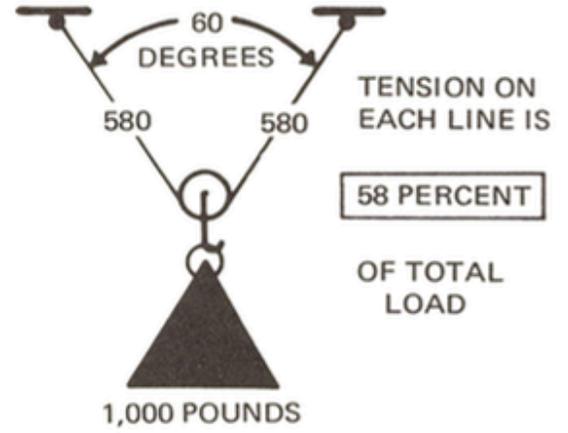
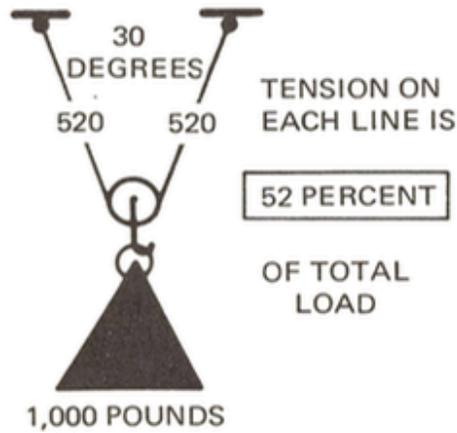
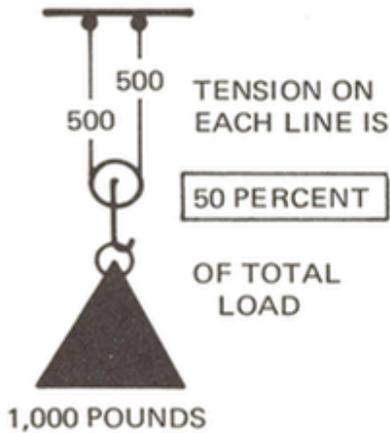


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# How Line Angles Affect Tensions

LINES PARALLEL



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# 10,000 lb Coil, Single Line to Load

Now, test your understanding of the winching information. Try to find the tensions on the cables on the following problems. Then determine the minimum size cable for the problem, disregard friction when calculating.



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# 10,000 lb Coil, Two Lines to Load

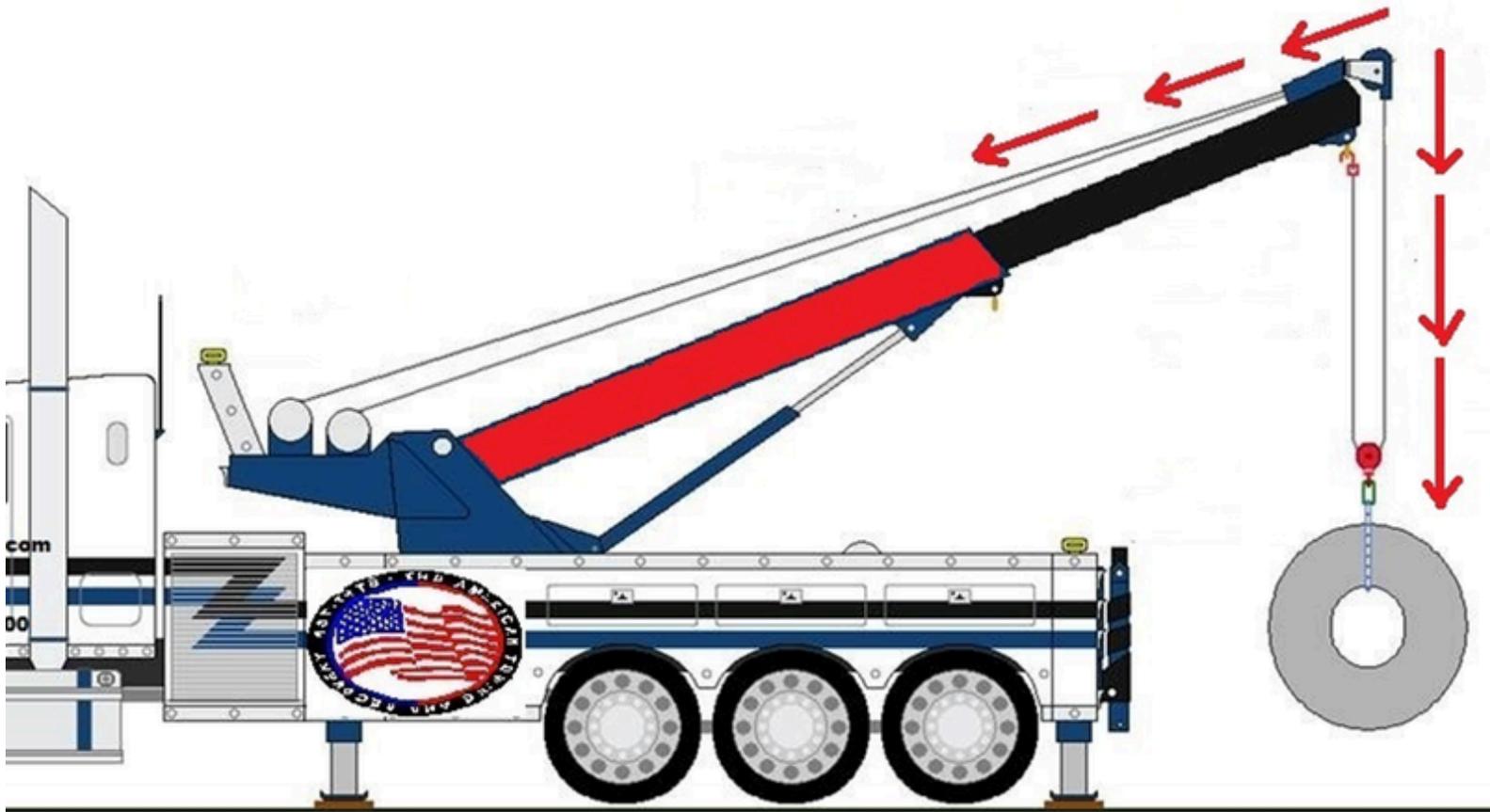
Now, test your understanding of the winching information. Try to find the tensions on the cables on the following problems. Then determine the minimum size cable for the problem, disregard friction when calculating.



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Opposing forces create more stress at the boom pulley.



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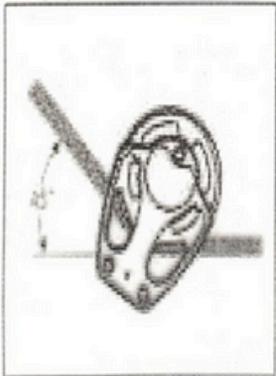
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# Loads on Snatch Blocks & Other Sheaves

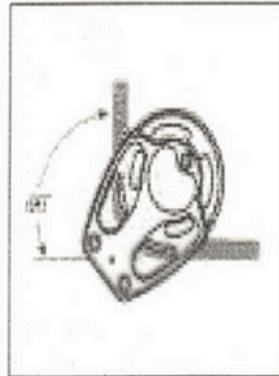
## Loading Formulas

### Block Loading vs. Angle of Deflection

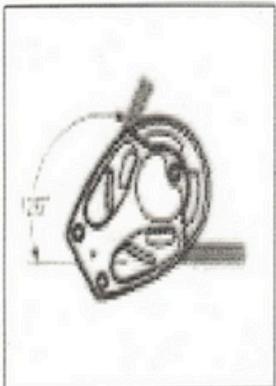
Load on a block is a combination of the load on the line passing through the block, plus a block loading factor, which is determined by the angle of which the block supports the line.



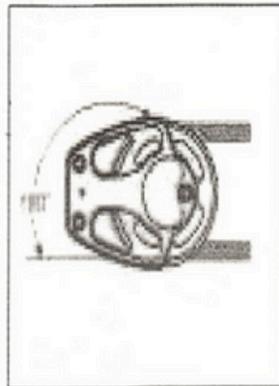
45°



90°



120°



180°

Angle of Deflection	Load Factor
30°	52%
45°	76%
60°	100%
75°	122%
90°	141%
105°	159%
120°	173%
135°	185%
150°	193%
160°	197%
180°	200%

### Boom Load vs Angle of Deflection

If Boom Angle is	Angle Multiplier
60°	1.93
50°	1.87
45°	1.85
30°	1.73



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# Calculating Boom Load – Single Line

Boom angle is 45 degrees, so use line load x 1.85 = load on pulley

$$\boxed{\text{Line Load}} \times 1.85 = \boxed{\text{Total Boom Load}}$$

## 10,000lb Coil, Single Line to Load



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# Calculating Boom Load – Two Lines

Boom angle is 45 degrees, so use line load x 1.85 = load on pulley

$$\boxed{\text{Line Load}} \times 1.85 = \boxed{\text{Load on Pulley}}$$

10,000lb Coil, Two Lines to Load



$$\boxed{\text{Load on pulley}} + \boxed{\text{Drivers Side Hook}} = \boxed{\text{Total Boom Load}}$$



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# Working Load Limits

What they are, how they are determined, and why they are important

Working Load Limit (WLL) is the maximum load a product should ever see.

WLL is a ratio of the minimum breaking strength (MBS)

MBS is determined by testing, then a ratio or design factor is applied

All chains, straps, shackles, and other rigging items have at least one WLL

Items can have two or more WLLs depending on how they are rigged and what angles are present



**WARNING: NEVER EXCEED WORKING LOAD LIMIT**



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# Design Factors & WLL Applied to Products

Synthetic Web, Winchlines, Round Slings, etc. – 5 to 1

Chain, Hooks, Connectors, Oblongs, & most Shackles – 4 to 1

Wire Rope (normally in Towing) – 3.55 to 1

For overhead lifting 5:1

Tie-Down Straps & Ratchets – 3 to 1

\*AMSE/ANSI B30.5, formerly SAE J-959

## Basic recovery strap suggestions...

Always use at least two ply for heavy recovery work.



Always use wear pads at all corners to give the recovery strap a better surface to touch as it stretches.



Cordura wrapped is always a good idea. It does NOT make the strap bullet-proof but it does help!



Always load fiber evenly



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## Rated alloy web shackles allow you to load the fibers evenly.



These web shackles will help to extend the life of your recovery straps by evenly distributing the load of the fibers of the strap. All ratings on these straps are obtained using a straight pin style shackle. The load rating info is forged into the body of the shackle and manufacturer info on the pin as well.

### Alloy Web Shackle Info

Width	Working Load Limit
6 in.	22,500 lbs

6 inch is the largest size & WLL available. Something to consider when you are choosing recovery straps.

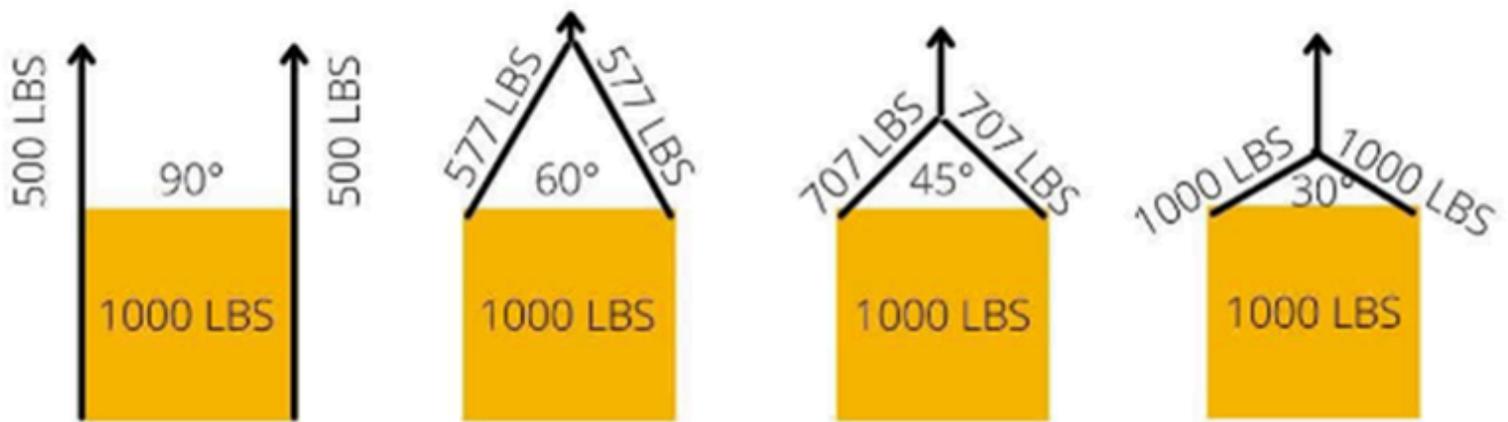


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# Angles matter, BIG TIME!

How horizontal angle affects slings capacity



**NOTE:** A good operating practice is to keep sling angles from going below 60 degrees



Sling angle should not be less than 30°

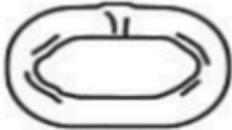


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# CHAIN SLING SAFETY CHECKLIST

Check #1 - Inspections Visually examine chain slings daily and before each use. Inspect for removal criteria such as missing or illegible ID Tag, stretched, bent, or worn links, gouges, weld splatter, corrosion, or other damage. All sling attachments including master links, connecting links, and hooks must also be examined for open throats, twists, cracks or distortion, or other damage.



Worn Links



Bent Links



Gouged Links



Stretched Links

Check #2 -Balance Know the load — determine the weight, center of gravity, angle and lift and select the proper size of sling.



Check #3 - Overload Never overload the sling — check the working load limit on the identification tag. Always consider the effect of Angle of Lift — the tension on each leg of the sling is increased as the angle of lift, from horizontal, decreases. Use the chart in the Peerless Industrial Group, Inc. catalog or in the Peerless Chain Sling User's Manual for this purpose.



Check #4 -Knots, Twists & Kinks Make sure chain is not twisted, knotted or kinked before lifting load. Slings should not be shortened with knots, bolts or other make-shift devices.



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Check #5 - Sharp Edges Protect chain slings with padding or protection from damage caused by sharp edges on loads.



Check #6 - Abrupt Movement Lift and lower loads smoothly. Do not jerk.



Check #7 - High Temperatures Use alloy chain slings within a temperature range of  $-40^{\circ}\text{F}$  ( $-40^{\circ}\text{C}$ ) and  $400^{\circ}\text{F}$  ( $204^{\circ}\text{C}$ ). Do not expose slings to temperatures that exceed this range. Refer to the Chain Sling User's Manual or the Safety Guidelines for capacity reductions when chain is exposed to temperature greater than  $400^{\circ}\text{F}$ .



Check #8 - Chain Care Store chain slings properly off the floor to protect form corrosion during storage. Do not drag chain slings across the floor. Peerless recommends applying a lubricant or light oil to protect chains from environmental corrosion.



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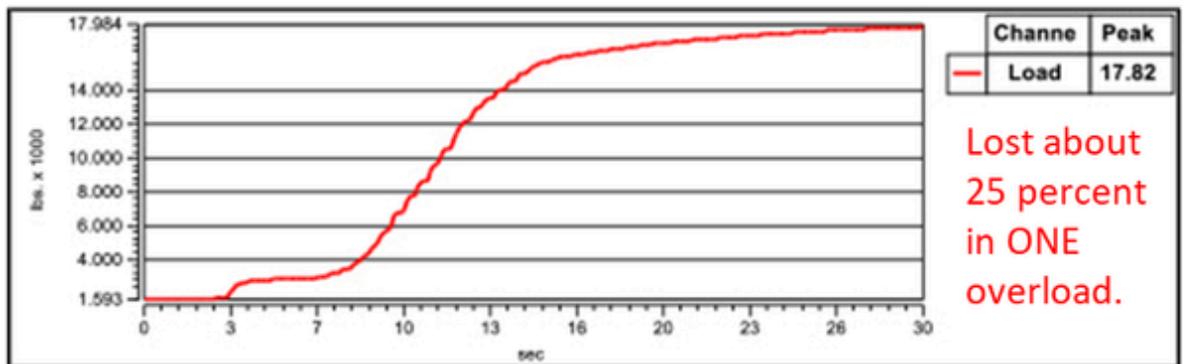
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# CHAIN MEMORY

How much does a one-time overload affect the overall strength of a chain?

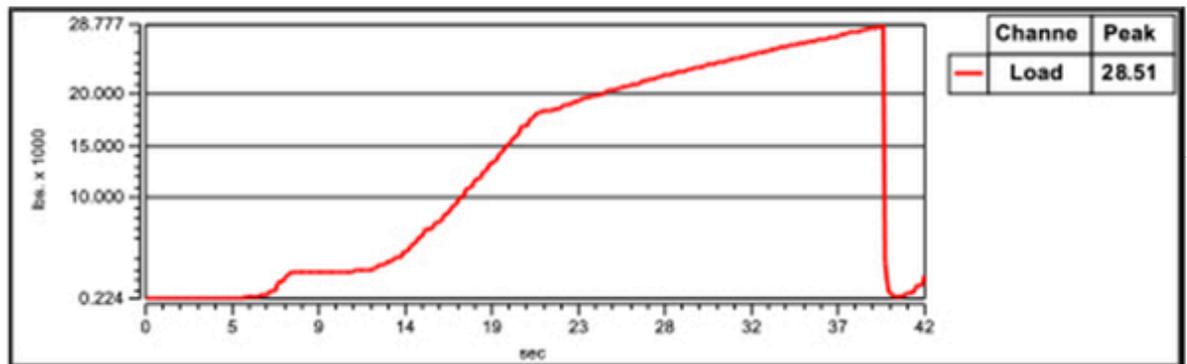
Grade 100 3/8"  
WLL 8800lbs  
MBS 35,200lbs

1<sup>st</sup> pull  
17,820 lbs



Lost about  
25 percent  
in ONE  
overload.

2<sup>nd</sup> Pull  
28,510 lbs



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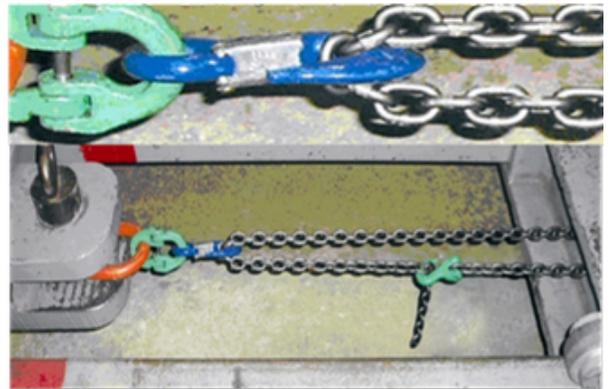
## Break Test #1

- **Chain:** 9/32" Grade 100 - Working load limit 4,300 lbs.
- **Fittings:** 2 Grade 100 alloy grab hooks
- **Configuration:** Single leg with one end of chain choked around 3-inch pin and the chain hooked back onto itself. The other end of the chain hooked back onto itself with the power coming from a 2-ton slip hook similar to what is found on many light duty wreckers.
- **Amount of force to break:** 16,140 lbs.
- **Where did it fail:** A **chain link failed** where a grab hook was connected to the chain on the right hand side.
- **Notes and comments:** While this method allows the chain to be as long as possible the two small loops proves to be weaker than one larger loop.



## Break Test #2

- **Chain:** 9/32" Grade 100 - Working load limit 4,300 lbs.
- **Fittings:** 1 Grade 100 alloy grab hook
- **Configuration:** Single leg with chain in one large loops and wrapped around 3-inch pin and the chain is hooked back onto itself. The power provided by a 2-ton slip hook similar to what is found on many light duty wreckers.
- **Amount of force to break:** 25,360 lbs.
- **Where did it fail:** The **chain link failed** at the two ton hook, the source of the power(left hand side. Notice how hard the chain is bent at the hook. My theory is we can control that bend by making a small change in the attachments we choose to add to our chains.
- **Notes and comments:** This method was the stronger of the two methods tested using grab hooks.



## Break Test #3

Chain: 9/32" Grade 100 - Working load limit 7,400 lbs  
Fittings: 1 Oblong ring (rated for a two leg bridle), 1 Grade 100 alloy chain coupler - hammer lock, 1 Grade 100 sling hook.

Configuration: Created almost a two legged bridle with chain legs encompassed around 3-inch pin.

Amount of force to break: 37,840 lbs

Where did it fail: The chain link failed in the bend at the connection at the load, i.e. the 3-inch pin. The alloy chain coupler - hammer lock was stretching significantly as well. All of the assembly was warm to the touch.

Notes and comments: This method was the strongest of the all of the methods tested and is the best method for achieving the best strength expectations when rigging a chain for a serious heavy pull or lift.



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## Winching Chains



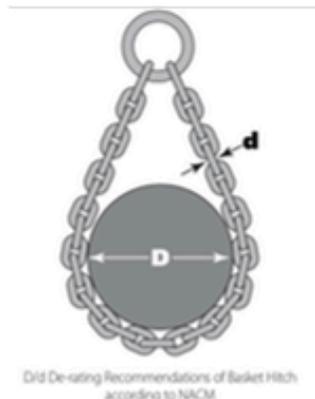
### Slings & D/D Ratio – Alloy Chain Slings

D/d ratio is the diameter of curvature around which a sling is bent affecting its capacity. The upper case "D" refers to the diameter of the object to which the sling hitch is applied, and the lower case "d" represents the diameter of the chain link of the sling

An example  
of a tv  
chain brockle

D/d Ratio	% of Rated Capacity
Less than 2	Not Recommended
2	60
3	70
4	80
5	90
6 and Greater	100

### Chain Conversion Table



1/4"	1.5 inches
9/32"	1.68 inches
5/16"	1.88 inches
3/8"	2.25 inches
1/2"	3 inches
5/8"	3.75 inches
3/4"	4.5 inches



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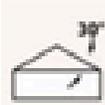
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SIZE	WIRE TYPE	WLL
<b>3/8"</b>	Fiber Core 6x25 Construction	<b>3,780</b>
	Steel Core 6x25 Construction	<b>4,250</b>
<b>7/16"</b>	Fiber Core 6x25 Construction	<b>5,120</b>
	Steel Core 6x25 Construction	<b>5,740</b>
<b>1/2"</b>	Fiber Core 6x25 Construction	<b>6,650</b>
	Steel Core 6x25 Construction	<b>7,490</b>
<b>9/16"</b>	Fiber Core 6x25 Construction	<b>8,390</b>
	Steel Core 6x25 Construction	<b>9,520</b>
<b>5/8"</b>	Fiber Core 6x25 Construction	<b>10,360</b>
	Steel Core 6x25 Construction	<b>11,600</b>
<b>3/4"</b>	Steel Core 6x37 Construction	<b>16,560</b>



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	Single Leg Sling	Double Leg Sling			Triple & Quad Leg Sling		
Size							
<b>Grade 80</b>							
7/32" (6mm)	2,100	3,600	3,000	2,100	5,500	4,400	3,200
9/32" (7mm)	3,500	6,100	4,900	3,500	9,100	7,400	5,200
5/16" (8mm)	4,500	7,800	6,400	4,500	11,700	9,500	6,800
3/8" (10mm)	7,100	12,300	10,000	7,100	18,400	15,100	10,600
1/2" (13mm)	12,000	20,800	17,000	12,000	31,200	25,500	18,000
5/8" (16mm)	18,100	31,300	25,600	18,100	47,000	38,400	27,100
3/4"	28,300	49,000	40,000	28,300	73,500	60,000	42,400
7/8"	34,200	59,200	48,400	34,200	88,900	72,500	51,300
1"	47,700	82,600	67,400	47,700	123,900	101,200	71,500
1-1/4"	72,300	125,200	102,200	72,300	187,800	153,400	108,400
1-1/2" "	100,000	173,200	141,400	100,000	259,800	212,100	150,000
1-3/4" "	131,250	227,300	185,600	131,250	341,000	278,400	196,900
2" "	175,000	303,100	247,500	175,000	454,600	371,200	262,500
<b>Grade 100</b>							
9/32"	4,300	7,400	6,100	4,300	11,200	9,100	6,400
5/16"	5,700	9,900	8,100	5,700	14,800	12,100	8,500
3/8"	8,800	15,200	12,400	8,800	22,900	18,700	13,200
1/2"	15,000	26,000	21,200	15,000	39,000	31,800	22,500
5/8"	22,600	39,100	32,000	22,600	58,700	47,900	33,900
3/4"	35,300	61,100	49,900	35,300	91,700	74,900	53,000
7/8"	42,700	74,000	60,400	42,700	110,900	90,600	64,000
1"	59,700	103,400	84,400	59,700	155,100	126,800	89,550



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