TOWING

OPERATIONS

- Dispatch
  - Information needed to effectively respond
  - TRAA Vehicle Identification Guide
- Safe Towing Capacity
- Essential Equipment & Tools
- Axle Shaft Removal Procedures
- Brake Releasing
- Set-Back Front Axles
- Camper – RV Towing
- Vehicle Towing Preparation
- Winching
- Maintenance

INFORMATION NEEDED BY TOW TRUCK OPERATORS TO EFFECTIVELY RESPOND TO MOTOR VEHICLE INCIDENTS

In order for the towing company to dispatch the necessary manpower as well as the appropriate type and number of towing/recovery vehicles to the incident scene, traffic officers and dispatchers should be able to answer the following questions when requesting service:

AUTOS AND LIGHT TRUCKS

1. REASON FOR TOW?
   Accident
   Disabled – Why?
   Enforcement – OWI, driver's License problem, etc.
   Abandoned

2. LOCATION?
   Be specific as possible.
   Is vehicle on shoulder of road or in median?

3. IS OWNER OR DRIVER PRESENT?
   Are ignition keys with the vehicle?

4. IDENTIFY VEHICLE?
   Make?
   Model?
   Year?
   4 – wheel/all wheel drive?
   How many vehicles (pulling a boat, travel or utility trailer)?

HEAVY TRUCKS

1. REASON FOR TOW?
   Accident
   Disabled - Why?
   Enforcement - OWI, driver's license problem, etc.
   Abandoned

2. LOCATION?
   Be specific as possible.
   Is vehicle on shoulder of road or in median?

3. IS OWNER OR DRIVER PRESENT?
   Are ignition keys with the vehicle?

4. IDENTIFY VEHICLE?
   Make? Model? Year?

5. DESCRIPTION OF UNIT(S) INVOLVED
   Straight Truck (Van, Dump or Tank)
   Truck Tractor (Bobtail)
   Truck-Trailer
   Tractor-Semitrailer
   Tractor-Trailers
   The name of trucking company as marked on unit

6. LOADED OR UNLOADED?
   What is cargo?
   Is cargo intact or spilled on roadway?

7. IS ROAD BLOCKED?
   Is unit on or off the roadway? If off, approximately how far?

OAT

INFORMATION IS NEEDED PRIOR TO DISPATCHING A WRECKER. HERE ARE SOME ADDITIONAL QUESTIONS YOU MIGHT WANT TO ASK IN ORDER TO ASSESS THE SITUATION:

- Who owns the unit?
- Have they been notified?
- Is the driver or a company official at the scene?
- Is the vehicle empty or loaded?
- What is the cargo?
- Is cargo leaking of spilled?
- If liquid reloading is necessary, how long should this take?
- How soon do you want us to respond?
- Would waiting for daylight be more practical?
- What are the weather conditions, also road conditions?
- Is the vehicle in danger of tipping?
- If it is already over will it stay up after we upright it?
- How close is the unit to the roadway now?
- Has the roadway ample shoulders?
- When the vehicle is uprighted will any of it be on the roadway?
- Are the top or sides of the trailer or van box bulged or ripped?
- Are the rear doors closed? (This is critical information if you are considering uprighting the vehicle loaded)
- Have the tires, wheels or suspension been damaged?
- Can it be towed on any of its wheels?
- What's the condition of the terrain? (muddy, swampy)
- Are there any large trees that would be useful as anchors?
- What is the ditch like on the opposite side of the roadway from the wreck?
- Do you suggest more than one wrecker?
- If this unit is a motor coach or motor home, please advise of make, model, approximate length, etc. These vehicles are very fragile and some require special equipment.

WINCHING

(Important points for outside demonstration)

1. Put tow truck too far from the vehicle to be recovered. Then show how easy the front end of the tow truck will come up off the ground.

Then move tow truck closer to the vehicle to be recovered and use boom again - - front end still lifts up. Then put center line on and winch.

2. Show how to use winch to stabilize wrecked vehicle during recovery. Lift on low side, pull down on high side.

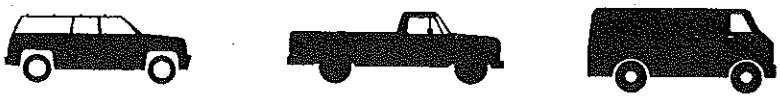
3. When executing a "hard pull", try to find other anchors if possible and run snatch blocks to the anchors. DO NOT tie down tow truck.

4. Winch on spring hangers, NOT AXLES. If you must pull on axles, double wrap over spring and pull on one wrap of chain so it chokes spring on the axle. Watch out for the tie rods.

TRAA VEHICLE IDENTIFICATION GUIDE©

CLASS 1 • LIGHT-DUTY • (6,000 lbs. or less GVW - 4 tires)*

CLASS 2 • LIGHT-DUTY • (6,001 - 10,000 lbs. GVW - 4 tires)*



Classes 1 and 2 include passenger vehicles, light trucks, minivans, full size pickups, sport utility vehicles and full size vans.

CLASS 3 • MEDIUM-DUTY • (10,001 - 14,000 lbs. GVW - 6 tires or more)*

CLASS 4 • MEDIUM-DUTY • (14,001 - 16,000 lbs. GVW - 6 tires or more)*

CLASS 5 • MEDIUM-DUTY • (16,001 - 19,500 lbs. GVW - 6 tires or more)*

CLASS 6 • MEDIUM-DUTY • (19,501 - 26,000 lbs. GVW - 6 tires or more)*

Classes 3 through 6 include a wide range of mid-size vehicles, delivery trucks, utility vehicles, motorhomes, parcel trucks, ambulances, small dump trucks, landscape trucks, flatbed and stake trucks, refrigerated and box trucks, small and medium school and transit busses.

Information Needed To Correctly Dispatch Towing and Recovery Units:

- Year, Make and Model of Vehicle to be Towed or Recovered
- DOT Classification (Class 1 – 8 based on GVW)
- Location of Vehicle
- Type of Tow (impound, accident, recovery motorist assist, etc.)
- Additional Vehicle Information
  - 2 wheel drive, 4 wheel drive, all wheel drive
  - damage to vehicle, tire condition
  - vehicle loaded or empty
  - cargo contents
  - does the vehicle have a trailer
  - are the keys with the vehicle

Note: Any vehicle may carry hazardous materials. Advise if placarded.

*** Note:** The Gross Vehicle Weight Rating (GVWR) of the vehicle to be towed or recovered can be found on the identification label on the vehicle's driver's side doorframe. The number of pounds listed on the label can then be compared with the DOT Classification Vehicle Type Chart for the correct DOT class.

CLASS 7 • HEAVY-DUTY • (26,001 - 33,000 lbs. GVW - 6 tires or more)*

CLASS 8 • HEAVY-DUTY • (33,001 lbs. and over GVW - 10 tires or more)*

Classes 7 and 8 include a wide range of heavy vehicles, large delivery trucks, motor coaches, refuse trucks, cement mixers, all tractor trailer combinations including double trailers.

Law enforcement communications with towing and recovery operators describing an incident and the vehicles involved can insure quick and efficient clearing of these scenes and less disruption to traffic flow. In an effort to standardize communications, the towing industry is adopting the federal vehicle class standards as outlined herein.

VIN CODES

The year of the vehicle is critical information for towing operators in order for them to reference correct towing procedures. The diagrams on the front are examples of classifications. The following information about vehicle identification numbers affixed to the chassis will help determine the vehicle's year. As noted, the vehicle's year, identified by a letter or number in the VIN sequence, is the eighth character from the right.

EXAMPLE 1995 VIN NUMBER: 1P8ZA1279SZ215470

1980.....A	1987.....H	1994.....R	2001.....1	2008.....8
1981.....B	1988.....J	1995.....S	2002.....2	2009.....9
1982.....C	1989.....K	1996.....T	2003.....3	2010.....A
1983.....D	1990.....L	1997.....V	2004.....4	2011.....B
1984.....E	1991.....M	1998.....W	2005.....5	2012.....C
1985.....F	1992.....N	1999.....X	2006.....6	
1986.....G	1993.....P	2000.....Y	2007.....7	

TOW TRUCK/CAR CARRIER CLASSIFICATION

LIGHT-DUTY

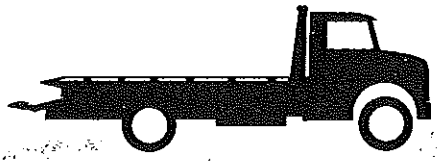
TOW TRUCK

CAR CARRIER

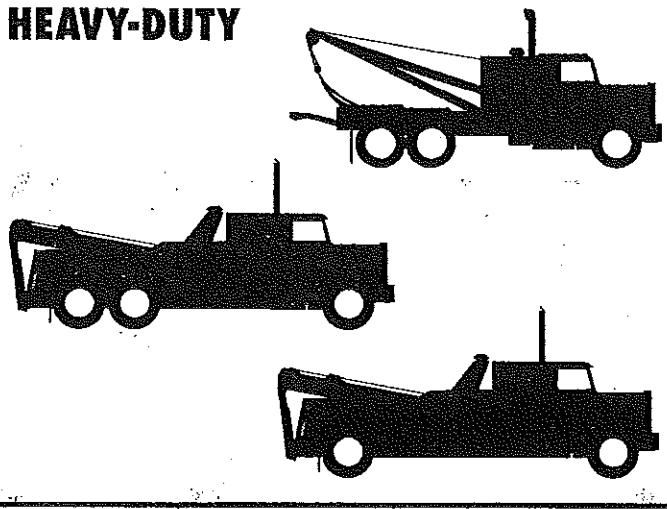
MEDIUM-DUTY

TOW TRUCK

CAR CARRIER



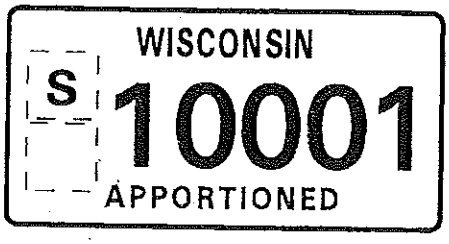
HEAVY-DUTY



LOW BOY TRAILER

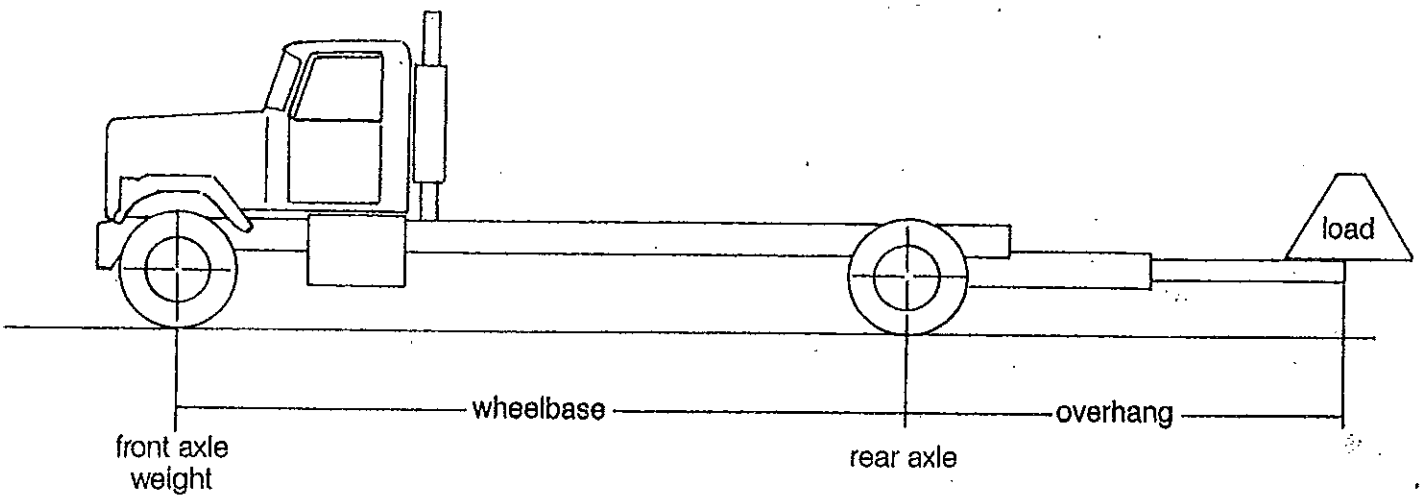
LICENSE PLATE WEIGHT INDICATOR FOR TRUCKS

WT IND.	VEH GROSS WT. Not Over (Pounds)
A	4,500
	5,000
B	6,000
C	8,000
D	10,000
E	12,000
F	16,000
G	20,000
H	26,000
I	32,000
J	38,000
K	44,000
L	50,000
M	54,000
N	56,000
O	62,000
P	68,000
Q	73,000
R	76,000
S	80,000

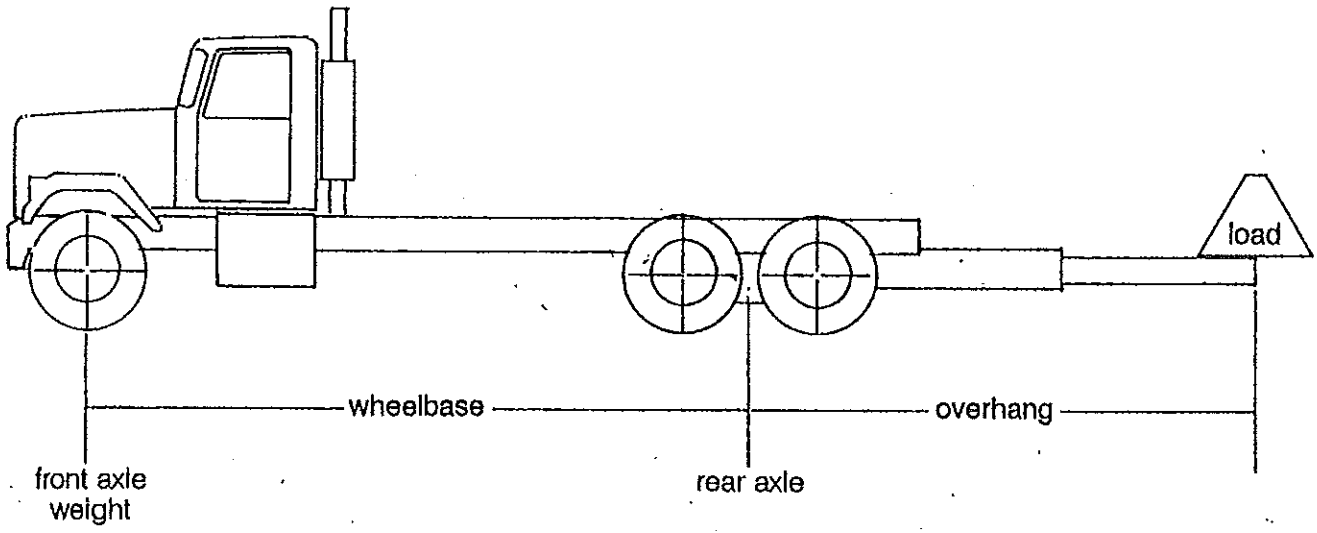


FORMULAE MEASUREMENT LOCATIONS

TWO AXLE



THREE AXLE



1) SAFE TOW CAPACITY:

This formula is used to determine how much weight a wrecker can lift and still maintain enough front axle weight so as to have adequate braking and steering.

Generally the objective has been to maintain 35 to 50 percent of the original front axle weight of the wrecker.

FORMULA #1

$$\frac{\textit{(FRONT AXLE WEIGHT)} \times \textit{(WHEEL BASE)}}{\textit{DIVIDED BY (OVERHANG)}} = \textit{POINT OF LIFT-OFF}$$

The answer will tell how much load (applied to the pick-up point) it will take to lift the front end of your wrecker off the ground.

EXAMPLE:

If the front axle weight of a sample tow truck is 10,000 lbs, the wheelbase is 250 inches and the overhang 100 inches.

10,000 × 250 ÷ 100 = 25,000 LBS

Therefore it would take 25,000 lbs at the hook-up point of this sample to lift the front wheels.

If you feel 35 percent retention is adequate, multiply the answer by .65.

25,000 × .65 = 16,250

Therefore, the sample wrecker could pick up a load of 16,250 lbs and still maintain 35 percent of its original front axle weight.

If you feel 50 percent retention is necessary, multiply the answer by .50.

25,000 × .50 = 12,500

In this case the sample wrecker could pick up a load of 12,500 lbs and still maintain 50 percent of its original front axle weight.

2) FRONT AXLE WEIGHT LOSS — REAR AXLE GAIN

This formula is used to determine how much weight leaves the front axle of the tow truck and is applied to the rear axle of the wrecker when a lift is made.

From this figure we can determine:

A) If the load on the rear axle is within axle ratings of the tow truck chassis.

B) If the load on the rear axle is within weight laws within your jurisdiction.

NOTE: The weight-lifted figure used in the actual weight at the pick-up point of the tow bar or underlift.

FORMULA #2

$$\frac{\textit{(OVERHANG)} \times \textit{(LOAD)}}{\textit{DIVIDED BY (WHEEL BASE)}} = \textit{AMOUNT OF WEIGHT TRANSFERRED}$$

EXAMPLE:

If the front axle weight of a sample tow truck is 10,000 lbs, the wheelbase is 250 inches, the overhang 100 inches and the rear axle weight empty is 15,000 lbs. If a load of 8,000 lbs was picked up, the amount of weight that would transfer from the front to rear axles would be:

100 × 8,000 ÷ 250 = 3,200 LBS OF TRANSFERRED WEIGHT

NOTE: (I) To calculate actual weight remaining on the front axle subtract the answer from the original front axle weight:

ORIGINAL FRONT AXLE WEIGHT	10,000 LBS
LESS AMOUNT OF TRANSFER	3,200 LBS

EQUAL AMOUNT OF WEIGHT REMAINING ON FRONT AXLE 6,800 LBS

(II) To calculate actual weight gain of the rear axle, add the original rear axle weight plus the load plus the amount of transfer:

ORIGINAL REAR AXLE WEIGHT	15,000 LBS
PLUS AMOUNT OF LOAD	8,000 LBS
PLUS AMOUNT OF TRANSFER	3,200 LBS

EQUAL THE TOTAL WEIGHT OF THE REAR AXLE 26,200 LBS

AXLE SHAFT REMOVAL PROCEDURES

1. If both drive axles on a tandem tractor are not on the ground, make sure you remove the axle shafts on the one that turns. You will not have to remove the driveline in this situation. Driveline removal would be required if you chained up the lead axle because of damage or had to lift the front end higher than normal to tow it.

2. If a unit has parking brakes on the lead drive axle only, and you can't air-up the complete system (check air gauges), all axle shafts must be pulled if you are going to tow it from the front. This system uses an air lock power divider that locks when the parking brakes are applied.

If the unit has parking brakes on both rear axles, it should be alright to remove the drive shaft if towing for a distance of less than 350 miles. If the rear ends are not damaged, try to air up unit.

3. If for some reason, you can't remove the drive shaft; removing one axle shaft on each rear end is alright. For a distance of less than 25 miles under emergency circumstances, pull the axle shaft on the left side. The resulting slant of the highway will reduce the amount of grease lost during the tow.

4. Make sure grease comes out with the shaft. This is an indication that there is grease in the differential to lubricate wheel bearings. Put axle covers on and periodically check hubs for running warm if you tow vehicle any distance.

AXLE REMOVAL

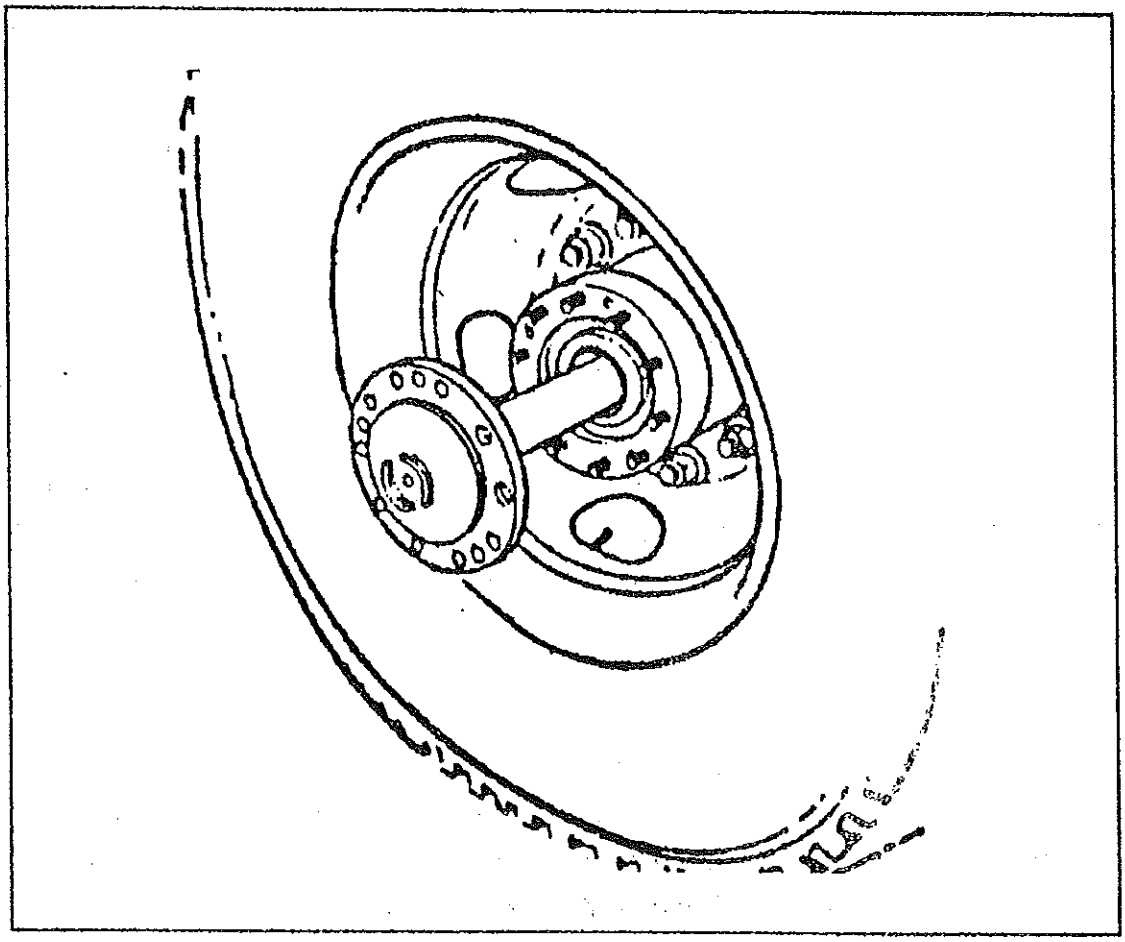
The removal of axle shafts before towing is recommended by most of the manufacturers. Whenever possible the majority of tow-ers prefer to tow a disabled vehicle from the rear. If the vehicle is to be towed to a service depot with the drive axles on the ground, removal of all axles should be seriously considered.

Two items to be aware of are the following:

- Some right hand side axles may prove to be difficult to remove, due to the differential style. These axles have two sets of splines on the shaft. If this is the case it will become necessary for the operator to rotate the shaft slightly to align the side gear spline teeth with the clutch collar teeth before complete removal.
- As a tip: leave the nuts slightly on the stud. This will save the stud in the event the operator was to miss and strike a bare stud and bend it.

NOTE: Be sure to install axle covers. This should prevent the loss of the rear end oil and maintain proper lubrication of the wheel bearings while in tow.

Drive Axle

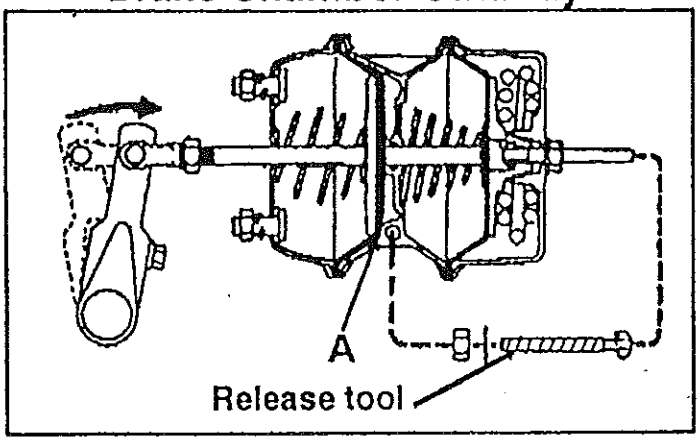


BRAKE RELEASING

In the event it is necessary to release a truck's parking brake manually, the emergency parking spring can be compressed mechanically to release the brake. A release tool is furnished with the brake chamber assembly. The release tool engages in the spring pressure plate and its nut is tightened to compress (cage) the spring and release the brake:

- Remove release tool assembly from carrying pocket. [A]
- Remove the access plug from the end of the spring chamber. [B]
- Insert the release tool through the opening in chamber and into the spring pressure plate.
- Turn the release tool one-quarter turn to engage the tangs on the release tool into the slot in the pressure plate.
- Install the nut on the release tool.
- Be sure tang on release tool stays engaged with slot on pressure plate while installing the nut.
- Tighten nut with wrench to compress spring.

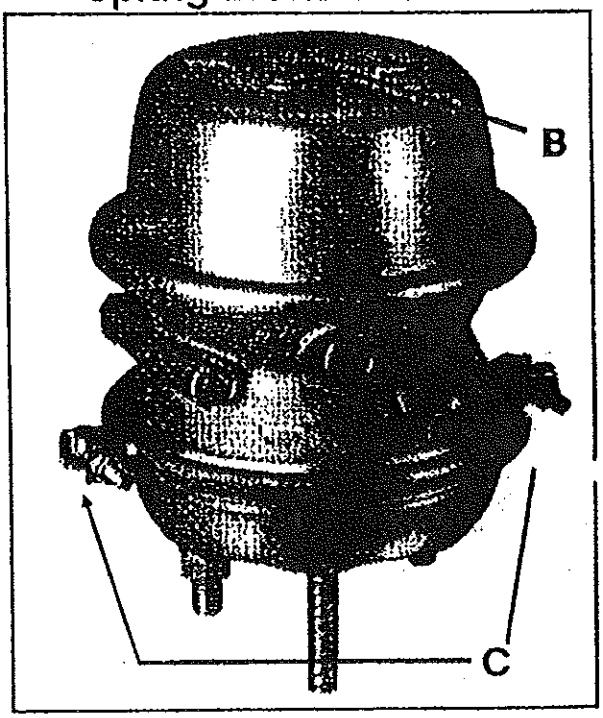
Brake Chamber Cutaway



CAUTION! ***Spring brake chambers assembly must NOT be disassembled without following the procedures described in the service manual. Bypassing these procedures may result in personal injury or death. (I.e. do NOT remove bolts on clamp rings [C]!)***

CAUTION! ***To avoid personal injury or property damage when manually releasing the spring brakes be sure to block the wheels so the vehicle cannot move when the brakes are released for towing. Be sure the vehicle is securely connected to the tow truck and the tow truck parking brakes are applied before releasing the disabled vehicle's spring brake.***

Spring Brake Chamber



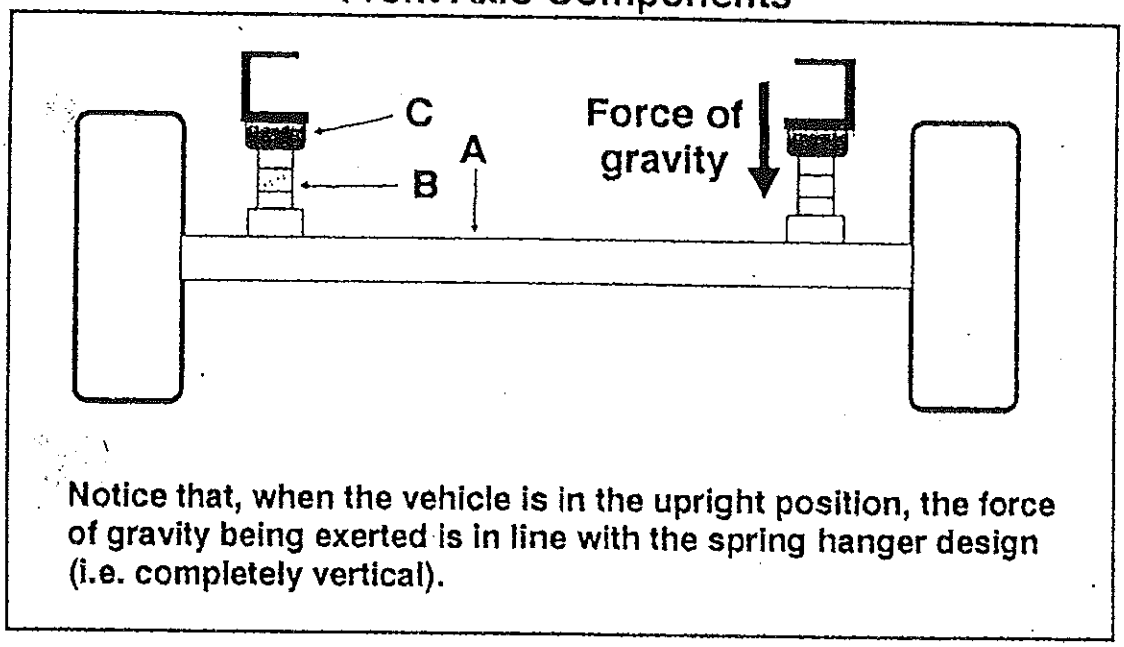
In the event the truck is equipped with disc brakes the same procedures will apply to release the brakes.

The above procedure is for releasing an ANCHORLOCK chamber. There are many other types on the market, and the procedures for releasing will vary.

SET-BACK FRONT AXLES

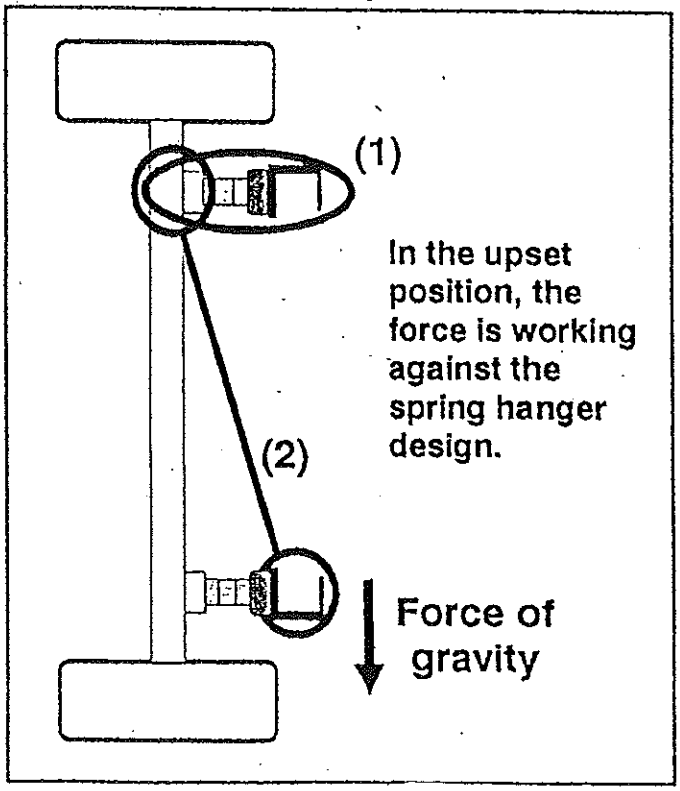
Newer aerodynamic trucks of today are lighter and therefore more susceptible to damage in the event of an upset (Rollover). One very important aspect to remember is the front axle and its components. As illustrated below, the major components are the front axle (A), the springs (B) and the spring hangers (C).

Front Axle Components



Notice that, when the vehicle is in the upright position, the force of gravity being exerted is in line with the spring hanger design (i.e. completely vertical).

Front Axle in Upset Position



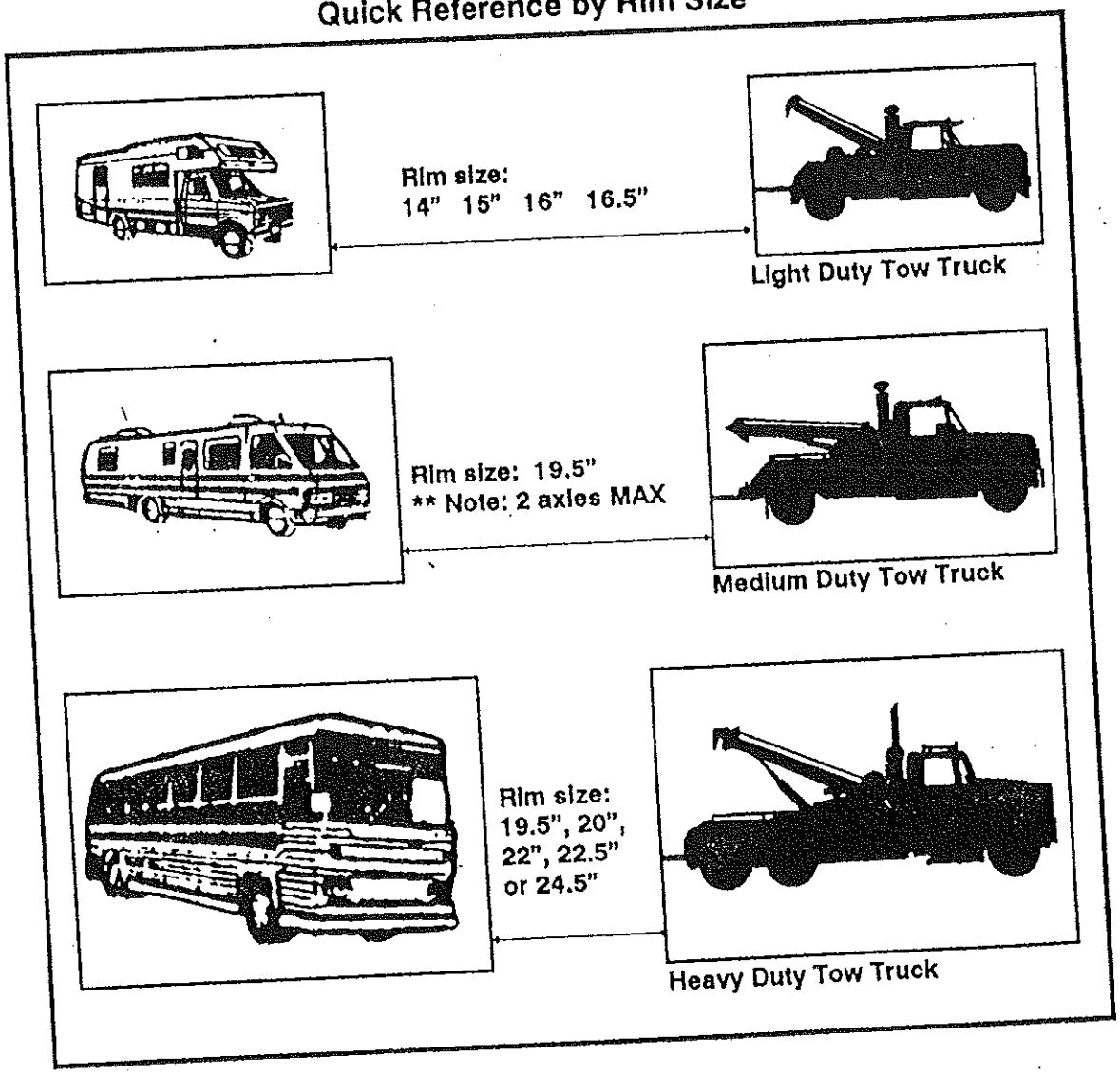
In the case of a vehicle upset, the force of the load is transferred to the spring hangers, possibly causing immediate failure or fracture. In this case scenario, we recommend that you secure the front axle to the frame (1). It is also recommended that you cross chain (2), in order to minimize the side movement of the axle and reduce the force that is transmitted to the spring hangers. (Tightening with a chain binder is a must.)

CAMPER TOWING

Even the best dispatcher can't know exactly what the situation is when a customer calls in. Camper towing is a perfect example. There are many kinds of campers, having different towing requirements. A typical customer has no idea what size of wrecker will be needed for his/her camper. Below is a useful method which relates wrecker size in terms of wheel rim sizes, something the customer can usually readily provide. This chart illustrates a method of determining the compatible size of tow truck for a size of camper (motor-home):

Camper Towing

Quick Reference by Rim Size



Note: These are RIM size measurements. This number is found in the last few digits of the tire code (i.e. 285RX16 - indicates a 16" rim.)

VEHICLE TOWING - PREPARATION

GOALS: Safe, damage free towing

- Obtain as much information about the vehicle to be towed prior to dispatch - What and who will you be dealing with at the scene of the wreck or disablement?

- After arrive at the scene, do a "walk around" inspection of the disabled vehicle to assess your situation.

- Hook-Up - after deciding if your going to hook from the front or rear of the disabled vehicle:

    - Hook up and lift
    - Release Brakes
    - Prepare drive train
    - Safety chains
    - Safety lights
    - Chain suspension prior to hooking up (Rear hook-up)
    - Secure steering wheel (Rear Hook-up)

- Final safety check

- Proceed to destination with caution.

MAINTENANCE

Daily safety inspection

1. Towing devices - tow sling and wheel lift.
2. Winch
3. Boom ends and cable guides
4. Missing bolts and fasteners
5. Loose mounting bolts
6. Cables
7. Wrecker and tow accessories
8. Equipment properly secured
9. Lights
10. No oil leaks

Monthly Service: towing and recovery equipment

1. Oil level of reservoir with all cylinders fully retracted
2. Wrecker mounting bolts
3. Wrecker boom and structure
4. Cables
5. Chains
6. Wrecker controls
7. Backlash brake on cable drum(s)
8. Which (worm) mechanical brakes
9. Hydraulic hoses and connections
10. Loose or missing parts
11. Lubricate wrecker
12. Operate wrecker under power to make sure all controls function properly.

Lubrication: Grease

Cable lubricant

Gear box lubricant

Oil

Oil filter

Replacing parts

CABLE – WIRE ROPE

CHAINS

HOOKS

STRAPS

SNATCH BLOCKS

WINCHES

ESSENTIAL EQUIPMENT AND TOOLS

LIGHT DUTY TOWS

GOAL: To have everything you would normally need to do the job.

Hand Tools:

Tow Lights

Straps/Rope/Securement Devices

Blocking

Recovery Straps (auto & motorcycle)

Chain (safety, chokers, binders)

Snatch Blocks

Scotch Blocks

Dollies

Air supply (compressor)

Two-way Radio/Mobile Telephone

Miscellaneous Tools: sledge hammer, pry bar, shovel, axe, bucket, Oil dry/sweeping compound, rechargeable flashlight, jumper cables

Personal Safety/Foul Weather Gear: gloves, coveralls, etc.

First Aid Kit

Flares

D.O.T. Safety Equip.: fire extinguisher, reflective triangles

ESSENTIAL EQUIPMENT AND TOOLS

GOAL: To have everything you would normally need to do the job.

Hand Tools:

Miscellaneous Tools:
sledge hammer, pry bar, shovel, axe

Jacks:

Chain: chokers, binders

Snatch Blocks

Scotch Blocks

Light Bar: Adapters, aux. light cord

Straps/Rope/Securement Devices:

Blocking/Angle Iron:

Personal Safety/Foul Weather Gear:

First Aid Kit

Flares

Recovery Straps

D.O.T. Safety Equip.:
fire extinguisher
reflective triangles

CABLE – WIRE ROPE

CHAINS

HOOKS

STRAPS

SNATCH BLOCKS

WINCHES

A. Cable - Wire Rope

There are two types of wire rope: steel core and fiber core. The rope's core provides a foundation for strands in addition to providing support for the entire rope structure.

A steel core may consist of either an Independent Wire Rope Core (IWRC) normally made of seven strands or Wire Strand Core (WSC) usually made of seven or nineteen wires. A steel core is preferred when long winching causes excessive heat. This would char fiber core. Steel core is essential for use in such operations as hoist lines.

Fiber cores are made from Polypropylene, a synthetic fiber or Sisal, a natural fiber. Fiber core offers some advantages not found in steel core in that fiber cores have the ability to elongate and recover under rapidly changing loads and are used in wire ropes requiring elasticity. Fiber core acts as a cushion for the steel strands during operation. The fiber core is soaked with lubricant before manufacturing, therefore it acts as an internal lubricant for the rope.

Strands

Generally a wire rope consists of six strands laid around a core. Depending upon the applications, the number of strands may vary from 3 to 19. Each strand determines the operating characteristics of a finished rope. The design and spacing between wire allows movement of the wires while giving strength and support.

In the towing industry two types of wire rope are the most popular:

6 x 19 (6 wires and 19 strands) because it has high strength and toughness with moderate flexibility.

6 x 37 (6 wires and 37 strands) because it also has high strength and toughness, but is very flexible.

Wire Rope Lay

"Lay" of a wire rope is simply a description of the way wires and strands are placed during construction. See wire rope reference section following for illustrations.

Components of Wire Rope:

- Strands
- Core
- Wire

Construction:

- Number of strands
- Number of wires per strand
- Wire arrangement in each strand
- Type of lay

Grade of Wire:

- Iron
- Traction Steel
- Mild Plow Steel
- Improved Plow Steel (commonly used in towing industry)
- Extra Improved Plow Steel

Core Type:

- PFC Polypropylene Fiber Core
- FC Fiber Core
- IWRC Independent Wire Rope Core
- WSC Wire Strand Core

* There is only 7.5% difference in strength between the fiber core and steel core wire rope.

Wire Rope Weaknesses:

Cable or wire rope is regarded as a machine and, therefore, should be treated with as much care as a machine. Wire rope is used on the winch for lifting loads and sometimes to support wrecker booms. Wire rope comes in a variety of strengths, sizes, weights and flexibility. Wrecker manufacturers select the wire rope suitable for each particular wrecker and, therefore, when replacing wire rope you should always do so with the type recommended by the manufacturer.

Cables are used in most towing and recovery work, and it is especially important that operators know how to use and care for cable as it is easy to damage. Damaged cables are a serious safety hazard and can also be expensive to replace. It is vital that you know both the working load limit (WLL), sometimes referred to as safe working load (SWL) of cable, and the breaking strength. Working load limit is the maximum load recommended. The breaking strength is the rating by the manufacturers who determine this rating by performing rigid laboratory tests. *PLEASE NOTE that both the working load limit and the breaking strength ratings are assuming new and undamaged cable conditions. The reason for your reference to breaking strength would only be in getting placement cables -- at all times while actually using cable in towing and recovery operations you should go by the working load limit.

So on the one hand you are given a working load limit of the wire rope by the manufacturer, but you are faced with figuring out what the weight is of the job before you. To estimate the amount of pull you will consider:

The weight of the vehicle
The type of surface
The slope of ground
Wheel mobility
Number of layers on the drum

All of the elements will contribute to the total amount of pull. This will be fully discussed in the recovery section.

By overloading a cable there are two very dangerous possibilities: breaking a cable and having a hook pull loose. If the cable breaks it will recoil with great force. If a hook pulls loose it will fly along with the cable, also with great force. *Always make sure you never load beyond the working load limit and that hooks are securely fastened.

Wear - Although wear is expected during the life of a rope, it is often accelerated by failure to maintain it in proper condition. Compensating for unavoidable wear is often possible by cutting short lengths off at the drum to move wear spots. If the wear is greater at one end, reversing the rope ends is a standard method of prolonging rope life.

Fatigue - The continued variation of stresses from sheaving or vibration tends to lead to fatigue, a form of deterioration common to steel in any form. Using sheaves smaller than recommended sizes often causes fatigue. Unlike wear, fatigue cannot be readily spotted before it occurs. Care should be taken to examine special places for fatigue failure such as in the lengths passing over drums or sheaves, or at fittings where rope vibrations are dampened out. Where fatigue is a major factor in rope life, more flexible ropes will provide longer life.

Tensile Damage - Ropes that are overloaded by static pulls in excess of rated capacities or by sudden shock loads will have cup-and-cone breaks. In addition, any abuse that results in a distortion of wire arrangement will lead to weakening and probably failure.

Shear Damage - When ropes are crushed during bending around a sharp corner or at crossover points, they will fail with angular breaks. Both tensile and shear wire breaks are frequently found in the same rope failure. When some wires are crushed, the remaining ones cannot support the load and fail in tension.

Bird Cage - This is caused by a sudden release of load on a rope and results in permanent distortion. This is harmful to the rope and greatly reduces rope life.

Kink - A kink is caused by pulling tight a loop that has formed in the rope due to mishandling. This causes shortened rope life because of the distortions to the wires and strands.

<u>Where To Look For Abuse</u>:

Pick-up points - Sections in contact with drums and sheaves are constantly under stress when the initial load of a lift is applied.

End Attachments - The point at which the rope enters the end fitting (socket or sleeve) or the spliced section of the rope.

Drums - Drum grooves should be examined and maintained in good condition, as should the method of spooling.

Sheaves - Every sheave in the rope system should be checked periodically with a groove gauge.

SAFETY FIRST!

1. Always make sure that any bystanders at the scene are standing back five feet for every one foot of cable.

2. For every 50 feet of cable, the area should be cleared of bystanders by at least 250 feet. Evacuate the area. Never allow a bystander to assist you.

3. Look at the wire rope to tell where it will backlash. Stay out of the angle. Always be prepared to react safely if the cable should break.

4. Cable wears the most when you are riding empty with no weight to hold it to the sheave.

5. Wind the cable making sure there is consistent tension but not strain.

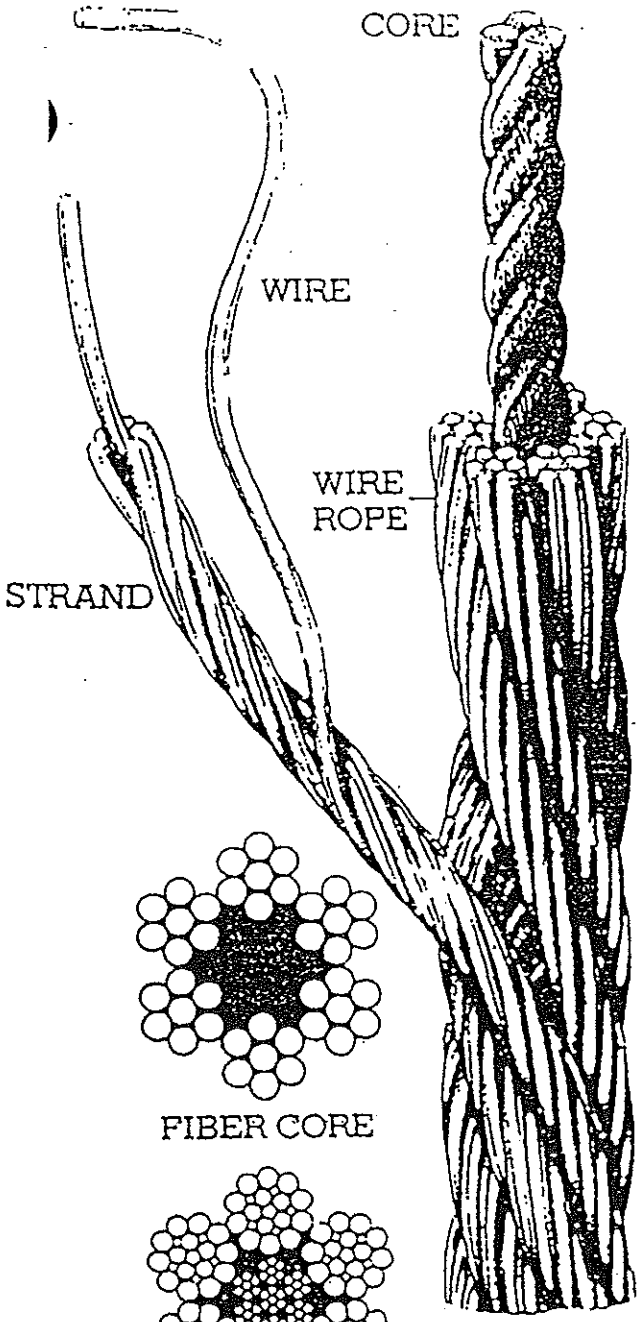
6. For emergency repair ONLY, remember cable clamps can only assure 80% efficiency. Do not put U-bolts on the live end of a cable (the part that goes back to the winch). You should install three clamps, 1" to 1½ " apart. Reinstall the thimble. If you don't, the sharpness of the hook will cut the cable. Torque nuts for 45 lbs. Check periodically for tightness.

7. Because of the varying factors involved, there can be no fixed values for working load. Working loads for wire rope may vary from ½" to 1/12 of the strength of the rope. As a general rule for rough estimation, a maximum working load of 1/5 of the strength is commonly used. The individual usage of the rope will have to be accounted for when you evaluate the working load.

WIRE ROPE REFERENCE FOR:

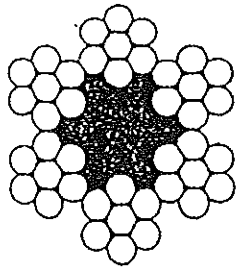
COMPONENTS
LAY OF WIRE ROPE
STRENGTH COMPARISON FIBER CORE & STEEL CORE
TERMINAL EFFICIENCIES
RECOMMENDED SHEAVE DIAMETERS
INSPECTION
REPLACEMENT
LUBRICATION
WORKING LOAD

COMPONENTS

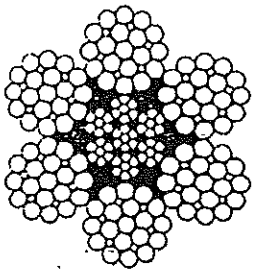


FIBER CORE

METALLIC CORE



6×7



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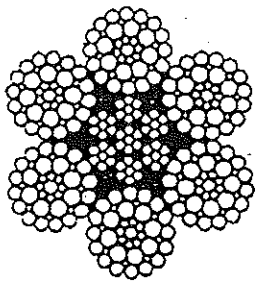

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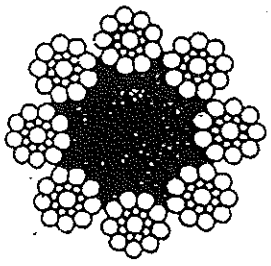

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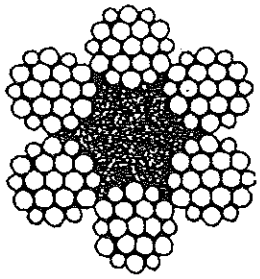
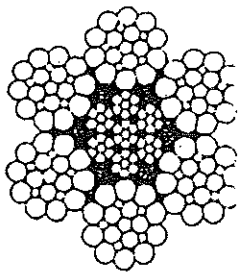


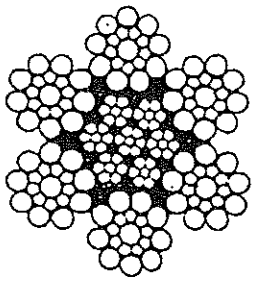
6×19 Class

6 strands of 15 to 26 wires per strand



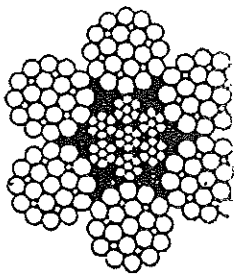
6×21 FW

IWRC Drag Ropes FC Mine Hoise Rope and Cable Tool Drillir Lines



6×19 Seale

IWRC Rotary Drilling Lines, logging and underground applications FC Mine Hoist Ropes and Cable Tool Drilling Lines



6×25 FW

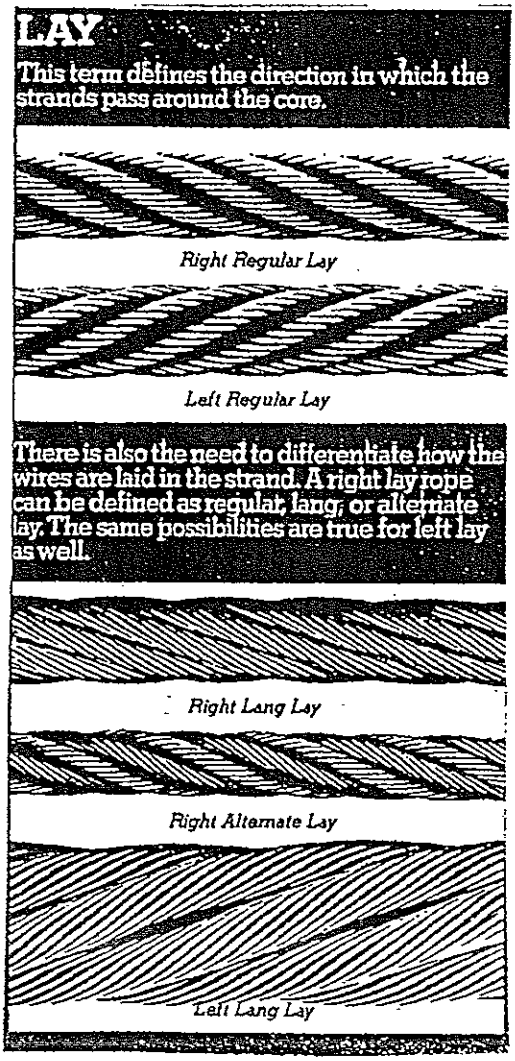
IWRC and FC most co monly used rope construction, wide variety of hoisting applications excellent combination flexibility and abrasion resistance.

UNDERSTAND WHAT THE "LAYS" OF WIRE ROPE MEAN

"Lay" of a wire rope is simply a description of the way wires and strands are placed during construction. Right lay and left lay refer to the direction of strands. Right lay means that the strands pass from left to right across the rope. Left lay means just the opposite: strands pass from right to left.

Regular lay and lang lay describe the way wires are placed within each strand. Regular lay means that wires in the strands are laid opposite in direction to the lay of the strands. Lang lay means that wires are laid in the same direction as the lay of the strands.

Most of the wire rope used is right lay, regular lay. This specification has the widest range of applications and meets the requirements of most equipment. In fact, other lay specifications are considered exceptions and must be requested when ordering.

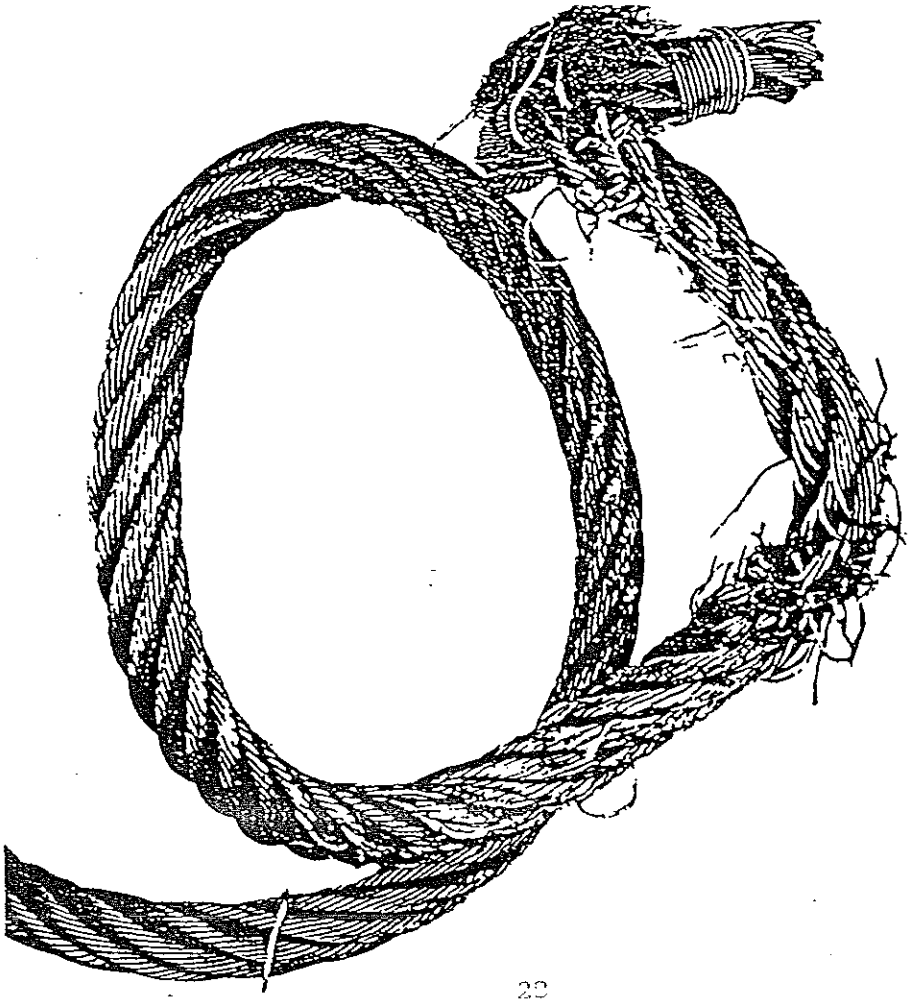


Strength Comparison Between Fiber Core & Steel Cables

Example: 6 x 37 Plow Steel

Fiber Care			Steel Core	
Size	PFC (Tons)	PFC (SWL 5:1) (Tons)	IWRC (+7.5%) (Tons)	IWRC (SWL) (Tons)
1/4"	2.39	.47	2.57	.51
5/16 "	3.71	.74	3.99	.80
3/8"	5.31	1.06	5.71	1.14
7/16"	7.19	1.43	7.73	1.55
1/2"	9.35	1.87	10.00	2.00
9/16	11.80	2.36	12.70	2.54
5/8"	14.50	2.90	15.60	3.12
¾"	20.70	4.14	22.20	4.44
7/8"	28.00	5.60	30.10	6.02
1"	36.40	7.28	39.10	7.82

The nominal Strength is the published Catalog design strength of a given wire rope.

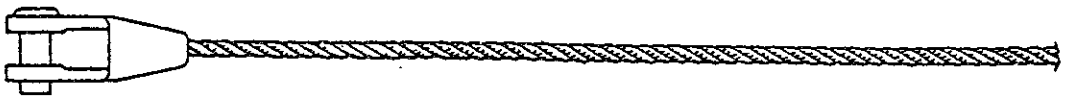


TERMINAL EFFICIENCIES (APPROXIMATE)

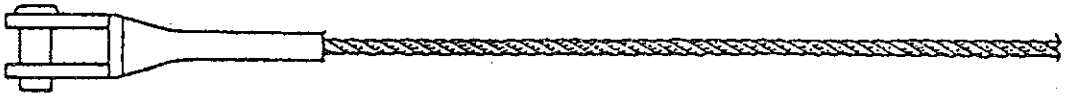
Efficiencies are based on nominal strengths

Method of Attachment	Efficiency	
	Rope with IRWC*	Rope with FC**
Wire Rope Socket-Spelter or Resin Attachment	100%	100%
Swaged Socket	100%	(Not Established)
Mechanical Sliced Sleeve		
1" diam. and smaller	95%	92.5%
1 1/8" diam. Through 7 7/8"	92.5%	90%
2" diam. And larger	90%	87.5%
Loop or Thimble Splice - Hand Spliced (Tucked) (Carbon Steel Rope)		
1/4"	90%	90%
5/16"	89%	89%
3/8"	88%	88%
7/16"	87%	87%
2"	86%	86%
5/8"	84%	84%
3/4"	82%	82%
7/8" through 2 1/2"	80%	80%
Loop or Thimble Splice - Hand Spliced (Tucked) (Stainless Steel Rope)		
1/4"	80%	
5/16"	79%	
3/8"	78%	
7/16"	77%	
1/2"	76%	
5/8"	74%	
3/4"	72%	
7/8"	70%	
Wedge Sockets*** (Depending on Design)	75% to 90%	75% to 90%
Clips*** (Number of clips varies with size of rope)	80%	80%

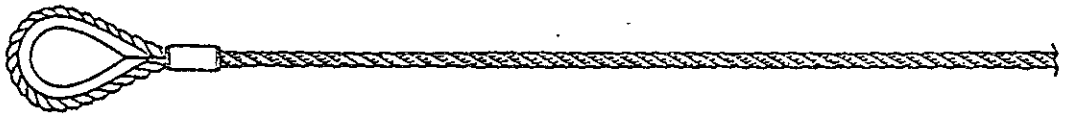
*IWRC = Independent Wire Rope Core **FC = Fiber Core
***Typical Values when applied properly. Refer to fittings manufacturers for exact value and method.



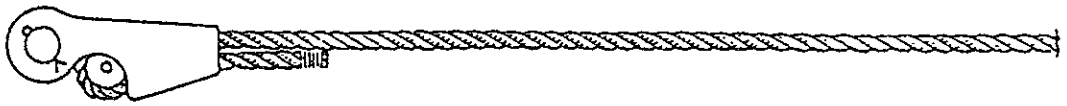
WIRE ROPE SOCKET-SPELTER OR RESIN ATTACHMENT



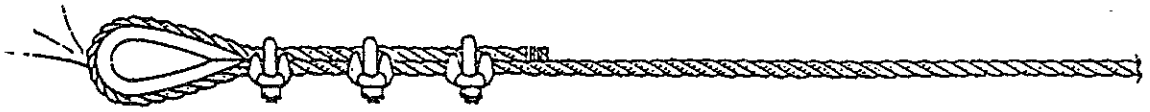
WIRE ROPE SOCKET - SWAGED



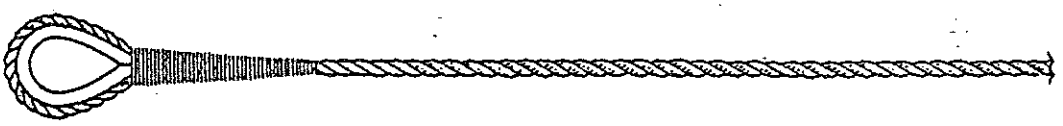
MECHANICAL SPLICE - LOOP OR THIMBLE ATTACHMENT



WEDGE SOCKET



CLIPS - NUMBER OF CLIPS VARIES WITH ROPE SIZE



LOOP OR THIMBLE SPLICE - HAND TUCKED

Wire Rope Manufacturer's Recommended Sheave Diameters

Cable Type	Recommended Diameter	Minimum Diameter
6 x 7	72D	42D
6 x 19G	45D	34D
6 x 19E	40D	30D
6 x 25F	35D	26D
6 x 37	27D	18D
8 x 29	31D	21D
19 x 7	51D	34D

NOTE: The "D" factor represents the diameter of the wire rope. To determine the recommended sheave diameter, multiply the outside diameter (inches) of the cable, times the given number that precedes the D.

Example: The 6 x 19G cable that is 1/2" diameter, has a recommended sheave diameter of 45D, which is 22.5".

Efficiency of Wire Rope Attachments

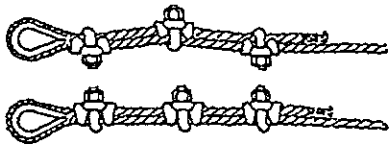
Zinc Type Sockets: Provide 100% of the cable's strength, if made properly. Its strength is as low as 25% if babbitt metal or lead is used.

Wedge Type Sockets: 75% to 90% of the cable's strength, depending on the design.

Crosby Clips: The Efficiency of Crosby Clips is dependent upon the arrangement, care in tightening, and the number of clips used. Important: Failure to apply the clips in accordance to the manufacturer's instructions or failure to periodically check and re-tighten to the recommended torque will cause reduction in the efficiency of the termination.

Right Way

Wrong Way



Properly Attached: All U-bolts on the dead side of the rope. 80%
Staggered Clip Arrangement.....75%
U-Bolts on the Load Side of the Wire.....70%
Improperly Tightened Nuts.....50% or less

CAUTION: Never over torque the U-bolts on Crosby Clips.

Swaged Fittings:

They provide for 100% of the cable's strength. Swaged Fittings are recommended by towing and recovery equipment manufacturers as well as all wire rope companies.

Summary:

We strongly suggest that wire rope inspections and proper lubrication be included as a vital part of your normal equipment service procedure.

Chain has a purpose ... cable has a purpose. Do not allow cable to become wrapped around any surface other than a winch or a sheave without protection.

Always try to avoid reverse bending configurations.

Careful inspections of wire rope are necessary to verify its condition furring different stages of its life. The objective in an inspection is to remove any rope that would be a potential hazard in normal operations. Judgment is a critical factor - be sure you know the product, its purpose, and safety factors that must be considered. If in doubt, throw it out.

INSPECTION

FREQUENT:

All ropes and connections in daily use should be visually inspected once each working day. The inspection should consist of observing for gross damage such as:

- Kinking, crushing, unstranding birdcaging, main strand displacement or cord protrusion.
- General Corrosion.
- Broken or cut strands.
- Number, distribution, and type of visibly broken wires.
- Lubrication (when bent, the core will have a rusty color if the rope needs lubrication).

Special care should be taken when inspecting:

- Portions subjected to rapid deterioration such as repetitive pick-up points on drums.

- Boom hoist, because of the importance of these ropes.

When damage is found, the rope should either be removed or given a detailed inspection as in the periodic inspection.

PERIODIC:
The frequency of periodic inspection should be based on expected life as experienced on similar or the same usage, severity of environment, percentage of capacity lifts, frequency of use, and exposure to shock loads.

Periodic inspections should be accompanied with a written, signed report and should cover the entire length of the rope. The individual wires in the strands should be inspected. If there is such deterioration that there may be a resultant appreciable loss of original strength it should be noted and further use should be determined.

DETERIORATIONS THAT MAY BE A HAZARD:

- Deteriorations such as those looked for in frequent inspection.

- Reduction of rope diameter below nominal diameter due to loss of core support, internal or external corrosion, or wear of outside wires.

- Severely corroded or broken wires at end connections.

- Severely corroded cracked, bent, worn, or improperly applied end connections.

- Lack of lubrication.

Special care should be used when inspecting rope subjected to rapid deterioration, such as:

- Portions in contact with saddles, equalizer sheaves, or other sheaves where rope travel is limited.

- Portions of the rope at or near terminal ends where corroded or broken wires may protrude.

ROPE REPLACEMENT

You must make your own decisions as to the exact time for the replacement of rope. Since the factors involved are variable, there are no determined rules. You must evaluate the remaining strength left in a used rope, based on the factors that you judge are important for your application.

However, there are some rope conditions that should offer sufficient reason to discontinue use or at least increase the frequency of inspection. These conditions are:

- In running ropes, six randomly distributed broken wires in one lay, or three broken wires in one strand in one lay. The number of wire breaks beyond which concern should be shown varies with rope usage and construction. For general applications six and three are satisfactory.

- One outer wire broken at the contact point with the core of the rope that has worked its way out of the rope structure and protrudes or loops out from the rope structure.

- Wear of 1/3 the original diameter of outside individual wires.

- Kinking, crushing, birdcaging, or any other damage resulting in distortion of the rope structure.

- Evidence of any heat damage from any cause.

- Valley breaks.

Reductions from nominal rope diameter of more than:

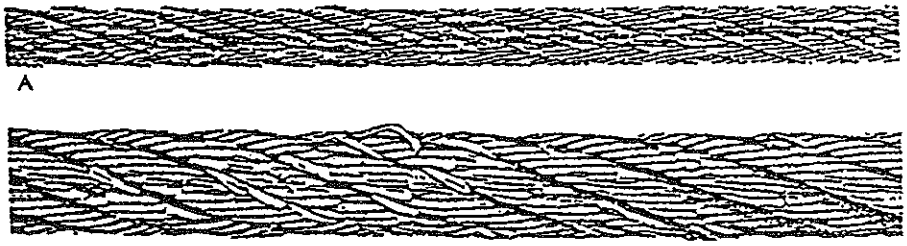
REDUCTION OF:	NOMINAL ROPE DIAMETERS
1/64"	up to & inc. 5/16"
1/32"	over 5/16" through 1/2"
3/64"	over 1/2" through 3/4"
1/16"	over 3/4" through 1 1/8"

- In standing ropes, more than two broken wires in one lay in a section beyond end connections or more than one broken wire at an end connection.

Replacement rope should have a strength rating at least as great as the original rope.

All rope that has not been in use for a month or more should be given as thorough an inspection as done in periodic inspection before being put back into use.

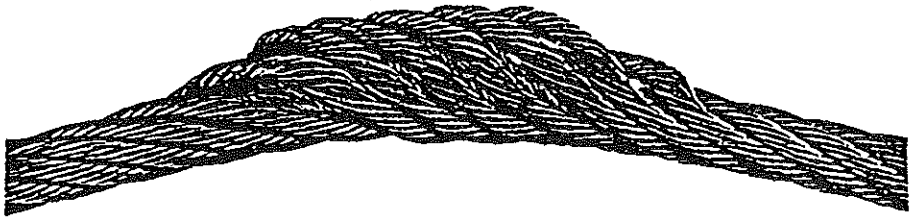
This is the appearance of a typical tension break: a result of overloading.



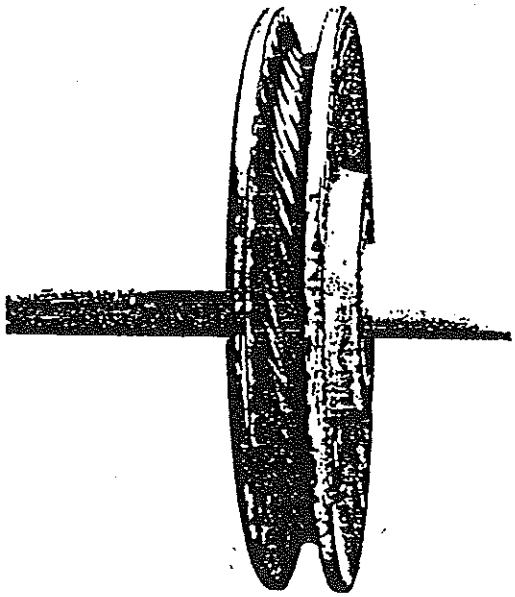
A) Serious wear resulting from excessive bending, and B) localized wear brought about by poor cut-off practice.

This is an illustration of a serious condition where the rope slides over or against itself.

An illustration of *valley type* fatigue breaks. Flexing the rope exposes broken wires hidden in valleys between strands.



This effect of drum crushing is evidence of bad winding conditions.



A deeply corrugated sheave.

This rope condition is called a dog leg.

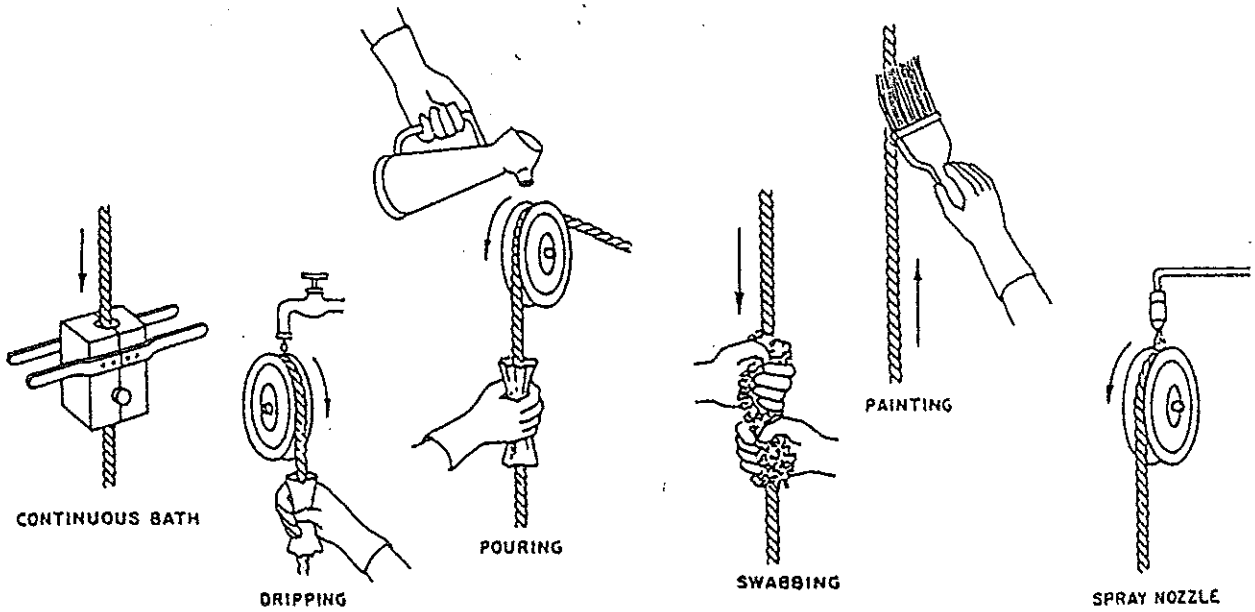
LUBRICATION:

Lubrication should be done monthly unless the rope is used in salt water, and then it should be lubricated daily. Left over motor oil, carb cleaner, or chassis grease should never be used because it has the same chemical effect as acid. Cable lubricant penetrates the wires of the cable, is free of acids or alkalis, is water repellent, and will resist oxidation.

All dirt or other abrasive material should be removed from the rope before lubricating. A stiff wire brush, solvent, and compressed air or live steam should be used for cleaning. Lubrication should be done immediately after cleaning. If the rope is to be used in abrasive material such as dirt, the lubricant used should be of a consistency that it will penetrate while not picking up the material the rope must drag through.

Cable lubricant should be applied while the cable is under light tension and bent. Bending opens the wire strands and helps the lubricant to penetrate the cable.

A method of lubrication that continually applies the lubricant while the rope is in operation is the most efficient and economical. As illustrated below, some of the methods used are: continuous bath, dripping, pouring, swabbing, painting, or automatic systems that apply lubricants either by drip or pressure spray.



PROPER WORKING LOAD FOR WIRE ROPE

The dead weight plus the loading resulting from acceleration, retardation, and shock load are included in the actual working load of a wire rope. Other factors influencing the permitted working load include the size of drums and sheaves, method of reeving, and the end attachments on the rope. Wire rope is used at a higher load in some types of operations. The piece of equipment used and the economy and efficiency of the operation will determine the useful life of the rope.

Because of the varying factors involved, there can be no fixed values for working load. Working loads for wire rope may vary from 1/2 to 1/12 of the strength of the rope. As a general rule for rough estimation, a maximum working load of 1/5 of the strength is commonly used. The individual usage of the rope will have to be accounted for when you evaluate the working load.

B. Chains, Hooks and Straps

Chains are used for tie downs and to lift, support and pull loads. A wide variety of chains are available, but not all are recommended for towing. The National Association of Chain Manufacturers (NACM) has adopted a system of identification whereby chain that is manufactured by these standards contains a letter which identified by its grade. Ductile is a term given by the NACM which indicates that most chains, hooks, and attachment links have the ability to stretch allowing the sidewalls to collapse before a brake occurs. Operators should check chain each time before using.

There are many different grade classification most of which will be found in one of the following categories:

1. Proof Coil - (identified as "3") is made from low carbon steel and is non-heat treated. It is dangerous when used for pulling or lifting and is not recommended for use in towing. The safe working load (SWL) for 3/8" Proof Coil chain is about 2,650 pounds. These general purpose chains are easily nicked and bent.

2. High Test - (identified as "4") also is heat treated, but is suitable for most towing applications. It should not be used for recovery work. This chain will have a #4 or 43 forged into the link. The safe working load (SWL) for 3/8" High Test is 5,400 lbs.

3. Transport - (identified as "7") is a high quality heat treated chain. It has a high degree of hardness and was developed primarily for the transportation industry to secure loads on flatbed carriers. Although widely used in the towing industry, it is not approved for overhead lifting. The safe working load (SWL) for 3/8" Transport chain is 6,600 lbs.

4. Alloy - (identified as "8") is a heat treated chain and is the highest quality and strength available. It is the only chain approved by OSHA for overhead lifting. Alloy chain is the lightest in weight. The safe working load (SWL) for Alloy chain is 7,100 lbs.

Examples of chain identification: The Crosby Group identify their chain with the letters CG. They call their high test chain "Spectrum 4" and mark it C4. They call their Alloy chain "Spectrum 8" and mark it A8.

CHAIN SPECIFICATIONS

	CHAIN SIZE (INCHES)	MAX. LENGTH, 100 LINKS (INCHES)	WEIGHT PER 100 FEET (POUNDS)	WORKING LOAD LIMIT (POUNDS)
PROOF COIL	3/16	99	33	750
CHAIN	1/4	104	63	1250
	5/16	114	98	1900
	3/8	128	144	2650
	1/2	158	278	4500
	5/8	194	422	6900
	3/4	220	606	9750
	1	286	1069	13950
HIGH TEST	1/4	104	71	2600
CHAIN	5/16	114	98	3900
	3/8	128	144	5400
	1/2	156	278	9200
	5/8	194	422	11500
	3/4	220	606	16200
	7/8	260	769	22500
	1	286	1069	26500
TRANSPORT	1/4	87	74	3150
	5/16	102	100	4700
	3/8	119	156	6600
	7/16	134	204	8750
	1/2	149	259	11300
ALLOY	1/4	"	74	4100
	3/8	"	151	7300
	1/2	"	253	13000
	5/8	"	383	20300
	3/4	"	524	29300
	7/8	"	738	39900

Strength Ratings Defined By the Crosby Group:

Safe Working Load (SWL) or Working Load Limit (WLL) - The maximum load in pounds that should ever be applied to a chain when it is new or in as-new condition. This rating applies only when the load is uniformly applied to a straight length chain. Never exceed the safe working load or the working load limit.

Proof Test - Is the term designating the tensils test applied to a new chain for the purpose of detecting defects in the material or manufacture. It is a load in pounds that the chain has withstood under a test in which the load has been applied in direct tension to a straight length of new chain. Proof Test is 2 times the safe working load rating.

Minimum Ultimate Load - The minimum ultimate load at which a new chain will break when tested by applying direct tension to a straight length of chain at a uniform rate of speed in a testing machine. The minimum Ultimate Load rating is 4 times the safe working load rating.

Example:

1/2"	Proof Coil Chain	
	Safe Working Load	4,500 pounds
	Proof Test	9,000 pounds
	Minimum Ultimate Load	18,000 pounds

Example: Comparison of Safe Working Load

Size:	High Test	Alloy
3/8 inch	5,100 pounds	6,600 pounds
1/2 inch	8,200 pounds	11,250 pounds
5/8 inch* (standard on 750)	11,500 pounds	16,500 pounds

Most experienced recovery workers prefer 1/2 and 5/8 inch alloy chain for heavy duty lifting and recovery.

Task	Grade of Chain Required
Hook-ups	High Test or better
Safety Chains	Alloy
Chaining Suspensions	High Test 3/8 inch or larger

Precautions when Using Chains

1. Always inspect chain and attachments for kinking, twisting, knotting and visible defects...these will lessen the load the chain can safely hold.

2. Protect chains from corrosion, between jobs clean and store chains in bags to prevent rust.

3. Acceleration in the rate of application could cause dangerous overloading. Avoid sudden, heavy impact loads, they usually exceed the working load drastically and cause sudden failure.

4. Variations in the angle or inclination of the load will vary the working load capacity. As the angle increases, the working load capacity increases.

5. Never exceed the safe working load or the working load limit of a chain. When you replace the chains that come with a tow truck, replace them with the same grade of the original chain.

6. If the chain assemblies you use are not assembled by the factory, make sure all components are rated to chain being used. Be sure chains are rated to do the job for which they are intended.

7. When chains are overloaded the links are stretched and strength is drastically reduced.

8. Always pad a chain when wrapping it around an object in a recovery. This will prevent sharp objects from damaging the chain.

Hooks & Links

Hooks come in the same grade as chains: Proof Coil, High Test, Transport and Alloy. Any attachments used with chains should be of the same type, grade and size as the chain being used. If a lower grade of attachment is being used, then the capacity is lowered to that of the attachment.

Grab hooks are used with safety chains and with some tow hook-ups. They are meant for use when a chain is being wrapped around the structure, it is highly recommended that they be made of alloy. The grab hook is hooked onto the chain itself. Grab hooks are not designed to be hooked directly onto the structure of the vehicle.

Precautions when using hooks:

1. Loads may be discharged from hooks if proper procedures are not followed.

2. Always inspect the hook and latch before using. MAKE SURE LATCHES ARE IN FUNCTIONAL ORDER. Hooks on winch cable or scotch blocks used in anchoring lifting must have latches.

3. Always make sure the hook supports the load. The load must never be supported by the latch. The load should be totally supported in the throat of the hook.

4. When placing two or more sling legs in the hook, make sure the angle between the legs is small enough and the legs are not tilted. Make sure nothing bears against the bottom of the latch.

5. All hooks (snatch blocks, winch hooks, chain hooks) should be positioned with throat (opening) of the hook facing upward.

EYE SLIP HOOKS

Drop Forged Grade NO.	Trade Size	Working Load Limit
28	1/4"	1,250
	5/16"	1,900
Use with	3/8	2,650
Proof Coil	7/16"	3,500
	1/2"	4,500
	5/8"	6,900

EYE GRAB HOOKS

Drop Forged Grade NO.	Trade Size	Working Load Limit
28	1/4"	1,250
Use with	5/16"	1,900
Proof Coil	3/8"	2,650
	7/16"	3,500
	1/2"	4,500
	5/8"	6,900

CLEVIS GRAB HOOKS

Grade No.	Trade Size	Working Load Limit
43 Use with Hi test or proof coil	1/4"	2,600
	5/16"	3,900
	3/8"	5,400
	7/16"	7,200
	1/2"	9,200
	5/8"	11,500
70 Use with alloy or P-7	1/4 - 5/16"	4,700
	3/8"	6,600
80 Use with alloy or P-7	1/4"	4,100
	5/16"	5,100
	3/8"	7,300
	1/2"	13,000
	5/8"	20,300

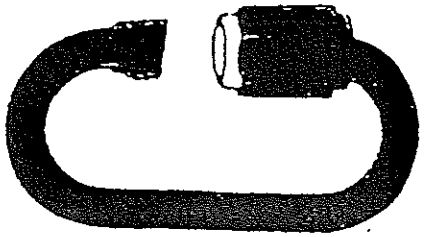
CLEVIS SLIP HOOKS

Grade NO.	Trade Size	Working Load Limit
43 Use with Hi test or proof coil	1/4"	2,600
	5/16"	3,900
	3/8"	5,400
	7/16"	7,200
	1/2"	9,200
	5/8"	11,500
63 Use with Alloy or P-7	1/4"	3,250
	5/16"	5,000
	3/8"	6,600
	1/2"	11,250
	5/8"	16,500

REPAIR LINKS AND HOOKS

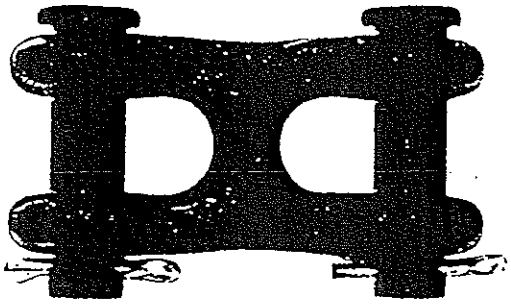
QUICK LINKS

Trade Size	Working Load Limit
1/8"	220
3/16"	616
1/4"	880
5/16"	1,540
3/8"	2,200
1/2"	3,300



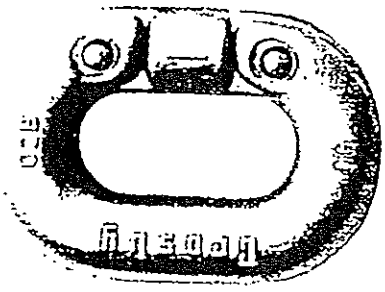
MID-LINKS

Trade Size	Working Load Limit
1/4"-5/16"	4,700
3/8"	6,600
7/16"-1/2"	11,300



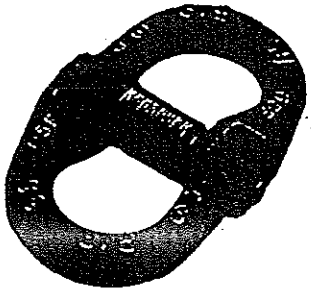
CONNECTING LINKS

Trade Size	Working Load Limit
3/16"	800
1/4"	1,400
5/16"	2,000
3/8"	2,800
1/2"	4,750
5/8"	7,250



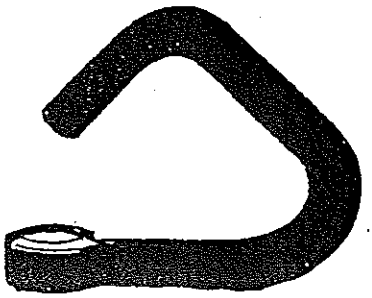
LOK-A-LOY KUPLUX

Trade Size	Working Load Limit
1/4"	3,250
3/8"	6,600
1/2"	11,250
5/8"	16,500
3/4"	23,000
7/8"	28,750
1"	38,750
11/4"	57,500



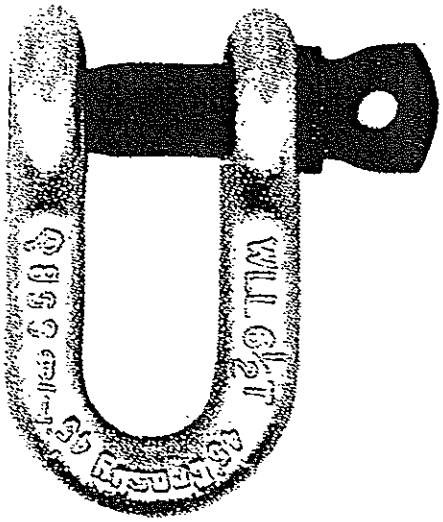
COLD SHUTS

Trade Size	Working Load Limit
3/16"	450
1/4"	750
5/16"	1,250
3/8"	1,900
7/16"	2,650
1/2"	3,500
5/8"	4,500



ANCHOR SHACKLES-SCREW PIN

Trade Size	Working Load Limit Tons
1/4"	1/2
5/16"	3/4
3/8"	1
1/2"	2
5/8"	3-1/4
3 / 4"	5
7/8"	6-1/2
1"	8 1 /2
1-1/4"	12
1-1/2"	17



Recovery straps are made of fabric webbing. These straps are light and strong and in many cases are safer than chains. Straps won't rust and are relatively inexpensive. Straps can be used for stabilizing, recovering, moving and assisting.

Although straps have great strength and elasticity, they are composed of a soft medium that is easily weakened by careless use. The key to strap strength lies in the combined strength of the thousands of strands woven together and multiplying their resistance in unity. When all of the fibers work together they are very strong. If some are cut, the remaining fibers must carry the load, reducing the overall capacity of the strap. Straps must not be cut in the process of doing the job. One should avoid putting the loop eye of the strap on a sharp surface or allowing a strap to rub against a sharp surface. One process is to position protective material between the strap and any sharp, protruding edges.

Permanently mounted hooks are the recommended points of attachment for straps. They should be securely bolted or welded to the frame a suitable frame member and located in a convenient spot.

Proper maintenance is necessary to ensure long life of straps. Straps are subject to water, dirt, mud, snow, ice and chemicals during their use. The recommended care for straps is as follows:

1. Wash the strap with warm water and mildew detergent after a day of use.

2. Avoid dry cleaning solvents, chemical cleaners or petroleum-based cleaning agent.

3. After cleaning allow it to dry and store in a clean dry space free from gas, oil abrasion, and sunlight.

4. During use, attach strap to vehicle via frame mounted hook - never attach to bumper or other sharp object.

5. Avoid dragging the strap behind the vehicle as it can be run over and damaged, or snagged and cut by foreign objects.

6. Use common sense! Respect your strap's capabilities and limitations.

7. Always use winch for recovery work. The winch pulls harder than the truck.

Basic Hitches

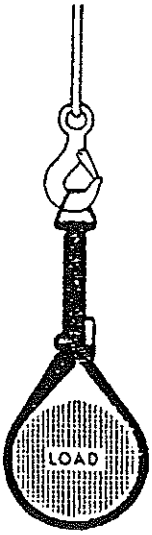
Straight

Using a strap to connect a lifting hook to a load is a straight or vertical attachment. Load rotation may cause damage to the strap. To prevent this, whenever a single strap is used, a tagline should also be used. When two or more straps are attached to the same hook in a straight or vertical method, it becomes a lifting bridle and the load is distributed equally among the individual straps.

STRAIGHT

Choker

Choker hitches affect the ability of components to adjust during a lift, thus reducing the lifting capacity of a strap. When the lift will require the strap to be snug against the load, and the load or the strap will not be seriously damaged, choker may be used. The diameter of the bend where the strap contracts the load should keep the point of choke against the strap body - never against a splice or the eye. When a choke is used at an angle of less than 135 degrees, the strap rated capacity must be adjusted downward to compensate for further loss of capability. A choker hitch should be pulled tight before a lift is made - not pulled down during the lift. It is also dangerous to use only one choker hitch to lift a load that might shift or slide out of the choke.



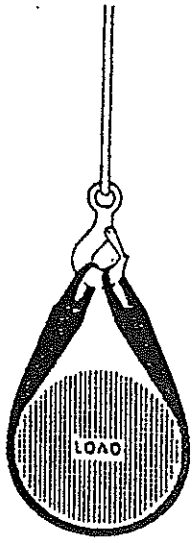
CHOKER

Basket

Basket hitches distribute a load equally between two legs of a strap - within limitations which will be addressed below. The capacity of a strap used in a basket is affected by the bend or curvature where the strap body comes in contact with the load - just as any wire rope is affected and limited by bending action as over a sheave.

Calculating the Load on Each Strap

As the included angle between the legs of a strap increase, the load on each leg increases. The effect is the same whether a single strap is used as a basket or two straps are used with each in a straight pull, as with a two-legged bridle. Any time pull is exerted at an angle on a leg or legs of a strap, the load per leg can be determined by using the data in the table on the following page. Proceed as follows to calculate the load and determine the proper strap use.



BASKET

Rated Capacity for Straps

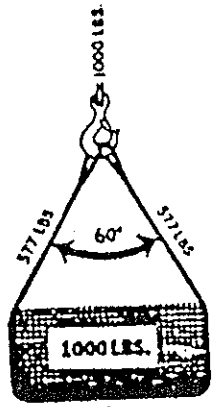
Web tensile strength is the foundation and starting point for the calculation.

Capacity = Safe Load (for a 5 to 1 safe load capacity)
5

Calculating Actual Load When the Legs Are At An Angle

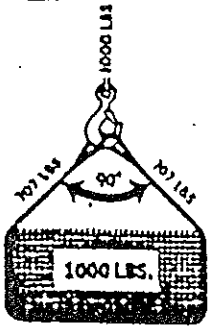
LEG ANGLE (Degree)	LOAD FACTOR
0	1.000
10	1.003
20	1.015
30	1.035
40	1.064
50	1.103
60	1.154
70	1.220
80	1.305
90	1.414
100	1.555
110	1.743
120	2.000

EXAMPLES:



1000 ÷ 2 = 500 (Load Per Leg if a vertical lift)

500 x 1.154 = 577 lbs. ACTUAL LOAD on each leg at the 60 included angle being used.



1000 ÷ 2 = 500 (Load Per Leg if a vertical lift)

500 x 1.414 = 707 lbs. ACTUAL LOAD on each leg at the 90 included angle being used.

1. First, divide the total load to be lifted by the number of legs to be used. This provides the load per leg if the lift is being made with all legs lifting vertically.

2. Determine the angle between the legs of the strap. When three or more legs are used, the angle will be twice the angle between one leg and an imaginary line extending straight down from the lifting hook.

3. Then multiply the load per leg (as computed in 1) by the Load factor for the leg angle being used (from the table) to compute ACTUAL LOAD on each leg for this lift and angle. The actual load must not exceed the calculated Safe Load.

Selecting A Strap

The following is presented as a guide in the help in the selection of a strap for a particular job.

1. Determine the load.

2. Decide on a hitch: Shape and bulk of the load must be accommodated as well as weight.

3. Adequacy of the winch: the winch must have adequate capacity for making the lift.

4. Room for the Recovery: This will affect the length of the strap.

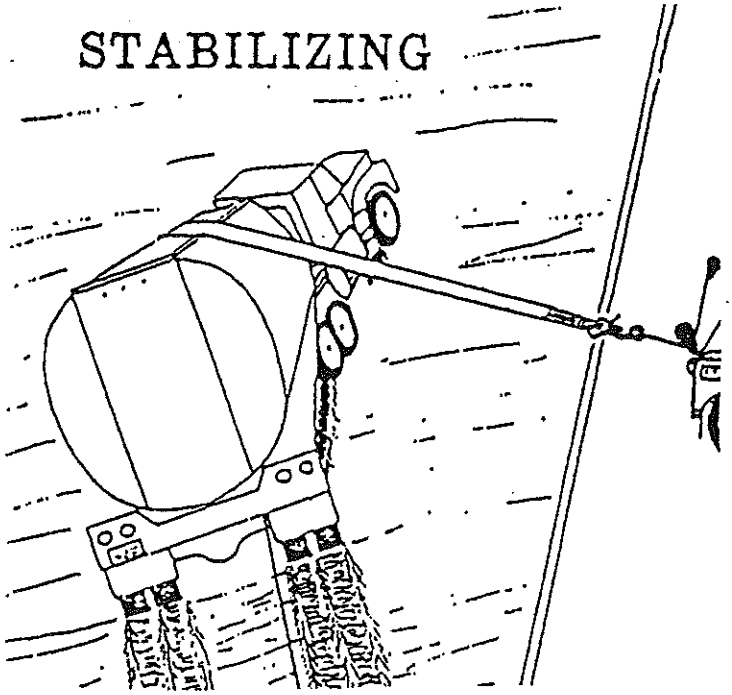
5. Length of the strap.

6. Use Rated Capacity Chart.

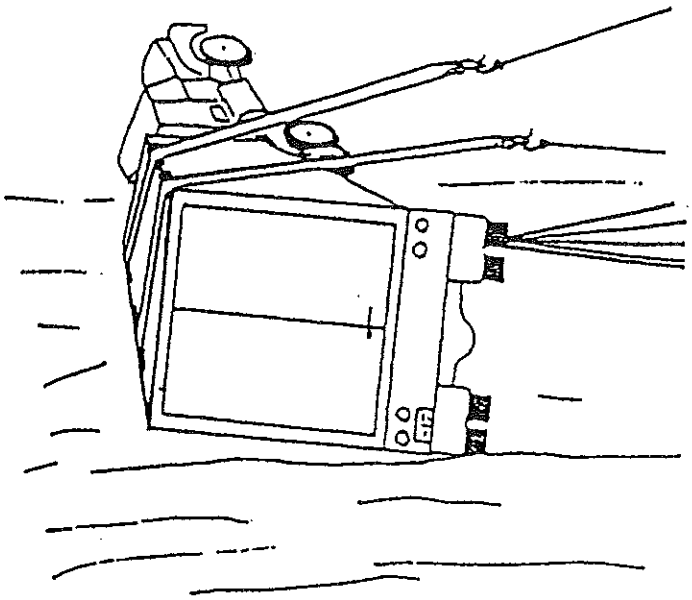
7. Plan to protect both the load and the strap from damage.

8. The strap should be visually examined from end to end before each use.

STABILIZING



RECOVERING



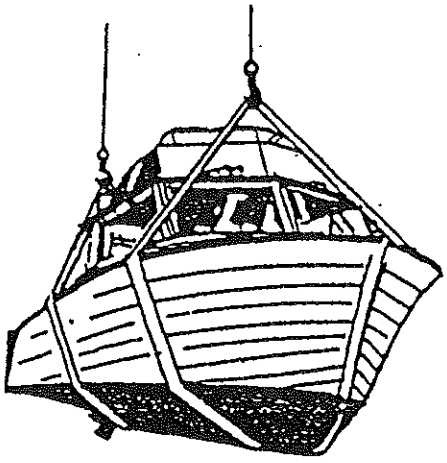
TO BUY (OR NOT BUY) STRAPS!

What did we do before straps such as these shown here? Of course, it is well known that recovery operators never do any damage, but without straps it is difficult to know how to handle most of these jobs without damage.

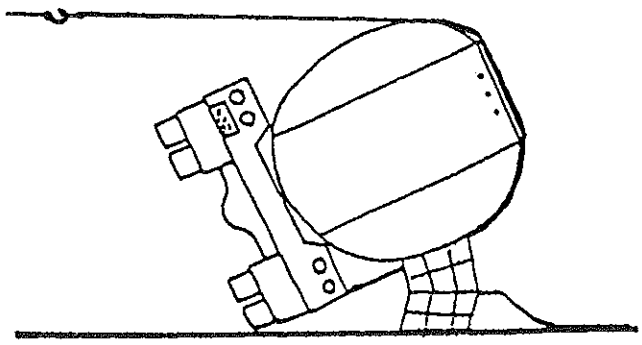
Since straps are available in any length, width, and strength, you can choose your own capacities. A pair of 26' long, 16" wide straps with a breaking strain of 100,000 lbs. Will do most of your work.

Do remember that straps have very different safe loads depending on whether you use them as a vertical lift, a choker, or a basket. When you order, tell the supplier what you want to do with the straps and rely on his expert advice.

MOVING



ASSISTING



SNATCH BLOCK REFERENCE

COUNT THE LINE PARTS GOING TO THE LOAD
HOW TO FIGURE LINE PARTS
LOADS ON BLOCKS
FITTING MAINTENANCE
SNATCH BLOCK MAINTENANCE
LUBRICATION

c. SNATCH BLOCKS

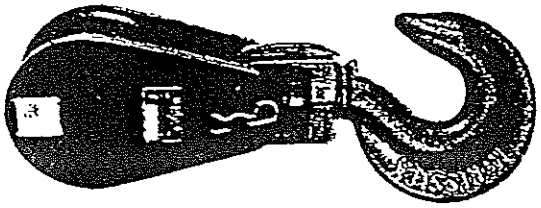
Definition: Block and tackle, a snatch block is a round sheave (a pulley) with a hole in the middle. Since it is round, it is a spinning lever. From the center core to the edge, the radius is the same all the way around. A sideplate is attached on both sides, a cable passed through and a hook connected to the end. As the snatch block spins, it changes the direction of the cable.

A snatch block has two uses: it changes direction or it builds mechanical advantage. The desired usage most of the time is to build mechanical advantage (to reduce line tension). If the snatch block is moving with the load, it is reducing tension, if it is not moving, it is changing the direction of the pull.

A single snatch block used to its best advantage would give the effect of connecting two lines to a load. We say the line has two parts or is a two-part line. Each of these two parts share the load equally, thus the tension on each part of a two-part line would be reduced to 1/2 the tension of a single line.

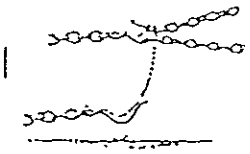
Tow operators use snatch blocks to increase the mechanical advantage of the tow truck and also use them for loads that would exceed the recommended working limits of wire rope. Snatch blocks have rating plates which show a rating of the safe working limit (SWL). The safe working limit or working load limit (WLL) is the maximum load that should be applied to the block. The load on a block varies with the angle of its line. *See reference following for "loads on blocks".

SNATCH BLOCKS

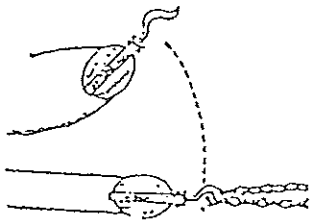


THE HOOK IN CORRECT WINCHING POSITION

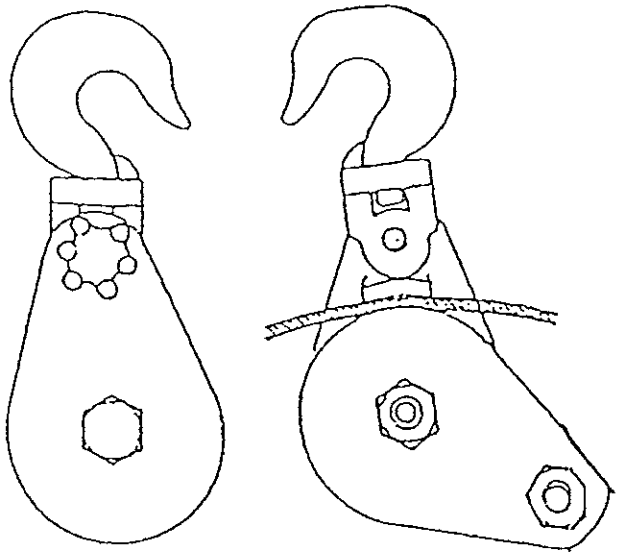
A. Hook broken, flys downward. Hook in Correct position.



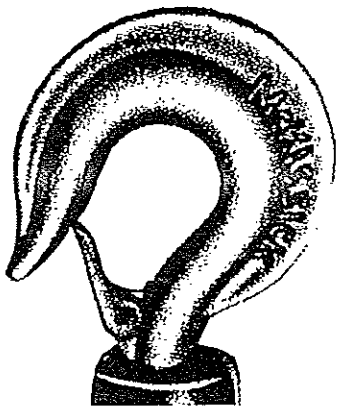
B. Hook broken, flys upward. Hook in incorrect position.



DROP SIDE SNATCH BLOCK. WE STRONGLY RECOMMEND USING THIS TYPE OF SNATCH BLOCK FOR TOWING RATHER THAN DROP LINK.



WITH HOOK LATCH

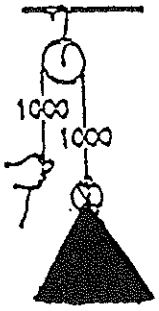


COUNT THE LINE PARTS GOING TO THE LOAD

Where snatch blocks are used to reduce line tension, always study the application in light of the information on the previous page. One way to help avoid errors in estimating tension on the lines is to note the number of line parts actually going to the load, disregarding the number of snatch blocks that are used. Each line part connected to the load will support an equal share of the load. Determine what that share is by dividing the number of line parts connected to the load into the total load. See the figure below.

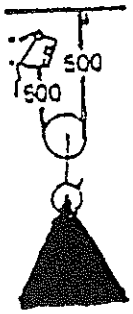
ONLY LINES CONNECTED TO LOAD REDUCE TENSION

One snatch block used, but only one line is connected to the load. The tension throughout the line is as great as the total load.



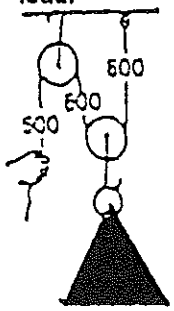
1,000 POUNDS

Again only one snatch block used. But now two lines are connected to the load. Each line shares only 1/ 2 the total load.



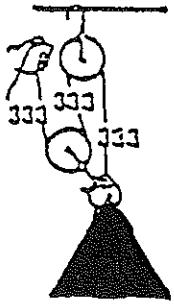
1,000 POUNDS

Two snatch blocks used. But only two lines are connected to the load. Each of the two lines shares ½ of the total load.



1,000 POUNDS

Again only two snatch blocks used. But now three lines are connected to the load. Each of the three lines shares 1/3 of the total load.

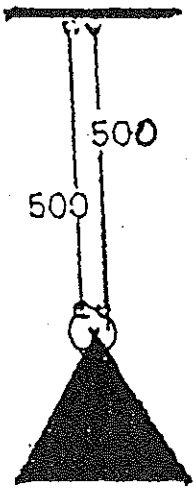


1,000 POUNDS

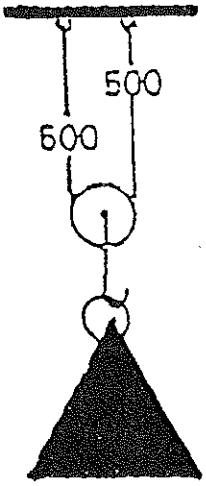
LINE ANGLES CAN CAUSE TROUBLE

In the previous explanations about line parts, no mention was made of line angles. The lines attached to the load are assumed to be parallel to each other. When parallel, the sum of the tensions on all lines attached to the load will be practically the same as the actual weight of the load. See the figure below.

TENSIONS PRODUCED WITH PARALLEL LINES



1,000 POUNDS



1,000 POUNDS

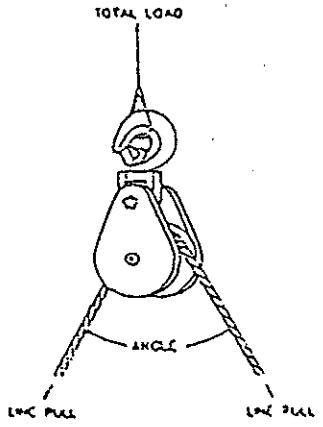
LOADS ON BLOCKS

The maximum load that should be exerted on a block and its fittings is called the Safe Working Load. Often there is more than one block in a lifting system. The total load enacted on each block in the system must be determined before a decision can be made for the rate capacity of the block to be used.

The total load on a single snatch block being used to change line direction can be vastly different from the weight being lifted or pulled. This difference varies with the angle between the incoming and departing lines of the block.

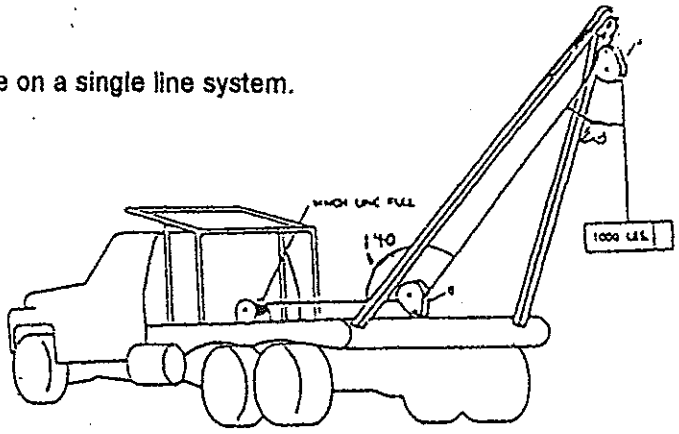
The following chart shows the angle factor to be multiplied by the line pull to obtain the total load on the block:

Angle Factor Multipliers			
Angle	Factor	Angle	Factor
0	2.00	100	1.29
10	1.99	110	1.15
20	1.97	120	1.00
30	1.93	130	.84
40	1.87	135	.76
45	1.84	140	.68
50	1.81	150	.52
60	1.73	160	.35
70	1.64	170	.17
80	1.53	180	.00
90	1.41	-	-



Calculations for determining total load value on a single line system.

Truck lifting 1,000 lbs.



Since this is a single line, there is no mechanical advantage. The line pull is equal to the weight being lifted.

To determine total load on snatch block A:
A = 1,000 lbs. X 1.73 (60 angle) = 1,730 lbs.

To determine total load on snatch block B:
B = 1,000 lbs. X .68 (140 angle) = 680 lbs.

FITTING MAINTENANCE

Observe the condition of hooks, shackles, links, etc. through regular inspection. All equipment becomes worn with use. All nicks, gouges, and sharp corners should be remedied. For smoothing surfaces, grinding is the procedure of choice. More than a 10 percent reduction in original dimension in load bearing areas from wear and repair could dictate a reduced Working Load Limit. Replace any part that has a crack or deformity.

SNATCHBLOCK MAINTENANCE

The regular inspection, lubrication, and maintenance is as important for peak performance of snatch blocks as for other equipment. The frequency of inspection and lubrication is directly related to the frequency of use and also to environmental conditions.

INSPECTION

1. Pins or axles, rope grooves, side plates, bushing or bearings, and fittings should be examined for wear. Excessive wear may be a cause to replace parts or remove block from service.

2. Side plates, pins and axles, fitting attachment points, trunnions, etc. should be checked for deformation. Deformation can be caused by abusive service and/or overload and may be a cause to remove snatch block from service.

3. Sheaves should be examined for wobble or misalignment.

4. Nuts, bolts, and other locking methods should be examined for security, especially after reassembly following a tear down inspection. Original securing method should be used; e.g., staking, set screw, collar pine, cap screw.

5. Pins retained by snap rings should be checked for missing or loose rings.

6. Sheave pin nuts should be end checked for proper positioning. Pins for tapered roller bearings should be tightened to remove all and play during sheave rotation. Pins for bronze bushings and straight roller bearings should have a running clearance of .031 inch of end play per sheave and should be adjusted accordingly.

7. Hook or shackle to swivel case clearance should be checked for increases over factory settings. Clearance is set at .031 to .062 at the factory. Increased clearance can result from component wear. Clearance exceeding 112 to 118 should necessitate disassembly and further inspection.

8. Hook and nut threads should be examined for deformation or corrosion.

9. The hook should be checked for surface condition and deformation.

10. Welded side plates should be examined for weld corrosion or weld cracking.

11. Hook latch should be examined for deformation, proper fit, and operation.

LUBRICATION

Assuming normal product use, the following lubrication schedule is suggested when using lithium-base grease of a medium consistency.

Sheave Bearings

Tapered Roller Bearings - Every 40 hours of continuous operation or every 30 days of intermittent operation.

Roller Bearings - Every 24 hoursof continuous operation or every 14 days of intermittent operation.

Bronze Bushings - (Not self-lubricated) - Every 8 hours of continuous operationor every 14 days of intermittent operation.

Hook Bearings - Anti Friction- Every 14 days for frequent swiveling; every 45 days for infrequent swiveling.

Bronze Thrust Bushing or No Bearing- Every 16 hours for frequent swiveling;
every 21 days for infrequent swiveling.

d. Winches

Winches are used to pull in loads and hoist them free of the ground. The single winch unit consists of one winch and one cable which is normally routed over the boom and sheaves -- it can limit the recovery capabilities of the towing unit but use of the snatch blocks greatly increase the unit's versatility.

Auxiliary winches are called drag winches and their cables are routed directly to the load without going over the boom. Some tow trucks have a manual winch for raising and lowering the boom. A twin winch unit consists of two winches and two cables.

Twin winches give you the ability to spread the pull over several attachment points. They also allow you to do vertical lifts while making horizontal pulls. Twin winches can compensate for more weight at one specific attachment point.

Winches have two types of controls: Power Control
Engagement Control

The engagement control engages and disengages the winch drive system. It must be engaged before the winch can be operated under power. When disengaged, the drum free-wheels and cable can be pulled out by hand.

The in-out control has two operating directions, usually indicated by a nameplate. Returning the control to its center position stops winch movement. The control automatically returns to the center position, but if it is not in good working order, it may stick, which could cause the winch cable to move under power. Never release the control handle and walk away without making sure the winch has actually stopped.

Planetary and Worm Gear Winches

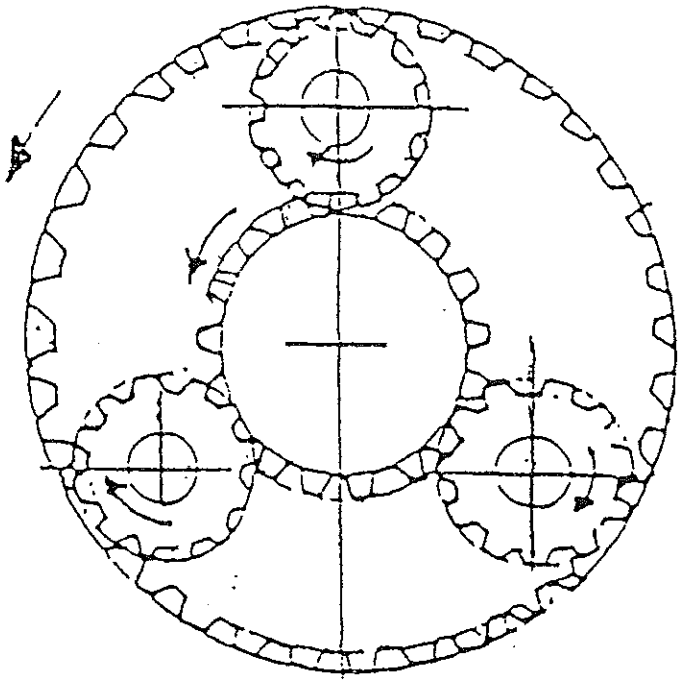
As the planetary winch illustration shows, the three gears within the planetary winch rotate around the center gear with a reduction of approximately 5:1 in each set of

planetary gears. There are three such sets in the DP Planetary Winch, resulting in the total reduction of approximately 140:1 (30 ton winches).

As the gears mesh directly, the planetary winch is 78 percent efficient, compared to 45 to 50 percent for the worm gear winches. Accordingly, there is less heat build-up in a planetary winch, which means longer service life, as heat tends to destroy seals and other components in the winch.

Due to the gear design, a planetary winch can run as much as 2½ times faster than a worm gear winch. In case of the Vulcan's DP on the 940, two pumps are used which deliver 20 gallons per minute for a total of 40 gallons per minute to the winch with lower loads. The winch operates at maximum speed until a heavier load is imposed, at which time the winch automatically slows down for greater control.

The planetary winch uses a wet disc brake system whenever the system is in neutral. The DP winch also has an air-operated free spool, which engages the gear trains.



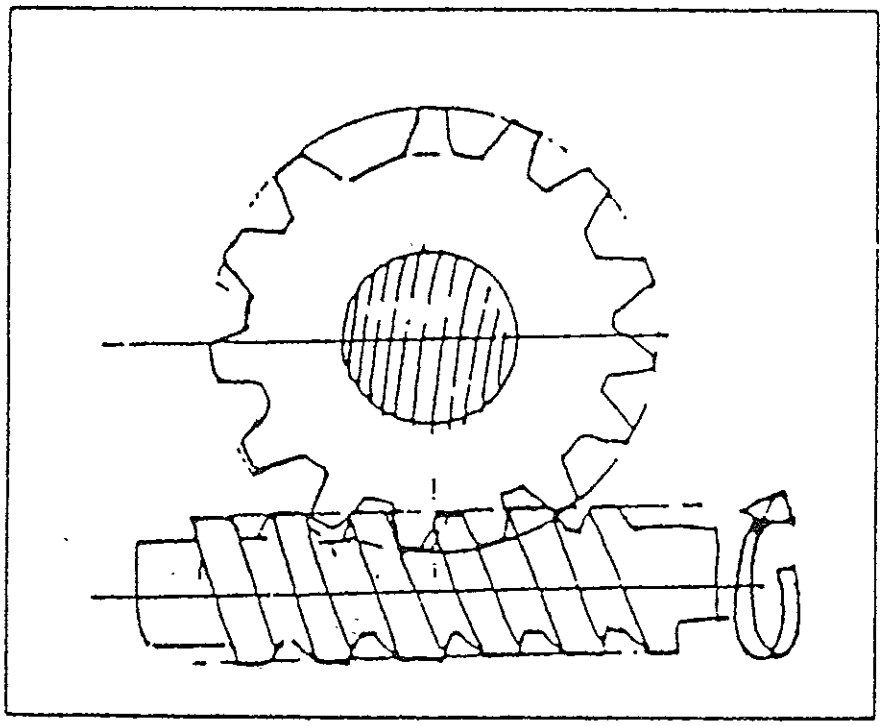
The worm gear winch operates with a single worm and interfacing bevel gear that has a direct reduction of 40:1. This type of system has more friction and accordingly the efficiency is 50 percent of the efficiency of the planetary gear winch.

A worm gear winch operates slower than a planetary winch, and there is no automatic speed reduction.

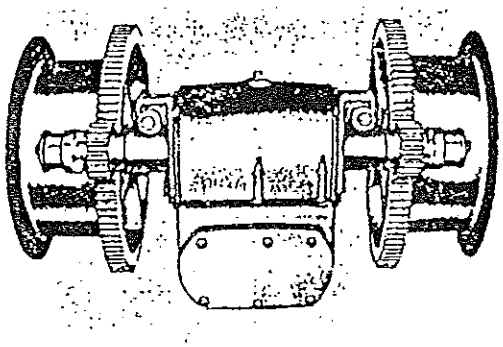
A brake is built into the system of a worm gear winch, and independent air-free spool actuation disengages the drive shaft of the drum

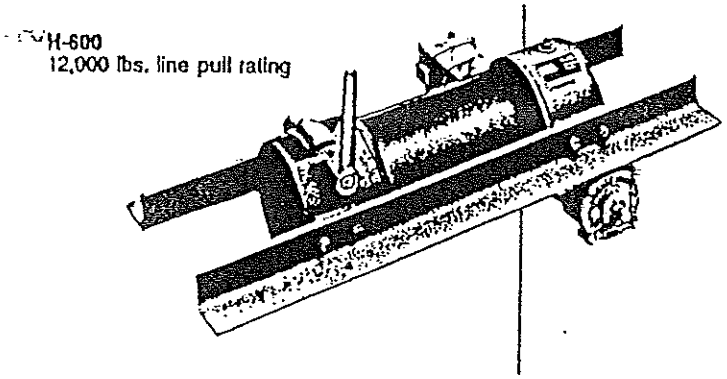
Worm gear winches have done an adequate job for the industry and have provided a reliable service. Today, however, the planetary winch is the ideal work horse for heavy duty recovery.

WORM GEAR WINCH

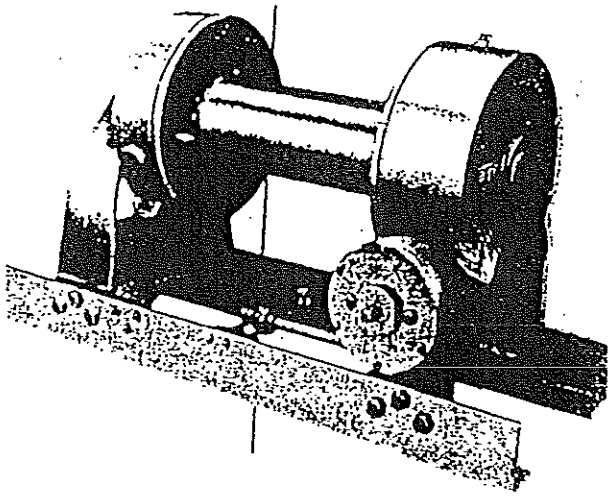


PERIMETER DRIVE AND CENTER DRIVE WINCHES





Rapid-reverse, twin-worm power unit.
Two worm-drive units in one case, each provides independent, single lever control of each drum.
Large drums store more cable in fewer layers, keep cable pile up and pinching to a minimum.



CAR

CARRIER

"Operating Your Car Carrier" reproduced from *Tow Times*, March 1994

OPERATING YOUR CAR CARRIER

Controls:

- PTO
- Throttle
- Cable drum engagement
- Winch cable
- Bed travel
- Bed tilt
- Tow bar
- Wheel-lift

Using the winch

Placing loads

Securing loads

Loading and unloading the bed

Positioning the bed for ground level loading and unloading

Positioning the bed for travel

Loading an auto onto the bed

Towing an auto

Hooking up to a tow bar

Loading a wheel-lift