ALDON COMPANY, INC.
WAUKEGAN, ILLINOIS

GUIDELINES AND WARNINGS
FOR USING ALDON RAILROAD CAR PULLING ROPE AND FITTINGS

PLEASE READ ALL PAGES

These Guidelines and Warnings are designed to help your workers use Aldon car pulling rope, shackles and hooks in a safe and effective manner. Please be aware that no supplier guidelines or warnings can anticipate all the possible railcar pulling situations. The customer and its workers are ultimately responsible for taking care that the rope assemblies are used in a safe and proper manner. We recommend that only well-trained and well-supervised workers should use Aldon car pulling rope, shackles, and hooks.

ALL WORKERS WHO ARE IN THE AREA WHERE CAR PULLING TAKES PLACE SHOULD READ THESE GUIDELINES AND WARNINGS AND APPLY THEM WHEN USING CAR PULLING ROPE ASSEMBLIES. USE COMMON SENSE AT ALL TIMES.

1. The use of the rope assembly (rope, shackle, hook) should be limited to vertical, smooth-drum capstans, minimum drum diameter of 12", with maximum drum output capacity of 20,000 lbs. DO NOT use the Aldon car pulling rope assembly on capstans having greater output force than 20,000 lbs.

2. **TRACK MUST BE FLAT.** Do not use a capstan car puller or this rope assembly if the track is sloped. You cannot hold the load on a slope, and if you try to pull railcars downhill, you will lose control of them.

3. When pulling railroad cars, **NEVER STAND IN DIRECT LINE OF THE ROPE OR NEAR THE ROPE**. Rope is elastic. Under load, a rope can suddenly break and recoil in both directions at extremely high speed. You can be seriously injured if you are standing in line with or near the recoiling rope.

CAPSTAN OPERATOR:

Always stand at right angle to the line of the stretched rope, and far enough away to avoid being struck by the rope if it breaks, or if the hook or shackle come loose. An adequate barrier may be needed to protect the capstan operator.

A buzzer, horn, or other warning system should be used to alert all workers to clear out of the area before car pulling begins, and to alert all workers when it is safe to return.

Before starting to pull a railcar, the capstan operator should signal to all workers to immediately leave the area. Once the operator has given the signal, the operator should make sure that the car pulling area is completely clear of workers and other personnel. When a car movement is completed, and the rope is lying relaxed on the ground, the operator can then give the all-clear signal.

ALL OTHER PEOPLE:

When the capstan operator signals that car pulling is about to begin, leave the area at once, getting far enough away to avoid being struck by a broken recoiling rope or loose shackle or hook.

DO NOT STAND between the hooking point on the railcar and the capstan, nor behind the hooking point.

Adequate barriers may be needed to protect all workers in the general area of car pulling. Do not return to the car pulling area until the capstan operator has given the all-clear signal, and you can see that the rope is lying relaxed on the ground.

4. **THE RAILCAR MUST BE FREE TO ROLL**. Before using the rope assembly to pull railcars, railcar brakes (air and mechanical) must be off, all wheel chocks and other blocking devices must be removed from the rails, and rails and flangeways must be clear of debris, ice and snow. In winter, car wheels can freeze to the rails. You may need to thaw the wheels before you can pull the car.

5. **BEFORE EACH USE OF THE CAR PULLER ROPE ASSEMBLY** inspect the rope, hook and shackle for any signs of heavy wear, distortion, defect, noticeable wear, loose fit or improper assembly.

   - Replace rope if the jacket is frayed or cut, and/or rope strands are broken. A frayed jacket or broken rope strands mean that the rope is weakened and may break under load. Inspect rope splice for broken strands or loose fit in the thimble. Replace the rope at once if these conditions are present.
   - Be sure the screw pin shackle is fully engaged (not partially engaged) and that the screw pin stays put. Apply enough force on the thumb tab of the screw pin to seat the screw firmly. Check screw tightness after each pull. Replace the shackle when it shows sign of noticeable wear, distortion, loose fit, or if the screw cannot be fully inserted. If the screw pin is rusty, clean off the rust. If rust is heavy, replace the shackle with a new one.
   - Replace hook if any sign of distortion or noticeable wear appears.

7. **DO NOT substitute** Aldon components with other types or brands of components. **DO NOT alter** Aldon components.

8. Aldon's car pulling rope is designed for capstan car pullers and has a low stretch factor. NEVER use high-stretch rope, like nylon, as an alternative. Too much stretch can cause rope to suddenly break, with serious injury potential for workers.

9. The car pulling hook should be inserted in the designated receptacle on the railcar. The hook should be securely engaged in the receptacle and be lying in line with the rope. Never hook to car couplers, grab irons, steps, ladders, wheel frames or other parts of the railcar. They will not hold. UNDER LOAD, A HOOK AND/OR CAR PART THAT BREAKS FREE CAN CAUSE SERIOUS OR LETHAL INJURY.

10. Be sure the motor is off and the power locked out before you install the rope on the capstan drum. Apply 3 to 4 wraps of rope on the drum, no more. If the car cannot be pulled with 3 to 4 wraps, something may be blocking the wheels, or you are trying to pull too many railcars. Additional wraps of rope around the drum will not increase pulling force. The operator should instead drop the rope, turn off the motor, lock out the power, and investigate the cause of blockage.

11. **NEVER wrap the rope around your body** in an effort to gain more pulling power. If the motor stalls, or the cars stop moving forward and roll backwards, you could be forcibly thrown against the capstan drum and seriously injured.

12. **KEEP FINGERS AND HANDS AWAY FROM THE ROPE AS IT WINDS ON THE DRUM. NEVER PUT YOUR HANDS OR FINGERS BETWEEN THE ROPE COILS AND THE DRUM.** If the rope coils are tangled on the drum, drop the rope, turn off the motor, lock out the power source. Then rearrange the coils on the drum.

13. For best control, keep both hands on the rope at all times. If the drum stops turning, or the cars do not start to move, or if the railcars unaccountably stop during pulling, drop the rope, turn off the motor, and lock out the power. Then find out the reason for the stoppage.

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THANK YOU
for selecting rope manufactured by Samson

THE STRONGEST NAME IN ROPE

THE IMPROPER USE OF ROPE MAY BE DANGEROUS.

- Use the right size and rope construction for the job
- Make sure you use the rope safely
- Never stand in line with the rope under tension
- Avoid abrasive surfaces
- Do not overload rope
- Do not shock load rope
- Do not bend rope over sharp corners
- Check temperature rating before using rope in hot environments

See inside for additional information on safe usage of rope.

Instructions on the use and splicing of this rope are available from your local authorized distributor online at *SamsonRope.com* or via email, contact *CustServ@SamsonRope.com*.

WARNING

The use of rope for any purpose subjects it to friction, bending, and tension. All rope hardware, sheaves, rollers, capstans, cleats, and knots are, in varying degrees, damaging to the rope. It is important to understand that rope is a moving, working strength member, and, even under ideal conditions, it will lose strength during use in any application. Maximizing the safety and rope performance begins with selecting the right rope, managing its strength loss through optimal handling practices, and retiring it from service before it creates a dangerous situation. Ropes are serious working tools, and when used properly they will give consistent and reliable service. The cost of replacing a rope is extremely small when compared to the physical damage or injury to personnel a worn out rope can cause.

ROPE SELECTION

Selecting a rope involves evaluating a combination of factors. Some of these factors are straightforward like comparing rope specifications. Others are not easily quantified, such as a preference for a specific color or how a rope feels in your hand. Reducing application factors that pertain to sizes or strengths on an initial purchase creates unnecessary frequent replacements and potentially dangerous conditions, in addition to increasing long-term costs. For ropes of equal fiber and construction, a larger rope will outlast a smaller rope because of the greater surface-wear distribution. Similarly, a stronger rope will outlast a weaker one because it will be used at a lower percentage of its break strength with a reduced chance of it being overstressed.

STRENGTH

When given a choice between ropes, select the strongest of any given size. A load of 200 pounds represents 2% of the strength of a rope with a breaking strength of 10,000 pounds. The same load represents 4% of the strength of a rope that has a breaking strength of 5,000 pounds. The weaker rope will have to work harder and as a result will have to be retired sooner.

Our published strengths and test results reflect as accurately as possible the conditions under which they are to be used. Because all ropes are terminated with a splice, all published strengths herein are spliced strengths. This is so the customer can select the appropriate size and strength of the rope for the application, and to ensure the utmost in safety and length of service life. This ensures that you are selecting the best sizes and strengths for your actual application and use of the rope. When comparing our data to that of other rope manufacturers, please be sure that spliced strengths are used.

ELONGATION

It is widely accepted that ropes with lower elongation under load will give you better load control, which is a big help at complicated job sites. However, a rope with lower elongation that is shock loaded can fail without warning even though it appears to be in good shape. Low elongating ropes should be selected with the highest possible strength. Twisted rope has lower strength and more stretch. Braided rope has higher strength and lower stretch.

SHOCK LOADING

Whenever a load is picked up, stopped, moved, or swung there is an increased force caused by the dynamic nature of the movement. The force increases as these actions occur more rapidly or suddenly, which is known as "shock loading." Any sudden load that exceeds the working load by more than 10% is considered a shock load.,The farther an object falls, the greater the impact. Synthetic fibers have a memory and retain the effects of being overloaded or shock loaded. A rope that has undergone shock loading can fail at a later time even though it is loaded within the working load range.

Examples of applications where shock loading occurs include rope used as a towline, picking up a load on a slack line, or using rope to stop a falling object. In extreme cases, the force put on the rope may be two, three, or more times the normal load involved. Shock-loading effects are greater on a low elongation rope such as polyester than on a high-elongation rope such as nylon, and greater on a short rope than on a long one.

For dynamic loading applications that involve severe exposure conditions, or for recommendations on special applications, consult the manufacturer.

FIRMNESS

Select ropes that are firm and round and hold their shape during use. A soft or loose rope construction will snag easily and abrade quickly causing accelerated strength loss. However, the same construction will almost always have higher break strengths than a similar rope that is firm and holds its shape because the fibers are in a straighter line, which improves strength but compromises durability.

CONSTRUCTION AND ABRASION

Choosing the right rope construction plays an important role in the longevity of the rope because of how it impacts resistance to normal wear and abrasion. Braided ropes have a round, smooth construction that tends to flatten out somewhat on a weight bearing surface. This distributes the wear over a much greater area, as opposed to the crowns of a 3-strand or, to a lesser degree, an 8-strand rope.

WORKING LOADS

Working loads are the loads that a rope is subjected to in everyday activity. For rope in good condition with appropriate splices, in noncritical applications, and under normal service conditions, working loads are based on a percentage of the approximate breaking strength of new and unused rope of current manufacture. For the products depicted in this catalog, and when used under normal conditions, the working load percentage is 20% of published strengths.

Normal working loads do not cover dynamic conditions such as shock loads or sustained loads, nor do they cover where life, limb, or valuable property are involved. In these cases, a lower working load must be used. A higher working load may be selected only with expert knowledge of conditions and professional estimates of risk, if the rope has been inspected and found to be in good condition, and if the rope has not been subject to dynamic loading (such as sudden drops, snubs, or pickups), excessive use, elevated temperatures, or extended periods under load.

ROPE CLASS

All Samson ropes are categorized for splicing and testing purposes as a Class I or Class II construction.

Class I ropes are produced with non high-modulus fibers that impart the strength and stretch characteristics to the rope, which have tenacities of 15 grams/denier (gpd) or less and a total stretch at break of 6% or greater. Class I ropes are produced with traditional fibers such as: polypropylene or polyethylene), nylon, and polyester.

Class II ropes are produced with high-modulus fibers that impart the strength and stretch characteristics to the rope which have tenacities greater than 15 grams/denier (gpd) and a total stretch at break of less than 6%. Typical Class II ropes are produced with: HMPE (Dyneema®), aramid (Technora®), LCP (Vectran®), PBO (Zylon®), and carbon fibers.

Both Class I and Class II ropes can be produced in various rope constructions such as: 3-strand, 8-strand, 8x3-strand, 12-strand, double braids, or core-dependent braids.

ROPE USAGE

DANGER TO PERSONNEL

Persons should be warned against the serious danger of standing in line with a rope under tension. Should the rope part, it may recoil with considerable force and speed. In all cases where any such risks are present, or where there is any question about the load involved or the condition of use, the working load should be substantially reduced and the rope properly inspected before every use.

INSTALLING ROPE ON A WINCH

A minimum of the first 3 or 4 layers of rope around the winch storage drum should be installed so the rope has a close and tight fit on the drum. The installation tension on the rope should be approximately 5% of the rope's minimum breaking strength. For new rope installations, the greater the number of wrap layers installed under the suggested tension will minimize or prevent subsequent wraps from diving or burying down into lower wraps. As the rope is used, the wrap tensions may loosen, it is suggested the total rope be retensioned at original installation loads and thereby prevent potential downward wrap slippage. A single drum or split drum winch, should always keep a minimum of 8 to 10 wraps of rope on the drum at all times. This is to ensure that the connecting point of the rope to the winch does not under go load.

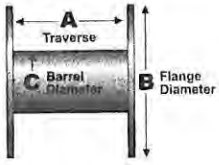
ROPE CAPACITY OF A WINCH DRUM

Effect of rope diameter on drum capacity.

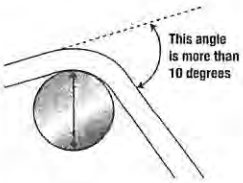
The formula for determining the length of rope that will fit on a winch drum is:

$$\text{LENGTH TO BE STORED} = \frac{A\,(B^2 - C^2)}{15.3\ (\text{rope diameter})^2}$$

(Where *A*, *B*, *C*, and rope diameter are expressed in inches and length (*L*) is expressed in feet.)

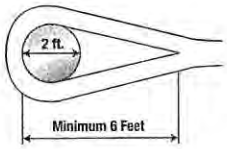


BENDING RADIUS



Any sharp bend in a rope under load decreases its strength substantially and may cause premature damage or failure. In sizing the radius of bitts, fairleads, and chocks for best performance the following guidelines are offered. Where a rope bends more than 10 degrees around or across any surface, the diameter of that surface should not be less than 3 times the diameter of the rope. Stated another way, the diameter of the surface should be at least three times the rope's diameter. A 4:1 ratio (or larger) would be better yet because the durability of the rope increases substantially as the diameter of the surface over which it is worked increases.

EYE SPLICES



The ratio of the eye-splice length to the diameter of the object over which the eye is to be placed (bollard, bitt, cleat, etc.) should be a minimum 3:1 relationship (thimbles are normally designed with a 3:1 ratio) and preferably 5:1. Therefore, if you have a bollard two feet in diameter, the eye splice should be six to ten feet in length. By observing this recommendation, the angle of the two legs of the eye splice at its throat will not be so severe as to cause a parting or tearing action.

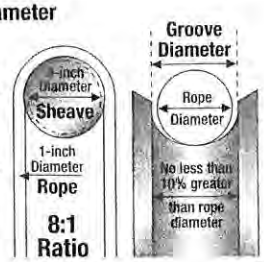
On a cleat when the rope does not bend radially, the barrel of the cleat can be one-half the rope's circumference (minimum).

SHEAVE DIAMETERS AND SIZES

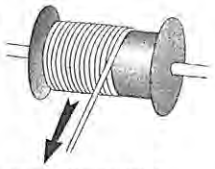
SHEAVE DIAMETERS SHOULD BE:

- **Twisted/Plaited Ropes = 10 times rope diameter**
- **Braided Ropes = 8 times rope diameter**

To assure maximum efficiency and safety, sheaves for braided ropes should be no less than eight times the rope diameter. The sheave groove diameter should be no less than ten percent greater than the rope diameter. The sheave groove should be round in shape. (Sheaves with "V" shaped grooves should be avoided, as they tend to pinch and damage the rope through excessive friction and crushing of the rope fibers.) Sheave surfaces should be kept smooth, and free of burrs and gouges. Bearings should be maintained to ensure smooth rotation of sheaves.



REMOVING ROPE FROM REEL OR COIL



Synthetic-fiber rope should be removed from the reel by pulling it off the top while the reel is free to rotate.

Synthetic fiber ropes are normally shipped on reels for maximum protection while in transit. The rope should be removed from the reel by pulling it off the top while the reel is free to rotate. This can be accomplished by passing a pipe through the center of the reel and jacking it up until the reel is free from the deck. Rope should never be taken from a reel lying on its side. If the rope is supplied on a coil, it should always be uncoiled from the inside so that the first turn comes off the bottom in a counter clockwise direction.

AVOID KINKING AND HOCKLING

The continuous use of a line on one side of a winch or windlass is a common abuse that can render a line useless in a comparatively short time. Repeated hauling of a line over a winch in a counterclockwise direction will extend the lay of the rope and simultaneously shorten the twist of each strand. As this action continues, hockles (or kinks) will develop. Once these hockles appear, they cannot be removed and the rope is permanently damaged at the point of hockling.

If, on the other hand, the line is continuously hauled over a winch in a clockwise direction, the rope lay is shortened the rope becomes stiff and readily kinks.

To avoid detrimental conditions, the direction of turns over the winch should be alternated regularly. Clockwise turns are recommended for the initial use of a new line. If this practice is observed, the original rope balance will be maintained and the lines will have a much longer useful life.

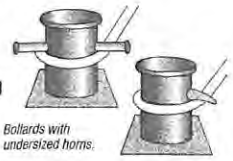
MINIMIZE TWIST IN THE LINE

A braided or plaited rope, being torque-free, can have twist induced by constant working on winches and capstans. If a twist develops, it can easily be removed by "counter-rotating" the rope when it is relaxed.

As little twist as four turns per three feet (or meter) introduced into the line can cause as much as 10 to 30% reduction of strength. Another way to help prevent twist is to preset the line. Once these ropes have been loaded, they do not return to their original dimensions. A rope that has been preset is less likely to accept permanent twist. Presetting should be performed only on new and unused rope, and with extreme caution. For lines in use that have not been preset, alternate wrap directions on the bitt to minimize twist each time the line is used.

UNDERSIZED HORNS

In the tug industry, many tugboats using 8- and 9-inch-circumference headlines in ship-handling work have bitts 18 inches in diameter or greater, which are adequate bending radii. However, many of these bow and shoulder bitts are equipped with "horns" of a relatively small diameter (5 or 6 inches), and it is these horns under or over which the lines pass and bend first in many cases, resulting in a shortened rope life. It is recommended that the hardware be replaced with the appropriate sized horns to avoid excessive rope replacement costs.



Bollards with undersized horns.

AVOID ALL ABRASIVE CONDITIONS

All rope will be severely damaged if subjected to rough surfaces or sharp edges. Chocks, bitts, winches, drums, and other surfaces must be kept in good condition and free of burrs and rust. Pulleys must be free to rotate and should be of proper size to avoid excessive wear.

AVOID OVERHEATING

Heat can seriously affect the strength of synthetic ropes. When using rope where the temperature exceeds 250° (or if it is too hot to hold), consult the manufacturer for recommendations as to the size and type of rope for the proposed continuous heat-exposure conditions. When using ropes on a capstan or winch, care should be exercised to avoid surging while the capstan or winch head is rotating. The friction from the slippage causes localized overheating, which can melt or fuse synthetic fibers, resulting in severe loss of tensile strength.

The critical and melting temperatures for synthetic fibers are listed below:

TEMPERATURES	Critical	Melting
Dyneema®	150° F	300° F
Polypropylene	250° F	330° F
Nylon	325° F	425° F
Polyester	350° F	480° F
Technora	450° F	900° F*

**While the term "melting" does not apply to these fibers, they do undergo extreme degradation at these temperatures: Technora chars.*

AVOID CHEMICAL EXPOSURE

Rope is subject to damage by chemicals. Consult the manufacturer for specific chemical exposure, such as solvents, acids, and alkalis. Consult the manufacturer for recommendations when a rope will be used where chemical exposure (either fumes or actual contact) can occur.

ROPE STORAGE: COILING, FLAKING, AND BAGGING

Great care must be taken in the stowage and proper coiling of 3-strand ropes to prevent the natural built-in twist of the line from developing kinks and hockles. Braided ropes on the other hand have no built-in twist and are far more resistant to kinking. Even if kinks do develop, they cannot develop further into hockles.

3-strand and braided ropes should be coiled in a clockwise direction (or in the direction of the lay of the rope) and uncoiled in a counterclockwise direction to avoid kinks. An alternate and perhaps better method is to flake out the line in a figure eight. This avoids putting twist in the line in either direction and lessens the risk of kinking.

Bagging is the most common method of storing braided or twisted lines. The rope is allowed to fall into its natural position without deliberate direction.

STORAGE

All rope should be stored in a clean, dry area, out of direct sunlight, and away from extreme heat. It should be kept off the floor and on racks to provide ventilation underneath. Never store rope on a concrete or dirt floor, and under no circumstances should cordage and acid or alkalis be kept in the same vicinity. Some synthetic rope (in particular polypropylene and polyethylene) may be severely weakened by prolonged exposure to ultraviolet (UV) rays unless specifically stabilized and/or pigmented to increase UV resistance. UV degradation is indicated by discoloration and the presence of splinters and slivers on the surface of the rope.

KNOTS

While it is true that a knot reduces rope strength, it is also true that a knot is a convenient way to accomplish rope attachment. The strength loss is a result of the tight bends that occur in the knot. With some knots, ropes can lose up to 50% of their strength. It is vital that the reduction in strength by the use of knots be taken into account when determining the size and strength of a rope to be used in an application. To avoid knot strength reduction, it is recommended that a rope be spliced according to the manufacturer's instructions. Splice terminations are used in all our ropes to determine new and unused tensile strengths. Therefore, whenever possible, spliced terminations should be used to maximize the rope strength for new and used ropes.

INSPECTION AND RETIREMENT

One question frequently asked is "When should I retire my rope?" The most obvious answer is before it breaks. But, without a thorough understanding of how to inspect it and knowing the load history, you are left making an educated guess. Unfortunately, there are no definitive rules nor are there industry guidelines to establish when a rope should be retired because there are so many variables that affect rope strength. Factors like load history, bending radius, abrasion, chemical exposure or some combination of those factors, make retirement decisions difficult. Inspecting your rope should be a continuous process of observation before, during, and after each use. In synthetic fiber ropes, the amount of strength loss due to abrasion and/or flexing is directly related to the amount of broken fiber in the rope's cross section. After each use, look and feel along every inch of the rope length inspecting for abrasion, glossy or glazed areas, inconsistent diameter, discoloration, and inconsistencies in texture and stiffness.

VISUAL INSPECTION

The load-bearing capacity of double braid ropes such as Stable Braid is divided equally between the inner core and the outer cover. If upon inspection, there are cut strands or significant abrasion damage the rope must be retired because the strength of the entire rope is decreased.

Core-dependent double braids such as AmSteel® II have 100% of their load-bearing capacity handled by the core alone. For these ropes, the jacket can sustain damage without compromising the strength of the load-bearing member. Inspection of core-dependent double braids can be misleading because it is difficult to see the core.

ABRASION

For double braid ropes, 50% wear on the cover is the retirement point, and with 3-strand ropes, 10% or more wear is accepted as the retirement point.

GLOSSY OR GLAZED AREAS

Glossy or glazed areas are signs of heat damage with more strength loss than the amount of melted fiber indicates. Fibers adjacent to the melted areas are probably damaged from excessive heat even though they appear normal. It is reasonable to assume that the melted fiber has damaged an equal amount of adjacent unmelted fiber.

DISCOLORATION

With use, all ropes get dirty. Be on the lookout for areas of discoloration that could be caused by chemical contamination. Determine the cause of the discoloration and replace the rope if it is brittle or stiff.

INCONSISTENT DIAMETER

Inspect for flat areas, bumps, or lumps. This can indicate core or internal damage from overloading or shock loads and is usually sufficient reason to replace the rope.

INCONSISTENT TEXTURE

Inconsistent texture or stiff areas can indicate excessive dirt or grit embedded in the rope or shock load damage and is usually reason to replace the rope.

RESIDUAL STRENGTH

Samson offers customers residual strength testing of our ropes. Periodic testing of samples taken from ropes currently in service ensures that retirement criteria are updated to reflect the actual conditions of service.

INSPECTION AND RETIREMENT CHECKLIST*

Any rope that has been in use for any period of time will show normal wear and tear. Some characteristics of a used rope will not reduce strength while others will. Here we have defined normal conditions that should be inspected on a regular basis.

If upon inspection you find any of these conditions, you must consider the following before deciding to repair or retire it:

> the length of the rope,
> the time it has been in service,
> the type of work it does,
> where the damage is, and
> the extent of the damage.

In general, it is recommended to:

> Repair the rope if the observed damage is in localized areas.
> Retire the rope if the damage is over extended areas.

*REFERENCES Cordage Institute International, *International Guideline CI2001-04, Fiber-Rope Inspection and Retirement Criteria: Guidelines to Enhance Durability and the Safer Use of Rope,* 2004.

DOUBLE BRAID vs. CORE-DEPENDENT

Double braid ropes consist of a cover or jacket braided over a separately braided core. Samson produces two types of double braided ropes: standard double braids and core-dependent double braids.

The strength of standard double braid ropes is shared between the cover and the core. Damage to the cover also usually affects the core and ultimately the strength of the rope.

In core-dependent double braids, the core is the strength member and carries the entire load. Damage to the cover of a core-dependent double braid may not compromise strength of the rope.

Inspection of both standard double braids and core-dependent double braids is essential to determining whether the rope can be repaired or if it needs to be retired.

Repair the rope if the observed damage is in localized areas.
Retire the rope if the damage is over extended areas.

SINGLE BRAID INSPECTION

Rope displaying original bulk.

☐ CUT STRANDS

> 12-strand braid by two or more adjacent strands cut
> 8-strand plait and 3-strand by one or more adjacent strands cut

☐ REDUCED VOLUME (from abrasion)

> 12-strand braid and 8-strand plait by 25%
> 3-strand by 10%

☐ MELTED OR GLAZED FIBER

> Visibly charred and melted
> Extreme stiffness unchanged by flexing the rope

☐ COMPRESSION

> Visible sheen
> Stiffness reduced by flexing the rope
> Not to be confused with melting
> Not a permanent characteristic

☐ PULLED STRAND

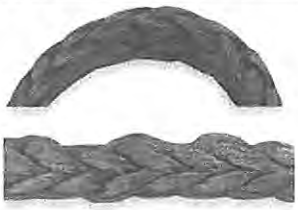
> Strand can be worked back in to rope
> Not a permanent characteristic

☐ DISCOLORATION

> Brittle
> Stiff
> Embedded dirt
> Chemical contamination

☐ INCONSISTENT DIAMETER

> Localized diameter reduction
> Flat areas
> Lumps and bumps



DOUBLE BRAID INSPECTION

Rope displaying original bulk.

☐ CUT STRANDS

DOUBLE BRAID: *Repair or retire* **CORE-DEPENDENT:** *May not affect strength*

> Double Braid* by three or more adjacent strands cut

*Refers to double braids that have both core and cover strength members

☐ REDUCED VOLUME

DOUBLE BRAID: *Repair or retire* **CORE-DEPENDENT:** *May not affect strength*

> Double Braid* cover by 50%

*Refers to double braids that have both core and cover strength members

☐ MELTED OR GLAZED FIBER

> Visibly charred and melted
> Extreme stiffness unchanged by flexing the rope

☐ DISCOLORATION

> Brittle
> Stiff
> Embedded dirt
> Chemical contamination

☐ INCONSISTENT DIAMETER

> Localized diameter reduction
> Flat areas
> Lumps and bumps

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Ferndale, WA 98248

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or +1 360.384.4669
Fax: +1 360.384.0572
SamsonRope.com

samson®
THE STRONGEST NAME IN ROPE

G-209

Shackles

G-2130

The Market Leader: Yesterday, Today and Tomorrow

"Crosby: There is No Equal"

	COMPETITION	CROSBY
DESIGN The theoretical reserve capability of carbon shackles should be as a minimum 5 to 1, and alloy shackles a minimum of 5 to 1*. Known as the DESIGN FACTOR, it is usually computed by dividing the catalog ultimate load by the working load limit. The ultimate load is the average load or force at which the product fails or no longer supports the load. The working load limit is the maximum mass or force which the product is authorized to support in general service. The design factor is generally expressed as a ratio such as 5 to 1. Also important to the design of shackles is the selection of proper steel to support fatigue, ductility and impact properties.	***Ask:*** *What is Working Load Limit and design factor for shackles?* ***Ask:*** *Is deformation upon overloading a critical consideration in their design?* ***Ask:*** *Do they jeopardize other properties by having hardness high in order to increase working load or design factor?*	Crosby carbon shackles have the highest design factor (6 to 1) in the industry. All of Crosby's design factors are documented. Crosby purchases only special bar forging quality steel with special cleanliness and guaranteed hardenability. All material chemistry is independently verified prior to manufacturing. The design of Crosby shackles assure that strength, ductility, fatigue properties are met. Load Rated®
CLOSED DIE FORGED The proper performance of premium shackles depends on good manufacturing techniques that include proper forging and accurate machining. Closed die forging of shackles assures clear lettering, superior grain flow, and consistent dimensional accuracy. A closed die forged bow allows for an increased cross section that, when coupled with quench and tempering, enhances strength and ductility. Closed die bow forgings combined with close tolerance pin holes assures good fatigue life. Close pin to hole tolerance has been proven to be critical for good fatigue life, particularly with screw pin shackles.	***Ask:*** *Are their shackles closed die forged with close tolerance pin holes?* ***Ask:*** *Do their shackles have good fatigue life?* ***Ask:*** *Do their shackles have a fatigue life that meets the new world standards?* Many forge bows, utilizing an open die forging process which allows for inconsistent dimensional accuracy and increased pin hole clearance, thus jeopardizing the fatigue life of the shackle in actual use.	Each shackle is closed die forged. Closed die forging produces consistent dimensions. Close tolerance holes and concentric pins with good surface finishes are provided by Crosby and are proven to provide improved fatigue life in actual use. Crosby shackles are fatigue rated as well as load rated. Fatigue Rated®
QUENCHED AND TEMPERED Quench and tempering assures the uniformity of performance and maximizes the properties of the steel. This means that each shackle meets its rated strength and has required ductility, toughness, impact and fatigue properties. The requirements of your job demand this reliability and consistency. This quench and tempering process develops a tough material that reduces the risk of brittle, catastrophic failure. The shackle bow will deform if overloading occurs, giving warning before ultimate failure.	***Ask:*** *Are their bows and pins quenched and tempered?* ***Ask:*** *If not, are they willing to accept the increased risk of inconsistency?* ***Ask:*** *If not, why are they willing to accept inferior impact, toughness, and product deformation?* ***Ask:*** *Why do many manufacturers <u>not recommend</u> non-heat treated shackles for overhead lifting?* ***Ask:*** *Why do some recommend Quench and Tempering for alloy but not carbon grades?* Many normalize the shackle bows. As a result, desired properties are not achieved. A few even provide bows in an "as forged" condition, resulting in the possibility of brittle failure.	All Crosby shackle bows and pins are quenched and tempered, which enhances their performance under cold temperatures and adverse field conditions. Crosby's Quenched and Tempered carbon shackles are recommended for all critical applications including overhead lifting. Alloy shackles are recommended when specific dimensional requirements dictate a size that requires higher working load limits. Crosby's Quenched and Tempered shackles provide the tensile strength, ductility, impact and fatigue properties that are essential if they are to perform time after time in adverse conditions. These properties assure that the inspection criteria set forth by ANSI will effectively monitor the ability of the shackles to continue in service. "QT" QUENCHED & TEMPERED
IDENTIFICATION AND APPLICATION INFORMATION The proper application of shackles requires that the correct type and size of shackle be used. The shackle's working load limit, its size, a traceability code and the manufacturer's name should be clearly and boldly marked in the bow. Traceability of the material chemistry and properties is essential for total confidence in the product. Material chemistry should be independently verified prior to manufacturing.	***Ask:*** *Do they have an active traceability system used in manufacturing?* ***Ask:*** *Is the material chemistry independently verified?* ***Ask:*** *What training support is provided?*	Crosby forges "Crosby" or "CG", the Working Load Limit, and the Product Identification Code (PIC) into each bow and "Crosby" or "CG", and the Product Identification Code (PIC) into each pin of its full line of screw pin, round pin, and bolt type anchor and chain shackles. Seminars conducted by Crosby provide training on the proper use of shackles. Crosby training packets, supplied free to attendees of Crosby seminars, provide training materials needed to explain the proper use of shackles. QUIC-CHECK®

* G-2160 Wide Body Shackles are metric rated at 5 to 1. G-2140 Shackles, 200 ton and above, are rated at 4 to 1 in short tons.

the Crosby® group

Remember, "When buying Crosby, you're buying more than product, you're buying Quality."

Crosby Value Added

- **Charpy impact properties:** Crosby's Quenched and Tempered shackles have enhanced impact properties for greater toughness at all temperatures. If requested at the time of order, Crosby can provide Charpy impact properties.
- **Fatigue properties:** Fatigue properties are available for 1/3 to 55 metric ton shackles. These Crosby shackles are fatigue rated to 20,000 cycles at 1-1/2 times the Working Load Limit.
- **Ductility properties:** Typical ductility properties are available for all sizes upon special request.
- **Hardness levels and material tensile strengths:** Typical values are available for all sizes of shackles, and actual values can be furnished if requested at the time of order.
- **Proof Testing:** If requested at the time of order, shackles can be furnished proof tested with certificates.
- **Mag Certification:** If requested at the time of order, shackles can be Mag inspected with certificates.
- **Certification:** Certification to World Class Standards is available upon special request at the time of order; American Bureau of Shipping, Lloyds Register of Shipping, Det Norske Veritas, American Petroleum Institute, RINA, Nuclear Regulatory Commission, and several other world wide standards.
- **Applications:** *Round Pin Shackles* can be used in tie down, towing, suspension or lifting applications where the load is strictly applied in-line. *Screw Pin Shackles* can be used in any application where a round pin shackle is used. In addition, screw pin shackles can be used for applications involving side-loading circumstances. Reduced working load limits are required for side-loading applications. *Bolt-Type Shackles* can be used in any application where round pin or screw pin shackles are used. In addition, they are recommended for permanent or long-term installations and where the load may slide on the shackle pin causing the pin to rotate.
- **Material analysis:** Crosby can provide certified material (mill) analysis for each production lot, traceable by the Product Identification Code (PIC). Crosby, through its own laboratory, verifies the analysis of each heat of steel. Crosby purchases only special bar forging quality steel with specific cleanliness requirements and guaranteed hardenability.
- **Field inspection:** Written instructions for visual, magnaflux, and dye penetrant inspection of shackles are available from Crosby. In addition, acceptance criteria and repair procedures for shackles are available.
- **QUIC-CHECK®**: Shackles incorporate two marking indicators forged into the shackle bow at 45° angles from vertical. These are utilized to quickly check the approximate angle of a two-legged hitch or quickly check the angle of a single leg hitch when the shackle pin is secured and the pull of the load is off vertical or side loaded, thus requiring a reduction in the working load limit of the shackle.

G-209
Screw pin anchor shackles meet the performance requirements of Federal Specification RR-C-271F Type IVA, Grade A, Class 2, except for those provisions required of the contractor.

G-213
Round pin anchor shackles meet the performance requirements of Federal Specification RR-C-271F Type IVA, Grade A, Class 1, except for those provisions required of the contractor.

G-2130
Bolt-type anchor shackles meet the performance requirements of Federal Specification RR-C-271F Type IVA, Grade A, Grade A, Class 3, except for those provisions required of the contractor.

G-210
Screw pin chain shackles meet the performance requirements of Federal Specification RR-C-271F Type IVB, Grade A, Class 2, except for those provisions required of the contractor.

G-215
Round pin chain shackles meet the performance requirements of Federal Specification RR-C-271F Type IVB, Grade A, Class 1, except for those provisions required of the contractor.

G-2150
Bolt-type chain shackles meet the performance requirements of Federal Specification RR-C-271F Type IVB, Grade A, Class 3, except for those provisions required of the contractor.

Crosby® Shackles

APPLICATION INFORMATION

G/S-213

G/S-215

Round Pin Shackles can be used in tie down, towing, suspension or lifting applications where the load is strictly applied in-line. Round pin shackles should never be used in rigging applications to gather multiple sling legs, or where side loading conditions may occur.

G/S-209

S-209T

Screw Pin Shackles are used in Pick and Place* applications. For permanent or long-term installations, Crosby recommends the use of bolt type shackles.

If you choose to disregard Crosby's recommendation, the screw pin shall be secured from rotation or loosening (Page 90).

Screw pin shackles can be used for applications involving side-loading circumstances. Reduced working load limits are required for side-loading applications. While in service, do not allow the screw pin to be rotated by a live line, such as a choker application.

* Pick and Place application: Pick (move) a load and place as required. Tighten screw pin before each pick.

G-209A

S-253

G/S-2130

G/S-2150

G/S-210

G-2169

G/S-2140

G/S-2160

Bolt-Type Shackles can be used in any application where round pin or screw pin shackles are used. In addition, they are recommended for permanent or long term installations and where the load may slide on the shackle pin causing the pin to rotate. The bolt-type shackle's secondary securement system, utilizing a nut and cotter, eliminates the requirement to tighten pin before each lift or movement of load.

QUIC-CHECK® INFORMATION

All Crosby Shackles, with the exception of 2160, 2169, 2170, 252 and 253 styles incorporate markings forged into the product that address an easy to use **QUIC-CHECK®** feature. Angle indicators are forged into the shackle bow at 45 degree* angles from vertical. These are utilized on **screw pin** and **bolt type shackles** to quickly check the approximate angle of a two-legged hitch, or quickly check the angle of a single leg hitch when the shackle pin is secured and the pull of the load is off vertical (side loaded), thus requiring a reduction in the working load limit of the shackle.

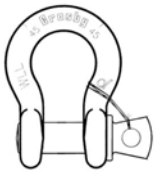
* **Round Pin Shackles** utilize the 45 degree **QUIC-CHECK®** indicators to ensure load is applied strictly in-line.

G-2130

Crosby® Shackles

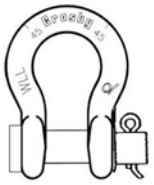
SCREW PIN SHACKLES PIN SECURITY

MOUSE SCREW PIN WHEN USED IN LONG TERM OR HIGH VIBRATION APPLICATIONS.



Mouse or Mousing (screw pin shackle) is a secondary securement method used to secure screw pin from rotation or loosening. Annealed iron wire is looped through hole in collar of pin and around adjacent leg of shackle body with wire ends securely twisted together.

SHACKLES



ROUND PIN

Do not side load, do not use as a collector ring, always use cotter pin.

SCREW PIN

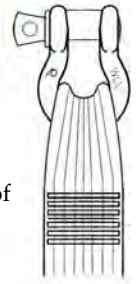
Use when picking and placing a load, tighten pin prior to each lift.

BOLT-TYPE

Use in permanent or long-term installations always use nut and cotter.

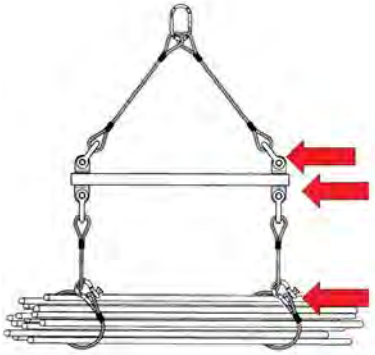
CONNECTION OF SLINGS TO SHACKLES

Diameter of shackle must be greater than wire rope diameter if no thimble in eye.



Shackle must be large enough to avoid pinching of synthetic slings.

BOLT-TYPE SHACKLES



Use Bolt-Type Shackle when a permanent or long term connection

Use a screw pin shackle when it will be a temporary connection.

RIGGING PRACTICE SHACKLES

Screw pin shall be fully engaged.

If designed for a cotter pin, it shall be used and maintained.

Applied load should be centered in the bow to prevent side loading.

Multiple sling legs should not be applied to the pin.

If side loaded, the rated load shall be reduced according to Table 1 on page 91.

SIDE LOADED RATING REDUCTION TABLE FOR 3/16" - 3" (120 METRIC TONS)

Angle loads must be applied in the plane of the bow.

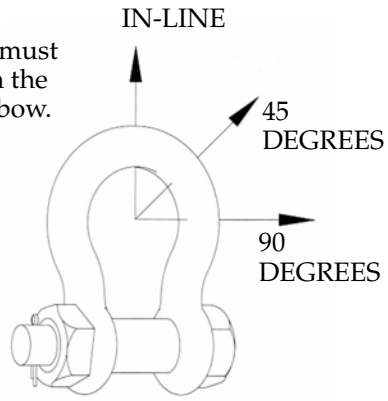


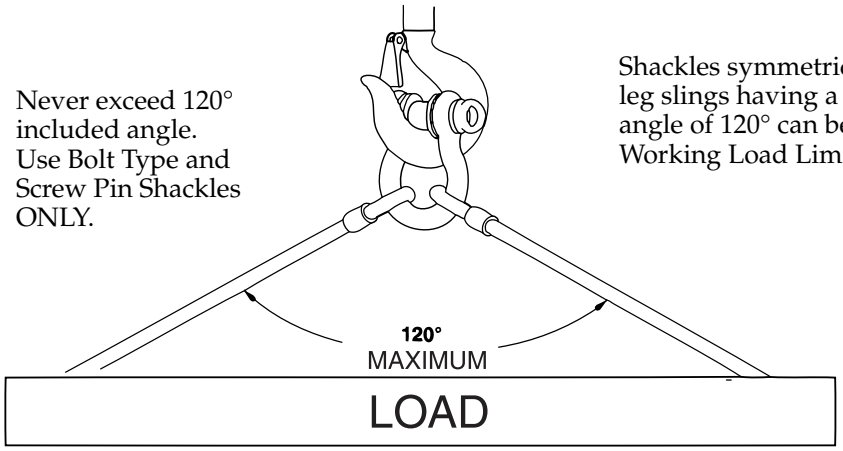
Table 1 Side Loading Reduction Chart for Screw Pin and Bolt Type Shackles Only+	
Angle of Side Load from Vertical In-Line of Shackle	Adjusted Working Load Limit
0° - 5° In-Line*	100% of Rated Working Load Limit
45° from In-Line*	70% of Rated Working Load Limit
90° from In-Line*	50% of Rated Working Load Limit

+ In-Line load is applied perpendicular to pin.
* DO NOT SIDE LOAD ROUND PIN SHACKLE.

For shackles larger than 125 metric tons, where the angle of the side load is greater than 5 degrees, contact Crosby Engineering.

INCLUDED ANGLE - SHACKLES

Never exceed 120° included angle. Use Bolt Type and Screw Pin Shackles ONLY.



Shackles symmetrically loaded with two leg slings having a maximum included angle of 120° can be utilized to full Working Load Limit.

For shackles larger than 125 metric tons, the maximum included angle is 90 degrees for full working load limit. Contact Crosby Engineering if included angle is greater than 90 degrees.

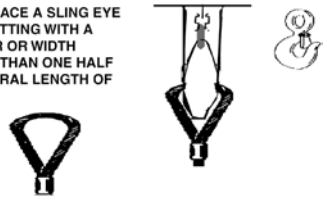
WIRE ROPE SLINGS AND CONNECTIONS TO FITTINGS

USE A THIMBLE TO PROTECT SLING AND TO INCREASE D/d

NEVER PLACE EYE OVER A FITTING SMALLER DIAMETER OR WIDTH THAN THE ROPE'S DIAMETER

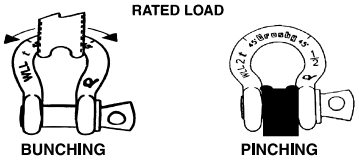
WIRE ROPE SLINGS AND CONNECTIONS TO FITTINGS

NEVER PLACE A SLING EYE OVER A FITTING WITH A DIAMETER OR WIDTH GREATER THAN ONE HALF THE NATURAL LENGTH OF THE EYE



SYNTHETIC SLINGS RATED LOAD

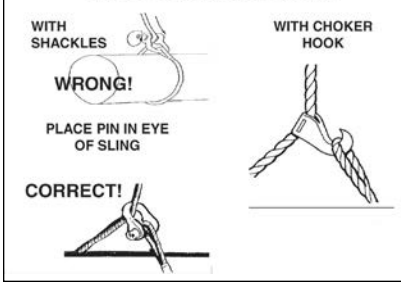
FOLDING, BUNCHING OR PINCHING OF SYNTHETIC SLINGS, WHICH OCCURS WHEN USED WITH SHACKLES, HOOKS OR OTHER APPLICATIONS WILL REDUCE THE RATED LOAD



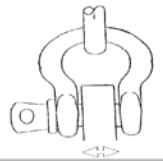
BUNCHING PINCHING

ANSI B30.9-1994

CHOKER HITCH FORMED



CROSBY SHACKLES POINT LOADING



POINT LOADING OF CROSBY SHACKLE PINS IS ACCEPTABLE AS LONG AS LOAD IS REASONABLY CENTERED ON THE PIN

ALTHOUGH POINT LOADING IS ACCEPTABLE, A PAD EYE WIDTH OF 80% OR MORE OF SHACKLE SPREAD IS BEST PRACTICE