Section 12
MATERIAL HANDLING

12.1 Manual Handling Lifting of Material

(a) When any heavy object is to be lifted and carried to another point, first inspect and clear the area and route over which the object is to be carried. Be sure nothing is in the way that might cause slipping or tripping.

(b) Inspect the object to be lifted to determine how it will be grasped. Make sure it is free of sharp edges, protruding nail points, slivers or other hazards that might cause injury to the hands or body. Wear appropriate gloves to protect hands. (See Section 3.)

(c) Do not permit material storage within 6 ft (1.8 m) of escalator wellways.

Lifting Loads

(a) Incorrect lifting methods require unnecessary effort and often cause strain or other types of injuries. When it is necessary to lift any object which is difficult for one person to handle, ask for help.

(b) The safest way to lift is actually the easiest way to lift (see Figure 12a):

Figure 12a

(1) Get a secure footing.
(2) Bend at knees to grasp the object.
(3) Keep a natural curve in back and as nearly upright as possible.
(4) Get a firm hold.
(5) Lift gradually by straightening legs, keeping the back as nearly straight as possible.

The same procedure must be observed when setting loads down.

(c) Two common injuries that occur in our industry are back sprain or strain. Low-back pain is the most common ailment. The misconception that back injuries are only caused by improper lifting lulls us into a false sense of security. Overexertion, overextending, overreaching and improper bending are some of the many causes of low-back pain. Most of the low-back ailments are normally not of a serious nature, until we choose to ignore the warning signs. When this happens, the backaches become chronic.

Figure 12b **Position for Lifting**

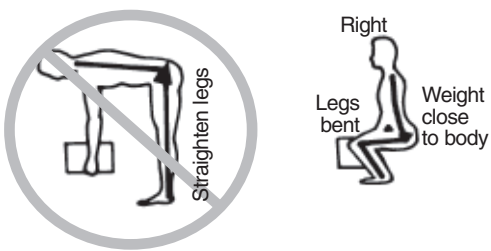


Figure 12c

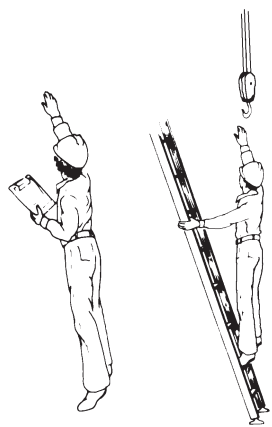
HELPFUL HINTS FOR ON AND OFF THE JOB

Walk with good posture. Keep head high – chin tucked in. Don't slouch. Don't wear improper shoes.

DO'S

Stay close to your work and keep feet flat on floor.

DONT'S



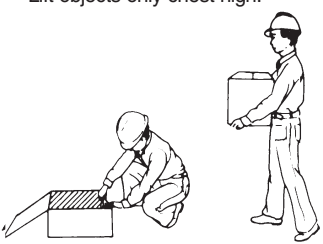
Don't overextend your reach by being on tip-toes.

Figure 12d

DO'S

Keep feet flat on the floor when sitting. Your back should be firmly against the back of the chair.

Bend with your knees – keep a natural curve in your back. Lift objects only chest high.

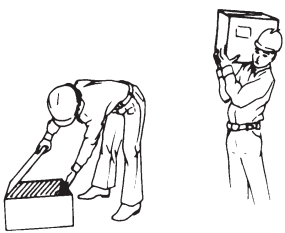


Sleep on firm mattress. Sleep on your side with your knees bent.

DONT'S

Don't Slump. Keep chair close to your work. Avoid excessive leaning and arching your back.

Don't bend with your legs straight. Avoid lifting above shoulder level.



Don't sleep on soft, sagging mattresses. Sleeping on your stomach will cause sway back.

12.2 Ramping and Blocking of Material

(a) Handling of all heavy materials requires considerable care. Never use "short cuts."
(b) Pay particular attention to the position of fingers and feet when using rollers, pinchbars, jacks and blocking to move heavy materials and equipment.
(c) Before trying to lift a load with a pinchbar, be sure to take an ample "bite."
(d) Jacks shall always be placed on a solid footing and so located that a good "bite" is provided on the object being moved.
(e) Timber used for blocking and cribbing shall be of adequate size to carry and distribute loads being supported.
(f) When placing blocking and cribbing, be sure to have ample bearing surface. Never stack the timber in such a manner that maneuvering the load could cause it to tip.
(g) Whenever more than two tiers of timber are used, be sure to cross-rib.
(h) Secure skid-boards to eliminate the possibility of their shifting, and block or crib them to prevent excessive or uneven deflection.
(i) Passageways for the movement of materials and equipment shall be cleared of debris and obstacles to afford needed working space and ease of movement.
(j) Before moving extremely heavy loads (machines, escalator trusses, etc.) check with your Superintendent/ Manager that the floor will support the load.

12.3 Hoisting and Rigging

(a) The cardinal rules of hoisting are: stay clear of the load at all times, never stand under the load, know the weight of the load, capacity of your equipment, the structure to which you are rigging and the overall condition

of these items. Stand uphill or to the side of a load that's on a ramp.

(b) Do not allow non-Company personnel to use Elevator Company hoisting and rigging.

(c) Elevator personnel must be aware of all hoisting being done in or around their work area. Always take necessary safety precautions.

(d) When elevator personnel are conducting hoisting operations, access to hoisting areas, especially hoistways and wellways, shall be restricted to elevator personnel involved in the lift. Warning signs shall be posted.

(e) Elevator personnel shall avoid areas where other trades are hoisting.

(f) Before making the first hoist, and at the start of each day thereafter, when the hoist is to be used, the rigging, overhead supports, blocking, etc., shall be inspected by the mechanic/MIC. The hoist shall be inspected visually prior to each use. It shall be tested by raising the load several inches and holding it there prior to making an actual lift.

(g) Power operated rigging equipment shall be tested to ensure the machine stalls prior to rigging breaking or coming loose (i.e., tie to major support structure – activate motor to ensure integrity of rigging system).

(h) The safe working load of a hoist, or any part of the rigging system, as determined by the manufacturer, shall be clearly marked on the hoist or other equipment, and this safe working load shall not be exceeded. If the hoist or other equipment is not marked with the safe working load – do not use.

(i) Only company approved hoisting and rigging equipment shall be used.

(j) No alterations to any hoisting and rigging equipment shall be made without the manufacturer's written approval. Annual or manufacturer's recommended testing to certify the safe working load of the hoist shall be done by a qualified testing facility and the hoist shall be tagged or identified certifying test and date.

(k) The supporting structure to which the hoist is attached shall have sufficient strength to support the load. (Refer to Allowable Concentrated Loads on American Standard Beams in Figure 22i).

(l) The support shall be arranged so as to provide for free movement of the hoist and shall not restrict the hoist from lining itself up with the load.

(m) The hoist shall be installed only in locations that permit the operator to stand clear of the load at all times.

(n) The overhead structure shall be padded where any choke or assembly is passed over steel. This padding is essential to keeping the rigging in good condition.

(o) Only properly made wire rope or nylon slings and chokers shall be used for rigging.

(p) Do not use the hoist chain as a choker.

(q) Do not use a jack wrench as a lifting block. These are not designed for these uses.

(r) The use of two or more chain hoists for hoisting a single load is not permitted, unless any one of them will handle the entire load by itself.

(s) Whenever a load cannot be lifted by one person pulling on the chain, investigate for overload or a defect in the chain fall.

(t) To prevent hooks from being disengaged from the load or overhead support, it is recommended that only hooks with safety latches be used. Hooks which do not have safety latches shall be moused as a temporary measure.

(u) A clevis-type shackle, with locking device or through bolt with jam nut, or nut with cotter pin, shall be used to hoist rails, brackets, etc.

(v) Use only manufacturer recommended wire rope of the proper size for powered hoists. Always examine such wire rope for defects. Wire ropes found to be defective shall not be used.

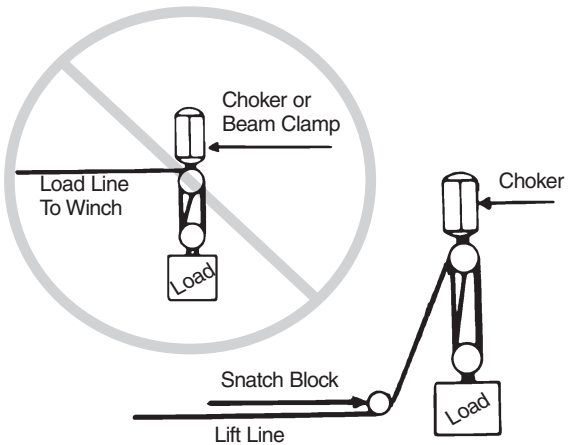
(w) Always wear gloves when handling wire rope.

(x) When using a capstan hoist, do not stand in the coil of rope.

(y) Do not rig the capstan hoist so as to overload it.

Figure 12e

VERTICAL PULL ONLY



Do not pull so that bending stress is put on beam clamp.

(aa) Do not drill additional holes in the capstan hoist's mounting brackets, as this could weaken the hoist.

(ab) Rated load divided by the number of parts of the rope shall not exceed 20% of the nominal breaking strength of the rope (i.e., safety factor of 5).

(ac) Wire rope used for supporting the top block hoist rig shall have, as a minimum, one more turn than the number of sheaves used in the traveling hoist rope, and shall be well padded where it goes around the support beam. Remember: Wire rope strength deteriorates 25% when it is wrapped around supports and is secured with fist grip type clips.

(ad) Hoist machines shall be substantially secured so that they will not shift under a load.

(ae) When starting a lift, gradually take slack out of slings and make sure that no one's hands are in a position to be caught between the load and sling hook.

(af) Never attempt to make a lift or move equipment when anyone is in a position to be injured should the load shift or fall.

(ag) Do not drag sling, chains, etc., along the floor or across equipment.

(ah) When hoisting rails into a hoistway, and the guardrail system must be removed to allow access, if there is more than a 6 ft (1.8 m) fall exposure, the employee feeding the rails into the hoistway shall be protected from falling into the hoistway by a personal fall arrest system attached to a lifeline. Remember to keep the guardrail system up on the unused portions of the hoistway and keep others out of your hoisting area.

(ai) Clear communications are required. All verbal commands shall be repeated by the receiving party and reconfirmed by the directing party.

Figure 12f

Allowable Number of Broken Strands for Wire Ropes used in Hoisting Equipment

1. Six randomly distributed broken wires in one lay.
2. Three broken wires in one strand on one lay.
3. If one-third of the outside wires show wear or disintegrate at any place on the rope.

Causes Of Wire Rope Failure

1. Using wire rope of insufficient strength for the job.
2. Improper rigging.
3. Kinking.
4. Improper lubrication, storage and care, allowing rusting, corrosion or internal abrasion.
5. Exposure to extreme heat.
6. Crushing on winch drum.
7. Using drums or sheaves of insufficient diameter of incorrect tread.
8. Permitting ropes to abrade over sharp corners or other fixed objects.
9. Contact with electrical current.

Signs Of Wire Rope Deterioration

1. Reduction of rope diameter below nominal diameter due to loss of core support, internal/ external corrosion, or wear of outside wire.
2. Broken outside wires and degree of distribution or concentration of broken wires.
3. Worn outside wires.
4. Corroded, rusty or broken wires at end connections.
5. Severe kinking, crushing, cutting and/or unstranding.

12.4 Wire Rope Fastenings

(a) When it is necessary to make a short bend, as in attaching wire rope or when it is to be looped, thimbles shall always be used.

(b) Fist grips are preferred fasteners because the wire rope does not become damaged.

(c) In forming an eye, the loose or "dead" end is clamped against the main part of the rope, with the wire-rope clips spaced a distance equal to six times the diameter of the rope.

(d) Wire-rope clip fastenings seldom develop more than 80% of rope strength, at best.

(e) The point of greatest fatigue and/or wear in a rope usually develops at or near the end where it is attached to the becket on the block. Clips shall be inspected at least daily, and tightened if they show signs of loosening. All connections shall be periodically disassembled and the wire rope inspected for damage on a regular basis.

Figure 12g

Double Saddle Clips (Fist Grip and "J" Clips)

12.5 Chain Hoists

(a) Generally chain hoists are more durable, more adaptable and stronger than block and tackle.
(b) All chain hoists shall be visually inspected for defects prior to first use, and daily when in use.
(c) The lower hook on all chain hoists is designed to be the weakest part and will spread when overloaded. When this occurs, the entire hoist shall be inspected.
(d) Damaged hoists shall be removed from service.
(e) Repairs shall only be made by an authorized representative of the manufacturer. This includes the replacement of a chain.
(f) The unit shall be returned to the vendor for testing, maintenance and internal inspection as recommended by the manufacturer.
(g) Always use proper hand signals when hoisting. See Figures 12i and 12j.
(h) Discard hooks that spread beyond allowable spread, see Figure 12y.

12.6 Slings and Hitches

(a) Chain slings shall not be used when hoisting material.
(b) Nylon slings are to be used for hoisting equipment within their rated load. Label with rating shall be attached to sling.
(c) Nylon slings shall be inspected for cuts or tears before using and damaged slings discarded.
(d) The type of sling or hitch to be used shall be determined from the shape of the load and by the flexibility and condition of the rope. In lifting multiple objects, such as a load of lumber or steel sheathing, the sling must bind on the load sufficiently to prevent slipping of the individual pieces. In handling single pieces, such as timbers, posts

or piles, a timber hitch with two half-hitches (or a similar hitch) shall be used.

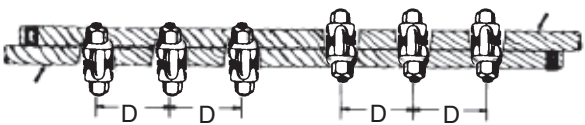
(e) Only approved slings of proper size shall be used for slinging loads.

(f) In using wire rope as straps for hooking onto tackle blocks, there shall be the same number of parts of rope in the strap as there are moving parts in the tackle. For instance, if triple-block tackle is used, there shall be six parts of rope for the strap.

(g) Endless wire slings shall be made using a minimum of six fist grip rope clips as shown in Figure 12h. If the rope is greater than 5/8 in. (16 mm) additional fist grip rope clips are required, see Figure 12ac.

Figure 12h

ENDLESS SLING ASSEMBLY



D = 6 times diameter of rope

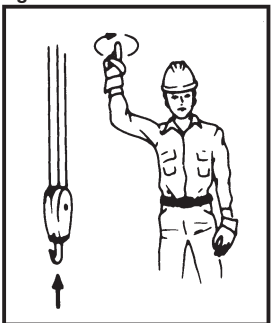
(Also see Section 12.7 Crosby Lifting Guide)

12.7 Crosby Lifting Guide

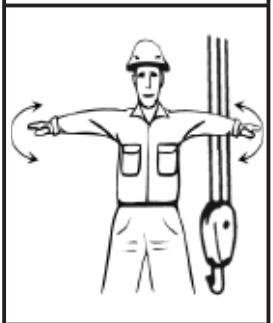
The following pages of information in this section have been printed with permission of The Crosby Group Inc. The strengths of the slings, shackles and other rigging equipment identified within these pages are to be used in conjunction with the referenced Crosby products. When using rigging equipment not manufactured by Crosby, obtain appropriate strength and capacity information from the manufacturer of the products that are being used.

Figure 12i

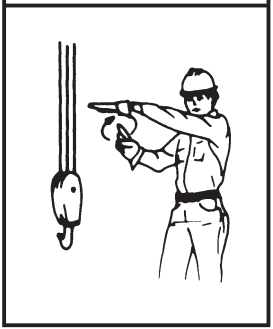
HAND HOISTING SIGNALS



HOIST.
With forearm vertical, forefinger pointing up move hand in small horizontal circle.



EMERGENCY STOP.
Arms extended palms down, move hands rapidly right and left.

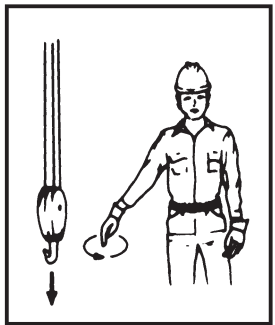


MOVE SLOWLY.
Use one hand to give any motion signal and place other hand motionless in front of hand giving the motion signal. (Hoist Slowly shown in example.)

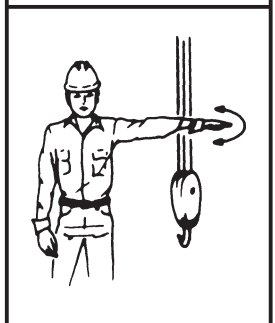
Figure 12j

HAND HOISTING SIGNALS

LOWER.
With arm extended downward, forefinger pointing down, move hand in small horizontal circles.



STOP.
Arm extended, palm down, move hand rapidly right and left.



DOG EVERYTHING.
Clasp hands in front of body.

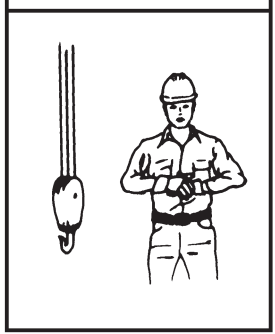
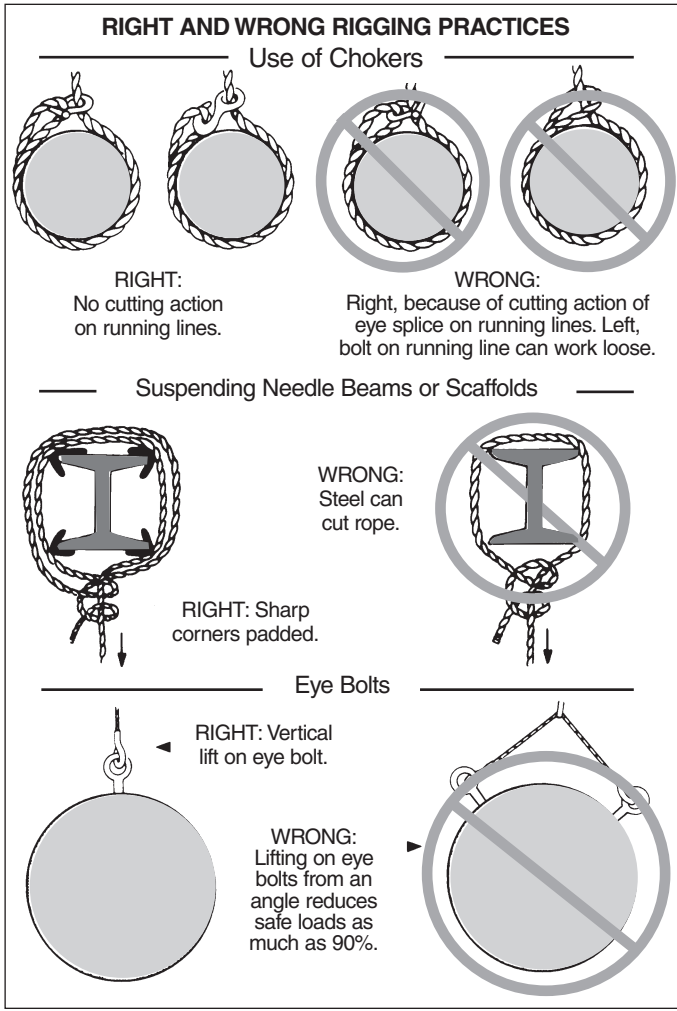
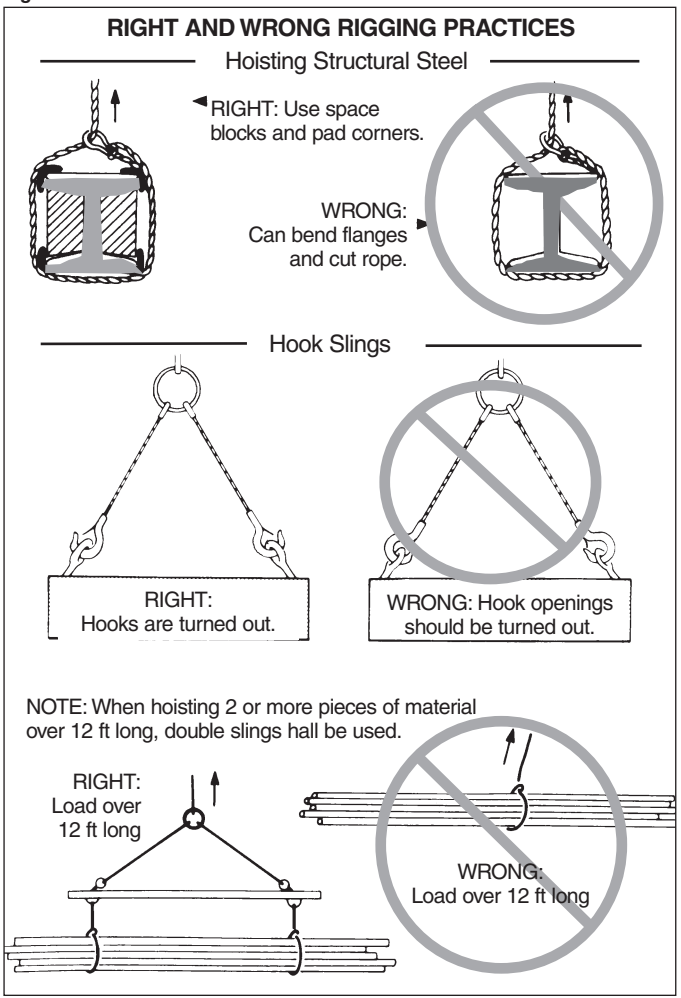


Figure 12k



(Also see Section 12.7 Crosby Lifting Guide)

Figure 12l



(Also see Section 12.7 Crosby Lifting Guide)

Figure 12m

Crosby® USER'S GUIDE LIFTING

1

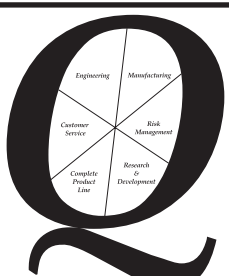
VERSION (4/02)

RISK MANAGEMENT

DEFINITION

COMPREHENSIVE SET OF ACTIONS THAT REDUCES THE RISK OF A PROBLEM, A FAILURE, AN ACCIDENT

Crosby® *Quality Continuum*



TERMINOLOGY

WORKING LOAD LIMIT (WLL)

THE MAXIMUM MASS OR FORCE WHICH THE PRODUCT IS AUTHORIZED TO SUPPORT IN A PARTICULAR SERVICE.

PROOF TEST

A TEST APPLIED TO A PRODUCT SOLELY TO DETERMINE INJURIOUS MATERIAL OR MANUFACTURING DEFECTS.

ULTIMATE STRENGTH

THE AVERAGE LOAD OR FORCE AT WHICH THE PRODUCT FAILS OR NO LONGER SUPPORTS THE LOAD.

DESIGN FACTOR

AN INDUSTRIAL TERM DENOTING A PRODUCT'S THEORETICAL RESERVE CAPABILITY; USUALLY COMPUTED BY DIVIDING THE CATALOG ULTIMATE LOAD BY THE WORKING LOAD LIMIT. GENERALLY EXPRESSED AS A RATIO, e.g. 5 TO 1.

Load Rated®

FOR ADDITIONAL SUPPORT

the Crosby® group, inc.

P.O. Box 3128
Tulsa Oklahoma 74101
Phone: (918) 834-4611
Fax: (918) 832-0940
1-800-777-1555
Web:
www.thecrosbygroup.com
E-Mail:
crosbygroup@thecrosbygroup.com

BLOCKS & FITTINGS FOR WIRE ROPE & CHAIN

CROSBY® FITTINGS
LEBUS® McKISSICK®
WESTERN NATIONAL

Figure 12n

THE BASIC RIGGING PLAN

1. WHO IS RESPONSIBLE (COMPETENT) FOR THE RIGGING? COMMUNICATION ESTABLISHED?
2. IS THE EQUIPMENT IN ACCEPTABLE CONDITION? APPROPRIATE TYPE, PROPER IDENTIFICATION?
3. ARE THE WORKING LOAD LIMITS ADEQUATE?
   CAPACITY OF GEAR KNOWN?
   WHAT IS THE WEIGHT OF LOAD?
   WHERE IS THE CENTER OF GRAVITY?
   WHAT IS THE SLING ANGLE?
   WILL THERE BE ANY ANGULAR OR SIDE LOADING?
   ARE THE SLINGS PADDED AGAINST SHARP CORNERS?
4. WILL THE LOAD BE UNDER CONTROL?
   IS THE LOAD RIGGED TO THE CENTER OF GRAVITY?
   IS THE HITCH APPROPRIATE?
   TAG LINE NEEDED?
   IS THERE ANY POSSIBILITY OF FOULING?
   CLEAR OF PERSONNEL?
5. ARE THERE ANY UNUSUAL LOADING OR ENVIRONMENTAL CONDITIONS?
   WIND, TEMPERATURE, OTHER?
6. SPECIAL REQUIREMENTS?

QUIC-CHECK®

"QT" QUENCHED & TEMPERED

RESPONSIBILITY 2

USER RESPONSIBILITY

1. UTILIZE APPROPRIATE RIGGING GEAR SUITABLE FOR OVERHEAD LIFTING.
2. UTILIZE THE RIGGING GEAR WITHIN INDUSTRY STANDARDS AND THE MANUFACTURER'S RECOMMENDATIONS.
3. CONDUCT REGULAR INSPECTION AND MAINTENANCE OF THE RIGGING GEAR.

MANUFACTURERS RESPONSIBILITY

1. PRODUCT AND APPLICATION INFORMATION
2. PRODUCT THAT IS CLEARLY IDENTIFIED
   - NAME OR LOGO
   - LOAD RATING AND SIZE
   - TRACEABILITY
3. PRODUCT PERFORMANCE
   - WORKING LOAD LIMIT
   - DUCTILITY
   - FATIGUE PROPERTIES
   - IMPACT PROPERTIES

Figure 12o

INSPECTION OF HARDWARE

DEFORMATION

REMOVE FROM SERVICE IF ANY SIGNIFICANT DEFORMATION. CHECK THROAT OPENING OF HOOKS.

WEAR

REMOVE FROM SERVICE IF EXCESSIVE WEAR. WEAR IS EXCESSIVE IF:
MORE THAN 5% WEAR IN THROAT OR EYE OF HOOK AND OTHER CRITICAL AREAS OF HARDWARE.
MORE THAN 10% WEAR IN OTHER AREAS.

CRACKS, NICKS, GOUGES

REMOVE FROM SERVICE IF CRACKS, NICKS, OR GOUGES ARE DETECTED.

MODIFICATION

DO NOT WELD, DO NOT SUBSTITUTE SHACKLE PINS OR OTHER COMPONENTS, DO NOT HEAT, BEND OR MODIFY IN ANY MANNER.

PROPER FUNCTION

IMPROPERLY INSTALLED HARDWARE OR MALFUNCTION IS CAUSE FOR REMOVAL. CHECK FOR LATCHES, SWIVEL BEARINGS, LOCKING DEVICES, AND INSTALLATION OF WIRE ROPE CLIPS AND WEDGE SOCKETS.

INSPECTION OF WIRE ROPE SLINGS 3

PER ANSI B30.9

ALL SLINGS AND ATTACHMENTS SHALL BE VISUALLY INSPECTED BY THE PERSON HANDLING THE SLING EACH DAY THEY ARE USED. IN ADDITION, A PERIODIC INSPECTION SHALL BE PERFORMED BY A DESIGNATED PERSON, AT LEAST ANNUALLY, AND SHALL INCLUDE A RECORD OF THE INSPECTION.

INSPECTION CRITERIA

KINKING
CRUSHING
UNSTRANDING
BROKEN OR CUT STRANDS
STRANDING DISPLACEMENT
CORE PROTRUSION
CORROSION
BIRDCAGING
BROKEN WIRES

BROKEN WIRES

REMOVE FROM SERVICE STRAND LAID AND SINGLE PART SLINGS IF TEN OR MORE RANDOMLY DISTRIBUTED WIRES IN ONE ROPE LAY, OR FIVE BROKEN WIRES IN ONE ROPE STRAND IN ONE ROPE LAY.

DISTORTION OF WIRE ROPE

REMOVE FROM SERVICE WIRE ROPE SLINGS THAT HAVE ANY DAMAGE RESULTING IN DISTORTION OF THE WIRE ROPE STRUCTURE SUCH AS KINKING, CRUSHING, UNSTRANDING, BIRDCAGING, STRAND DISPLACEMENT OR CORE PROTRUSION.

Figure 12p

INSPECTION OF CHAIN SLINGS

PER ANSI B30.9

ALL SLINGS AND ATTACHMENTS SHALL BE VISUALLY INSPECTED BY THE PERSON HANDLING THE SLING EACH DAY THEY ARE USED. IN ADDITION, A PERIODIC INSPECTION (NORMAL SERVICE: YEARLY, SEVERE SERVICE: MONTHLY) SHALL BE PERFORMED BY A DESIGNATED PERSON, AT LEAST ANNUALLY, AND SHALL INCLUDE A RECORD OF THE INSPECTION.

INSPECTION CRITERIA

WEAR
NICK, CRACKS, BREAKS
GOUGES, STRETCH, BENDS
WELD SPLATTER
EXCESSIVE TEMPERATURE
THROAT OPENING OF HOOK

CHAIN LINKS

REMOVE SLING FROM SERVICE IF LINKS ARE WORN EXCESSIVELY (MORE THAN 10% OR REFER TO MANUFACTURER'S INFORMATION), SHARP TRANSVERSE NICKS AND GOUGES SHOULD BE ROUNDED OUT BY GRINDING (DO NOT EXCEED WEAR ALLOWANCE). CHAIN LINKS AND ATTACHMENTS SHOULD HINGE FREELY TO ADJACENT LINKS.

IDENTIFICATION

CHAIN SLINGS SHALL HAVE PERMANENTLY AFFIXED IDENTIFICATION STATING: SIZE, GRADE, RATED LOAD, NUMBER OF LEGS AND MANUFACTURER.

INSPECTION OF SYNTHETIC SLINGS [4]

PER ANSI B30.9

ALL SLINGS AND ATTACHMENTS SHALL BE VISUALLY INSPECTED BY THE PERSON HANDLING THE SLING EACH DAY THEY ARE USED. IN ADDITION, A PERIODIC INSPECTION SHALL BE PERFORMED BY A DESIGNATED PERSON, AT LEAST ANNUALLY, AND SHALL INCLUDE A RECORD OF THE INSPECTION.

INSPECTION CRITERIA

ACID OR CAUSTIC BURNS
MELTING OR CHARRING
HOLES, CUTS
TEARS, SNAGS
BROKEN STITCHES
WORN STITCHES
EXCESSIVE ABRASION
KNOTS

ROUND SLING NOTES

REMOVE FROM SERVICE ROUND SLINGS THAT HAVE CORE FIBER EXPOSED BY HOLES, TEARS, CUTS, EMBEDDED PARTICLES, WEAR OR SNAGS.
REMOVE FROM SERVICE ROUND SLINGS THAT HAVE MELTING, CHARRING OR WELD SPLATTER ON ANY PART OF SLING.

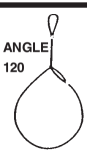
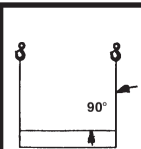
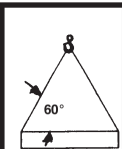
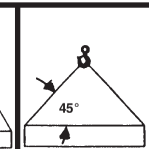
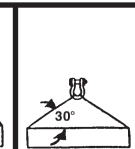
IDENTIFICATION

WEB SLINGS AND ROUND SLINGS SHALL BE PERMANENTLY MARKED INDICATING: MANUFACTURER'S TRADEMARK AND CODE (OR STOCK NUMBER), RATED LOADS FOR THE THREE HITCHES AND MATERIAL.

Figure 12q

WIRE ROPE SLING CAPACITIES (LBS.) - FLEMISH EYE - ANSI B30.9 5

6 X 19 AND 6 X 37 IMPROVED PLOW STEEL - IWRC 5/1 DESIGN FACTOR

WIRE ROPE SIZE	Crosby Q & T CARBON SHACKLE MINIMUM SHACKLE SIZE FOR A D/d>1 AT LOAD CONNECTION						
	SHACKLE SIZE	VERTICAL (SINGLE LEG)	CHOKER	TWO LEG OR BASKET HITCH	60 DEGREE SLING ANGLE	45 DEGREE SLING ANGLE	30 DEGREE SLING ANGLE
1/4	5/16	1120	820	2200	1940	1500	1120
5/16	3/8	1740	1280	3400	3000	2400	1740
3/8	7/16	2400	1840	4800	4200	3400	2400
7/16	1/2	3400	2400	6800	5800	4800	3400
1/2	5/8	4400	3200	8800	7600	6200	4400
9/16	5/8	5600	4000	11200	9600	7900	5600
5/8	3/4	6800	5000	13600	11800	9600	6800
3/4	7/8	9800	7200	19600	16900	13800	9800
7/8	1	13200	9600	26400	22800	18600	13200
1	1-1/8	17000	12600	34000	30000	24000	17000
1-1/8	1-1/4	20000	15800	40000	34600	28300	20000
1-1/4	1-3/8	26000	19400	52000	45000	36700	26000
1-3/8	1-1/2	30000	24000	60000	52000	42400	30000

- RATED CAPACITIES BASED ON PIN DIAMETER OR HOOK NO LONGER THAN THE NATURAL EYE WIDTH (1/2 X EYE LENGTH) OR LESS THAN THE NOMINAL SLING DIAMETER

REFER TO ANSI B30.9 FOR FULL DETAILS

HORIZONTAL SLING ANGLES OF LESS THAN 30 DEGREES ARE NOT RECOMMENDED

Figure 12r

WIRE ROPE SLING CAPACITIES - TONS (2000 LBS.) - FLEMISH EYE - ASME B30.9 5A

6 X 19 AND 6 X 37 EXTRA IMPROVED PLOW STEEL - IWRC 5/1 DESIGN FACTOR
HORIZONTAL SLING ANGLES OF LESS THAN 30 DEGREES ARE NOT RECOMMENDED

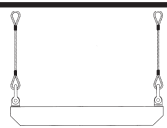
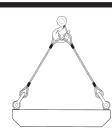
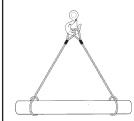
WIRE ROPE SIZE INCHES						
	SINGLE LEG (VERTICAL)	SINGLE CHOKER	TWO LEG SLING VERTICAL	TWO LEG SLING 60° HORIZONTAL SLING ANGLE	45° HORIZONTAL SLING ANGLE	TWO LEG CHOKER 60° HORIZONTAL SLING ANGLE
1/4	0.65	0.48	1.3	1.1	0.9	0.8
3/8	1.4	1.1	2.9	2.5	2.0	1.8
7/16	1.9	1.4	3.9	3.4	2.7	2.5
1/2	2.5	1.9	5.1	4.4	3.6	3.2
9/16	3.2	2.4	6.4	5.5	4.5	4.1
5/8	3.9	2.9	7.8	6.8	5.5	5.0
3/4	5.6	4.1	11.0	9.7	7.9	7.1
7/8	7.6	5.6	15.0	13.0	11.0	9.7
1	9.8	7.2	20.0	17.0	14.0	13.0
1-1/8	12.0	9.1	24.0	21.0	17.0	16.0
1-1/4	15.0	11.0	30.0	26.0	21.0	19.0

Figure 12s

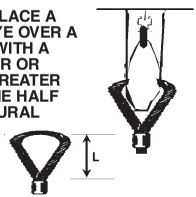
WIRE ROPE SLINGS AND CONNECTIONS TO FITTINGS

USE A THIMBLE TO PROTECT SLING AND INCREASE D/d

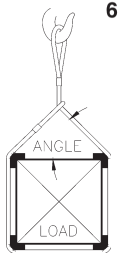
NEVER PLACE EYE OVER A FITTING SMALLER DIAMETER OR WIDTH THAN THE ROPE'S DIAMETER.

WIRE ROPE SLINGS AND CONNECTIONS TO FITTINGS

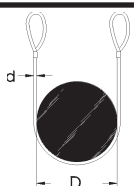
NEVER PLACE A SLING EYE OVER A FITTING WITH A DIAMETER OR WIDTH GREATER THAN ONE HALF THE NATURAL LENGTH OF THE EYE.



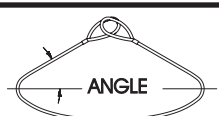
A CHOKER HITCH HAS 75% OF THE CAPACITY OF A SINGLE LEG ONLY IF THE CORNERS ARE SOFTENED AND THE HORIZONTAL ANGLE IS GREATER THAN 30 DEGREES. USE A BLOCK OF WOOD UNDER CHOKE TO INSURE ANGLE IS PROPER.



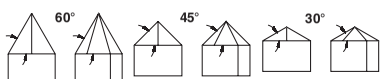
6



A BASKET HITCH HAS TWICE THE CAPACITY OF A SINGLE LEG ONLY IF D/d RATIO IS 25/1 AND THE LEGS ARE VERTICAL.



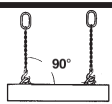
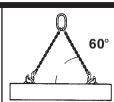
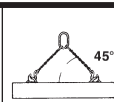
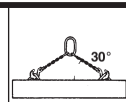
ANGLE	CAPACITY % OF SINGLE LEG
90	200 %
60	170 %
45	140 %
30	100 %



TRIPLE LEG SLINGS HAVE 50% MORE CAPACITY THAN DOUBLE LEG ONLY IF THE CENTER OF GRAVITY IS IN CENTER OF CONNECTION POINT AND LEGS ARE ADJUSTED PROPERLY (EQUAL SHARE OF THE LOAD)
QUAD LEG SLINGS OFFER IMPROVED STABILITY BUT DO NOT PROVIDE INCREASED LIFTING CAPACITY.

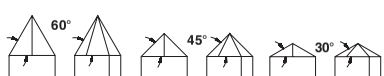
Figure 12t

CHAIN SLING CAPACITIES (LBS.) - CHAIN GR-8 - ASME B30.9 DESIGN FACTOR 4/1 7

CHAIN SIZE (IN.)						Crosby® QT ALLOY	
CHAIN GR - 8 DESIGN FACTOR 4/1	VERTICAL (SINGLE LEG)	TWO LEG OR BASKET HITCH	60 DEGREE SLING ANGLE	45 DEGREE SLING ANGLE	30 DEGREE SLING ANGLE	SINGLE LEG MASTER LINK SIZE (IN.)	DOUBLE LEG MASTER LINK SIZE (IN.)
1/4 - (9/32)	3500	7000	6050	4900	3500	1/2	1/2
3/8	7100	14200	12200	10000	7100	3/4	3/4
1/2	12000	24000	20750	16950	12000	7/8	1
5/8	18100	36200	31350	25500	18100	1	1-1/4
3/4	28300	56600	49000	40000	28300	1-1/4	1-1/2
7/8	34200	68400	59200	48350	34200	1-1/2	1-3/4
1	47700	95400	82600	67450	47700	—	—
1-1/4	72300	144600	125200	102200	72300	—	—

HORIZONTAL ANGLE	CAPACITY % OF SINGLE LEG
90	200%
60	170%
45	140%
30	100%

A CHAIN GRAB HOOK APPLICATION WILL RESULT IN A 20% REDUCTION OF CHAIN CAPACITY OF A SINGLE LEG. THE HORIZONTAL ANGLE MUST BE GREATER THAN 30 DEGREES.

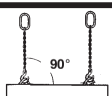
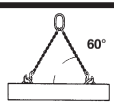
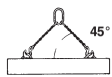


TRIPLE LEG SLINGS HAVE 50% MORE CAPACITY THAN DOUBLE LEG ONLY IF THE CENTER OF GRAVITY IS IN CENTER OF CONNECTION POINT AND LEGS ARE ADJUSTED PROPERLY (EQUAL SHARE OF THE LOAD).

QUAD LEG SLINGS OFFER IMPROVED STABILITY BUT DO NOT PROVIDE INCREASED LIFTING CAPACITY.

Figure 12u

CHAIN SLING CAPACITIES (LBS.) - CHAIN GR-10 - ASME B30.9 DESIGN FACTOR 4/1 — 7A

CHAIN SIZE (IN.)						Crosby® QT ALLOY	
CHAIN GR - 10 4 TO 1 DESIGN FACTOR	VERTICAL (SINGLE LEG)	TWO LEG OR BASKET HITCH	60 DEGREE SLING ANGLE	45 DEGREE SLING ANGLE	30 DEGREE SLING ANGLE	SINGLE LEG MASTER LINK SIZE (IN.)	DOUBLE LEG MASTER LINK SIZE (IN.)
1/4 - (9/32)	4300	8600	7400	6100	4300	1/4-5/16 in.	3/8 in.
5/16	5700	11400	9900	8100	5700	1/4-5/16 in.	3/8 in.
3/8	8800	17600	15200	12400	8800	3/8 in.	1/2 in.
1/2	15000	30000	26000	21200	15000	1/2 in.	5/8 in.
5/8	22600	45200	39100	32000	22600	5/8 in.	3/4 in.

Crosby® Spectrum® 10 System Makes Assembly Easy

A-1342
Master Link

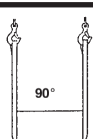
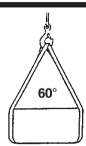
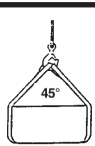
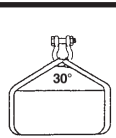
Load Rated®

"QT" QUENCHED & TEMPERED

Figure 12v

WEB SLING CAPACITIES - ANSI B30.9 - DESIGN FACTOR 5/1

9

					
VERTICAL (SINGLE LEG)	CHOKER	TWO LEG OR BASKET	60 DEGREE SLING ANGLE	45 DEGREE SLING ANGLE	30 DEGREE SLING ANGLE
100% OF SINGLE LEG	80% OF SINGLE LEG	200% OF SINGLE LEG	170% OF SINGLE LEG	140% OF SINGLE LEG	SAME AS SINGLE LEG

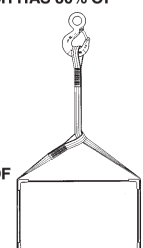
SYNTHETIC SLINGS RATED LOAD

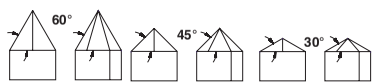
FOLDING, BUNCHING OR PINCHING OF SYNTHETIC SLINGS, WHICH OCCURS WHEN USED WITH SHACKLES, HOOKS OR OTHER APPLICATION WILL REDUCE THE RATED LOAD.

BUNCHING

PINCHING

A CHOKER HITCH HAS 80% OF THE CAPACITY OF A SINGLE LEG IF THE CORNERS ARE SOFTENED AND THE HORIZONTAL ANGLE IS GREATER THAN 30 DEGREES. USE A BLOCK OF WOOD UNDER CHOKE TO INSURE ANGLE IS PROPER.





TRIPLE LEG SLINGS HAVE 50% MORE CAPACITY THAN DOUBLE LEG ONLY IF THE CENTER OF GRAVITY IS IN CENTER OF CONNECTION POINT AND LEGS ARE ADJUSTED PROPERLY (EQUAL SHARE OF THE LOAD).

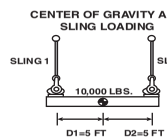
QUAD LEG SLINGS OFFER IMPROVED STABILITY BUT DO NOT PROVIDE INCREASED LIFTING CAPACITY.

Figure 12w

CENTER OF GRAVITY AND SLING LOADING

WHEN LIFTING VERTICALLY, THE LOAD WILL BE SHARED EQUALLY IF THE CENTER OF GRAVITY IS PLACED EQUALLY BETWEEN THE PICK POINTS.

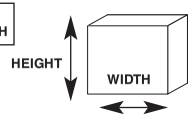
IF THE WEIGHT OF THE LOAD IS 10,000 LBS., THEN EACH SLING WILL HAVE A LOAD OF 5,000 LBS. AND EACH SHACKLE AND EYEBOLT WILL ALSO HAVE A LOAD OF 5,000 LBS.



WEIGHT = VOLUME X UNIT WEIGHT OF MATERIAL 10

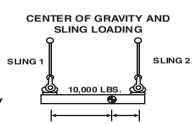
UNIT WEIGHT STEEL = 490 LBS/FT^3
UNIT WEIGHT ALUMINUM = 165 LBS/FT^3
UNIT WEIGHT CONCRETE = 150 LBS/FT^3
UNIT WEIGHT WOOD = 50 LBS/FT^3
UNIT WEIGHT WATER = 62 LBS/FT^3
UNIT WEIGHT SAND AND GRAVEL = 120 LBS/FT^3

VOLUME OF CUBE =
HEIGHT x WIDTH x LENGTH



CENTER OF GRAVITY AND SLING LOADING

WHEN THE CENTER OF GRAVITY IS NOT EQUALLY SPACED BETWEEN THE PICK POINTS, THE SLING AND FITTINGS WILL NOT CARRY AN EQUAL SHARE OF THE LOAD. THE SLING CONNECTED TO THE PICK POINT CLOSEST TO THE CENTER OF GRAVITY WILL CARRY THE GREATEST SHARE OF THE LOAD.



SLING 2 IS CLOSEST TO COG. IT WILL HAVE THE GREATEST SHARE OF THE LOAD.

SLING 2 = 10,000 X 8 / (8+2) = 8,000 LBS.
SLING 1 = 10,000 X 2 / (8+2) = 2,000 LBS.

WEIGHT = VOLUME X UNIT WEIGHT OF MATERIAL

VOLUME OF SPHERE =
3.14 x (DIAM. x DIAM. x DIAM.) / 6

VOLUME OF CYLINDER =
3.14 x (DIAM. x DIAM. x LENGTH) / 4

Figure 12x

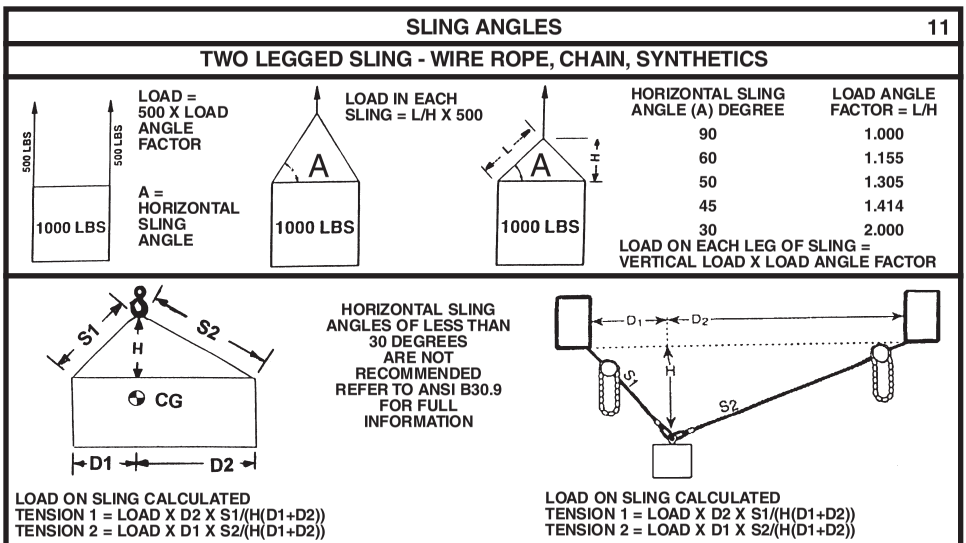

SLING ANGLES
11
TWO LEGGED SLING - WIRE ROPE, CHAIN, SYNTHETICS
500 LBS
500 LBS
1000 LBS
LOAD = 500 X LOAD ANGLE FACTOR
A = HORIZONTAL SLING ANGLE
A
1000 LBS
LOAD IN EACH SLING = L/H X 500
L
H
A
1000 LBS
HORIZONTAL SLING ANGLE (A) DEGREE
LOAD ANGLE FACTOR = L/H
90 1.000
60 1.155
50 1.305
45 1.414
30 2.000
LOAD ON EACH LEG OF SLING = VERTICAL LOAD X LOAD ANGLE FACTOR
S1
S2
H
CG
D1
D2
LOAD ON SLING CALCULATED
TENSION 1 = LOAD X D2 X S1/(H(D1+D2))
TENSION 2 = LOAD X D1 X S2/(H(D1+D2))
HORIZONTAL SLING ANGLES OF LESS THAN 30 DEGREES ARE NOT RECOMMENDED REFER TO ANSI B30.9 FOR FULL INFORMATION
D1
D2
S1
H
S2
LOAD ON SLING CALCULATED
TENSION 1 = LOAD X D2 X S1/(H(D1+D2))
TENSION 2 = LOAD X D1 X S2/(H(D1+D2))

Figure 12y

Crosby RIGHTING HARDWARE 12

Crosby SHACKLES — QUENCHED & TEMPERED IN METRIC TONS

SCREW PIN AND BOLT TYPE — CARBON SHACKLE DESIGN FACTOR 6/1 — ALLOY SHACKLE DESIGN FACTOR 5/1 — QUIC-CHECK®

NOMINAL SIZE (IN) DIAMETER OF BOW	CARBON MAXIMUM WORKING LOAD TONS	ALLOY MAXIMUM WORKING LOAD TONS	INSIDE WIDTH AT PIN (INCHES)	DIAMETER OF PIN
3/16	1/3		.38	.25
1/4	1/2		.47	.31
5/16	3/4		.53	.38
3/8	1	2	.66	.44
7/16	1-1/2	2.6	.75	.50
1/2	2	3.3	.81	.63
5/8	3-1/4	5	1.06	.75
3/4	4-3/4	7	1.25	.88
7/8	6-1/2	9.5	1.44	1.00
1	8-1/2	12.5	1.69	1.13
1-1/8	9-1/2	15	1.81	1.25
1-1/4	12	18	2.03	1.38
1-3/8	13-1/2	21	2.25	1.50
1-1/2	17	30	2.38	1.63

- INSURE SCREW PIN IS TIGHT BEFORE EACH LIFT
- USE BOLT TYPE SHACKLE FOR PERMANENT INSTALLATION

- DO NOT SIDE LOAD ROUND PIN SHACKLE
- USE SCREW PIN OR BOLT TYPE TO COLLECT SLINGS.

MAXIMUM INCLUDED ANGLE 120 DEGREES

Crosby HOOKS — QUENCHED & TEMPERED IN METRIC TONS

DESIGN FACTOR

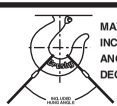
SHANK HOOK
SWIVEL HOOK
EYE HOOK

- EYEHOOKS - 5/1 (EXCEPT ALLOY 30 TON AND LARGER ARE 4-1/2 TO 1)
- SHANK AND SWIVELS ARE 4-1/2 TO 1.

QUIC-CHECK®

CARBON MAXIMUM WORKING LOAD TONS	CODE	ALLOY MAXIMUM WORKING LOAD TONS	CODE	THROAT OPENING (INCHES)	DEFORMATION INDICATOR A - A
3/4	DC	1	DA	.89	1.50
1	FC	1-1/2	FA	.91	2.00
1-1/2	GC	2	GA	1.00	2.00
2	HC	3	HA	1.09	2.00
3	IC	*4-1/2 /5	IA	1.36	2.50
5	JC	7	JA	1.61	3.00
7-1/2	KC	11	KA	2.08	4.00
10	LC	15	LA	2.27	4.00
15	NC	22	NA	3.02	5.00
20	OC	30	OA	3.25	6.50
25	PC	37	PA	3.00	7.00
30	SC	45	SA	3.38	8.00
40	TC	60	TA	4.12	10.00

* 320 EYE HOOK IS NOW RATED AT 5 TONS



MAXIMUM INCLUDED ANGLE 90 DEGREES

- DO NOT SIDELOAD
- DO NOT TIP LOAD
- DO NOT BACKLOAD

EYE HOOK

FOR ADDITIONAL INFORMATION REFER TO THE Crosby PRODUCT WARNINGS

Figure 12z

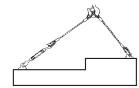
Crosby RIGGING HARDWARE

Crosby LINKS AND RINGS WITH WIRE ROPE AND SYNTHETIC SLINGS 5/1 DESIGN FACTOR

SIZE INCHES	WORKING LOAD LIMIT POUNDS G-341	A-341	A-342
1/2	2900	7000	7000
5/8	4200	9000	9000
3/4	6000	12300	12300
7/8	8300	14000	14000
1	10800	24360	24360
1-1/8	N/A	30600	N/A
1-1/4	16750	36000	36000
1-3/8	20500	43000	N/A
1-1/2	N/A	54300	54300
1-5/8	N/A	62600	N/A
1-3/4	N/A	84900	84900
2	N/A	102600	102600

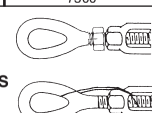
WORKING LOAD LIMITS ARE FOR USE WITH WIRE ROPE AND SYNTHETIC SLINGS, NOT FOR CHAIN SLINGS. WORKING LOAD LIMITS ARE BASED ON SINGLE LEG (IN-LINE), OR RESULTANT LOAD ON MULTIPLE LEGS WITH AN INCLUDED ANGLE LESS THAN OR EQUAL TO 120 DEGREES.

Crosby TURNBUCKLES



SIZE	WORKING LOAD LIMIT JAW AND EYE 5/1 DESIGN FACTOR	WORKING LOAD LIMIT HOOK END FITTING 5/1 DESIGN FACTOR
1/4	500	400
5/16	800	700
3/8	1200	1000
1/2	2200	1500
5/8	3500	2250
3/4	5200	3000
7/8	7200	4000
1	10000	5000
1-1/4	15200	6500
1-1/2	21400	7500

THE USE OF LOCKNUTS OR MOUSING IS AN EFFECTIVE METHOD OF PREVENTING TURNBUCKLES FROM ROTATING.



FOR ADDITIONAL INFORMATION REFER TO THE Crosby PRODUCT WARNING

Figure 12aa

Crosby® RIGGING HARDWARE 14

Crosby® SHOULDER EYE BOLTS

QUENCHED & TEMPERED DESIGN FACTOR 5/1

QUIC-CHECK®

SHANK DIAMETER	WORKING LOAD LIMIT IN LINEPULL (LBS.)	WORKING LOAD LIMIT 60 DEGREES SLING ANGLE (LBS.)	WORKING LOAD LIMIT 45 DEGREES SLING ANGLE (LBS.)	WORKING LOAD LIMIT ANGLE LESS THAN 45 DEGREES (LBS.)
1/4	650	420	195	160
5/16	1200	780	360	300
3/8	1550	1000	465	380
1/2	2600	1690	780	650
5/8	5200	3380	1560	1300
3/4	7200	4680	2160	1800
7/8	10600	6890	3180	2650
1	13300	8645	3990	3325
1-1/4	21000	13600	6300	5250
1-1/2	24000	15600	7200	6000

SHOULDER EYE BOLTS

- NEVER EXCEED WORKING LOAD LIMITS.
- NEVER USE REGULAR NUT EYE BOLTS FOR ANGULAR LIFTS.
- ALWAYS USE SHOULDER NUT EYE BOLTS FOR ANGULAR LIFTS.
- FOR ANGULAR LIFTS, ADJUST WORKING LOAD AS SHOWN ABOVE.
- ALWAYS TIGHTEN NUTS SECURELY AGAINST THE LOAD.
- ALWAYS APPLY LOAD TO EYE BOLT IN THE PLANE OF THE EYE.

Crosby® SWIVEL HOIST RINGS

DESIGN FACTOR 5/1

WORKING LOAD LIMIT FULL 180 DEGREE PIVOT (LBS.)	THREAD SHANK SIZE U.N.C.	TORQUE FT - (LBS)
800	5/16	7
1000	3/8	12
2500	1/2	28
4000	5/8	60
7000	3/4	100
8000	7/8	160
10000	1	230
15000	1-1/4	470
24000	1-1/2	800
30000	2	1100

SWIVEL HOIST RINGS

- WHEN USING LIFTING SLINGS OF TWO OR MORE LEGS MAKE SURE THE FORCES IN THE LEG ARE CALCULATED. SELECT THE PROPER SIZE SWIVEL HOIST RING TO ALLOW FOR LOAD IN SLING LEG.
- ALWAYS INSURE HOIST RING IS FREE TO ALIGN ITSELF WITH SLING.

- ALWAYS INSURE HOIST RING IS PROPERLY TORQUED TO REQUIRED VALUE.

FOR ADDITIONAL INFORMATION REFER TO THE Crosby® PRODUCT WARNING

Figure 12ab

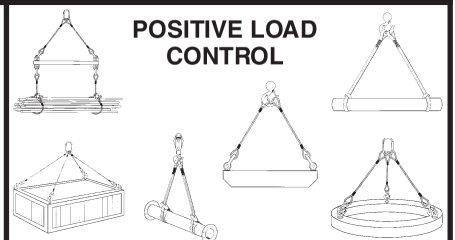
OPERATING PRACTICES - ANSI B30.9

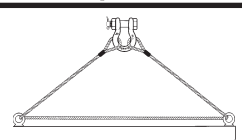
WHENEVER ANY SLING IS USED, THE FOLLOWING PRACTICES SHALL BE OBSERVED.

1. SLINGS THAT ARE DAMAGED OR DEFECTIVE SHALL NOT BE USED.
2. SLINGS SHALL NOT BE SHORTENED WITH KNOTS OR BOLTS OR OTHER MAKESHIFT DEVICES.
3. SLING LEGS SHALL NOT BE KINKED.
4. SLINGS SHALL NOT BE LOADED IN EXCESS OF THEIR RATED CAPACITIES.
5. SLINGS USED IN A BASKET HITCH SHALL HAVE THE LOADS BALANCED TO PREVENT SLIPPAGE.
6. SLINGS SHALL BE SECURELY ATTACHED TO THEIR LOAD.
7. SLINGS SHALL BE PADDED OR PROTECTED FROM THE SHARP EDGES OF THEIR LOADS.
8. SUSPENDED LOADS SHALL BE KEPT CLEAR OF ALL OBSTRUCTION.
9. ALL EMPLOYEES SHALL BE KEPT CLEAR OF LOADS ABOUT TO BE LIFTED AND OF SUSPENDED LOADS.
10. HANDS OR FINGERS SHALL NOT BE PLACED BETWEEN THE SLING AND ITS LOAD WHILE THE SLING IS BEING TIGHTENED AROUND THE LOAD.
11. SHOCK LOADING IS PROHIBITED!
12. A SLING SHALL NOT BE PULLED FROM UNDER A LOAD WHEN THE LOAD IS RESTING ON THE SLING.

INSPECTION: EACH DAY BEFORE BEING USED, THE SLING AND ALL FASTENINGS AND ATTACHMENTS SHALL BE INSPECTED FOR DAMAGE OR DEFECTS BY A COMPETENT PERSON DESIGNATED BY THE EMPLOYER. ADDITIONAL INSPECTIONS SHALL BE PERFORMED DURING SLING USE WHERE SERVICE CONDITIONS WARRANT. DAMAGED OR DEFECTIVE SLINGS SHALL BE IMMEDIATELY REMOVED FROM SERVICE.

LOAD CONTROL 15





REEVING THROUGH CONNECTIONS TO LOAD INCREASES LOAD ON CONNECTION FITTINGS BY AS MUCH AS TWICE.

DO NOT REEVE!

Figure 12ac

Crosby RIGGING HARDWARE 16

Crosby WIRE ROPE CLIPS

G-450 U-Bolt Clip

CLIPS 80% EFFICIENT UNDER 1", 90% 1" AND ABOVE

SIZE	NUMBER OF CLIPS	TURNBACK LENGTH (IN.)	TORQUE FT-LBS.
1/8	2	3-1/4	4.5
3/16	2	3-3/4	7.5
1/4	2	4-3/4	15
5/16	2	5-1/4	30
3/8	2	6-1/2	45
7/16	2	7	65
1/2	3	11 -12	65
9/16	3	12	95
5/8	3	12	95
3/4	4	18	130
1	5	26	225

APPLY U-BOLT OVER DEAD END OF THE WIRE ROPE. LIVE END OF THE ROPE RESTS IN THE SADDLE. A TERMINATION IS NOT COMPLETE UNTIL IT HAS BEEN RETORQUED A SECOND TIME. NEVER SADDLE A DEAD HORSE!

CLIPS 80% EFFICIENT UNDER 1", 90% 1" AND ABOVE

G-429 Fist Grip Clip

SIZE	NUMBER OF CLIPS	TURNBACK LENGTH (IN.)	TORQUE FT-LBS.
3/16	2	4	30
1/4	2	4	30
5/16	2	5	30
3/8	2	5-1/4	45
7/16	2	6-1/2	65
1/2	3	11	65
9/16	3	12-3/4	130
5/8	3	13-1/2	130
3/4	4	16	225
1	5	37	225

THE NUMBER OF CLIPS SHOWN IS BASED ON USING RRL OR RLL WIRE ROPE, 6X19 OR 6X37 CLASS, FC OR IWRC: IPS OR XIP. IT ALSO APPLIES TO ROTATION RESISTANT RRL WIRE ROPE, 8X19 CLASS, IPS, XIP, SIZES 1-1/2 INCH AND SMALLER, AND TO ROTATION RESISTANT RRL WIRE ROPE, 19X7 CLASS, IPS, XIP, SIZES 1-3/4 INCH AND SMALLER. FOR ELEVATOR, PERSONNEL HOIST, AND SMALLER, FOR ELEVATOR, PERSONNEL HOIST, AND SCAFFOLD APPLICATIONS REFER TO ANSI A17.1 AND ANSI A10.4. THESE STANDARDS DO NOT RECOMMEND THE USE OF U-BOLT STYLE WIRE ROPE CLIPS.

FOR ADDITIONAL INFORMATION REFER TO THE Crosby PRODUCT WARNING

Do not use U-Bolts

12.8 Synthetic Webbing Slings – Selection, Use and Maintenance

This section applies to slings fabricated by sewing of woven synthetic webbing of nylon or polyester type yarns, for the purpose of hoisting, lifting, and general material handling.

12.8.1 Construction

12.8.1.1 Webbing

Webbing should be of fabric woven of high tenacity synthetic yarns, offering suitable characteristics for use in the fabrication of web slings. Webbing shall have the following characteristics.

(a) Sufficient certified tensile strength to meet the sling manufacturer's requirements.
(b) Uniform thickness and width.
(c) Full woven width, including selvage edges.
(d) Webbing ends shall be sealed by heat, or other suitable means, to prevent raveling.

12.8.1.2 Thread

The thread used in the manufacture of synthetic web slings shall be of the same generic type yarn as the sling webbing.

12.8.1.3 Stitching

(a) Stitching shall be the only method used to fabricate synthetic web slings within the scope of this standard.
(b) The stitching pattern and length of stitching shall be in accordance with the manufacturer's standard practice.

12.8.1.4 Fittings

(a) The material selected shall be compatible with the mechanical and environmental requirements imposed on the fitting. Material selected should be carbon steel, alloy steel, aluminum, or other suitable material.
(b) Fitting shall have sufficient strength to sustain twice the rated load of the sling without permanent deformation and a minimum breaking strength equal to five times the rated load of the sling.
(c) All surfaces shall be cleanly finished and sharp edges removed so as not to cause damage to the webbing.
(d) Slings incorporating aluminum fittings shall not be used where fumes, vapors, sprays, mists or liquids of caustic, or acids are present.
(e) The eye opening in the fitting shall be the proper shape and size to insure that the fitting will seat properly in the hook or other attachment.

12.8.1.5 Marking (Sling identification)

Each sling shall be permanently marked to show.

(a) Name of trademark or manufacturer.
(b) Manufacturer's code or stock number.
(c) Rated loads for types of hitches used.
(d) Type of synthetic web material.

12.8.2 Design Factor

The design factor for synthetic web slings shall be a minimum of 5.

12.8.3. Rated Load

(a) A sling shall not be used at a load greater than that shown on its tags. Slings shall be used in accordance with the manufacturer's recommendations.
(b) Each manufacturer shall make available on request test data to justify these recommended rated loads.

12.8.4 Proof Test

When specified by the purchaser, web slings of all types shall be proof loaded:

(a) The proof load for single leg slings and endless slings shall be two times the vertical rated load.
(b) The proof load for multiple leg bridle slings shall be applied to the individual legs and shall be two times the vertical rated load of a single leg sling.

12.8.5 Effects of Environment

(a) Chemically active environments, such as acids and caustics, can affect the strength of slings the manufacturer should be consulted before slings are used in chemically active environments.
(b) Nylon and polyester slings shall not be used at temperatures in excess of 194°(F) 90°(C).

12.8.6 Inspection

(a) Initial Inspection. Before using any new or repaired sling, it shall be inspected to insure that the correct sling is being used as well as to determine that the sling meets the requirements of this standard.
(b) Frequent Inspection. This inspection should be made by the person handling the sling each day the sling is used.

(c) Periodic Inspection. This inspection should be conducted by the Competent Person. Frequency of inspection should be based on:
    (1) Frequency of sling use;
    (2) Severity of service conditions; and
    (3) Experience gained on the service life of slings used in similar applications
(d) Periodic inspections should be conducted at least annually.

12.8.7 Removal Criteria

A sling shall be removed from service if damage such as the following is visible and shall only be returned to service when approved by a Qualified Person.

(a) Acid or caustic burns
(b) Melting or charring of any part of the sling
(c) Holes, tears, cuts or snags
(d) Broken or worn stitching in load bearing splices
(e) Excessive abrasive wear
(f) Knots in any part of the sling
(g) Excessive pitting or corrosion, or cracked, distorted, or broken fittings
(h) Other visible damage that causes doubt as to the strength of the sling.

12.8.8 Repairs

(a) Slings shall be repaired only by a sling manufacturer or a Qualified Person. When repaired, a sling shall be permanently marked to identify the repair agent.
(b) Temporary repairs of either webbing, fittings, or stitching shall be not permitted.
(c) Repaired sling shall be proof tested to two times its assigned rated load before being put back into service.

12.8.9 Operating Practices

(a) The weight of load shall be within the rated load of the sling.
(b) Slings shall not be shortened or lengthened by knotting or other methods not approved by the sling manufacturer.
(c) Slings that appear to be damaged shall not be used unless inspected and accepted as usable under Section 12.7.6.
(d) Sling shall be hitched in a manner providing control of the load.
(e) Sharp corners in contact with the sling should be padded with material of sufficient strength to minimize damage to the sling.
(f) Personnel should stand clear of the suspended load.
(g) Personnel shall not ride the sling.
(h) Shock loading should be avoided.
(i) Slings should not be pulled from under a load when the load is resting on the sling.
(j) Slings should be stored in a cool dry, and dark place to prevent environmental damage.
(k) Twisting and kinking the legs shall be avoided.
(l) Load applied to the hook should be centered in the base (bowl) of hook to prevent point loading on the hook.
(m) During lifting, with or without load, personnel shall be alert for possible snagging.
(n) In a basket hitch, the load should be balanced to prevent slippage.
(o) The sling's legs should contain or support the load from the sides above center of gravity when using a basket hitch.
(p) Slings should be long enough so that the rated load is adequate when the angle of the legs is taken into consideration.
(q) Slings should not be dragged on the floor or over an abrasive surface.
(r) In a choker hitch, slings shall be long enough so the choker fitting chokes on the webbing and never on the other fitting.

(s) Nylon and polyester slings shall not be used at temperatures in excess of 194°(F) 90°(C).
(t) When extensive exposure to sunlight or ultraviolet light is experienced by nylon or polyester web slings, the sling manufacturer should be consulted for recommended inspection procedure because of loss in strength.

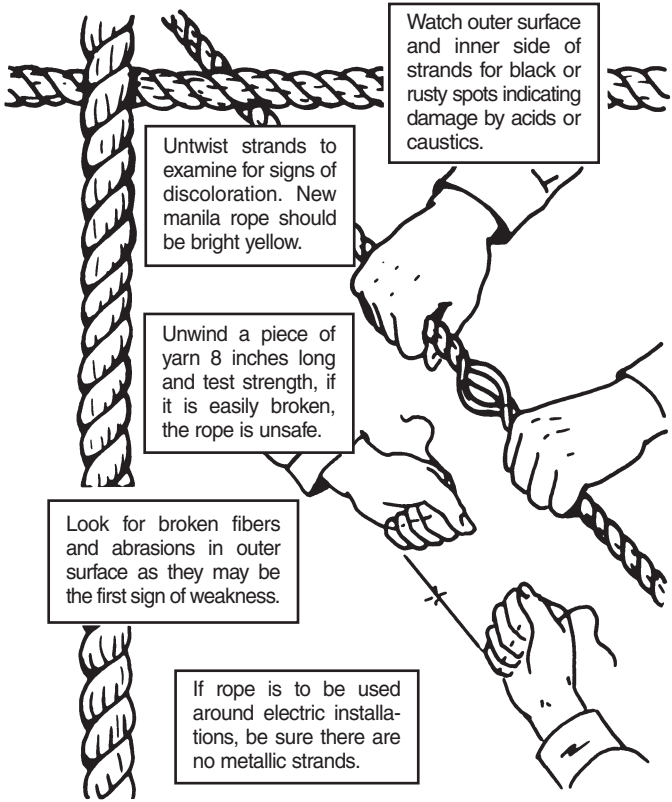
12.9 Beam Clamps

(a) A beam clamp used for rigging shall be engineered to properly support the expected load.
(b) Before moving extremely heavy loads, check with your Superintendent/Manager who shall obtain the maximum load the beam will support.
(c) Do not use a choker through the eye of the beam clamp while hoisting.
(d) Do not load the lower flange to more than 50% of the beam's capacity.
(e) Beam clamps shall be properly sized for the beam to which it is attached.
(f) Use only case-hardened bolts with lock nuts or nuts with lock washers for the beam clamp assembly.

Figure 12ad

Figure 12ae

INSPECTING MANILA ROPE



Safe Practice Rules

1. Frozen fiber rope shall not be used in load carrying service.
2. Fiber rope that has been subjected to acids or excessive heat shall not be used for load carrying purposes.
3. Fiber rope shall be protected from abrasion by padding where it is fastened or drawn over square corners or sharp or rough surfaces.

Figure 12af

Five-Part Falls

A five-part reeve is accomplished using a two- and three-sheave block as follows: Enter the lead line through the front of the stationary block at sheave (B), then go down in back of traveling block and through at sheave (E), up behind stationary block and through at sheave (C), down in front of traveling block and through at sheave (D), up in front of stationary block and through at sheave (A), down to the traveling block and becket off. This reeving is more widely used for rope falls (manila), but is also used for wire rope (cable).

Six-Part Falls

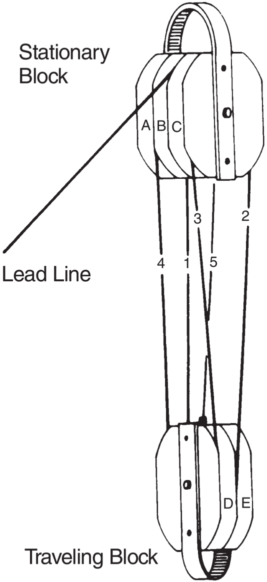
Using a pair of three-sheave blocks, a six-part reeve is accomplished as follows: Enter the lead line through the front of the stationary block at sheave (B), then go down in front of traveling block and through at sheave (E), up behind stationary block and through at sheave (A), down behind traveling block and through at sheave (D), up in front of stationary block and through at sheave (C), down in front of traveling block and through at sheave (F), up to stationary block and becket off. This reeving is more widely used for rope falls (manila), but is also used for wire rope (cable).

Seven-Part Falls

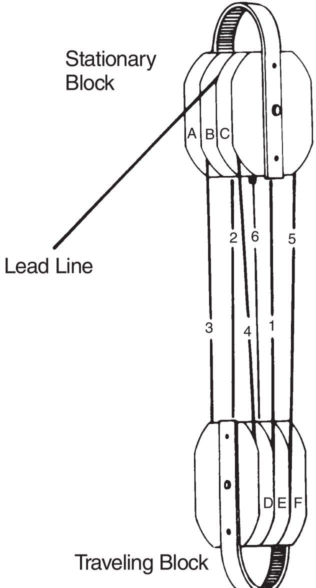
A seven-part reeve is accomplished using a three- and four-sheave block as follows: Enter the lead line through the front of the stationary block (four-sheave) at sheave (C), go down in front of traveling block and through at sheave (F), up behind the stationary block and through at sheave (A), down behind traveling block and through at sheave (E), up in front of stationary block and through at sheave (D), down in front of stationary block and through at sheave (G), up behind stationary block and through at sheave (B), down to the traveling block and becket off.

Figure 12ae Continued

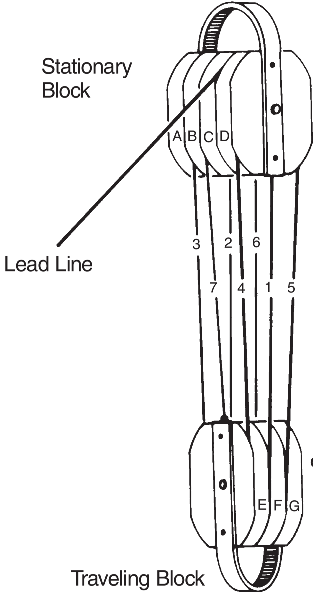
FIVE-PART FALLS



SIX-PART FALLS



SEVEN-PART FALLS



This theory applies to two-part, three-part and four-part falls.

12.10 Manila Rope

(a) Frozen manila rope shall not be used in load-carrying service.
(b) Manila rope shall be protected from abrasion by padding where it is fastened or drawn over square corners, or sharp or rough surfaces.
(c) Even the finest-quality rope deteriorates very rapidly when not given the best of care. Kinking, overheating, moisture and acid all cause deterioration, which is not readily noticeable upon casual inspection.
(d) Manila rope shall be stored in a clean, dry location. Keep off pit floor, coil into protective device such as a drum.
(e) Manila rope is not a substitute for wire rope. It shall only be used for lashings, tackles, tag lines, straps on light leads and temporary guy lines and light hoisting.
(f) Points to look for during manila rope inspection are:

Good Characteristics	Poor Characteristics
Hard but pliant	Brown spots – weak, soft
Silvery or pearly luster	Black or dark spots – weak
Inner fibers bright & clean	Abrasion of fibers
Individual yarn strong	Loss of stretch
Uncut and unabraded	Cuts – Burns
outer & inner fibers	Dirt between inner fibers
Stretch and spring good	Freezing of rope

12.11 Synthetic Rope

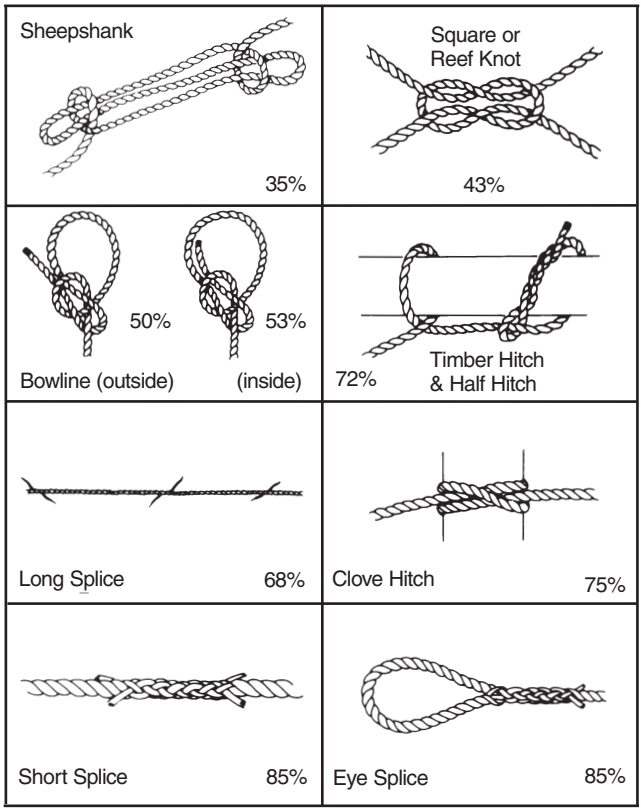
(a) Synthetic fiber ropes are made from nylon, polypropylene, or polyester. Synthetic fiber ropes consist of individual threads and fibers that run the full length of the rope (natural fibers are not continuous – in fact, they are short and overlapped).
(b) Do not choose synthetic rope when burning and welding. Synthetic rope is also more likely to be affected by chemicals and it tends to be slippery.
(c) Do not use clamps for splicing synthetic rope unless it is specifically designed for this purpose.

(d) Good practices when using synthetic rope:
    (1) Keep rope dry and clean and away from chemicals
    (2) Never overload a rope
    (3) Never use a frozen rope
    (4) Don't drag a rope on the ground. This will damage the outside surface of the rope.
    (5) Never allow the rope to bend over sharp edges
    (6) Don't permit the rope to drag against itself
    (7) Observe proper picking angles
    (8) Pad all corners when lifting materials
    (9) When coupling ropes, use thimbles
    (10) Inspect rope often by twisting to expose the inside yarns
(e) Synthetic rope shall be removed from service if it shows signs of:
    (1) Abnormal wear
    (2) Powder between strands
    (3) Broken or cut fibers
    (4) Variations in the size or roundness of strands
    (5) Discoloration or rotting
    (6) Distortion of hardware
(f) When rope is damaged and taken out of service, it shall be completely destroyed to prevent others from using it.

12.12 Knots Are Weak

If a knot or hitch of any kind is tied in a rope, its failure under stress is sure to occur at that place. Each fiber in the straight part of the rope takes proper share of the load. In all knots, the rope is cramped or has a short bend, which throws an overload on those fibers that are on the outside of the bend, and one fiber after another breaks until the rope is torn apart. The shorter the bend in the standing rope, the weaker the knot. The results given in Figure 12ag are approximate, but are sufficient to cause caution in all rope fastenings employed in important work.

Figure 12ag **Approximate Efficiency – Comparison of Rope Knots and Connections to Safe Load**

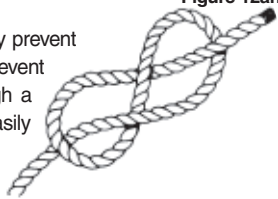


Source: Handbook for Riggers, 1977 Revised Edition

Note: Variations in test equipment, procedures, rope age, condition and construction, etc. may impact test results. The efficiencies shown above are for point of reference only. **Rigging methods, rope capacity, etc. shall well exceed the weight of the load to be hoisted. Knot efficiencies shall not be factored into the lift too closely; err on the side of caution.**

Figure Eight Knot

Figure 12ah



Used in the end of a rope to temporarily prevent the strands from unraveling. Useful to prevent the end of a rope from slipping through a block or an eye, and does not jam as easily as the overhand knot.

Figure 12ai

Catspaw

Used to secure the middle of a rope to a hook. Take two bights (loops) in the rope, twist in opposite directions and then bring the loops together and pass over hook.

Timber Hitch

(A) Used for hoisting planks, timbers and pipe. Holds without slipping and does not jam. A half-hitch is added in (B) This is done to keep a plank or length of pipe on end, while lifting.

Figure 12aj

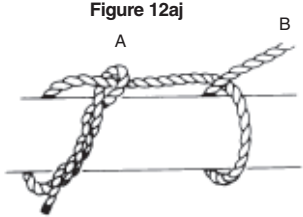
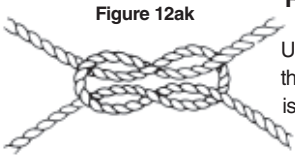


Figure 12ak



Reef Knot or Square Knot

Used to join two ropes or lines of the same size - holds firmly and is easily untied.

Figure 12al

Bowline on the Bight

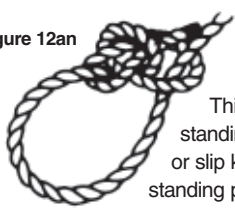
Used in emergencies to lift an injured person off a building or out of a hole. This is accomplished by sitting in one loop, and putting the other loop around the back and under the arms. Also used to tie bowline in middle of line.

Figure 12am

Clove Hitch or Builder's Hitch

Because of its wide use by construction workers in fastening rope to upright posts on staging to act as a rail or warning line, it is also known as a builder's hitch. Making a line fast is another common use.

Figure 12an

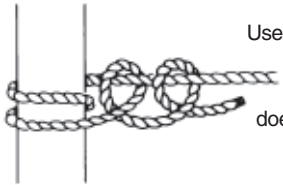


Running Bowline

This is merely a bowline knot made round the standing part of a rope to form a running noose or slip knot and is very reliable. Runs freely on the standing part and is easily untied. **This knot shall not be used for securing lifelines.**

Figure 12ao

Round Turn and Two Half Hitches



Used to secure a rope to a column or post, and will stand heavy strain without slipping. Easily tied and does not jam.

Figure Eight on a Bight

Figure 12ap

Provides a secure loop in the end of a rope. Made by doubling a line back on itself and then tying a Figure Eight knot in the double line. This knot may reduce the strength of a rope by 20%. **This knot shall not be used for securing a lifeline.** CAUTION: Be certain you tie a Figure Eight, not an Overhand on a Bight.

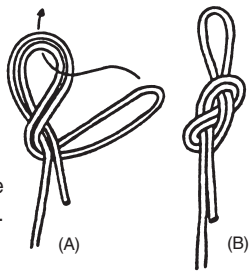
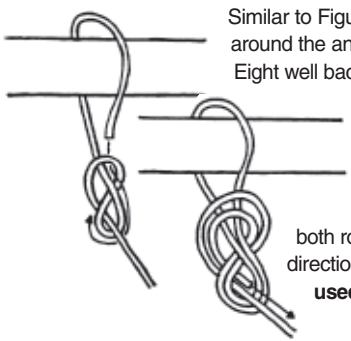


Figure 12aq

Figure Eight Follow Through



Similar to Figure Eight on a Bight, but is tied around the anchor point. Tie a simple Figure Eight well back from the end of the rope. Pass the end of the rope around the anchor point then follow back through parallel to the first knot. Follow every contour of the first knot with both rope ends going in the same direction. **This knot shall not be used for securing a lifeline.**

Bowline

One of the best-known and most-widely used of all knots. A favorite knot with riggers, it is easily constructed and used wherever a hitch is required that will not slip, jam or fail. (Hint: Leave a long tail and secure the tail with two half-hitches.) **This knot shall not be used for securing a lifeline.**

Figure 12ar

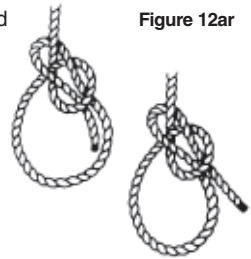
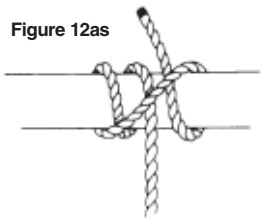


Figure 12as



Rolling Hitch

This knot is used for lifting round loads, such as pipe or bar steel. For a more efficient knot, add half-hitch, short end around long end.

Carrick Bend

Used for joining large ropes together, and easier to untie than most knots after being subjected to strain.

Figure 12at

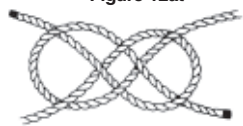


Figure 12au

Sheepshank

This knot is used for shortening a rope. The method shown is especially useful where the ends of the rope are not free, as it can be employed in the center of a tied rope. Taking the strain off a damaged piece of rope when there is not time to immediately replace with sound rope is another use. When seized, as shown, it is more secure.