RIGGING INFORMATION
Each app tool offers special enhancements and features that are easy to use and user friendly. Check out all the new Crosby® apps ready for download at the App Store today.

App Store® is a registered trademark of Apple Inc. Apple, lion are trademarks of Apple Inc. Google Play® is a trademark of Google Inc. Application availability and pricing are subject to change.
## Risk Management

**Definition**

Comprehensive set of actions that reduces the risk of a problem, a failure, an accident.

ASME B30.9 requires that sling users shall be trained in the selection, inspection, cautions to personnel, effects of environment, and rigging practices. sling identification is required on all types of slings.

ASME B30.26 requires that rigging hardware users shall be trained in the selection, inspection, cautions to personnel, effects of environment, and rigging practices. all rigging hardware to be identified by manufacturer with name or trademark of manufacturer.

Refer to the Crosby Group catalog and other product application information.

## 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.

## For Additional Support

**Crosby® Fittings**

LEBUS® McKISSICK®

WESTERN NATIONAL

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## The Basic Rigging Plan

Plan every lift, include the following questions with the questions your experience provides:

1. Who is responsible (competent) for the rigging?
2. Has communication been established?
3. Is the rigging in acceptable condition?
4. Is the rigging appropriate for lifting?
5. Does the rigging have proper identification?
6. Does all gear have known working load limits?
7. What is the weight of the load?
8. Where is the load’s center of gravity?
9. What is the sling angle?
10. Will there be any side or angular loading?
11. Are the slings padded against corners, edges, protrusions and abrasive surfaces?
12. Are the working load limits adequate?
13. Is the load rigged to the center of gravity?
14. Is the hitch appropriate for the load?
15. Is a tag line required to control the load?
16. Will personnel be clear of suspended loads?
17. Is there any possibility of fouling?
18. Will the load lift level and be stable?
19. Any unusual environmental concerns?
20. Any special requirements?

The rigging must be used within manufacturer’s recommendations and industry standards that include OSHA, ASME, ANSI, API and others.

## Responsibility

**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.
4. Provide employees with training to meet OSHA, API and ASME (B30.9, B30.26, etc.) requirements.

**Manufacturers Responsibility**

1. Product and application information
2. Product that is clearly identified
3. Product performance
4. Product training and training resources
INSPECTION OF RIGGING HARDWARE

INSPECTION FREQUENCY PER ASME B30.26

A VISUAL INSPECTION SHALL BE PERFORMED BY THE USER OR DESIGNATED PERSON EACH DAY BEFORE THE RIGGING HARDWARE IS USED. A PERIODIC INSPECTION SHALL BE PERFORMED BY A DESIGNATED PERSON, AT LEAST ANNUALLY. THE RIGGING HARDWARE SHALL BE EXAMINED AND A DETERMINATION MADE AS TO WHETHER THEY CONSTITUTE A HAZARD. WRITTEN RECORDS ARE NOT REQUIRED. SEMI-PERMANENT AND INACCESSIBLE LOCATIONS WHERE FREQUENT INSPECTIONS ARE NOT FEASIBLE SHALL HAVE PERIODIC INSPECTIONS PERFORMED.

REJECTION CRITERIA PER ASME B30.26

MISSING OR ILLEGIBLE MANUFACTURER’S NAME OR TRADEMARK AND/OR RATED LOAD IDENTIFICATION (OR SIZE AS REQUIRED)
A 10% OR MORE REDUCTION OF THE ORIGINAL DIMENSION
BENT, TWISTED, DISTORTED, STRETCHED, ELONGATED, CRACKED OR BROKEN LOAD BEARING COMPONENTS
EXCESSIVE NICKS, GOUGES, PITTING AND CORROSION
INDICATIONS OF HEAT DAMAGE INCLUDING WELD SPATTER OR ARC STRIKES, EVIDENCE OF UNAUTHORIZED WELDING
LOOSE OR MISSING NUTS, BOLTS, COTTER PINS, SNAP RINGS, OR OTHER FASTENERS AND RETAINING DEVICES
UNAUTHORIZED REPLACEMENT COMPONENTS OR OTHER VISIBLE CONDITIONS THAT CAUSE DOUBT AS TO THE CONTINUED USE OF THE SLING

ADDITIONALLY INSPECT WIRE ROPE CLIPS FOR:
1. INSUFFICIENT NUMBER OF CLIPS
2. INCORRECT SPACING BETWEEN CLIPS
3. IMPROPERLY TIGHTENED CLIPS
4. INDICATIONS OF DAMAGED WIRE ROPE OR WIRE ROPE SLIPPAGE
5. IMPROPER ASSEMBLY

ADDITIONALLY, INSPECT WEDGE SOCKETS FOR:
1. INDICATIONS OF DAMAGED WIRE ROPE OR WIRE ROPE SLIPPAGE
2. IMPROPER ASSEMBLY

ADDITIONAL REJECTION CRITERIA PER ASME B30.10 - HOOKS

• ANY VISIBLY APPARENT BEND OR TWIST FROM THE PLANE OF THE UNBENT HOOK
• ANY DISTORTION CAUSING AN INCREASE IN THROAT OPENING OF 5%, NOT TO EXCEED 1/4”
• MISSING OR ILLEGIBLE RATED LOAD IDENTIFICATION.
• MISSING OR ILLEGIBLE HOOK MANUFACTURER’S IDENTIFICATION OR SECONDARY MFG. IDENTIFICATION

INSPECTION OF SLINGS

INSPECTION FREQUENCY PER ASME B30.9

A VISUAL INSPECTION FOR DAMAGE SHALL BE PERFORMED BY THE USER OR DESIGNATED PERSON EACH DAY OR SHIFT THE SLING IS USED. A COMPLETE INSPECTION FOR DAMAGE SHALL BE PERFORMED PERIODICALLY BY A DESIGNATED PERSON, AT LEAST ANNUALLY. WRITTEN RECORDS OF MOST RECENT PERIODIC INSPECTION SHALL BE MAINTAINED.

REJECTION CRITERIA PER ASME B30.9

MISSING OR ILLEGIBLE SLING IDENTIFICATION; EVIDENCE OF HEAT DAMAGE; SLINGS THAT ARE KNOTTED; FITTINGS THAT ARE PITTED, CORRODED, CRACKED, BENT, TWISTED, GOUGED, OR BROKEN; OTHER CONDITIONS, INCLUDING VISIBLE DAMAGE, THAT CAUSE DOUBT AS TO THE CONTINUED USE OF THE SLING.

WIRE ROPE SLINGS
EXCESSIVE BROKEN WIRES, FOR STRAND-LAID AND SINGLE PART SLINGS, TEN RANDOMLY DISTRIBUTED BROKEN WIRES IN ONE ROPE LAY OR FIVE BROKEN WIRES IN ONE STRAND IN ONE ROPE LAY
SEVERE LOCALIZED ABRASION OR SCRAPING, KINKING, CRUSHING, BIRDCAGING
ANY OTHER DAMAGE RESULTING IN DAMAGE TO THE ROPE STRUCTURE
SEVERE CORROSION OF THE ROPE OR END ATTACHMENTS

CHAIN SLINGS
CRACKS OR BREAKS
EXCESSIVE WEAR, NICKS OR GOUGES
STRETCHED CHAIN LINKS OR COMPONENTS
BENT, TWISTED OR DEFORMED CHAIN LINKS OR COMPONENTS
EXCESSIVE PITTING OR CORROSION
LACK OF ABILITY OF CHAIN OR COMPONENTS TO HINGE FREELY
WELD SPATTER

WEB SLINGS
ACID OR CAUSTIC BURNS
MELTING OR CHARRING OF ANY PART OF THE SLING
HOLES, TEARS, CUTS OR SNAGS
BROKEN OR WORN STITCHING IN LOAD BEARING SPLICES
EXCESSIVE ABRASIVE WEAR
DISCOLORATION AND BRITTLE OR STIFF AREAS ON ANY PART OF THE SLING, WHICH MAY MEAN CHEMICAL OR ULTRAVIOLET / SUNLIGHT DAMAGE

ROUND SLINGS
ACID OR CAUSTIC BURNS
EVIDENCE OF HEAT DAMAGE
HOLES, TEARS, CUTS, ABRASIVE WEAR OR SNAGS THAT EXPOSE THE CORE YARNS
BROKEN OR DAMAGED CORE YARNS
WELD SPATTER THAT EXPOSES CORE YARNS
DISCOLORATION AND BRITTLE OR STIFF AREAS ON ANY PART OF THE SLINGS, WHICH MAY MEAN CHEMICAL OR OTHER DAMAGE
**Wire Rope Sling Connections and Hitches**

**Connection to Fittings**
- Use a thimble to protect sling and increase $D/d$.
- Never place eye over a fitting with smaller diameter or width than the rope’s diameter.

**Choker Capacity**
- A choker hitch has 75% of the capacity of a single leg sling only if the angle of choke is 120 degrees or greater. A choke angle less than 120 degrees can result in a capacity as low as 40% of the single leg.

**Wire Rope Sling Connections and Hitches**

**Basket Hitch Capacity**
- A basket hitch has twice the capacity of a single leg only if $D/d$ ratio is 25/1 and the legs are vertical.

**Multiple Leg Slings**
- Triple leg slings have 50% more capacity than double leg slings (at same sling angle) only if the center of gravity is in center of connection points and legs are adjusted properly. They must have an equal share of the load.

**Chain Sling Connections and Hitches**

**Connection to Fittings**
- Use master links to collect slings and to connect to hook.
- Use grade 8 (80) or grade 10 (100) fittings that match the WLL of chain and offer proper securing.

**Choker Capacity**
- A chain choker hitch has 80% of the capacity of a single leg sling only if the angle of choke is 120 degrees or greater. Rated loads for angles of choke less than 120 degrees shall be determined by the sling MFG or a qualified person.
- No loss in capacity results if a cradle grab hook is used when angle of choke is 120 degrees or greater.

**Basket Hitch Capacity**
- A true basket hitch has twice the capacity of a single leg only if the legs are vertical. Note that the basket is formed by using a chain sling with two masterlinks at each end connected to the hook.

**Horizontal Capacity % of Angle Single Leg**

<table>
<thead>
<tr>
<th>Angle</th>
<th>Capacity %</th>
</tr>
</thead>
<tbody>
<tr>
<td>90</td>
<td>200%</td>
</tr>
<tr>
<td>60</td>
<td>170%</td>
</tr>
<tr>
<td>45</td>
<td>140%</td>
</tr>
<tr>
<td>30</td>
<td>100%</td>
</tr>
</tbody>
</table>

**Multiple Leg Slings**
- Triple leg chain slings have 50% more capacity than double leg chain slings (at same sling angle) only if the center of gravity is in the center of the connection points and legs are adjusted properly. They must have an equal share of the load.

**Quad (4 Leg) Chain Sling**
- Quad (4 leg) chain slings offer improved stability, but do not provide increased capacity. The capacity of a four leg chain sling is considered the same as three leg chain sling.
Rigging Information

**WEB SLING AND ROUNDSLING CAPACITIES**

<table>
<thead>
<tr>
<th>WEB SLING IDENTIFICATION INCLUDES:</th>
<th>ROUNDSLING IDENTIFICATION INCLUDES:</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLING TYPE:</td>
<td>SLING NUMBER: 1-13</td>
</tr>
<tr>
<td>TC - TRIANGLE CHOKER</td>
<td>SLING NUMBERS ARE FOR REFERENCE</td>
</tr>
<tr>
<td>TT - TRIANGLE TRIANGLE</td>
<td>ONLY, SOME ROUNDSLINGS HAVE</td>
</tr>
<tr>
<td>EE - EYE AND EYE</td>
<td>DIFFERENT RATINGS.</td>
</tr>
<tr>
<td>EN - ENDLESS</td>
<td></td>
</tr>
<tr>
<td>NUMBER OF PLYS: 1 OR 2</td>
<td>SLING COLOR: PURPLE, GREEN, YELLOW,</td>
</tr>
<tr>
<td>WEBBING GRADE: 9 OR 6</td>
<td>TAN, RED, WHITE, BLUE, ORANGE</td>
</tr>
<tr>
<td>SLING WIDTH (INCHES)</td>
<td>SLING COLOR IS NOT FOLLOWED BY ALL</td>
</tr>
<tr>
<td></td>
<td>MANUFACTURERS AND SOME COLORS HAVE</td>
</tr>
<tr>
<td></td>
<td>MORE THAN ONE RATED LOAD.</td>
</tr>
<tr>
<td>EE 2-9 04 X 12</td>
<td></td>
</tr>
</tbody>
</table>

**CENTER OF GRAVITY AND SLING LOADING**

**WEB Sling and RoundSLing Capacities**

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.

**WEB Sling and RoundSLing Capacities**

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.

**WEB Sling and RoundSLing Capacities**

Sling 2 = 10,000 X 8 / (8+2) = 8,000 lbs.
Sling 1 = 10,000 X 2 / (8+2) = 2,000 lbs.

**WEB Sling and RoundSLing Capacities**

Center of gravity and sling loading

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SLING ANGLES

TWO LEGGED SLING - WIRE ROPE, CHAIN, SYNTHETICS

<table>
<thead>
<tr>
<th>HORIZONTAL SLING ANGLE (A) DEGREE</th>
<th>LOAD ANGLE FACTOR = L/H</th>
</tr>
</thead>
<tbody>
<tr>
<td>90</td>
<td>1.000</td>
</tr>
<tr>
<td>60</td>
<td>1.155</td>
</tr>
<tr>
<td>50</td>
<td>1.305</td>
</tr>
<tr>
<td>45</td>
<td>1.414</td>
</tr>
<tr>
<td>30</td>
<td>2.000</td>
</tr>
</tbody>
</table>

LOAD ON EACH LEG OF SLING = VERTICAL SHARE OF LOAD X LOAD ANGLE FACTOR

OPERATING PRACTICES - ASME 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 OR LENGTHENED BY KNOTTING OR TWISTING.
3. SLING LEGS SHALL NOT BE KINKED.
4. THE RATED LOAD OF THE SLING SHALL NOT BE EXCEEDED.
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 PROTECTED FROM EDGES, CORNERS, PROTRUSIONS AND ABRASIVE SURFACES TO PREVENT SLING DAMAGE.
8. DURING LIFTING, WITH OR WITHOUT LOAD, PERSONNEL SHALL BE ALERT FOR POSSIBLE SNAGGING.
9. ALL EMPLOYEES SHALL BE KEPT CLEAR OF LOADS ABOUT TO BE LIFTED AND OR 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 SHOULD BE AVOIDED.
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

POSITIVE LOAD CONTROL

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

DO NOT REEVE!
Rigging Information

**RISK MANAGEMENT**

**MECHANICAL ADVANTAGE AND TOTAL LOAD**

<table>
<thead>
<tr>
<th>True Mechanical Advantage</th>
<th>True Mechanical Advantage</th>
<th>True Mechanical Advantage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advantage for Bronze Bushing</td>
<td>Advantage for Anti Friction</td>
<td>Number of Line Parts</td>
</tr>
<tr>
<td>5.16</td>
<td>5.60</td>
<td>6</td>
</tr>
<tr>
<td>5.90</td>
<td>6.47</td>
<td>7</td>
</tr>
<tr>
<td>6.60</td>
<td>7.32</td>
<td>8</td>
</tr>
<tr>
<td>7.27</td>
<td>8.16</td>
<td>9</td>
</tr>
<tr>
<td>7.91</td>
<td>8.98</td>
<td>10</td>
</tr>
<tr>
<td>8.52</td>
<td>9.79</td>
<td>11</td>
</tr>
<tr>
<td>9.11</td>
<td>10.60</td>
<td>12</td>
</tr>
</tbody>
</table>

**TOTAL LOAD**

The total load placed on the block and its end fitting determines the working load limit required.

**WORKING WITH BLOCKS**

**OVERHAUL WEIGHT**

To determine the weight of the block or overhaul ball that is required to free fall the block, the following information is needed: Size of wire rope, Number of line parts, Type of sheave bearing, Length of crane boom, and Drum Friction.

**BLOCK REAVING**

Straight laced reeving is a basic method of placing the rope through a set of blocks. The end of the rope is fed through the outside sheave of the upper block to the outside sheave of the lower block. This continues to the last sheave.

**ADVANTAGES:**

1. Allows blocks to run closer together.
2. Is simple.
3. Has no reverse bends.

**DRAWBACKS:**

Tilting because of imbalanced loading can cause block rotation and wear of the sheaves and wire rope.

**SYMMETRICAL REEVING**

Reeve blocks symmetrically to distribute load evenly. All sheaves must be reeved to achieve the full working load limit of the block.

**BLOCK CABLEING**

1. Reduce wire rope length
2. Use even part reeving
3. Dead end to boom
4. Evaluate wire rope construction

**FOR ADDITIONAL INFORMATION REFER TO THE CROSBY GENERAL CATALOG**
RIGGING WITH BLOCKS

**TOTAL LOAD:**
Load Wt. (1000 lbs.) + Winch Pull (1000 lbs.) = 2000 lbs. MINIMUM

**ONE PART OF LINE**
No mechanical advantage = one winch pull = 1000 lbs.

**TOTAL LOAD = 1,000 LBS.**

**TWO PARTS OF LINE**
Mechanical advantage = two winch pull = 500 lbs.

**PULL P RQUIRED (LEVEL GROUND) = WEIGHT (W) X FRICTION FACTOR (f)**

- For steel on steel is .16 lubricated
- For steel on steel is .8 clean
- For wood on metal is .2 to .6 clean
- For wood on wood is .25 to .5 clean

**WINCH PULL REQUIRED = WEIGHT X FRICTION FACTOR MECHANICAL ADVANTAGE**

**ANGLE FACTOR MULTIPLIERS**

A single line sheave block used to change load line direction can be subject to total loads greatly different from the line pull.

<table>
<thead>
<tr>
<th>ANGLE</th>
<th>FACTOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>0°</td>
<td>2.00</td>
</tr>
<tr>
<td>10°</td>
<td>1.99</td>
</tr>
<tr>
<td>20°</td>
<td>1.97</td>
</tr>
<tr>
<td>30°</td>
<td>1.93</td>
</tr>
<tr>
<td>40°</td>
<td>1.87</td>
</tr>
<tr>
<td>45°</td>
<td>1.84</td>
</tr>
<tr>
<td>50°</td>
<td>1.81</td>
</tr>
<tr>
<td>60°</td>
<td>1.73</td>
</tr>
<tr>
<td>70°</td>
<td>1.64</td>
</tr>
<tr>
<td>80°</td>
<td>1.53</td>
</tr>
<tr>
<td>90°</td>
<td>1.41</td>
</tr>
</tbody>
</table>

**TOTAL LOAD = LINE PULL X ANGLE FACTOR**

Example: At 45 degrees, and 10,000 lb line pull, total load = 10,000 x 1.84 = 18,400 lbs.

For additional information refer to the Crosby General Catalog.
SHEAVE INSPECTION

Minimum groove radii for worn sheave tolerances per “Wire Rope User’s Manual” (third edition)

<table>
<thead>
<tr>
<th>NOMINAL WIRE ROPE SIZE</th>
<th>RADIUS</th>
<th>NOMINAL WIRE ROPE SIZE</th>
<th>RADIUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/4</td>
<td>.128</td>
<td>3/4</td>
<td>.384</td>
</tr>
<tr>
<td>5/16</td>
<td>.160</td>
<td>7/8</td>
<td>.448</td>
</tr>
<tr>
<td>3/8</td>
<td>.192</td>
<td>1</td>
<td>.513</td>
</tr>
<tr>
<td>7/16</td>
<td>.224</td>
<td>1-1/8</td>
<td>.577</td>
</tr>
<tr>
<td>1/2</td>
<td>.256</td>
<td>1-1/4</td>
<td>.641</td>
</tr>
<tr>
<td>9/16</td>
<td>.266</td>
<td>1-3/8</td>
<td>.705</td>
</tr>
<tr>
<td>5/8</td>
<td>.320</td>
<td>1-1/2</td>
<td>.769</td>
</tr>
</tbody>
</table>


FOR ADDITIONAL INFORMATION REFER TO THE CROSBY GENERAL CATALOG

BLOCK HOOK INSPECTION

CROSBY RECOMMENDS AS A MINIMUM:
1. A visual inspection for cracks, nicks, wear, gouges and deformation as part of a comprehensive documented inspection program, should be conducted by trained personnel in compliance with the schedule in B30.10.
2. For hooks used in frequent load cycles or pulsating load, or exposed to corrosive conditions (Road Salt, etc.) the hook and thread should be periodically inspected by Magnetic Particle or Dye Penetrant.

LUBRICATION OF HOOK BEARINGS:
Anti Friction — Every 14 days for frequent swiveling; every 45 days for infrequent swiveling.
Bronze Thrust Bushing or No Bearing — Every 16 hours for frequent swiveling; every 21 days for infrequent swiveling.

ASME B30.10 INSPECTION FREQUENCY
1. Frequent Inspection - Inspections by the operator or other designated person.
   (a) normal service - monthly.
   (b) heavy service - weekly to monthly
   (c) special or infrequent service as authorized by a qualified person - before and after each operation with records of the operation.
2. Period Inspection - Inspections by an appointed person making records of apparent external conditions to provide the basis for continuing evaluation.
   (a) normal service - equipment in place - yearly; (definition: service, normal - service that involves operating at less than 85 percent of rated load.
   (b) heavy service - as in normal service, unless elected.
   (c) special or infrequent service as authorized by a qualified person - before and after each operation with records of the operation.

FOR ADDITIONAL INFORMATION REFER TO ASME B30.10 AND OSHA 1910.179 OVERHEAD GANTRY CRANES