INFORMATION AND GUIDELINES on Webbing Slings

Glossary / Terminology

**Anchor Point** – The location to which a tie down is attached to a vehicle or trailer. If the anchor point cannot support the force of the tie down system, then the load rating of the tie down will be limited to the strength of the anchor point.

**Breaking Strength Capacity** – The minimum load a component or assembly can withstand before failure. Remember: All assemblies are only as strong as the weakest component.

**Cargo** – All materials carried by a vehicle or trailer including those used to operate the vehicle.

**Cotton** – A lightweight non-abrasive material ideal for moving blankets and furniture pads. Cotton is typically used in higher quality moving blankets and pads.

**Coating** – Sealing of webbing surface to improve resistance against wear and/or sharp edges, mainly made from Polyurethane.

**Design Factor** – The ratio of the breaking strength to the working load limit assigned to each synthetic web tie down assembly.

**Direct Tie down** – A tie down that is intended to provide direct resistance to a potential shift of an article.

**Elongation** – The length of stretch that a specific amount of pull divided by the original length multiplied by 100%.

**Eye** – Termination of a sewn webbing components, produced by turning the end of the webbing through 180 and securing it to the standing part of the webbing by a load bearing seam, so forming a terminal soft eye or attaching a terminal fittings.

**Eye slings** – Flat webbing slings with reinforced eyes at their ends.

**Fixed end** – The fixed end of a web lashing consists of the webbing, a tensioning device and an end fitting (Ratchet and hook).

**Flat Woven Webbing Slings** – Flexible slings consisting of sewn woven components, with or without fittings for attaching loads to the hook of a crane or other lifting machines.

**Friction coefficient** – It describes the friction between the load and the platform of the truck. The higher the friction coefficient the lower is the additional force to fix the load on the platform.

**Fabrication Efficiency** – The synthetic web tie down assembly break strength, as a percentage of the webbing strength prior to fabrication of the tie down assembly.

**Heavy Duty Truck** – A given truck with a gross vehicle weight generally in excess of 19,500 pounds (class 6-8). Other minimum weights are used by various laws or government agencies.

**Indirect Tie Down** – A tie down whose tension is intended to increase the pressure of an article or stack of articles on the deck of the vehicle or trailer.

**Keeper** – A device positioned on a hook to prevent the hook from inadvertently releasing.
Lashing capacity (LC) – Maximum force for use in straight pull that a web lashing is designed to sustain in use.

LC – Lashing capacity

Length – The distance between extreme end bearing points of the synthetic web tie down assembly including the fittings.

Load Binder – A binder incorporating an over center locking action.

Lifting methods – Different methods for the usage of webbing slings or round slings to lift loads.

Multi Layer Slings – Flat woven webbing sling, the sewn webbing component or components of which consists of two or more layers of identical webbing superimposed in the lengthwise direction.

Multi-Leg Sling Assembly – Flat woven webbing sling assembly, consisting of two, three or four identical flat woven webbing slings attached to the master link. (See table 2)

Nylon – Soft yet strong material that combines good elongation and recovery properties with abrasion and mildew resistance. Most mineral acids won’t affect nylon but it does lose strength when wet. Nylon is the ideal fabric for use with heavy duty recovery straps.

Polyester – A soft low stretch material with quick drying capabilities. Polyester retains much of its strength when wet, so it is ideal for ratchet tie down assemblies that will be used outdoors. Polyester also resists UV light, mildew and abrasion making it the first choice for heavy duty tie down assemblies.

Polypropylene – Economical lightweight material that repels water and resists mildew, most acids and alkalis.

Proof Load Test – A non destructive load test of a web tie down assembly to some multiple of the working load limit of a web tie down assembly.

Rated Load Capacity – Ratings are generally established and/or regulated by industry or legislative standards and may vary from industry to industry.

Ratchet – A tensioning device which is used to engage the tension force in web lashings. The hand operating force will be applied with a handle.

Round sling – An endless laid lifting device as per EN 1492-2. The load-bearing core is covered with a woven sleeve that protects the yarn of the core.

Selvage – The woven or knitted edge of synthetic webbing, so formed to prevent raveling.

Sew/Stitch Pattern – The pattern of the stitches used to sew the webbing together.

Shoring Bar – A structural section placed transversely between the walls of a vehicle to prevent cargo from tipping or shifting.

Stuffer – A longitudinal load bearing yarn in webbing.

Safety Factor – Safety factor of a line is the ratio between the breaking strength and the safe working load. Usually, a safety factor of four is acceptable, but this is not always the case. In other words, the safety factor will vary, depending on such things as the condition of the line and circumstances under which it is to be used. While the safety factor should NEVER be less than three, it often should be well above four (possibly as high as eight or ten).

Soft Eye – Terminal eye of a sewn webbing component so formed as to allow reeving, the attachment of removable fitting or connection to the hook of a crane or other lifting machine or lifting accessory.
Tensioning device – Mechanical device inducing and maintaining a tensile force in a load restraint

Tension force – The standard tension force (STF) is the force that can be applied into a web lashing with a tensioning device. It is the measured residual force after release of the handle of the ratchet.

Ultimate (Destructive) Test – A straight tensile load test of the synthetic web tie down assembly tested to failure. The failure load is the average breaking strength value of a minimum of five test samples.

Winch – A device for tensioning a webbing or wire rope tie down that is fitted with means to lock the initial tension.

Working Load Limit – The maximum load capacity that any given component or assembly should be subject to during use. US Cargo Control highly recommends the “working load limit” does not exceed 1/3 the “breaking strength capacity” of the component or assembly being used. Working load limits shown on this website are rated at 1/3(lashing strap), 1/4(G80 parts) or 1/7(webbing sling and round sling) of the minimum breaking strength.

Example: A ratchet strap rated at 6,000 pounds would have a working load limit of 2000 pounds.

Application / Warning Instructions for Polyester Webbing Slings

Before Use :

- Inspect sling for damage from cuts, heat, chemicals or excessive wear.
- If damage is visible, DO NOT USE! Remove sling from service IMMEDIATELY!
- Be sure sling capacity tag is in place and can be easily read.
- See Sling Angle Load Chart to determine loss of capacity due to lift angle and sling configuration
- NEVER expose sling to temperatures above 194 degrees F (90 degrees C)

During Use :

- ALWAYS protect sling from cuts. Avoid sharp edges & corners, pointed objects, and rough surfaces.
- NEVER tie knots in sling webbing.
- NEVER pull objects that are stuck or snagged.
- NEVER use near acids with nylon OR alkalis with polyester

Inspections

ALL INSPECTIONS MUST BE DONE ONLY BY TRAINED AND QUALIFIED PERSONNEL

1. Initial Inspection: Before any new or repaired Sling is placed in service, it shall be inspected to ensure that the correct Sling is being used, as well as to determine that the Sling meets the requirements of this specification and has not been damaged in shipment.
2. Frequent Inspection: This inspection shall be done each time the Sling is used.
3. Periodic Inspection: Frequency of inspection should be based on:
   A. Frequency of Sling use.
   B. Severity of service conditions.
   C. Experience gained on the service life of Slings used in similar applications.
   D. Periodic inspections should be conducted at least monthly.
Environmental Considerations

1. Web Slings should be stored in a cool, dry, and dark place to prevent loss of strength when not in use through exposure to ultra-violet rays. Web slings shall not be stored in chemically active areas.

2. Chemically active environments can affect the strength of web slings in varying degrees ranging from little to total degradation. The web sling manufacturer, or qualified person should be consulted before slings are used in a chemically active environment.
   A. ACIDS - Nylon is subject to degradation in acids, ranging from little to total degradation. Polyester is resistant to many acids, but is subject to degradation, ranging from little to moderate in some acids. Each application shall be evaluated, taking into consideration the following:
      a. Type of acid
      b. Exposure conditions
      c. Concentration
      d. Temperature
   B. ALKALIS - Polyester is subject to degradation in alkalis, ranging from little to total degradation. Nylon is resistant to many alkalis, but is subject to degradation ranging from little to moderate in alkalis. Each application shall be evaluated, taking into consideration the following:
      a. Type of Alkalis
      b. Exposure conditions
      c. Concentration
      d. Temperature

3. Nylon and polyester web slings shall not be used at temperatures in excess of 194º F (90º C), or at temperatures below minus 40º F (-40º C).

4. Web slings incorporating aluminum fittings shall not be used where fumes, vapors, sprays, mists, or liquids of alkalis and/or acids are present.

5. Environments in which synthetic web slings are continuously exposed to ultra-violet light can affect the strength of synthetic web slings in varying degrees ranging from slight to total degradation.

CAUTION: Degradation can take place without visible indications.

A. Factors which affect the degree of strength loss are:
   (1) Length of time of continuous exposure
   (2) Web sling construction and design
   (3) Other environmental factors such as weather conditions and geographic location
B. Procedures to minimize the affects of ultra-violet light
   (1) Store web slings in a cool, dry and dark place when not being used for prolonged periods of time
C. Some visual indications of ultra-violet degradation are:
   (1) Bleaching out of web sling color
   (2) Increased stiffness of web sling material
   (3) Surface abrasion in areas not normally in contact with the load
D. Proof Testing—Slings used in environments where they are subject to continuous exposure to ultraviolet light shall be proof tested to twice the rated capacity semi-annually, or more frequently depending on severity of exposure.

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Operating Practices for Synthetic Slings
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1. Determine weight of the load. The weight of the load shall be within the rated capacity of the Sling.
2. Select Sling having suitable characteristics for the type of load, hitch and environment.
3. Slings shall not be loaded in excess of the rated capacity. Consideration shall be given to the Sling to load angle which affects rated capacity. (See Sling Angle Chart)
4. Slings with fittings which are used in a choker hitch shall be of sufficient length to assure that the choking action is on the webbing and never on a fitting or splice.
5. Slings used in a basket hitch shall have the load controlled to prevent slippage.
6. The opening in fittings shall be the proper shape and size to insure that the fitting will seat properly in the hook or other attachments.
7. Slings shall always be protected from being cut by sharp corners, sharp edges, protrusions or abrasive surfaces with protection sufficient for the intended purpose.
8. Slings shall not be dragged on the floor or over abrasive surface.
9. Slings shall not be twisted or tied into knots, or shorten or joined by knotting.
10. Slings shall not be pulled from under loads if the load is resting on the Sling. Loads resting on Web slings could damage the Sling.
11. Do not drop Slings equipped with metal fittings.
12. Slings that appear to be damaged shall not be used unless inspected and accepted.
13. The Sling shall be hitched in a manner providing control of the load.
14. Personnel shall stand clear of the suspended load.
15. Personnel, including portions of the human body, shall be kept from between the Sling and the load, and from between the Sling and the crane hook or hoist hook.
16. Personnel shall not ride the Sling or load being lifted.
17. Shock loading shall be avoided.
18. Twisting and kinking the legs (branches) shall be avoided.
19. Load applied to the hook shall be centered in the base (bowl) of hook to prevent point loading on the hook.
20. During lifting, with or without the load, personnel shall be alert for possible snagging.
21. The Web Slings' legs (branches) shall contain or support the load from the sides above the center of gravity when using a basket hitch.
22. Slings shall be long enough so that the rated capacity of the Sling is adequate when the angle of the legs(branches) is taken into consideration. (see load chart)
23. Place blocks under load prior to setting down the load, to allow removal of the Web Sling, if applicable.
24. Nylon & Polyester Slings shall not be used in contact with objects or at temperatures above 194 degrees F (90 degrees C).
25. Exposure to sunlight or ultra-violet light degrades the strength of Slings. Store Slings in a cool, dry and dark place when not in use.
26. Slings shall not be used to pull on objects in a snagged or constrained condition.
27. Only Web Slings with legible identification tags shall be used.
28. Tags and labels should be kept away from the load, hook and point of choke.
29. Web Slings shall not be constricted or bunched between the ears of a clevis or shackle.
30. Web Slings shall not be used as bridles on suspended personnel platforms.

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Operating Practices for synthetic Web Tiedowns

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Recommended Operating Practices :

The purpose of this information is to provide guidelines for the care, use and inspection of synthetic web tiedowns. Mechanical Considerations:

1. Determine weight of the cargo to be secured, including expected gravity “G” forces.
2. Select tiedown having suitable characteristics for the type of load and environment.
3. Tiedowns shall not be loaded in excess of the Working Load Limit (WLL). Consideration shall be given to the angle from the vertical (cargo tiedown to load angle) which affects working load capacity.
4. Tiedown shall be attached to provide control of the load and positioned in accordance with applicable regulations.
5. Tiedowns shall not be dragged on the floor, ground, or over an abrasive surfaces.
6. Tiedowns shall not be tied in knots, or joined by knotting.
7. Tiedowns shall not be pulled from under loads when the load is resting on the Tiedown.
8. Tiedowns shall always be protected from being cut by sharp corners, sharp edges, protrusions or abrasive surfaces.
9. Tiedowns with metal fittings shall not be dropped.
10. The opening in fittings shall be the proper shape and size to insure that the fitting will seat properly in the anchorage point or other attachments. If the anchor point is inadequate to support the force of the tiedown system, then the load rating of the tiedown will be limited to the strength of the anchor point.
11. Tiedowns shall not be used for lifting.
Environmental Considerations:

1. Tiedowns should be stored in a cool, dry, and dark place and should not be exposed to sunlight when not in use.
2. Chemically active environments can affect the strength of synthetic web tiedowns in varying degrees ranging from none to total degradation. The tiedown manufacturer, should be consulted before tiedowns are used in a chemically active environment.

A. ACIDS
   a. Nylon is subject to degradation in acids, ranging from none to total degradation.
   b. Polyester is resistant to some acids, but is subject to degradation ranging from little to moderate with other acids.
   c. Each application shall be evaluated, taking into consideration the following:
      a. Type of Acid
      b. Exposure Conditions
      c. Concentration
      d. Temperature

B. ALKALIS
   a. Polyester is subject to degradation by alkalis, ranging from little to total degradation.
   b. Nylon is resistant to some alkalis, but is subject to degradation ranging from little to moderate with other alkalis.
   c. Each application shall be evaluated, taking into consideration the following:
      a. Type of alkali
      b. Exposure conditions
      c. Concentration
      d. Temperature

3. Nylon and Polyester webbing shall not be used at temperatures in excess of 194°F (90°C). Both types are routinely used at temperatures as low as -40°F (-40°C).
4. Tiedowns incorporating aluminum fittings shall not be used where fumes, vapors, sprays, mists or liquids of alkalis and/or acids are present.
5. Environments in which synthetic webbing tiedowns are continuously exposed to ultra-violet light can affect the strength of synthetic webbing tiedowns in varying degrees ranging from slight to total degradation.
   a. Factors which can determine the degree of strength loss are:
      i. Length of time of continuous exposure
      ii. Webbing construction and design
      iii. Other environmental factors such as weather conditions and geographic location.
   b. Suggested procedures to minimize effects of ultra-violet light.
      i. Store webbing tiedowns in a cool, dry and dark place when not being used for prolonged periods of time.
      ii. Inspect webbing tiedowns weekly or more often, depending on frequency of use.
      iii. Impregnate a coating into the webbing.
   c. Visual indications of possible ultra-violet degradation are:
      i. Bleaching out of webbing.
      ii. Increased stiffness of webbing material.
      iii. Surface abrasion in areas not normally in contact with the load.

CAUTION: Degradation can take place without visible indications.

Inspection:

- Initial Inspection—Before any tiedown is placed in service, it shall be inspected to insure that the correct tiedown is being used as well as to determine that the tiedown meets requirements of this specification.
- Frequent Inspection—This inspection shall be made by the person handling the tiedown each time it is used.
- Periodic Inspection—This inspection shall be conducted by designated personnel. Inspection frequency should be based on:
  a. Frequency of use
  b. Severity of service conditions
c. Experience gained on the service life of tiedowns used in similar applications

d. Inspections should be conducted at least monthly

**Tiedown Replacement:**

Tiedown shall be removed from service if any of the following are visible:

- Acid or alkali burns.
- Melting, charring, or weld spatter of any part of the webbing.
- Holes, tears, cuts, snags or embedded particles.
- Broken or worn stitching in load bearing stitch patterns.
- Excessive abrasive wear.
- Knots in any part of the webbing.
- Distortion and excessive pitting or corrosion or broken fittings. Other apparent defects which cause doubt as to the strength of the tiedown.

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**Hitching**

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**Vertical Hitches**

Vertical hitches are made directly from the crane hook to the load. Full rated capacity of the sling may be used but never exceeded. A tagline should be attached to prevent rotation which can damage the sling. A sling with a hand-tucked splice can unlay and fail if the sling is allowed to rotate.

**Choker Hitches**

Choker hitches reduce lifting capability of a sling, since this method of rigging affects the ability of the wire rope components to adjust during the lift, places angular loading on the body of the sling, and creates a small diameter bend in the body at the choke point.

**Basket Hitches**

Basket hitches distribute a load equally between the two legs of a sling. Rated capacities are influenced by sling angles.

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**Basic Rules of Hitching**

RATED CAPACITY – Be sure the Sling you intend to use is strong enough for the job.

CONTROL AND BALANCE – Use a hitch that will keep the load under control at all times and be sure the lifting device is directly over the Center of Gravity.

PREVENT DAMAGE – Use corner protectors when bending around sharp corners.

LIFTING LOAD – Lift load carefully, accelerating smoothly. Avoid shock loading.

CONDITION OF SLINGS – Inspect Slings and their parts carefully before each lift and at regular intervals.

USE OF LIFTING LUGS/EYE BOLTS – Many loads are equipped with lifting lugs for easy attachment of the Sling. Make sure pull is transmitted to them straight along the axis of the shank. Lifting lugs/eye bolts should be used in accordance with the lug/eye bolt manufacturer's recommendations. However, if “Hoist Rings” are utilized the pull does not have to be along the axis.

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**Control and Balance:**
Prevent Damage:

Use of Lifting Lugs/Eye Bolts:

Right Way

Wrong Way

RIGHT WAY

WRONG WAY
Calculating Load Levels

As the horizontal angle between the legs of a sling and the load decreases, the load on each leg increases. The effect is the same whether a single sling is used as a basket, or two slings are used with each in a straight pull, as with a 2-legged bridle.

Anytime pull is exerted at an angle on a leg—or legs—of a sling, the load per leg can be determined by using the data in the table at left. Proceed as follows to calculate this load—and determine the rated capacity required of the sling, or slings, needed for a lift.

1. First, divide load to be lifted by number of legs to be used. This provides load per leg if the lift were being made with all legs lifting vertically.
2. Determine angle between legs of sling and the horizontal.
3. Then MULTIPLY load per leg by the Load Factor for leg angle being used (from the table at the left) — to compute the ACTUAL load on each leg for this lift and angle.

ACTUAL LOAD MUST NOT EXCEED THE RATED SLING CAPACITY.

Example1: if sling angle is 60°: 1000 ÷ 2 = 500 (Load Per Leg if a vertical lift) 500 x 1.154 = 577 lbs. = ACTUAL LOAD on each leg at the 60° included angle being used.
Example2: If sling angle is 45°: 1000 ÷ 2 = 500 (Load Per Leg if a vertical lift) 500 ÷ 1.414 = 707 lbs. = ACTUAL LOAD on each leg at the 45° horizontal angle being used.

<table>
<thead>
<tr>
<th>LEG ANGLE (Degrees)</th>
<th>LOAD FACTOR</th>
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<tbody>
<tr>
<td>90</td>
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<td>85</td>
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<td>1.743</td>
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<tr>
<td>30</td>
<td>2.000</td>
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Choker Hitch Rated Capacity Adjustment

SLING ANGLES in this manual depart from the traditional method of vertical angles measured at the sling hook. It has long been the opinion of sling users that it is easier to measure a sling angle relative to the ground or horizontal. The method is the same whichever angle is used. When the horizontal angle is used you must use the trigonometric sine of the horizontal angle. When the vertical angle is used, you must use the trigonometric cosine of the vertical angle (see illustration).

CHOKER HITCH configuration affect the rated capacity of a sling. This is because the sling leg or body is passed around the load, through one end attachment or eye and is suspended by the other end attachment or eye. The contact of the sling body with the end attachment or eye causes a loss of sling strength at this point. If a load is hanging free, the normal choke angle is approximately 135 degrees. When the angle is less than 135 degrees an adjustment in the sling rated capacity must be made (see illustration at above). As you can see, the decrease in rated capacity is dramatic. Choker hitches at angles greater than 135 degrees are not recommended since they are unstable. Extreme care should be taken to determine the angle of choke accurately.

<table>
<thead>
<tr>
<th>ANGLE OF CHoke (Degrees)</th>
<th>RATED CAPACITY</th>
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<td>OVER 120</td>
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<td>0-29</td>
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