

Every Lift Uses 1 of 3 Basic Hitches

STRAIGHT OR VERTICAL, attachment, is simply using a sling to connect a lifting hook to a load. Full rated lifting capacity of the sling may be utilized, but must not be exceeded. Whenever a single sling is used in this manner, a tagline should be used to prevent load rotation which may cause damage to the sling.

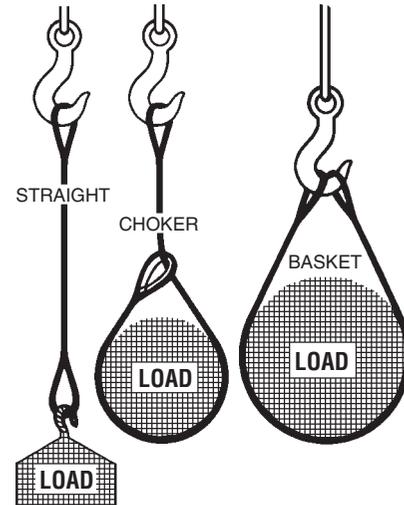
When two or more slings are attached to the same lifting hook in straight, or vertical, manner, the total hitch becomes, in effect, a lifting bridle, and the load is distributed among the individual slings.

CHOKER hitches reduce lifting capability of a sling, since this method of rigging affects ability of the wire rope components to adjust during the lift. A choker is used when the load will not be seriously damaged by the sling body—or the sling damaged by the load, and when the lift requires the sling to snug up against the load.

The diameter of the bend where the sling contacts the load should keep the point of choke against the sling BODY — never against a splice or the base of the eye. When a choke is used, the sling rated capacity must be adjusted downward to compensate for loss of capability.

A choker hitch should be pulled tight before a lift is made—NOT PULLED DOWN DURING THE LIFT. It is also dangerous to use only one choker hitch to lift a load which might shift or slide out of the choke.

BASKET hitches distribute a load between the two legs of a sling—within limitations described below. Capacity of a sling used in a basket is affected by the bend, or curvature, where the sling body comes in contact with the load— just as any sling is affected and limited by bending action, as over a sheave.



Calculating the Load on Each Leg of a Sling

As the horizontal angle between the legs of a sling 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.

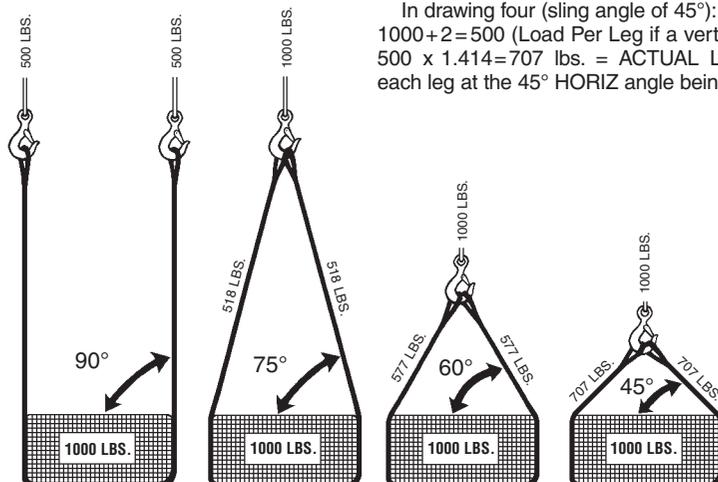
Anytime pull is exerted at an angle on a leg—or legs—of a sling, the load per leg can be determined by using the data in the table at right. Proceed as follows to calculate this load—and determine the rated capacity required of the sling, or slings, needed for a lift.

1. First, divide the total load to be lifted by the number of legs to be used. This provides the load per leg if the lift were being made with all legs lifting vertically.
2. Determine the angle.
3. Then MULTIPLY the load per leg (as computed in No. 1 above) by the Load Factor for the leg angle being used (from the table at right) — to compute the ACTUAL LOAD on each leg for this lift and angle. THE ACTUAL LOAD MUST NOT EXCEED THE RATED SLING CAPACITY.

Thus, in drawing three (sling angle at 60°):
 $1000 \div 2 = 500$ (Load Per Leg if a vertical lift)
 $500 \times 1.154 = 577$ lbs. = ACTUAL LOAD on each leg at the 60° HORIZ angle being used.

In drawing four (sling angle of 45°):
 $1000 \div 2 = 500$ (Load Per Leg if a vertical lift)
 $500 \times 1.414 = 707$ lbs. = ACTUAL LOAD on each leg at the 45° HORIZ angle being used.

LEG ANGLE (Degrees)	LOAD FACTOR
90°	1.000
85°	1.003
80°	1.015
75°	1.035
70°	1.064
65°	1.103
60°	1.154
55°	1.220
50°	1.305
45°	1.414





Effect of Angles

Various sling manufacturers refer in their specification tables to leg angles of slings during lifts — since these angles have a direct relationship to lifting capability of a sling. Regardless of how the sling angle may be stated, or the method used to compute stress in a sling leg, the sling is the same. Capacity does not change — but stresses on sling legs change with rigging angles.

Much misunderstanding results because the carrying capacity of a sling leg is reduced by the rigging angle. What happens is that the operator is lifting the load straight up (vertical) while the legs are pulling at an angle, thereby causing a disadvantage.

For quick figuring in the shop, a 60-degree leg angle causes a loss in lifting capacity of 15%. a 45-degree angle reduces capacity by 30% ...and a 30-degree angle, 50%. This rule of thumb is not 100% accurate, but is easy to remember and slightly on the safe side.

It is always good practice, within limits, to keep the sling leg angle as large as possible. The length and width of the load sling length, and available headroom are determining factors in this sling angle.

It is neither economical nor good practice to exceed a 45-degree sling leg angle. Angles less than 45 degrees not only build

up tension in the sling legs out of all proportion to the weight of the load, they also create a much greater “in-pull” on the ends of the load. This produces eccentrically loaded column effect, as an engineer would describe it — meaning simply that long, slender objects have a tendency to buckle. Angles less than 45 degrees indicate some thought should be given to the use of a lifting beam or other device in connection with the lift.

Studying typical sling charts readily reveals that lifting capacities on slings are misleading unless the sling angle is stated. The same sling that will handle 10 tons at a 85-degree leg angle will only handle 5 tons if this angle is decreased to 30-degrees.

Good Sling Practice

Regardless what type of sling may be employed, there are accepted good working rules which will help increase useful sling life — as well as improve safety. These include:

1. Use the proper sling for the lift. Whether Twin-Path, Web, Chain, or Wire Rope, the proper sling is the one with the best combination of work and handling feature — of the proper length and rated capacity for the situation.
2. Start and stop slowly. Crane hooks

should be raised slowly until the sling becomes taut and the load is suspended. Lifting or lowering speed should be increased or decreased gradually. Sudden starts or stops place heavier loads on a sling — comparable to jamming the brakes on a speeding automobile. A rule of thumb: Shock loads can double the stress on a sling.

3. If possible, set the load on blocks. Pulling a sling from under a load causes abrasion and “curling” — making the sling harder to handle on the next lift while reducing strength through loss of metal.
4. Sharp corners cut slings. Use protector arcs, Cornermax™ and Synthetic Armor Wear Pads between sharp corners and the sling body.
5. Store in a dry room. Moisture is a natural enemy of wire rope — as are acid fumes and other caustic gases.
6. Avoid handling hot material or objects in direct contact with the sling. Strength goes down as temperature goes up!
7. Dropping casting, tools or heavy objects on slings, or running over them with trucks, can cause damage. Always hang slings when not in use.
8. Use hooks properly. “Point loading” reduces hook capacity. Pull should be straight in the line of lift.

SELECTING A SLING

The following is presented as a guide only to help in selection of a sling for a lift.

1. Determine the Load: The weight of the load must be known. This is always the starting point.
2. Decide the Hitch: Shape and bulk of the load must be accommodated as well as weight. Determine whether a straight attachment at some point on the load, a choker around the load, or some form of basket hitch will best control the load during the lift.
3. Adequacy of Lifting Device: The lifting device must have adequate capacity for making the lift, and provide any maneuverability required once the load is hoisted.
4. Room to Lift: Make certain the lifting device has sufficient headroom to raise the load to the height required. Headroom will affect the length of sling.
5. Length of Sling: By applying your decision on the type of hitch to knowledge of the headroom offered by the lifting device, the length of sling can be calculated.
6. Use Rated Capacity Chart: Always double check that the sling type and capacity you choose, when rigged at the angle determined by the length of the sling, or the specific type of hitch, will handle the load.

Attaching the sling and completing the lift should be an orderly procedure without “surprises” when these steps have been followed. Two further precautions should be noted, however.

First, plan to protect both load and sling from damage at sharp corners, etc. Cornermax™ and Synthetic Armor Wear Pads should be provided at the lift site. A protective pad should be used anytime a sling passes around a sharp corner.

Last — by no means unimportant by being last — every sling should be visually examined from end to end BEFORE EVERY LIFT. It must be kept always in mind that the manufacturer’s Rated Capacity applies only to a new sling in “unused” condition. A sling should be carefully examined to determine that it is in as nearly new condition as practicable before each lift.

There are specific standards on the use and care of slings in industries such as shipping and construction, and these provide some guidance for sling inspectors. Consensus standards published as ANSI B30.9 are particularly helpful.

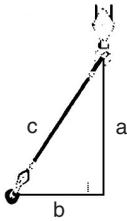
ANSI Standard B30.9 specifies that a wire rope sling should be removed from service any time any of the following conditions are detected:

- (1) Ten randomly distributed broken wires in one rope lay, or five broken wires in one strand in one rope lay.
- (2) Kinking, crushing, bird caging or any other damage resulting in distortion of the wire rope structure.
- (3) Evidence of heat damage.
- (4) End attachments that are cracked, deformed, or worn.
- (5) Hooks that have been opened more than 15% of the normal throat opening measured at the narrowest point, or twisted more than 10 degrees from the plane of the unbent hook.
- (6) Corrosion of the rope or end attachments.

It is apparent from the foregoing that inspection of a wire rope sling to meet these removal criteria requires more than a casual understanding of wire rope design and manufacture, and the responsibility for daily inspections must be in the hands of trained personnel.

Most of the foregoing applies equally to any type of sling and careful inspection by a trained inspector is necessary for safe sling use. If you require training for any type of sling inspection, SLINGMAX will provide you with the opportunity. Call us for information regarding all of our educational courses in slings.

Finding the Hypotenuse

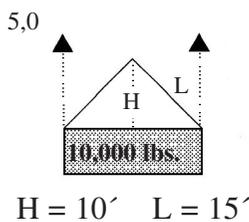


To find c (hypotenuse)

Given: $a^2 + b^2 = c^2$

Example: $4^2 + 3^2 = c^2$; $16 + 9 = c^2$; $\sqrt{25} = 5$

Load Angle Factors

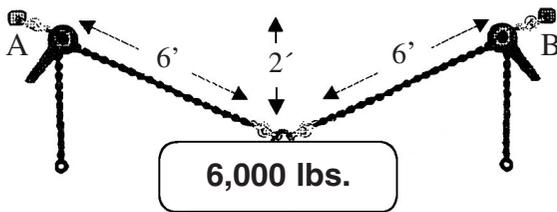


$\frac{L}{H} = LAF$ (Load Angle Factor) Example: $\frac{15}{10} = 1.5$ (LAF)

Tension in L = $\frac{L}{H} \times L$'s share of the load

Tension in L = $\frac{15}{10} \times 5,000$; $1.5 \times 5,000$ Ten. = 7,500 lbs.

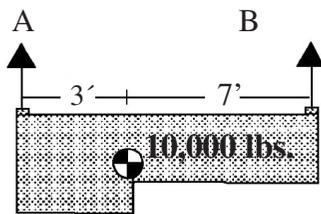
Tension in Overhead Hoists



Ten. in A = $\frac{6}{2} \times 3,000$ Ten. in A = 9,000 lbs.

(As load moves tension changes)

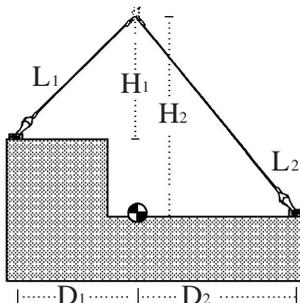
Off-set Center of Gravity (Share of the Load)



Inverse Proportion To Distance

Lift Point A	Lift Point B
$7 + 3 = 10, \frac{7}{10} = .70$	$7 + 3 = 10, \frac{3}{10} = .30$
$.70 \times 10,000 = 7,000$ lbs.	$.30 \times 10,000 = 3,000$ lbs.

Off-level Lift Points



$$TL_1 = \frac{W \times D_2 \times L_1}{(D_2 \times H_1) + (D_1 \times H_2)}$$

$$TL_2 = \frac{W \times D_1 \times L_2}{(D_2 \times H_1) + (D_1 \times H_2)}$$

LEGEND

- W = Load Weight
- L₁ = Length Leg 1
- L₂ = Length Leg 2
- H₁ = Vertical Height 1
- H₂ = Vertical Height 2
- D₁ = Horizontal Distance 1
- D₂ = Horizontal Distance 2