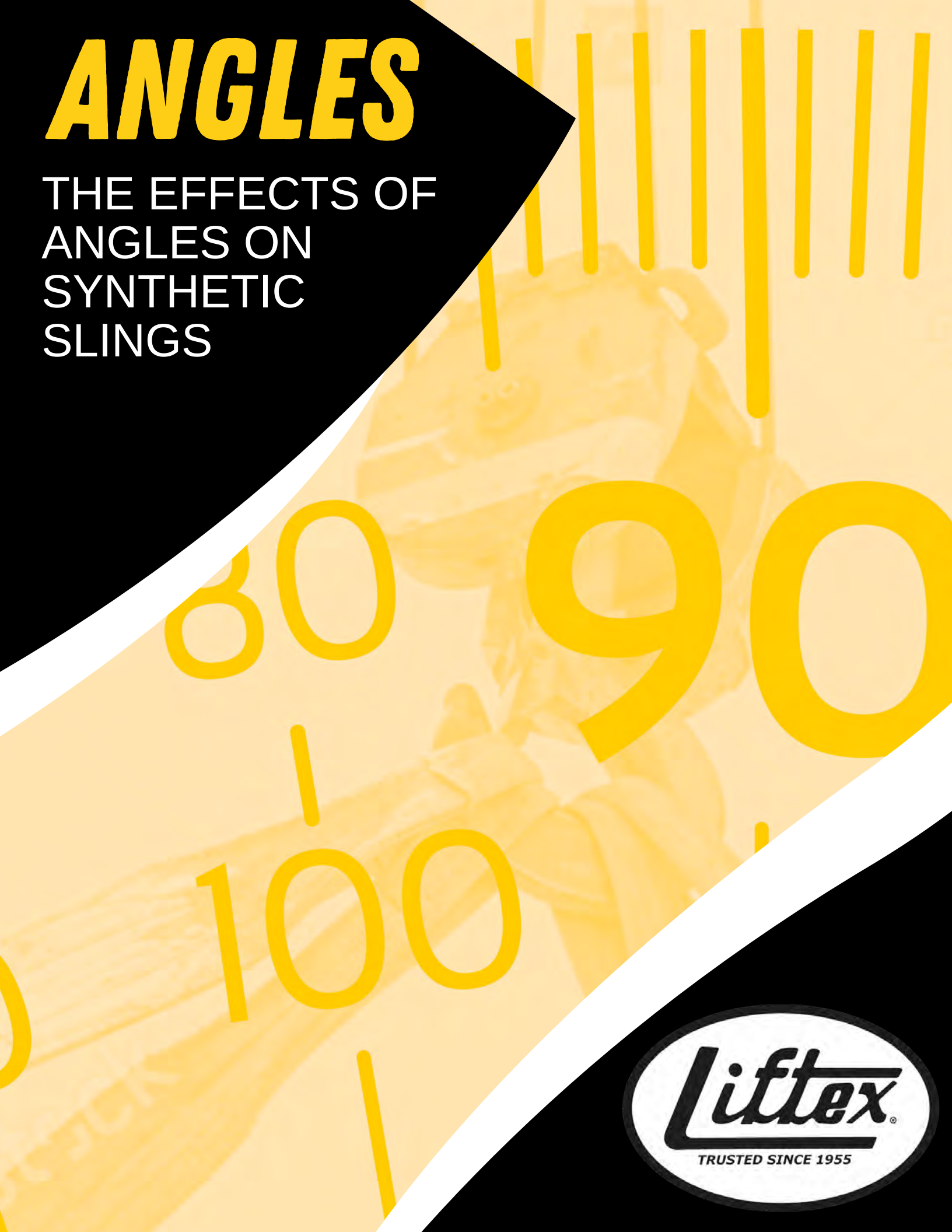
ANGLES

THE EFFECTS OF ANGLES ON SYNTHETIC SLINGS



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IMPORTANT:

- This document provides general information about the effects of angles on sling use. Sling-To-Load Angles and Choker Hitch Angles MUST be calculated by a qualified person, as defined by OSHA, "A person who, by possession of a recognized degree or certificate of professional standing in an applicable field, or who, by extensive knowledge training, and experience, has successfully demonstrated the ability to solve or resolve problems."
- Comprehensive information about the use of lifting slings can be obtained from the following sources:
  - ASME B30.9 Sling Safety Standard
    The American Society of Mechanical Engineers
    www.asme.org
    800-843-1763
  - WSTDA Web Sling Standard (WS-1) and Roundsling Standard (RS-1)
    The Web Sling and Tie Down Association
    www.wstda.com
    443-640-1070
  - OSHA "Industrial Slings" regulations published by the Office of the Federal Register, National Archives and Records Administration, Part 29 1910.814
    Occupational Safety and Health Administration
    www.osha.gov

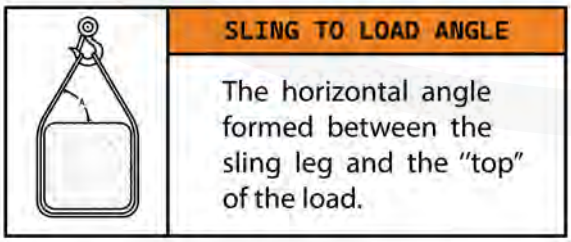
SLING TENSION AND ANGLE CONSIDERATIONS

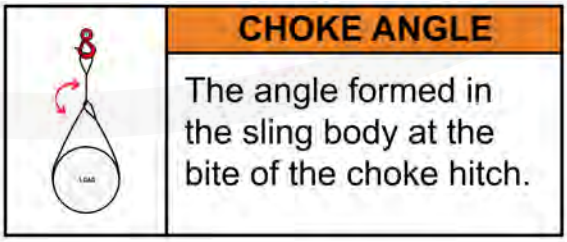
Angles create additional tensional forces on web and round slings. Therefore, it is critical to understand and consider the effects of angles on a sling's work load limit. **Property damage, injury or death may occur if the effects of angles on slings are not taken into consideration.**

This document will provide an overview of a.) the effects of Sling-To-Load Angle on Basket Hitches and Multi-Leg slings and, b.) the effects of Choker Angle on Choker Hitches.

On Basket Hitches and Multi-Leg slings, the Sling-to-Load Angle is the angle formed between a horizontal line and the sling leg or body. A simple but important concept to understand is the tension on each leg of the sling is INCREASED as the Sling-To-Load Angle DECREASES.

On Choker Hitches, the Choker Angle is the angle formed in the sling body at the bite of a choker hitch. A simple but important concept to understand is that the sling work load limit DECREASES as the Choker Angle DECREASES.





Sling-To-Load Angle Considerations: Basket Hitches and Multi-Legged Web and Round Slings

The effect of angles in basket hitches and on multi-legged web and round slings may be determined by using either of these two methods:

- Increased Tension Method (Recommended Method per WSTDA-WS-1)
- Reduced Sling Capacity Method (Alternative Method)

Increased Tension Method (Recommended Method per WSTDA-WS-1)

To use this method, the user shall:

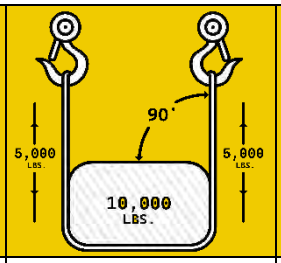
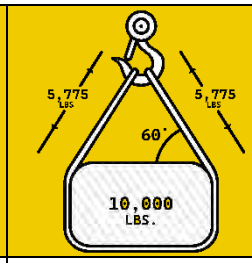
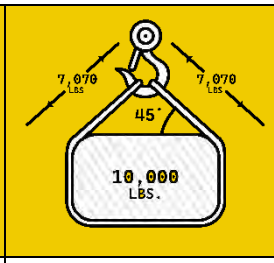
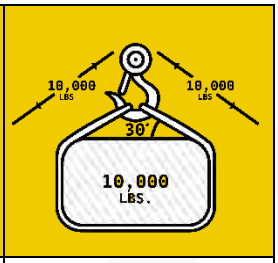
1. Have a Qualified Person (as defined by OSHA) calculate the Sling-To-Load Angle, as measured from the horizontal.
2. Determine the corresponding Tension Factor from Table ST-1.
3. Multiply the load weight by the tension factor to determine the loading on the sling leg(s). The result is the INCREASED TENSION or actual loading of the sling leg(s).

Table ST-1 Effect of Sling Angle - Tension Factor Chart

Angle in Degrees from Horizontal	Tension Multiplier	Angle in Degrees from Horizontal	Tension Multiplier
90	1.000	55	1.221
85	1.004	50	1.305
80	1.015	45	1.414
75	1.035	40	1.555
70	1.064	35	1.742
65	1.104	30	2.00
60	1.155		©Liftex Corporation

Source: WSTDA-WS-1

Table ST-2 Examples of the Effect of Sling-To-Load Angle on Tension

Tension in the Sling Increases as the Sling Angle Decreases				
SLING-TO-LOAD ANGLE (Degrees from Horizontal)	90°	60°	45°	30°
TENSION MULTIPLIER (from Table ST-1)	1.000	1.155	1.414	2.000
SLING TENSION (Lbs. Per Leg)	5,000	5,775	7,070	10,000
MINIMUM REQUIRED SLING CAPACITY (Lbs. Basket Hitch)	10,000	11,550	14,140	20,000

Source: WSTDA-WS-1

Reduced Sling Capacity Method (Alternative Method per WSTDA-WS-1)

To use this method, the user shall:

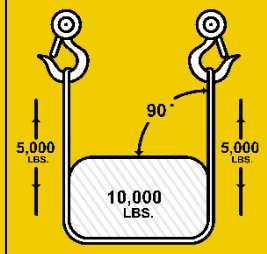
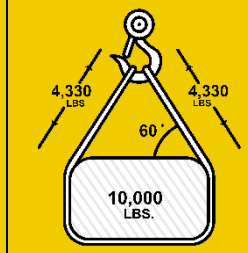
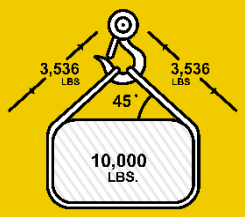
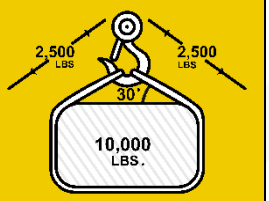
1. Have a Qualified Person (as defined by OSHA) calculate the Sling-To-Load Angle, as measured from the horizontal.
2. Determine the corresponding LOSS FACTOR from Table ST-3.
3. Multiply the sling capacity by the LOSS FACTOR to determine the actual sling capacity at the given angle of lift. The result is the REDUCED SLING CAPACITY.

Table ST-3 Effect of Sling Angle - Sling Capacity Loss Factor Chart

Angle in Degrees from Horizontal	Loss Factor	Angle in Degrees from Horizontal	Loss Factor
90	1.000	55	0.819
85	0.996	50	0.766
80	0.985	45	0.707
75	0.966	40	0.643
70	0.940	35	0.574
65	0.906	30	0.50
60	0.866		©Liftex Corporation

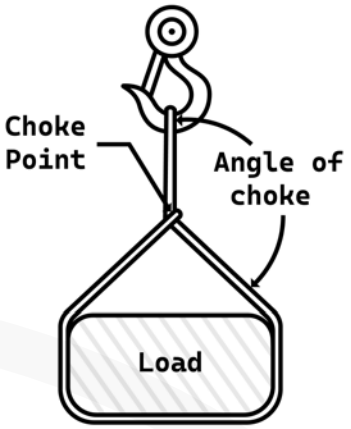
Source: WSTDA-WS-1

Table ST-4 Examples of Effect of Sling Angle - Reduced Sling Capacity

Work Load Limit Decreases As the Sling-To-Load Angle Decreases				
SLING-TO-LOAD ANGLE (Degrees from Horizontal)	90°	60°	45°	30°
LOSS FACTOR (from Table ST-3)	1.000	.8660	.7071	.5000
WORK LOAD LIMIT x LOSS FACTOR (from ST-3)	10,000Lbs x 1.000	10,000Lbs. x .8660	10,000Lbs x .7071	10,000Lbs x .5000
REDUCED SLING WORK LOAD LIMIT (Lbs.)	10,000	8,660	7,072	5,000
MINIMUM REQUIRED SLING WORK LOAD LIMIT (Lbs. Basket Hitch/Multi-Leg)	10,000	11,548	14,145	20,000

Source: WSTDA-WS-1

Sling To Load Angle Considerations: Choker Hitch Angle



When a synthetic sling (flat web or round sling) is used in a choker hitch and the load is hanging free, the normal choker hitch angle is approximately 135°. When the angle of choke is less than 120°, the sling capacity decreases and choker hitch work load limit ***MUST*** be adjusted. The capacity of the sling used in a choker hitch ***DECREASES*** as the angle of choke ***DECREASES***.

To determine the adjusted sling capacity at a given angle of choke the user shall:

1. Have a Qualified Person (as defined by OSHA) calculate the Choker Hitch Angle.
2. Determine the corresponding Reduction Factor.
3. Multiply the sling's rated choker hitch work load limit by the Reduction Factor. The result is the actual, reduced, Choker Work Load Limit of the sling at this angle.

Table ST-5 Effect of Choke Angle - Reduction Factor Chart

CHOKE HITCH ANGLE REDUCTION CHART	
Choke Hitch Angle (Degrees)	Reduction Factor
120-180	1.00
105-120	.82
90-105	.71
60-90	.58
0-60	.50

Source: WSTDA-WS-1

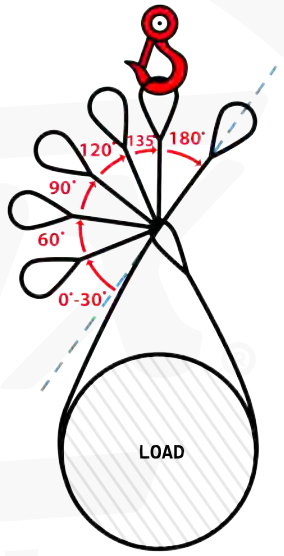


Table ST-6 Examples of Effect of Choke Angle - Reduced Choker Work Load Limit

Sling Work Load Limit DECREASES as Choke Angle DECREASES	10,600Lbs SLING CHOKE WORK LOAD LIMIT	10,600Lbs SLING CHOKE WORK LOAD LIMIT	10,600Lbs SLING CHOKE WORK LOAD LIMIT	10,600Lbs SLING CHOKE WORK LOAD LIMIT
CHOKE ANGLE (Degrees)	110°	90°	60°	30°
REDUCTION FACTOR (from Table ST-5)	.82	.71	.58	.50
LOAD WEIGHT x REDUCTION FACTOR	10,600Lbs x .82	10,600Lbs x .71	10,600Lbs x .58	10,600Lbs x .50
REDUCED WORK LOAD LIMIT OF SLING AT THIS ANGLE (CHOKE HITCH RATING)	8,692Lbs	7,526Lbs	6,148Lbs	5,300Lbs