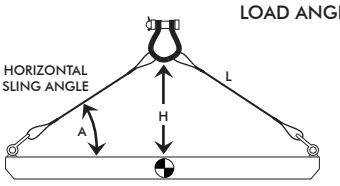
Rigging Hardware

Sling Tension & Load Angles

HORIZONTAL SLING ANGLES OF LESS THAN 30 DEGREES ARE NOT RECOMMENDED. REFER TO ANSI B30.9 FOR FULL INFORMATION.

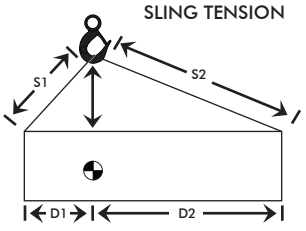
LOAD ANGLE FACTORS



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

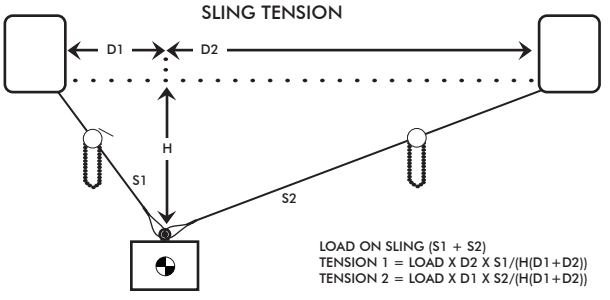
HORIZONTAL SLING ANGLE (A) DEGREE	LOAD ANGLE FACTOR = L/H
90	1.000
60	1.155
50	1.305
45	1.414
30	2.000

SLING TENSION



LOAD ON SLING (S1 + S2)
TENSION 1 = LOAD X D2 X S1/(H(D1+D2))
TENSION 2 = LOAD X D1 X S2/(H(D1+D2))

SLING TENSION



LOAD ON SLING (S1 + S2)
TENSION 1 = LOAD X D2 X S1/(H(D1+D2))
TENSION 2 = LOAD X D1 X S2/(H(D1+D2))

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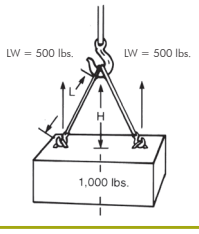
Rigging Hardware

Slings – Load Factors

Increased Tension



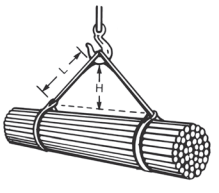
Example:
Load weight = 1,000 lbs.
Rigging - 2 slings in vertical hitch
Lifting Weight (LW) per sling = 500 lbs.
Measured Length (L) = 10 ft.
Measured Height (H) = 5 ft.
Tension Factor (TF) = 10 (L) ÷ 5
Minimum Vertical Rated Capacity required for this lift:
500 (LW) x 2.0 (TF)
= 1000 lbs. per sling

Effect of Angle Chart

Tension Factor (TF)	Angle From Horizontal	Reduction Factor (RF)
1.000	90°	1.000
1.155	60°	0.866
1.414	45°	0.707
2.000	30°	0.500

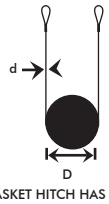
Sling capacity decreases as the angle from horizontal decreases. Sling angles of less than 30° are not recommended.

Reduced Capacity



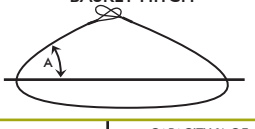
Example:
Vertical Choker rating of each sling = 6,000 lbs.
Measured Length (L) = 6 ft.
Measured Height (H) = 4 ft.
Reduction Factor (RF) = 4 (H) ÷ 6 (L) = .667
Reduced sling rating in this configuration = .667
(RF) x 6,000 lbs. = 4,000 lbs. of lifting capacity per sling

BASKET HITCH



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

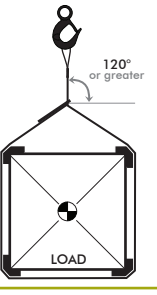
BASKET HITCH



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

CHOKER HITCH

A CHOKER HITCH HAS 75% OF THE CAPACITY OF A SINGLE LEG WHEN THE CORNERS ARE PROTECTED AND THE ANGLE OF THE CHOKE IS GREATER THAN 120°



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Rigging Hardware

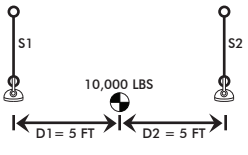
Center of Gravity/Weight of Material

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.

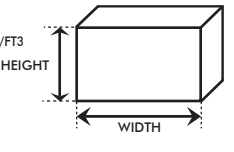
CENTER OF GRAVITY AND SLING LOADING



WEIGHT = VOLUME X UNIT WEIGHT OF MATERIAL

UNIT WEIGHT STEEL = 490 LBS/FT3
UNIT WEIGHT ALUMINUM= 165 LBS/FT3
UNIT WEIGHT REINFORECED CONCRETE = 150 LBS/FT3
UNIT WEIGHT WOOD (FIR-WET) = 50 LBS/FT3
UNIT WEIGHT WATER = 62 LBS/FT3
UNIT WEIGHT WET SAND AND GRAVEL = 120 LBS/FT3

VOLUME OF CUBE =
HEIGHT X WIDTH X LENGTH



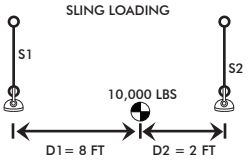
CENTER OF GRAVITY AND SLING LOADING

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 CLOSEST TO THE CENTER OF GRAVITY WILL CARRY THE GREATEST SHARE OF THE LOAD

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

SLING 1 = W x D2 / (D1 + D2)
SLING 2 = W x D1 / (D1 + D2)

CENTER OF GRAVITY AND SLING LOADING



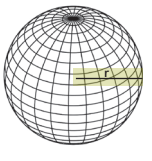
SLING 1 = 10,000 X 2 / (8+2) = 2,000 LBS
SLING 2 = 10,000 X 8 / (8+2) = 8,000 LBS

WEIGHT = VOLUME X UNIT WEIGHT OF MATERIAL

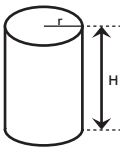
VOLUME OF SPHERE
$V = (4/3) \times 3.14 \times r^3$

VOLUME OF CYLINDER
$V = 3.14 \times r^2 \times H$

SPHERE



CYLINDER



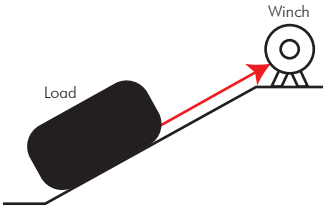
Rigging Hardware

Level & Incline Planes

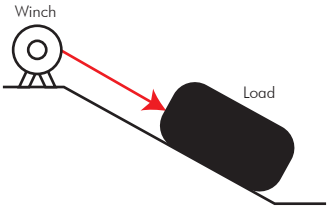
LEGEND

W – Weight of load	**F** – Force required to move load	**R** – Run, horizontal distance in feet
CF – Coefficient of friction	**H** – Height in feet	**L** – Length of ramp in feet

Level: CFxW=F



Uphill: [CFxWx(R/L)]+[(H/L)xW]=F



Downhill: [CFxWx(R/L)]-[(H/L)xW]=F

COEFFICIENTS OF FRICTION

Load on air	≤0.01	Cast Iron on Steel	0.25	Wood on Concrete	0.45
Load on wheels	0.05	Wood on Metal	0.30	Wood on Wood	0.50
Steel on Steel	0.10	Leather on Metal	0.40	Metal on Concrete	0.60
Continuous Lubricated Surface	0.15	Manila Rope on Wood	0.40	Concrete on Concrete	0.65

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Rigging Hardware

Links/Turnbuckles

LINKS AND RINGS WITH GRADE 80 ALLOY STEEL CHAIN MATERIAL

P-6830 WITH FLAT PART

FOR CONNECTING GRADE 80 CHAIN SLINGS

P-6820

WLL (tons)	P-6830 Diameter	P-6820 Diameter
1.6	.511"	---
2.5	---	.629"
3.2	.629"	---
3.5	---	.708"
4.5	.708"	---
6.2	.787"	---
6.5	---	.866"
8.2	.866"	---
8.5	---	.984"
10	---	1.102"
10.6	.984"	---
12.8	1.102"	---
13	---	1.181"
15.5	1.181"	---
17	---	1.417"
20	1.417"	1.496"
25	1.496"	---
27	---	1.772"
30	1.732"	1.772"
37	1.772"	---
40	---	1.969"
50	1.969"	2.165"
60	---	2.283"
63	2.165"	---
80	---	2.756"
100	2.756"	3.15"
125	3.15"	---

USE LOCKNUTS OR MOUSING TO PREVENT THE TURNBUCKLES FROM ROTATING. THIS METHOD IS MOST EFFECTIVE.

TURNBUCKLES

SIZE	WLL EYE AND EYE (tons) 5/1 DESIGN FACTOR	WLL HOOK AND HOOK (tons) 5/1 DESIGN FACTOR
3/8	.54	.54
1/2	1	.68
5/8	1.59	1.02
3/4	2.36	1.36
7/8	3.27	1.81
1	4.54	2.27
1-1/4	6.9	2.95
1-1/2	9.71	3.4
1-3/4	12.7	-
2-1/2	27.2	-
2-3/4	34	-

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Rigging Hardware

Shackles/Hooks

SHACKLES — SCREW COLLAR PIN / SAFETY BOLT

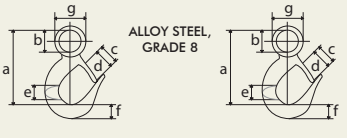
DIAMETER OF BOW (INCHES)	WORKING LOAD LIMIT (TONS)	INSIDE WIDTH AT PIN (INCHES)	DIAMETER OF PIN (INCHES)
1/2	2	7/8	5/8
5/8	3.25	1-1/16	3/4
3/4	4.75	1-7/32	7/8
7/8	6.5	1-13/32	1
1	8.5	1-11/16	1-1/8
1-1/8	9.5	1-27/32	1-1/4
1-1/4	12	2	1-3/8
1-3/8	13.5	2-1/4	1-1/2
1-1/2	17	2-3/8	1-5/8
1-3/4	25	2-29/32	2
2	35	3-9/32	2-1/4
2-1/4	42.5	3-3/4	2-9/16
2-1/2	55	4-1/8	2-3/4
3*	85	5	3-1/4

*Available in Safety Bolt Shackles

HOOKS — LARGE EYE

WLL (TONS) CARBON STEEL, GRADE 4	WLL (TONS) ALLOY STEEL, GRADE 8	HEADROOM LENGTH (IN) a	OPENING WIDTH (IN) d	WEIGHT (LBS)
0.8	1.25	3.22	0.787	0.59
1	1.6	3.66	0.866	0.88
1.6	2.5	4.05	0.905	1.21
2	3.2	4.72	1.06	1.82
3.2	5.4	5.78	1.37	4.18
5	8.2	7.36	1.69	7.71
7.5	12.8	9.05	2.08	15.21
10	16	10.07	2.28	23.14
15	22	12.51	3.07	38.58

CARBON STEEL, GRADE 4



ALLOY STEEL, GRADE 8

Product Information Supplied Courtesy of VAN BEEST