



# Lifting Gear Hire

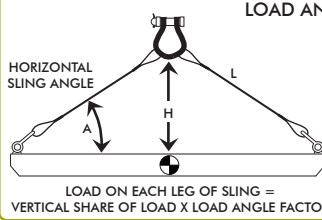
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# Rigging Hardware

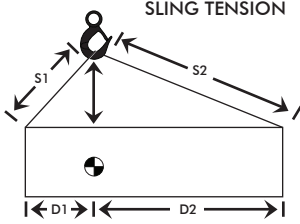
## Sling Tension & Load Angles

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

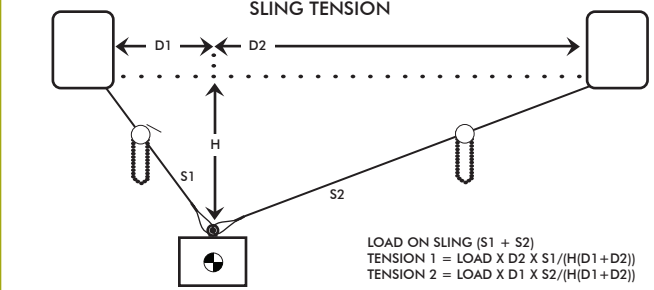


### LOAD ANGLE FACTORS

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



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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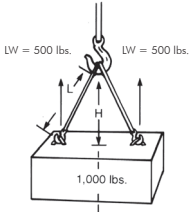
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## Slings – Load Factors

### Increased Tension



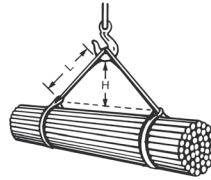
**Example:**  
 Load weight = 1,000 lbs.  
 Rigging - 2 slings in vertical hitch  
 Lifting Weight (LW) per sling = 500 lbs.  
 Measured Length (L) = 10 ft.  
 Measured Height (H) = 5 ft.  
 Tension Factor (TF) =  $10(L) \div 5$   
 Minimum Vertical Rated Capacity  
 required for this lift:  
 $500(LW)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

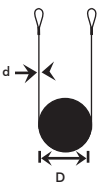
Sling capacity decreases as the angle from horizontal decreases. Sling angles of less than 30° are not recommended.

### Reduced Capacity



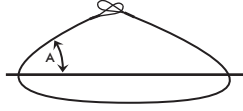
**Example:**  
 Vertical Choker rating of each sling = 6,000 lbs.  
 Measured Length (L) = 6 ft.  
 Measured Height (H) = 4 ft.  
 Reduction Factor (RF) =  $4(H) \div 6(L)$   
 = .667  
**Reduced sling rating in this configuration = 667 (RF) x 6,000 lbs. = 4,000 lbs. of lifting capacity per sling**

### BASKET HITCH



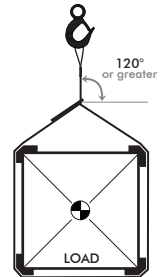
A BASKET HITCH HAS TWICE THE CAPACITY OF A SINGLE LEG ONLY IF D/d RATIO IS 25/1 AND THE LEGS ARE VERTICAL.

### 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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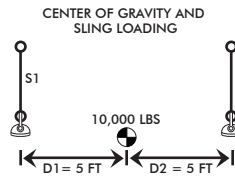
# Rigging Hardware

## 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,

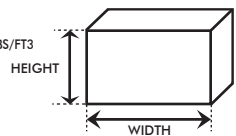
IF THE WEIGHT OF THE LOAD IS 10,000 LBS, THEN EACH SLING WILL HAVE A LOAD OF 5,000 LBS. AND EACH SHACKLE AND EYEBOLT WILL ALSO HAVE A LOAD OF 5,000 LBS.



### WEIGHT = VOLUME X UNIT WEIGHT OF MATERIAL

UNIT WEIGHT STEEL = 490 LBS/FT3  
 UNIT WEIGHT ALUMINUM = 165 LBS/FT3  
 UNIT WEIGHT REINFORCED 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

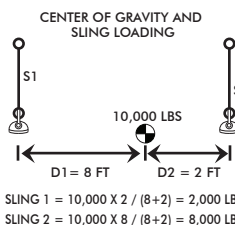


### CENTER OF GRAVITY AND SLING LOADING

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

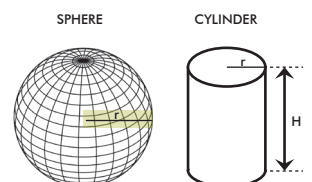
SLING 2 IS CLOSEST TO CENTER OF GRAVITY. IT WILL HAVE THE GREATEST SHARE OF THE LOAD

SLING 1 =  $W \times D2 / (D1 + D2)$   
 SLING 2 =  $W \times D1 / (D1 + D2)$



### WEIGHT = VOLUME X UNIT WEIGHT OF MATERIAL

VOLUME OF SPHERE  
 $V = (4/3) \times 3.14 \times r^3$   
 VOLUME OF CYLINDER  
 $V = 3.14 \times r^2 \times H$





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# Rigging Hardware

Level & Incline Planes

## LEGEND

W – Weight of load

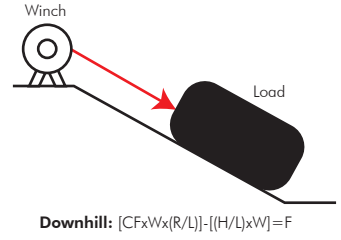
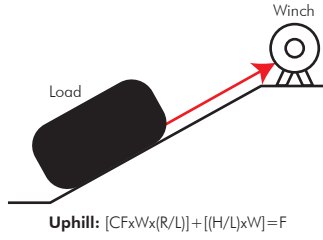
F – Force required to move load

R – Run, horizontal distance in feet

CF – Coefficient of friction

H – Height in feet

L – Length of ramp in feet



## 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"	---

## TURNBUCKLES

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

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



SCREW COLLAR PIN



SAFETY BOLT

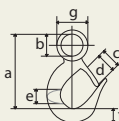
\*Available in Safety Bolt Shackles

## 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

