Part 3:

Supporting Material

Contents

1. Equipment Description

Contents of this section are facsimile editions from PG&E's previous Live-Line manual.

Chapter 1: Overhead Transmission and Distribution

Section ~~8~~ Rigging

Code of Safe Practices (*CSP*), Section 1, "General Rules"

Rule 39. Rigging

(a) Only employees trained and qualified to rig shall do so.

(b) Employees ~~shall~~:

1. Use Company-approved rigging
2. Inspect rigging components prior to and during use to ensure they are in good working order
3. Not exceed the working load limits of any component.

(c) Employees ~~shall~~ position themselves such that they are not at risk of an injury in the event that one of the rigging components fails or control is lost.

This section of the manual provides Pacific Gas and Electric Company (PG&E/Company) employees with procedures for rigging.

8.1. Terminology for Parts of a Block

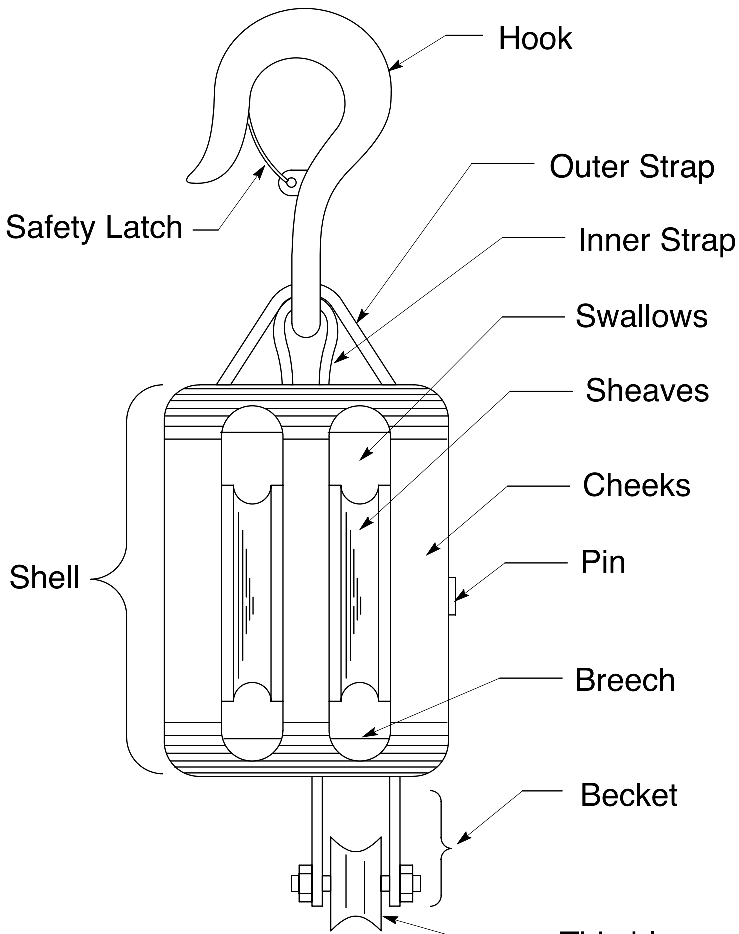


Figure 8-1
Block Terms

8.2. Working Load Limit (WLL) of Wood and Steel Single-Sheave Blocks Used for Synthetic Rope

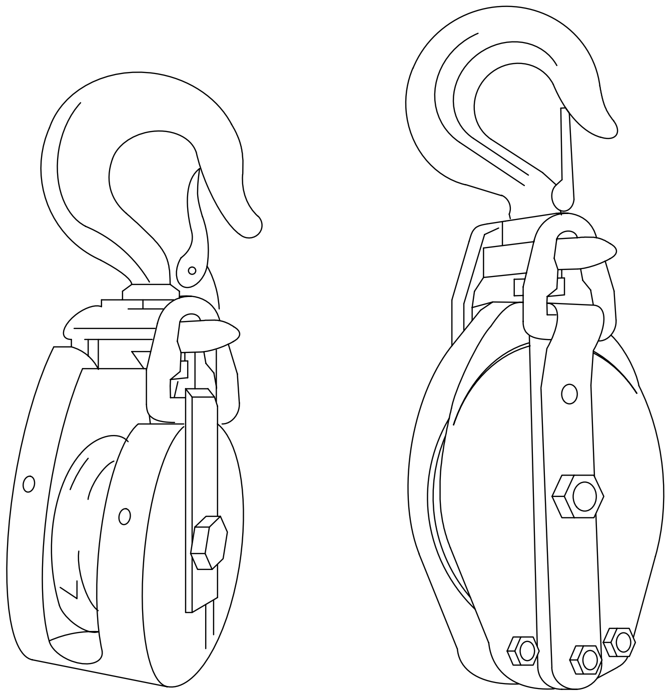


Figure 8-2
Snatch Blocks

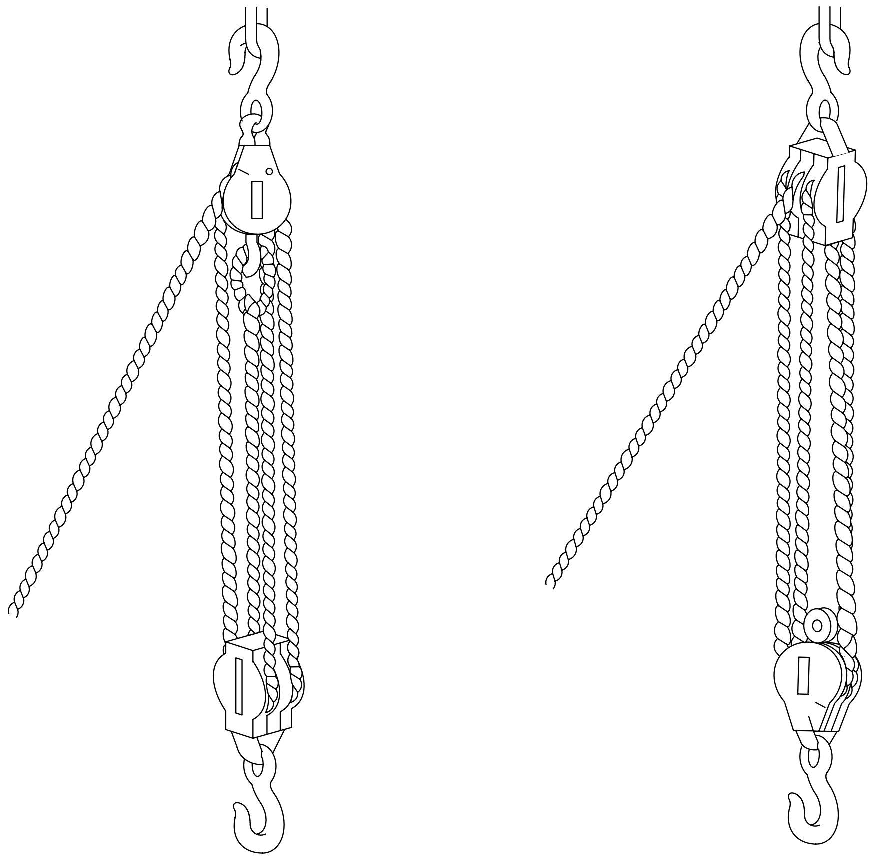
Table 8-1 Working Load Limit (WLL) of Wood and Steel Single-Sheave Blocks

Block Size Length of Shell (Inches)	Maximum Rope Size (Inches)	WLL (in Pounds) (When manufacturer's WLL is unknown) Safety Locking
4	1/2	800
6	3/4	3,000
8	1	5,000
10	1-1/4	8,000

8.3. Wood and Steel Shell, Multi-Sheave Blocks Used for Synthetic Rope

Table 8-2 Rope Size for Block Size

If the Synthetic Rope is This Size:	3/8”	1/2”	5/8”	3/4”	1”
Use This Block Size	3”	4”	5”	6”	8”



Note: Length of Shell Denotes Block Size

Figure 8-3
Multi-Sheave Blocks for Synthetic Rope

8.4. Maximum WLL of Multi-Sheave, Wood and Glass, Fiber-Filled Nylon Blocks

Table 8-3 WLL of Multi-Sheave Wood Blocks

Block Size Length of Shell (Inches)	Synthetic Rope Size (Inches)	WLL (in Pounds) (When manufacturer’s WLL is unknown)	
		Double	Triple
4	1/2	1,400	1,800
5	5/8	1,800	2,400
6	3/4	2,500	3,200
8	1	3,800	4,800

Table 8-4 WLL of Multi-Sheave, Glass, Fiber-Filled Nylon

Description	Maximum Rope Size	WLL (Pounds)	Wt. /Pr. (Pounds)	PG&E Code
Rope Blocks – Double Sheave T&E News	1/2" Spec. I-II	3,500	6.5	201962

8.5. Reeving

8.5.1. When reeving blocks, it is important to lay the fall block on its shell side and the load block on its sheave side; that is, at 90°, or at a 1/4-turn to each other.

8.5.2. Starting in each case with the fall line numbered (1), the correct reeving can be followed, as illustrated in Figure 8-6 on Page 8-6.

8.5.3. When both blocks have the same number of sheaves, the becket is on the fall-line block. When the number of sheaves differs, the block having the fewest sheaves carries the becket.

8.5.4. Blocks with shackles instead of hooks may also be used. In either case, the blocks' WLL must ***never*** be exceeded.

8.5.5. A shackle is much stronger than a hook of the same size. Also, the strain on the upper block is much greater than the strain on the lower one. The lower block supports only the load, but the upper block carries the load as well as the hoisting strain.

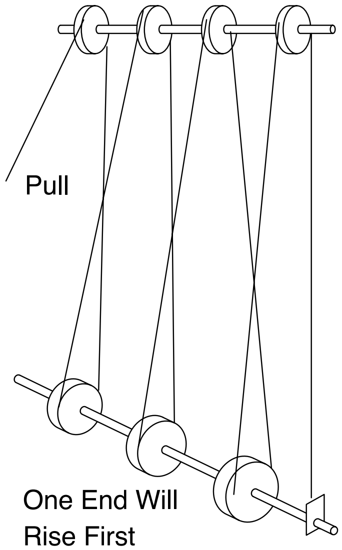
8.5.6. When making up a set of blocks or reeving a system having five or more parts of line, avoid lacing the blocks because they have a tendency to tilt the traveling block when running empty. This effect causes excessive wear and can damage the sheaves and rope.

8.5.7. When reeving, the two blocks should be placed so that the sheaves in the upper block are at right angles to the sheaves in the lower one, as illustrated in Figure 8-5 on Page 8-6. The blocks should be identical and square in relation to each other.

8.5.8. When reeving any kind of rope, ensure that the dead-end, or becket connection, is made and attached properly.

8.5.9. On wire-rope blocks, use either a wedge socket or cable clips for the becket.

8.5.10. On synthetic-rope blocks, use the becket hitch or eye splice to secure the dead-end.



Laced Multi-Fall Blocks Tend to
Tilt When
Running Empty

Figure ~~8~~-4
Lacing Rather than
Reeving Blocks

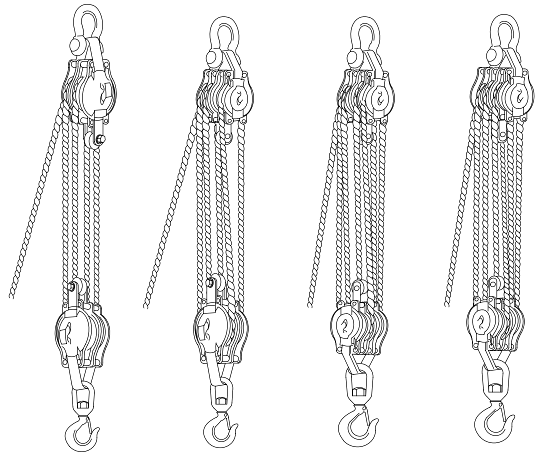


Figure ~~8~~-5
Right-Angle Reeving
Multi-Sheave Blocks: 4, 5, 6 & 7
Part Block-and-Tackle

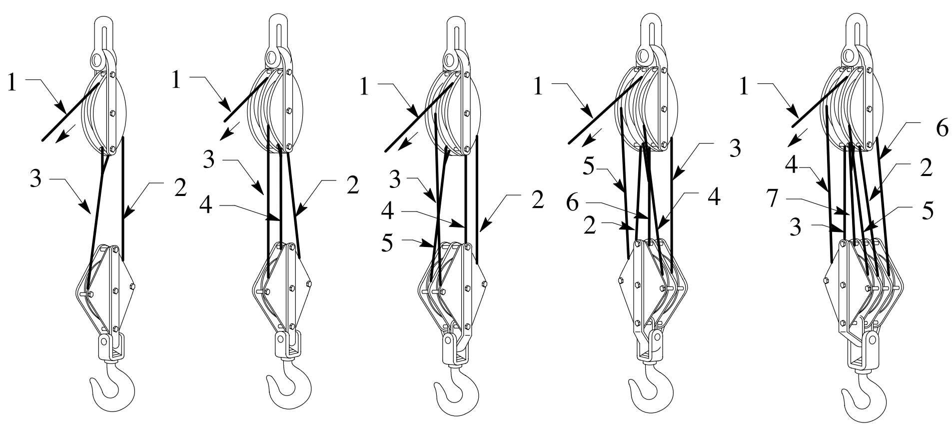
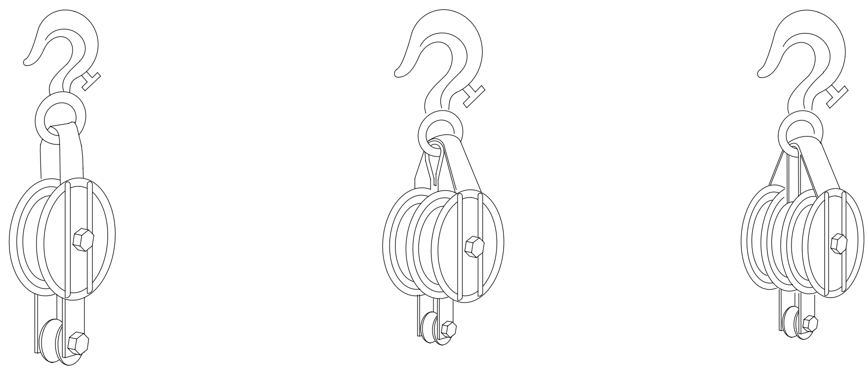


Figure ~~8-6~~
~~Reeving Block-~~and-Tackle

8.6. Hot Blocks

The Figure 8-7 below represents nylon shells for synthetic hot-line rope (i.e., Rope Specification 4) with a flattened hook.

Boston and Lockport Star brand blocks are supplied by Safety Line, Inc.



Single
3101 W

Double
3102 W

Triple
3103 W

Figure 8-7
Hot Blocks

Table 8-5 WLL of Nylon Blocks (Hot Blocks)

Size	WLL (In Pounds)			
Block Number	Rope Size (In Inches)	With Hooks		
		Single	Double	Triple
2	1/2	500	1,000	1,200
		Code 205258	Code 205259	Code 205260

~~8~~.7. Service Blocks

Figure ~~8~~-8 below represents a double block for 3/8-inch synthetic rope. Use 3/8-inch specification 1 or 1-II on conductors energized below 600 volts (V). Use either Code 100060 or Code 100077 when ordering this double-block system.

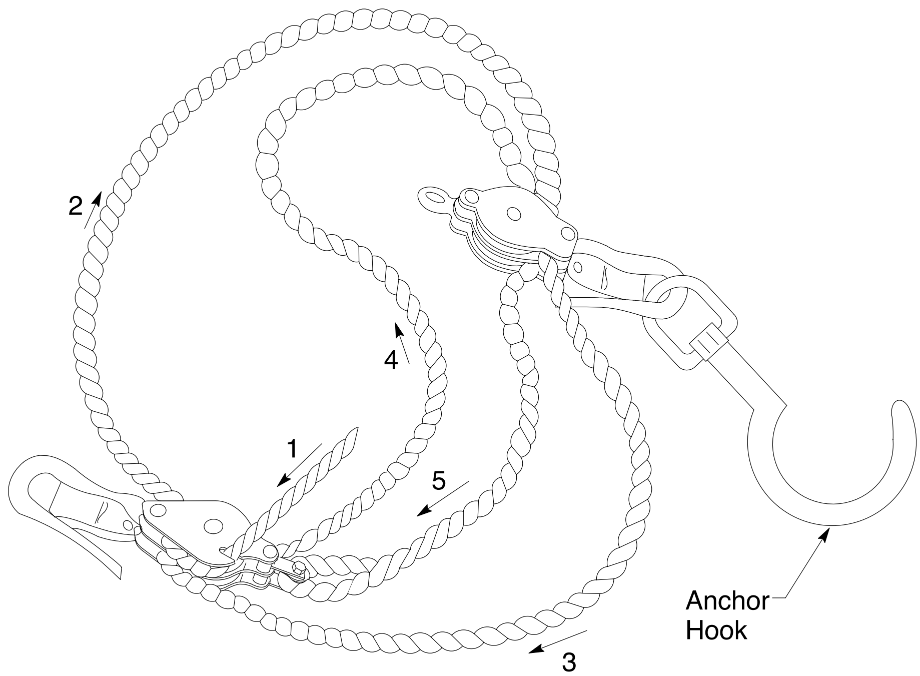


Figure ~~8~~-8
Information for Either Phone Blocks or Telephone Blocks

The WLL for service blocks is 450 pounds. Use Code 202931.

When you are using blocks for voltages above 600 V, use nonconductive, 3/8-inch hot rope (Rope Specification 4, Code 100056).

NOTE: Anchor Hook: Code 200452, WLL 750 pounds

~~8~~.8. Mechanical Advantage and Friction Loss

~~8~~.8.1. Each time a rope bends over a sheave, turning on its axle, friction is created. To overcome this friction, an additional pull is required on the fall line. Employees must add 10% to the load for each sheave in use. This 10% applies for each 180° bend of the rope. For each 90° bend of the rope, add 5% for friction.

EXAMPLE

Load x 1.1 = 10%
Load x 1.05 = 5%

8.8.2. The following information explains the application of mechanical advantage and friction loss when using tackle.

NOTE: Ensure that you design your rigging plan so you can identify your weakest link and that the weakest link will safely carry its planned load.

8.9. Definitions Used in Formulas

Sheave = One of the round pulleys in the block. Usually, there will be more than one sheave in the set of the blocks.

Snatch Block = Used to change the direction of the pull or strain on the load (i.e., haul line [HL]).

Weight (W) = The weight of the load on the block or blocks.

Parts of Line (P) = The number of lines running through the block or blocks.

Factor (F) = The 1.1 friction factor put on each sheave.

Haul Line (HL) = The strain that must be placed on the line that you are pulling. Also, the strain on the haul line (i.e., the last haul line) will determine the size of rope to use to support the load safely.

HL^1 = Strain on line coming into snatch block, when changing the direction of the pull.

HL^2 = Strain on line leaving the snatch block, when changing the direction of the pull.

Hook Strain (Hs) = Where you attach the block or blocks and that strain determines the size of the blocks you will use.

Angle Hook Strain (AHs) = (Snatch Block), hook strain on the snatch block depends on the angle (measured in degrees) of the change in direction of the haul line.

Angle Factor (AF) = The factor multiplier to compensate for the change in the direction of the pull.

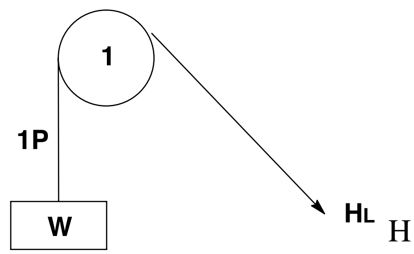
Sling (S) = A rope or wire rope configured so a weight can be lifted safely.

NOTE: A sling may be the weakest component of the rigging. To determine the maximum weight that can be lifted, multiply the rope's WLL (determined in the vertical configuration) by the factor given for the sling configuration. Sling loads calculated using this method apply to all slings regardless of sling material.

8.10. Single- and Multi-Sheave Blocks

Use the formula below to calculate the force that must be applied to the haul line to lift the load.

$H_L = W \times F$



Use the formula below to calculate the weight that can be picked up using a known-size haul line.

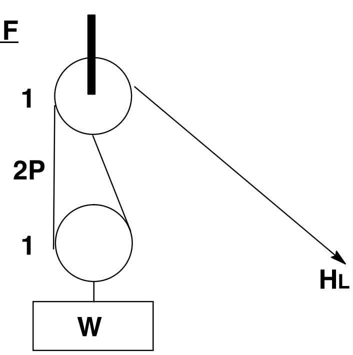
$$W = \frac{H_L{}^1 \times P}{F}$$

Adding an additional sheave (directly above the load) allows the use of 2 ropes to support the load. Each of the ropes supports half the weight of the load. Because 2 ropes now support the load, the force needed at the end of the rope is less. The mechanical advantage is now 2:1.

The mechanical advantage of multiple sheaves is not free. For example, using a set of blocks comprised of two double sheaves, top and bottom, takes 4 times as much rope to hold up the load. Also, friction is a factor. Every time the rope passes over a sheave, friction will increase the required pulling force by about 10%, or 1.1 factors, when the load is raised.

Use the formula below to calculate the force required to the haul line and lift the load.

$$H_L = \frac{W \times F}{P}$$



Use the formula below to calculate the force that is applied to the hook strain to lift the load.

$$H_S = H_L + W$$

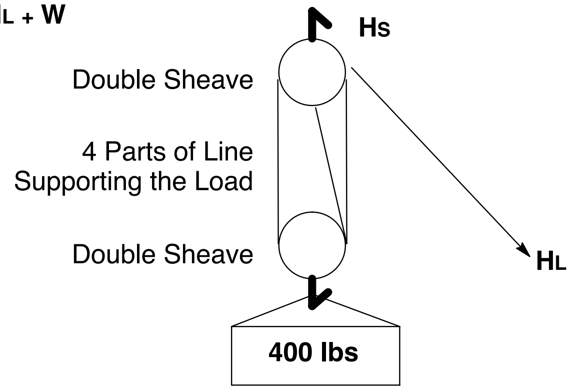


Table 8-6 Part of Line Factor Chart

Parts of Line	Exponent	Long Explanation	Multiplying Factor
1 part of line	1.1^1	=1.1 x 1	= 1.1
2 parts of line	1.1^2	=1.1 x 1.1	= 1.21
3 parts of line	1.1^3	=1.1 x 1.1 x 1.1	= 1.33
4 parts of line	1.1^4	=1.1 x 1.1 x 1.1 x 1.1	= 1.46
5 parts of line	1.1^5	=1.1 x 1.1 x 1.1 x 1.1 x 1.1	= 1.61
6 parts of line	1.1^6	=1.1 x 1.1 x 1.1 x 1.1 x 1.1 x 1.1	= 1.77
7 parts of line	1.1^7	=1.1 x 1.1 x 1.1 x 1.1 x 1.1 x 1.1 x 1.1	= 1.95

8.11. Angle Block

Use the formula below calculate the force to apply to the snatch-block hook strain to hold the load.

$$AH_S = \frac{H_L^1 + H_L^2 \times AF}{2}$$

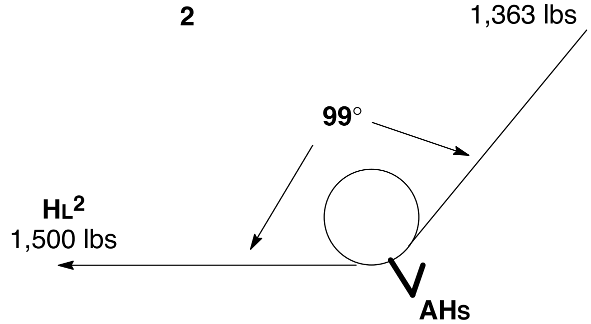


Table 8-7 Angle Factor Chart

Angle Factor Multipliers (AF)	
Angle (In Degrees)	F
0 to 19	2.2
20 to 39	2.15
40 to 59	2.0
69 to 79	1.8
80 to 99	1.6
100 to 119	1.3
120 to 139	1.0
140 to 159	0.65
160 to 180	0.38

8.12. Slings

8.12.1. Sling Carrying Positions

The four sling hitches (i.e., four ways of carrying an object with slings) that are used throughout the industry are illustrated below.

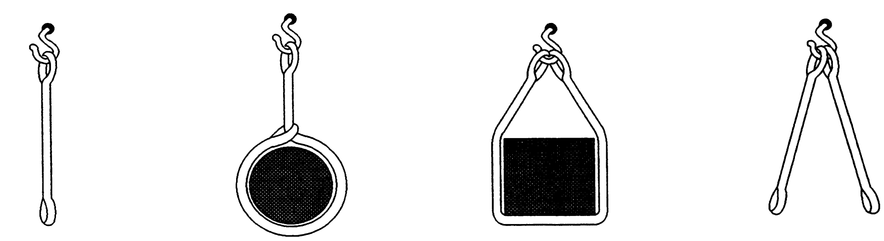


Figure 8-9
Sling Carrying Positions

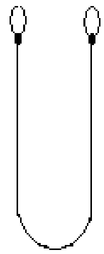
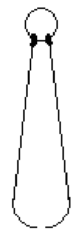
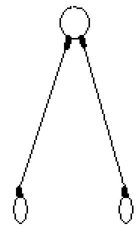
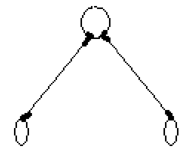
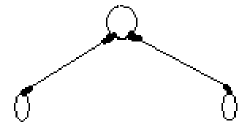
Use the formula below to calculate the sling size required to hold the load.

$$S = \frac{W}{F}$$

Use the formula below to calculate the WLL of a sling in a configuration.

$$W = S \times F$$

Table 8-8 Sling Factor Chart

Name	Single	Choker	"U"	Basket	60° Bridle	45° Bridle	30° Bridle
Type of Sling							
Use Factor	1.00	0.75[1]	2.00	Refer to Bridle Factor	1.732	1.414	1.000

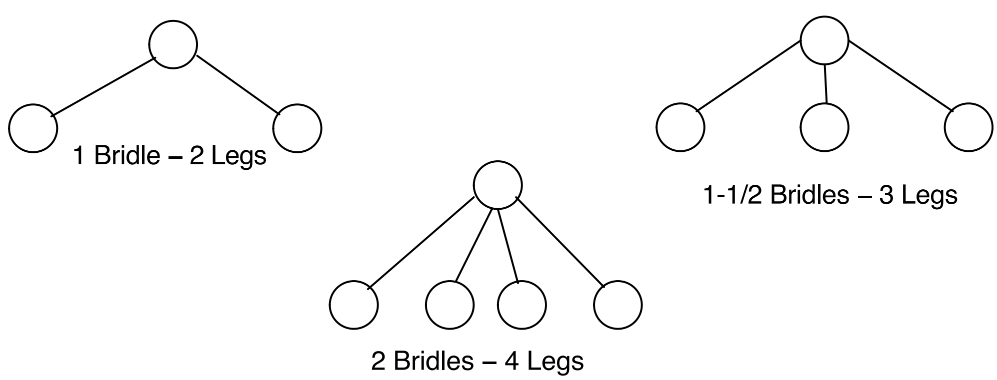
1 * This factor is for ***wire rope only.*** Use 0.50 for fiber rope chokers.

8.12.2. Bridle Slings

When determining the type of bridle sling to use, first you must determine the load weight. Then, determine the number of slings to be used (either 2, 3, or 4). Figure 8-10 illustrates the most common bridle-sling combinations. The numbers beside the different bridles in the figure indicate that a complete bridle must have 2 slings or legs. This method assumes that for any given load to be lifted, all slings are:

- Equal in length
- Connected an equal distance from the center of the load
- Equally loaded

The calculated sling load must be less than, or equal to, the rated capacity of each sling regardless of the number of slings used. Do *not* rig a sling so that the value of the sling exceeds 30%. Use a longer sling or connect the slings closer to the center of load.



(Use 1.5 factor, as described below the "Note" following Table 8-9.)

Figure 8-10
Bridles

Table 8-9 Bridle Factor

Bridle Configuration	Multiplying Factor
One Bridle (2 Legs)	1.0
One and ½ Bridle (3 Legs)	1.5
Two Bridles (4 Legs)	1.5

NOTE: Use the 1.5 calculation for all bridles with 3 or more legs to ensure that no sling is overloaded.

Use the formula below to calculate the bridle sling size required to hold the load.

$$S = \frac{W}{F \times \text{NUMBER OF BRIDLES}}$$

Use the formula below to calculate the WLL of a bridle sling in a configuration.

$$W = S \times F \times \text{NUMBER OF BRIDLES}$$

8.12.3. 12-Foot Fiberglass Transfer Gin

Do *not* exceed safe WLLs as specified in Table 8-10, "12-Foot Transfer Gin." A safe WLL is based on spacing the support brackets every 30 inches. Support brackets, as found in Safety Line, Inc., Catalog 17 and Catalog 18-A, come standard with pole spacers, Code 7019 and Code 7020. These spacers make belting between the structure and transfer gin easier.

Safety Line, Inc., Catalog 712FG,
Transfer Gin Assembly Code 205385

Table 8-10 12-Foot Transfer Gin

Up/Down-Line Configuration	WLL
Vertical	1,000 lbs.
30°	500 lbs.

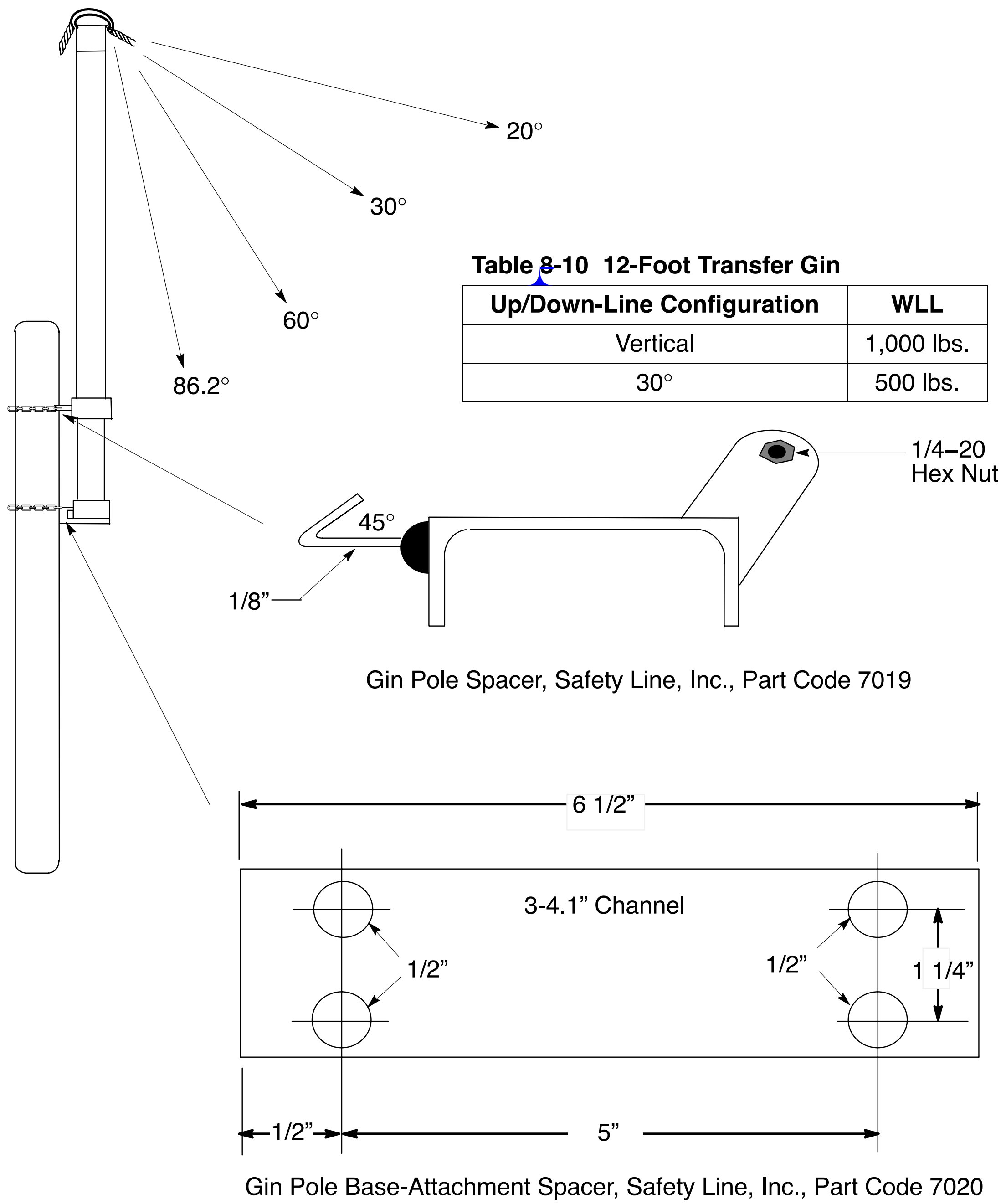


Figure 8-11
Transfer Gin Assembly

Table 8-11 Safety Line, Inc. 12-foot Gin Spacer Assembly

Description	MFG	MFG Part #
Gin pole spacer, for 12′ pole	Safety Line, Inc.	7019
Gin pole base attachment spacer	Safety Line, Inc.	7020

8.13. Transformer Gins

The following procedures apply to Wilson and heavy-duty transformer gins.

8.13.1. Employees must observe the minimum working distances from unprotected, energized conductors or apparatus.

8.13.2. Gins can be taken through a suitably protected, energized, 0 kilovolt (kV) through 25 kV conductor level for use on pole-top circuits.

8.13.3. Avoid contact with bond wires.

8.13.4. Circuits 0 kV through 25 kV, Crossarm Construction

Both the Wilson and heavy duty gins may be used to install and/or remove transformers and equipment connected to energized circuits between 0 kV and 25 kV, if the following conditions are met.

A. On single-phase circuits, both conductors are in the outer-pin positions and both conductors are covered with approved protective equipment.

B. On three-phase circuits (except for 0 kV through 5 kV), where the center phase is in the pole pin position, both the Wilson and heavy duty gins also can be used with approved protective equipment. The Safety Line, Inc., live line gin, Catalog Number 112, Code 205508, is approved for this application as described in Engineering Document 015069, "Application of Live Line, Inc. Transformer Gin – Double-Boom Type."

C. On three-phase circuits (except for 0 kV through 5 kV), where a cutout arm is present and the transformers are hung below the cutout arm, the gin should be mounted on the cutout arm and the lead wires that extend from the line conductors to the cutouts should be disconnected. Always use approved protective equipment on the energized line conductors above the cutout arm.

8.13.5. Circuits 0 kV Through 25 kV, Vertical or Triangle Construction

A. Both the Wilson and heavy duty gins may be used to install and/or remove transformers or equipment connected to energized circuits of 25 kV or less if the following conditions are met.

- *If* the gin's mounting chain is kept below the lowest insulator bracket or dead-end, *and*
- *If* approved, protective devices are used properly on the two lowest phases in vertical construction and on all phases in triangle construction.

B. The maximum allowable weights to be lifted must be posted on a decal that is attached to each gin. If these decals are missing, obtain replacement decals from Safety Line, Inc.

8.13.6. Wilson Transformer Gin

A. The transformer gin assembly is made of steel. Do *not* exceed the WLL. With the single-alloy chain, one lineman can install the assembly onto the pole. The assembly also can be installed over a crossarm. The gin weighs 25 pounds.

B. Blocks can be hung either in the eye or from the provided shackle. Rope guides for the fall line are located on both sides of the gin assembly. Ordering information is found in Safety Line, Inc., Catalog Number 133, Code 201788.

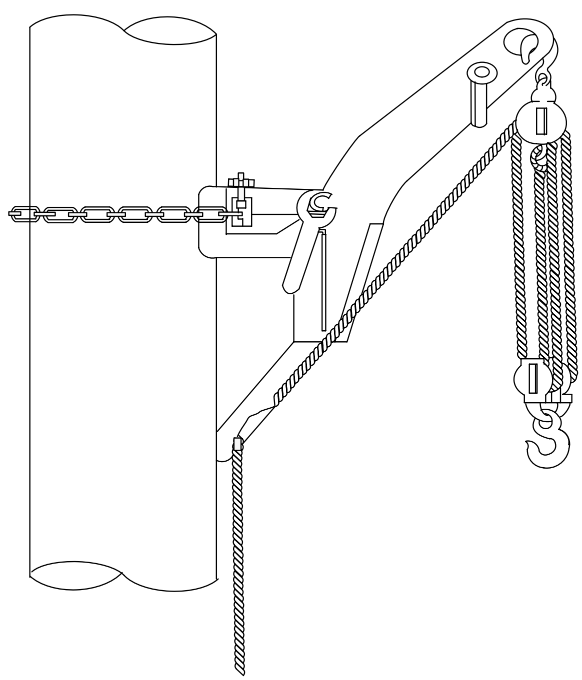


Figure 8-12
Metal Transformer Gin,
Code 201788

NOTE: The WLL of the metal Wilson transformer gin is a maximum 2,000 pounds hook strain.

NOTE: Tagging loads will subject the gin to side loading. This reduces the safe WLL.

8.13.7. Heavy-Duty Transformer Gin

The heavy-duty transformer gin assembly is designed and tested for lifting heavy loads. Do *not* exceed the WLL. The gin assembly is designed to be installed easily on the pole with a 5/16-inch-high test chain and a tightening handle. The assembly also can be installed over a crossarm. In these instances, the gin weighs 39 pounds.

Ordering information is found in Safety Line, Inc., Catalog Number 1200, Code 205780.

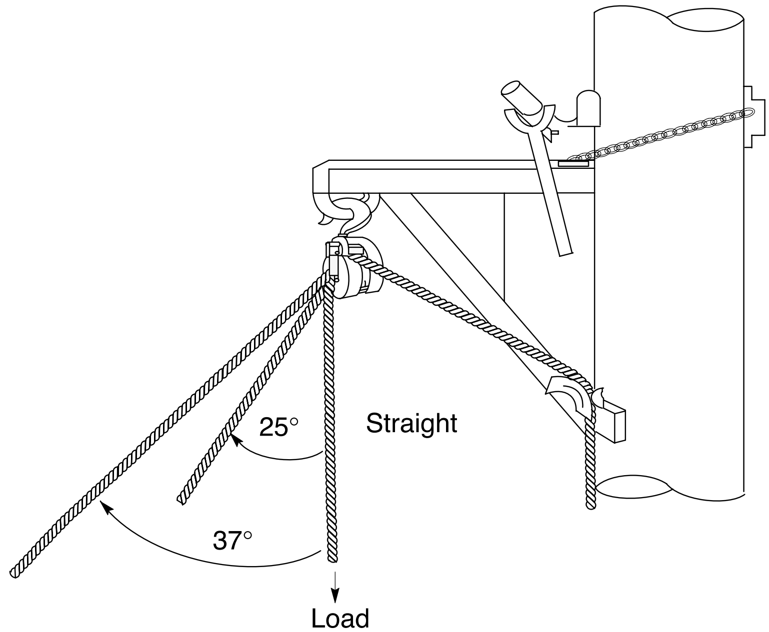


Figure 8-13
Heavy-Duty Transformer Gin

NOTE: The WLL of the metal, heavy-duty transformer gin is a maximum 5,000 pounds hook strain.

NOTE: Tagging loads will subject the gin to side loading. This reduces the safe WLL.

A. Both the Wilson and heavy-duty gins are designed so that all loads are essentially applied in a vertical plane. If side loading must occur, use the following limitations:

1. Up to 5° from vertical, no reduction in maximum allowable load is necessary.
2. From 5° to 10° vertical, reduce the load by 20%.
3. From 10° to 20° vertical, reduce the load by 50%.
4. When the load is over 20° vertical, ***do not use.***

8.13.8. Transformer Hot Gin

A. The gin assembly is designed to lift heavy loads of up to 1,646 pounds when it is rigged as described in Table 8-12 on Page 8-19.

Ordering information is found in Safety Line, Inc., Catalog Number 112FG, Code 205508.

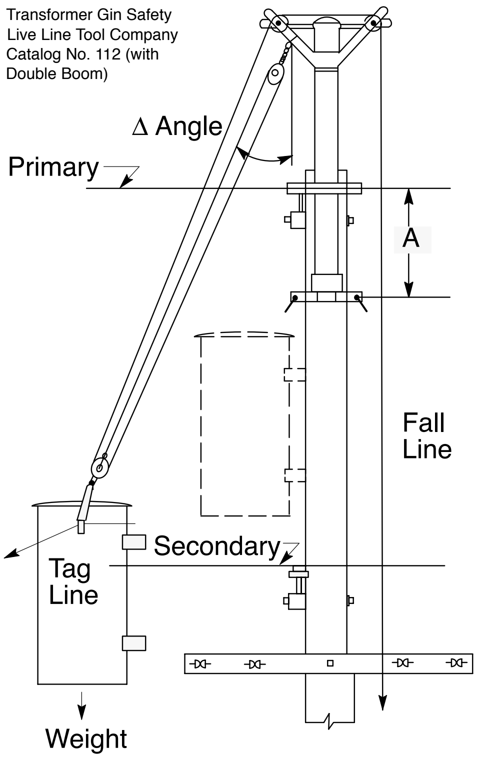


Figure 8-14
Double-Boom Type

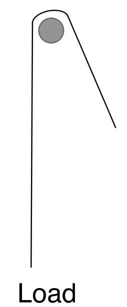
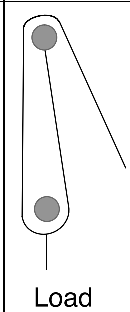
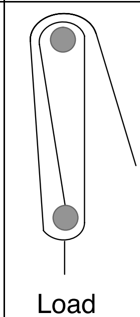
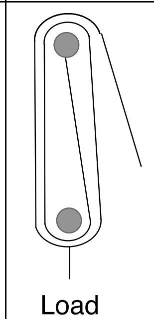
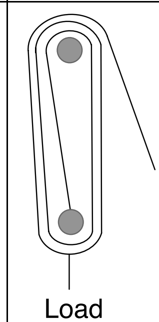
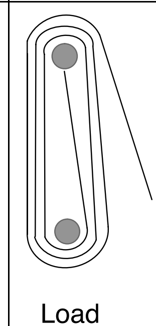
Table 8-12 Allowable Loads – Transformer Hot Gin

Spacing of Supports A (Inches)	Number of Lines Supporting Load	Allowable Weight When Lifting Straight Up (Pounds)	Allowable Weight When Lifting at Over 25° (Pounds)	Allowable Weight When Lifting at Over 37° (Pounds)
48	1	Allowable Load = 2,500 Pounds for the Spacing of all Gin Supports and Tackle Arrange-ments	1,005	610
	2		1,035	625
	3		1,100	655
	4		1,230	725
	5		1,885	1,015
36	1		700	395
	2		715	405
	3		750	420
	4		820	455
	5		1,130	575
26	1		555	310
	2		570	315
	3		590	325
	4		645	345
	5		845	425
18	1		480	260
	2		490	265
	3		510	275
	4		550	290
	5		705	350

Notes:

1. The maximum allowable loads shown in Table 8-12 above apply to transformer gins only. Do ***not*** exceed the tackle's rating.
2. The gin illustrated in Figure ~~8-14 shows the transformer either bolted to a pole or mounted in the center or outside~~ position on a hanger arm.
3. Ensure that each gin is provided the same level of care and protection and that all gins are tested periodically using methods similar to those used for hot line tools.

Table 8-13 Safe Load Ratings for Specification I-I Synthetic Rope

Safe Loads for Combination Synthetic (Specification I-I) and Tackle (In Pounds)								
Dia. Rope– Inches	**Min. Size Block– Inches**	**Straight Pull**	**1-Part Fall– 1 Single Block**	**2-Part Falls– 2 Single Blocks**	**3-Part Falls– 1 Single, 1 Double Block**	**4-Part Falls– 2 Double Blocks**	**5-Part Falls– 1 Double Block 1 Triple Block**	**6-Part Falls– 2 Triple Blocks**
								
1/2”	4	800	727	1322	1805	2192	2484	2712
3/4”	6	1600	1454	2645	3609	4384	4969	5424
1”	8	2660	2418	4397	6000	7288	8261	9017
11/4”	12	4000	3636	6612	9023	10959	12422	13559

Note: These values may be reduced depending on the strength of the blocks, hooks, shackles, and anchor points that are used.

8.14. Weight Tables, Approximate

The following tables represent pole weights for different types of wooden poles.

Table 8-14 Pole Weights

Length (In Feet)	Douglas Fir, Fully Treated (In Pounds)					
	Class					
	Penta					
	1	2	3	4	5	6
25	870	710	590	500	430	390
30	1,120	950	810	690	580	500
35	1,370	1,170	1,010	880	750	680
40	1,650	1,420	1,230	1,070	930	810
45	1,940	1,670	1,450	1,260	1,110	970
50	2,260	1,930	1,680	1,470	1,310	–
55	2,610	2,240	1,920	1,690	–	–
60	3,010	2,570	2,190	1,910	–	–
65	3,510	2,920	2,460	2,150	–	–
70	4,030	3,300	2,750	2,390	–	–
75	4,540	3,700	3,060	–	–	–
80	5,120	4,140	3,390	–	–	–
85	5,760	4,600	3,750	–	–	–
90	6,510	5,130	4,130	–	–	–
95	6,960	6,210	–	–	–	–
100	7,580	6,780	–	–	–	–

Table 8-14 Pole Weights, continued

Length (In Feet)	Douglas Fir, Fully Treated (In Pounds)					
	Class					
	Cellon					
	1	2	3	4	5	6
25	684	560	468	410	352	303
30	884	747	636	561	470	408
35	1,063	928	829	720	615	558
40	1,302	1,121	1,005	874	759	685
45	1,535	1,370	1,192	1,034	912	821
50	1,850	1,585	1,380	1,208	1,069	1,018
55	2,169	1,860	1,595	1,403	1,247	1,084
60	2,501	2,134	1,820	1,566	1,416	–
65	2,912	2,422	2,040	1,782	1,545	–
70	3,349	2,742	2,280	2,074	1,735	–
75	3,768	3,070	2,542	2,292	–	–
80	4,254	3,436	2,949	–	–	–
85	5,345	3,818	3,262	–	–	–
90	5,663	4,458	3,593	–	–	–
95	–	–	–	–	–	–
100	–	–	–	–	–	–

Table 8-14 Pole Weights, continued

Length (In Feet)	Western Red Cedar, Butt Treated (In Pounds)					
	Class					
	1	2	3	4	5	6
25	680	575	480	385	320	255
30	800	680	585	490	400	335
35	960	800	680	600	520	450
40	1,200	1,040	880	720	640	560
45	1,440	1,240	1,040	920	800	–
50	1,600	1,440	1,240	1,120	1,040	–
55	1,840	1,600	1,400	1,280	1,120	–
60	2,080	1,760	1,600	1,520	–	–
65	2,560	2,000	1,840	1,760	–	–
70	2,880	2,400	2,160	2,080	–	–
75	3,360	2,880	2,480	2,400	–	–
80	4,000	3,360	2,880	2,800	–	–
85	4,400	3,600	3,200	–	–	–
90	5,280	4,480	3,840	–	–	–

Table 8-14 Pole Weights, continued

Length (Feet)	Douglas Fir, Full Length (In Pounds)			
	Class			
	H1	H2	H3	H4
45	1,948	2,251	–	–
50	2,251	2,591	2,993	–
55	2,591	2,993	3,465	–
60	3,149	3,542	3,961	4,358
65	3,534	3,873	4,432	4,920
70	3,944	4,424	4,982	5,151
75	4,379	4,953	5,502	6,084
80	4,834	5,457	6,058	6,749
85	5,310	5,982	6,630	7,376
90	5,752	6,470	7,302	8,020
95	6,273	7,044	7,860	8,717
100	6,745	7,569	8,434	9,438
105	7,314	8,192	–	–

Table 8-15 Distribution Transformers

Size kVA*	Conventional				Subsurface		Pad-Mounted	
	2.3/4.16 kV		12 kV					
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
	In Pounds							
10	215	285	230	330	–	–	–	–
15	260	400	270	440	–	–	–	–
25	380	550	400	595	500	620	750	860
37.5	570	720	575	930	720	780	850	1,030
50	645	890	660	1,050	775	875	950	1,050
75	850	1,235	910	1,400	1,050	1,270	1,200	1,270
100	990	1,335	1,050	1,800	1,200	1,500	1,275	1,325
167	1,320	3,250	1,330	2,675	1,530	1,765	1,400	1,940
250	1,600	4,200	1,640	3,800	–	–	–	–
333	2,100	5,200	2,100	6,550	–	–	–	–

* kVA is kilovolt amperes

Table 8-16 Wood Crossarms

Distribution			Transmission		
Length (In Feet)	Type	Pounds	Length (In Feet)	Type	Pounds
8	Single Light	40	8	Single Heavy	70
8	Single Heavy	60	9	Single Heavy	80
9	Single Light	45	12	Single Heavy	110
9	Single Heavy	70	14	Single Heavy	125
10	Single Light	50	16	Single Heavy	145
10	Single Heavy	80	11.5	Figure 4	105
12	Single Heavy	95	13.5	Figure 4	120
14	Single Heavy	115	4.5	Braces (pair)	15
–	–	–	7	Braces (pair)	23

Table 8-17 Prefabricated – Including Insulators

Length (In Feet)	Type	Pounds
8	Single Light, With Steel Pin	100
8	Double Light, Dead-End, 2-Way	250

Table 8-18 Insulators

Type	Size	Insulators per Crate	Pounds
Pin	3 Part (60 kV)	3	145
Pin	4 Part (60 kV)	3	180
Post	9″ (Dist)	6	95
Post	21-3/4″ (60 kV)	1	55
Post	115 kV	1	250
Post	230 kV	**3 Unit Assembly (3 Crates)**	350
Susp	15,000	6	70
Susp	25,000	6	80
Susp	36,000	6	95
Susp	15,000 (FOG)	5	85

Table 8-19 Other Materials

Material	Cubic Inches (In Pounds)	Cubic Feet (In Pounds)
Concrete	0.063	144
Earth	0.058	100
Sand	0.070	120
Steel	0.260	487
Water (1 Gallon = 8.33 Pounds x 7.48 Gallon/Cubic Feet)	0.036	62.4
Fuel Oil (Diesel 1 Gallon = 7.21 Pounds)	–	–

Table 8-20 Lumber

Type	Board Foot (BF): 1″ x 12″ x 12″		Cubic Foot: 12″ x 12″ x 12″	
	Green (In Lbs.)	Dry (In Lbs.)	Green (In Lbs.)	Dry (In Lbs.)
Redwood Rough	0.446	0.244	54	29
Redwood Surfaced	0.331	0.187	40	22
Douglas Fir Rough	0.331	0.259	40	31
Douglas Fir Surfaced	0.245	0.144	30	17
(1 Cubic Foot = 12 BF)				

Table 8-21 Steel Crossarms (Wood Poles)

Size	Type	Pounds
5 Inches x 30 Feet	Channel	650
6 Inches x 30 Feet	Channel	740
7 Inches x 30 Feet	Channel	840
4 Inches x 38 Feet	Channel	430
5 Inches x 38 Feet	Channel	530

Chain and Counterweight Assembly (butt weights) for Pole Setting Application

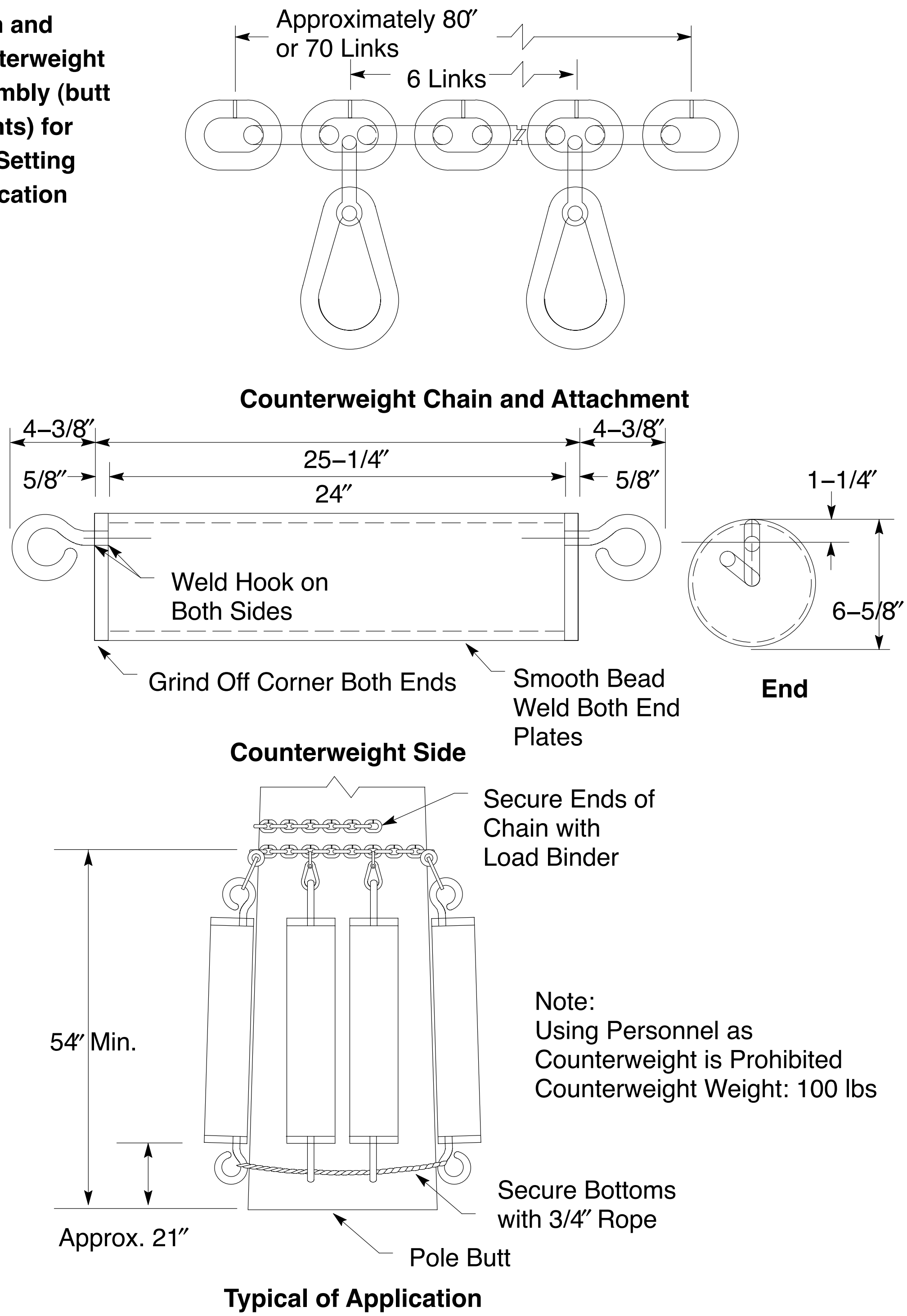


Figure 8-15
Typical Application and Details for Chain and Counterweight Assembly

8.14.1. Safety Line Guide

All crews engaged in setting poles must use a safety line guide (i.e., cable saver) when using a wire rope sling that is rigged as a choker.

Figure 8-16 below shows a safety-line guide. Its use increases your safety factor and prolongs the working life of a wire-rope sling.

Tests performed on wire rope demonstrated that the safety line guide increases the breaking strength at 33-1/3% compared to using a shackle.

Table 8-22 Safety Line Guide

Description	Pin Diameter (Inches)	Weight (Pounds)	Cat #	PG&E Code
Safety Line Guide (Cable Saver)	7/8	5-1/2	T-22	M205720

NOTE: Do not choke synthetic winch lines or wire rope winch lines.

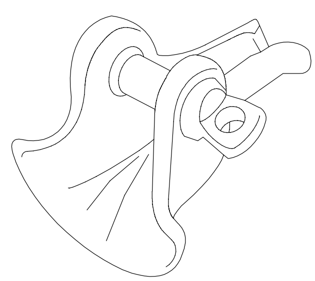


Figure 8-16
Safety Line Guide

Figure 8-17 below shows a typical application for and the proper installation of a safety line guide.

NOTE: The screw pin head is not in contact with pole.

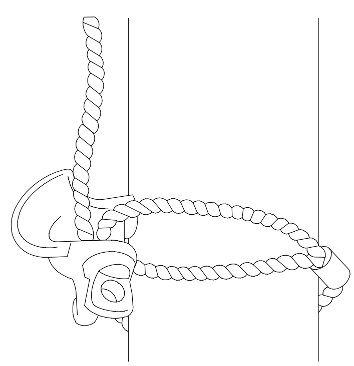


Figure 8-17
Safety Line Guide (Installed)

2. Light Duty Steel Poles & Weights

LIGHT DUTY STEEL POLES AND WEIGHTS											
		CLASS 2		CLASS 1		CLASS H1		CLASS H2		CLASS H3	
POLE LENGTH	TYPE **	MATL CODE	WEIGHT in LBS	MATL CODE	WEIGHT in LBS	MATL CODE	WEIGHT in LBS	MATL CODE	WEIGHT in LBS	MATL CODE	WEIGHT in LBS
50 FT	G	M35-0003	1060	M35-0016	1200	M35-0029	1330	M35-0042	1430	M35-0055	1540
50 FT	W	M35-0069	1028	M35-0084	1164	M35-0107	1290	M35-0124	1387	M35-0147	1494
55 FT	G	M35-0004	1200	M35-0017	1360	M35-0030	1500	M35-0043	1610	M35-0056	1740
55 FT	W	M35-0070	1164	M35-0085	1319	M35-0108	1455	M35-0125	1562	M35-0148	1688
60 FT	G	M35-0005	1410	M35-0018	1590	M35-0031	1770	M35-0044	1890	M35-0057	2050
60 FT	W	M35-0071	1368	M35-0086	1542	M35-0109	1717	M35-0128	1833	M35-0149	1989
65 FT	G	M35-0006	1560	M35-0019	1760	M35-0032	1950	M35-0045	2090	M35-0058	2260
65 FT	W	M35-0072	1513	M35-0087	1707	M35-0111	1892	M35-0129	2027	M35-0150	2192
70 FT	G	M35-0007	1710	M35-0020	1930	M35-0033	2140	M35-0046	2290	M35-0059	2480
70 FT	W	M35-0073	1659	M35-0088	1872	M35-0112	2076	M35-0130	2221	M35-0151	2406
75 FT	G	M35-0008	1890	M35-0021	2120	M35-0034	2350	M35-0047	2520	M35-0060	2720
75 FT	W	M35-0074	1833	M35-0089	2056	M35-0113	2280	M35-0131	2444	M35-0154	2638
80 FT	G	M35-0009	2060	M35-0022	2310	M35-0035	2550	M35-0048	2730	M36-0061	2950
80 FT	W	M35-0076	1998	M35-0090	2241	M35-0114	2474	M35-0139	2648	M35-0155	2862
85 FT	G	M35-0010	2240	M35-0023	2500	M35-0036	2760	M35-0049	2950	M35-0063	3190
85 FT	W	M35-0077	2173	M35-0094	2425	M35-0116	2677	M35-0140	2862	M35-0156	3094
90 FT	G	M35-0011	2420	M35-0024	2700	M35-0037	2970	M35-0050	3180	M35-0064	3440
90 FT	W	M35-0078	2347	M35-0095	2619	M36-0118	2881	M35-0142	3085	M35-0157	3337
95 FT	G	M35-0012	2610	M35-0025	2900	M35-0038	3190	M35-0051	3420	M35-0065	3700
95 FT	W	M35-0079	2532	M35-0097	2813	M35-0119	3094	M35-0143	3317	M35-0158	3589
100 FT	G	M35-0013	2810	M35-0026	3110	M35-0039	3420	M35-0052	3670	M35-0066	3960
100 FT	W	M35-0080	2726	M35-0099	3017	M35-0121	3317	M35-0144	3560	M35-0159	3841
** G = GALVANIZED FINISH											
W = WEATHERING FINISH											

3. Hydraulic Power Arm

Hydraulic Power Arm for Altec AC28-95B Stiff Crane

General Description:

The Power Arm is a hydraulic-actuated fiberglass boom that mounts on an Altec AC28-95B Stiff Crane. The Power Arm consists of a jib adapter plate, a hydraulic actuator, two fiberglass booms, and three conductor supports. The conductor supports can be mounted on the booms in various configurations.

Specifications:

- **Maximum jib tip height:** 113 feet ground to end of Power Arm.
- **Working range:** 113 feet maximum height; 40 feet maximum side reach.
- **Rated lifting capacity per phase:** 1000 lbs. at three phases horizontal.
- **Rated lifting capacity at single phase end holder:** 1000 lbs.
- **Rated capacity total unit:** 3000 lbs. over three conductor supports.
- **Di-electric rating:** 115 kV for three phase; 230 kV for single phase on end conductor holder only.
- **Weight:** Approximately 2800 lbs., including the crane adapter, hydraulic rotator, steel adapter, and fiberglass booms with conductor supports.
- **Hydraulic leveling system:** This is done by utilizing an auxiliary hydraulic circuit with approximately 3,000 PSI to supply hydraulic pressure to a hydraulic rotator which is attached to the Power Arm. The angle of the Power Arm is manually controlled by the operator of the crane.
- **Rotation:** Approximately 180 degrees, non-continuous. The limiting factor is the rated rotation angle of the hydraulic actuator.
- **Construction:** The Power Arm boom sections are spiral-wound fiberglass.

Mounting Procedure for Three-Phase Power Arm

1. Fully retract the boom and lower the boom tip until it can be reached from the ground.
2. Remove the load blocks from the load line at the boom tip.
3. Remove the anti-two block weight and chain clevis from the anti-two block switch.
4. Install the anti-two block lockout supplied by Altec Crane.
5. Remove the load line from the boom tip sheave and attach to the lug on top of the main crane boom.
6. Connect the hydraulic hoses from the boom tip circuit to the hydraulic hoses on the Power Arm.
7. Use the boom tip circuit to align the crane boom tip with the mounting head of the Power Arm.
8. Install 4 jib pins and retaining clips to fasten the main boom of the Three-Phase Power Arm in place on the end of the steel crane boom. The pins supplied with the original crane can be used for this.
9. Position the auxiliary pin-on Power Arm to align with mounting end of main Power Arm.
10. Rotate crane and align both sections of the Power Arm 138HD for end-to-end connection. Install 2 supplied 1-1/2" diameter through pins and keepers.
11. Install 2 pins and retaining clips to fasten the auxiliary boom of the Three-Phase Power Arm in place on the back of the main Power Arm boom with supplied pins.
12. Remove the vinyl storage covers and wipe the boom to remove any road dirt that may have accumulated in transit. Clamp the center conductor support bracket to the fiberglass portion of the Power Arm and install the keepers supplied. Repeat for two additional conductor support boom clamps as required.
13. Install two end pivot conductor supports and one adjustable boom clamp with a conductor support, or up to three adjustable boom clamps with conductor supports(if required) and space according to the conductors which are to be supported. Tighten the over center clamps with the conductor supports to the fiberglass boom and ensure that the retaining spring clips are installed.
14. Raise the crane boom to suitable angle and extend the crane boom to the required elevation and unfold the Three-Phase Power Arm so that it is in the same plane as the conductors.
15. Remove and store the Three-Phase Power Arm by reversing the above procedure.

Inspection of the Power Arm

- Inspect fiberglass components for cleanliness and any visible damage such as scratched, cracked or chipped gelcoat. Surface irregularities may trap dirt and contaminants which may reduce the dielectric properties of the fiberglass boom.
- Search for signs of looseness or movement at the bond areas at the mounting end of the fiberglass booms.
- Visually inspect all visible welds and metal joints on the jib adapter and hydraulic actuator for cracks and evidence of a failed weld or structure member.
- Visually inspect all hydraulic actuator hoses and fittings for leaks, tightness or damage.

Maintaining the Insulation Value of the Power Arm

- Keep the insulated section of the Power Arm clean and dry. Maintain a waxed or silicone surface to repel water. A dry jib with a chalky or non-water repelling surface may pass the dry dielectric test and still fail electrically after a brief shower.
- Keep the Power Arm interior clean and dry. The exterior of the fiberglass jib sections may be washed with mild detergent. After washing and drying, the exterior surface should be waxed or polished, following the manufacturer's instructions. The interior can be washed out with a pressure hose (clean water only), rinse thoroughly, and then dry out by leaving jibs in vertical position or using isopropanol if there is an immediate need to use the Power Arm.
- Ensure that the Power Arm gets an annual scheduled electrical retest.
- Vinyl covers are supplied to prevent road salt and road wash from contaminating the insulated portions of the unit. They can also prolong the life of the insulated booms by protecting them from the ultraviolet rays of the sun. Use the supplied jib covers or store them in a canvas bag.

Live-Line Maintenance with the Power Arm

1. Before using the Three-Phase Power Arm to support energized conductors, a check shall be made of: (1) The voltage rating of the circuit on which the work is proposed, (2) the distances from energized parts to ground potential and to other energized phases, and (3) the voltage limitations of the equipment intended to be used.
2. The circuit to be worked shall be placed on Non-Test.
3. The crane boom truck must be set up according to manufacturer's specifications.
4. The crane boom truck must be grounded before lifting the boom.
5. The crane boom truck and Three-Phase Power Arm shall be inspected according to manufacturer's instructions.
6. The Three-Phase Power Arm shall be mounted and cleaned according to the manufacturer's instructions.
7. Only Certified and qualified crane operators shall operate the crane boom truck and Three-Phase Power Arm controls.
8. Before moving the Three-Phase Power Arm into the work position, all controls shall be checked for proper working order. The crane boom and Power Arm should be lifted and moved through all intended ranges of motion and observed for stability before engaging or lifting energized conductors.
9. Minimum Working Distances between energized parts and all other electrical potentials shall be maintained by the Equipment Operator and workers in the air at all times. The only portion of the unit which is dielectrically insulated in the Three-Phase Power Arm is from above the steel pivot joint of the fiberglass boom toward the free end of the boom.
10. No portion of the insulated boom section of the Power Arm is permitted to be less than phase to ground MWD from an external ground potential part, or from any grounded lower crane sections.
11. No portion of the grounded crane sections are permitted closer than MWD to an energized conductor.
12. No portion of a workman, tools, crane or insulating section of the Power Arm is permitted within minimum phase to phase MWD.
13. All energized conductors shall be securely controlled in Power Arm insulator attachments before untying or unpinning from structure insulators.
14. The conductors can only be moved away from a structure to create adequate safe working distance by booming up.
15. All due care must be exercised while moving energized conductors from and to a structure.

Safety Precautions

- Failure to operate, inspect, clean, maintain, or to repair the Three-Phase Power Arm in accordance with the manufacturer's instructions can result in equipment failure and serious personal injury.
- Modifications of this equipment from the original design and specification without written permission from the manufacturer are strictly prohibited.
- Work operations shall be suspended immediately upon indication of a malfunction in the equipment.
- The boom truck shall be properly grounded and barricaded when in use.
- Ground personnel should always consider the boom truck energized while engaged in lifting energized conductors.
- The rotary actuator that keeps the Power Arm level is designed to carry rated load capacity only. The load must be supported or suspended by the conductor holders or lifting rings. Lifting material from any other portion of the Power Arm places excessive loads on the fiberglass boom.
- Side loading of the Power Arm must be avoided. Side loading may result in damage to the crane boom or Three-Phase Power Arm structure or the rotation system and may reduce the vehicle stability. The crane boom and Three-Phase Power Arm should be rotated to lift conductors perpendicular to the line only. The Power Arm is not designed for any side loading.
- Contact of either the crane boom or Three-Phase Power Arm with a fixed object, followed by continued movement, can cause the entire unit to upset.
- Firm contact of either the crane boom or the Three-Phase Power Arm with a fixed object, followed by a sudden release of pressure when the crane boom or Power Arm slides off the fixed object, will cause an unexpected and violent movement to the unit. This movement can cause the connected live conductors to come loose and fall, causing serious personal injury.
- The crane boom and the Three-Phase Power Arm will be damaged by attempting to lift or support weights in excess of the manufacturer's rating.

- Use the load charts provided with the machine and in the Operator's manual to determine the operating area for the Three-Phase Power Arm.
- Do not move the vehicle unless the crane boom is securely stored in its saddle and the Three-Phase Power Arm is secured to the deck or below the crane boom. If the boom is allowed to bounce or vibrate the fiberglass Power Arm may be damaged and eventually weaken beyond repair.