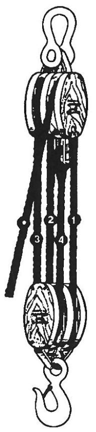
THE REEVING OF TACKLE BLOCKS

In reeving a pair of tackle blocks, one of which has more than two sheaves, the hoisting rope should lead from one of the center sheaves of the upper block.

When so reeved, the hoisting strain comes on the center of the blocks and they are prevented from toppling, with consequent injury to the rope by cutting across the edges of the block shell.

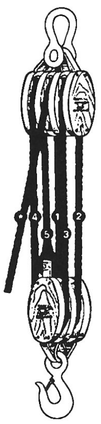
To reeve by this method, the two blocks should be placed so that the sheaves in the upper block are at right angles to those in the lower one, as shown in the following illustrations. Start reeving with the becket, or standing end, of the rope.

FIGURE 1



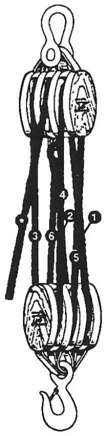
DOUBLE AND DOUBLE

FIGURE 2



TRIPLE AND DOUBLE

FIGURE 3



TRIPLE AND TRIPLE

FIGURE 4

QUADRUPLE AND TRIPLE

It is good practice to use a shackle block as the upper one of a pair and a hook block as the lower one. A shackle would prevent any accidental disengagement of the block from its attaching point in the event of an unusual movement of the attaching point or the block. The lower block having a hook is more readily attached or detached from the load. See Figures 1 through 5.

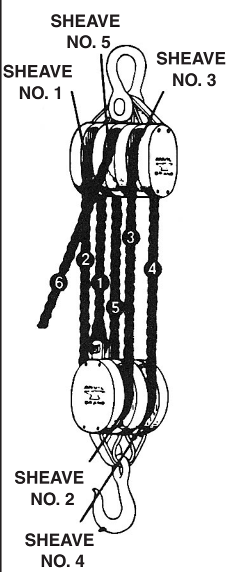
VARYING SHEAVE REVOLUTIONS IN A PAIR OF TACKLE BLOCKS

To raise a load one foot the lower block must be raised one foot, and in accomplishing this, each working rope must be shortened one foot.

In the example above, Ropes 1, 2, 3, etc., must be shortened one foot to raise the load one foot. Assuming that the circumference of each sheave is one foot, Sheave No. 1 must make one revolution to shorten Rope No.1; Sheave No. 2 must make one revolution to take up the one foot slack from Rope No. 1 and one additional revolution to shorten Rope No. 2; Sheave No. 3 must make two revolutions to take up the two feet of slack from Ropes 1 and 2 and one additional revolution to shorten Rope No. 3, etc. for each succeeding sheave.

Viz: Rope No. 1 must travel one foot on Sheave No. 1.
Rope No. 2 must travel two feet on Sheave No. 2.
Rope No. 3 must travel three feet on Sheave No. 3.
Rope No. 4 must travel four feet on Sheave No. 4.
Rope No. 5 must travel five feet on Sheave No. 5.

FIGURE 5



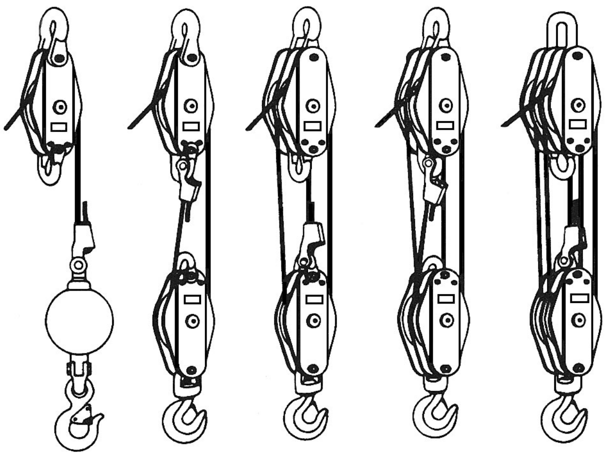
Therefore all the sheaves in a set of blocks revolve at different rates of speed. Sheave No. 2 rotates twice as fast as No. 1, Sheave No. 3 rotates three times as fast as No. 1, Sheave No. 4 four times as fast as No. 1, etc. Consequently the sheaves nearest the lead line, rotating at a higher rates of speed, wear out more rapidly.

All sheaves should be kept well lubricated when in operation to reduce friction and wear.

HOW TO FIGURE LINE PARTS

Number of Parts of Line	Ratio for Bronze Bushed Sheaves	Ratio for Anti-Friction Bearing Sheaves
1	.96	.98
2	1.87	1.94
3	2.75	2.88
4	3.59	3.81
5	4.39	4.71
6	5.16	5.60
7	5.90	6.47
8	6.60	7.32
9	7.27	8.16
10	7.91	8.98
11	8.52	9.79
12	9.11	10.6
13	9.68	11.4
14	10.2	12.1
15	10.7	12.9
16	11.2	13.6
17	11.7	14.3
18	12.2	15.0
19	12.6	15.7
20	13.0	16.4
21	13.4	17.0
22	13.8	17.7
23	14.2	18.3
24	14.5	18.9

To help figure the number of parts of line to be used for a given load or the line pull required for a given load, the following ratio table is provided with examples of how to use it:



USING THE RATIO TABLE RATIO FORMULA

$$\frac{\text{TOTAL LOAD TO BE LIFTED}}{\text{SINGLE LINE PULL IN POUNDS}} = \text{RATIO}$$

Example:

To find the *number of parts of line* needed when weight of load and single line pull is established.

Sample Problem:
72,480 lbs. (load to be lifted)
8,000 lbs. (single line pull) = 9.06 RATIO

Refer to ratio 9.06 in table or number nearest to it, then check column under heading "Number of Parts of Line" . . . 12 parts of line to be used for this load.

Example:

To find *single line pull* needed when weight of load and number of parts of line are established.

Sample Problem:
68,000 lbs. (load to be lifted)
6.60 (ratio of 8 part line)
= 10,300 lbs. (single line pull)

10,300 lbs. single line pull required to lift this load on 8 parts of line.

LOADS ON BLOCKS

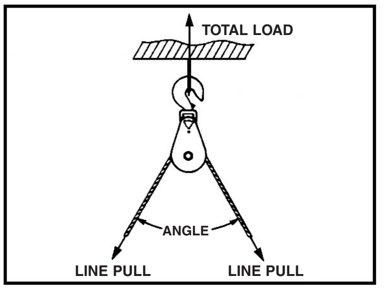
The Rated Load Values for blocks shown in Crosby Group literature are shown as "Working Loads," "Safe Working Loads" and "Resultant Safe Working Load"; and all these terms are defined as the maximum amount of total load that should be exerted on the block and its fitting, the fitting being a hook, shackle, eye, loop, etc.

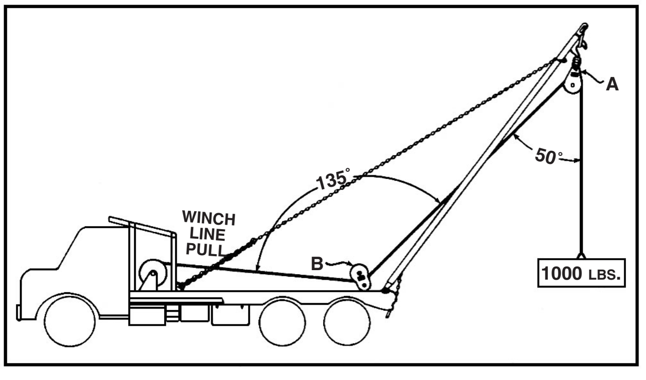
It must be recognized that this total load value MAY BE DIFFERENT than the weight being lifted or pulled by a hoisting or hauling system and, therefore, it is necessary to determine the total load being imposed on each block in the system in order to properly determine the rated capacity block to be used.

A single sheave block that is used to change direction of a load line can be subjected to total loads GREATLY DIFFERENT than the weight being lifted or pulled. The amount of total load changes with the angle between the incoming and departing lines to the block.

The following chart indicates the factor that is multiplied by the line pull to obtain the total load on the block:

Angle	Factor	Angle	Factor	Angle	Factor
0˚	2.00	60˚	1.73	130˚	.84
10˚	1.99	70˚	1.64	135˚	.76
20˚	1.97	80˚	1.53	140˚	.68
30˚	1.93	90˚	1.41	150˚	.52
40˚	1.87	100˚	1.29	160˚	.35
45˚	1.84	110˚	1.15	170˚	.17
50˚	1.81	120˚	1.00	180˚	.00





EXAMPLE: A gin pole truck being used to lift a weight of 1,000 lbs.

There is no mechanical advantage to a single part load line system, so, winch line pull is equal to 1,000 lbs. or the weight being lifted.

Total load on snatch block shown as A equals 1,000 lbs. times angle factor for 50˚.

Total load on A = 1000 x 1.81 = 1,810 lbs.

Total load on toggle block shown as B equals 1,000 lbs. times angle factor for 135˚.

Total load on B = 1000 x .76 = 760 lbs.

EXAMPLE: Hoisting system using a traveling block to lift a weight of 1,000 lbs.

The mechanical advantage at the traveling block C is 2 because 2 parts of a load line support the 1,000 lbs. weight; so, the line pull equals the 1,000 lbs. divided by 2 or 500 lbs.

Total load on traveling block shown as C equals 500 lbs. times angle factor for 0˚.

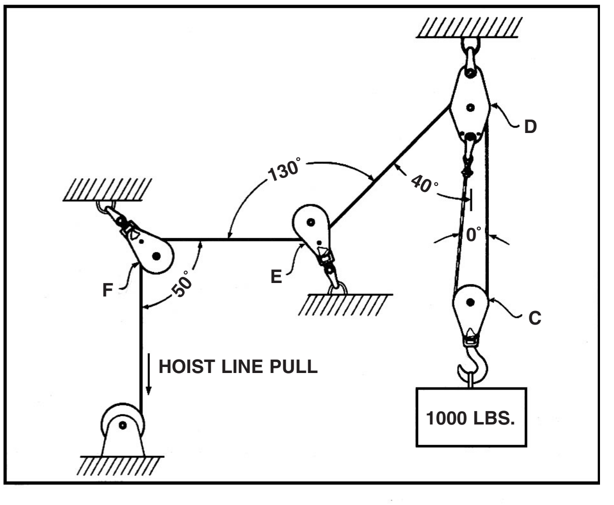
Total Load on C = 500 x 2.00 = 1,000 lbs.

Total load on stationary block shown as D equals the dead end load of 500 lbs. plus the line pull of 500 lbs. times the angle factor for 40˚.

Total Load on E = 500 x .84 = 420 lbs.

Total load on block shown as F equals 500 lbs. times the angle factor for 90˚.

Total Load on F = 500 x 1.41 = 705 lbs.



DEFINITIONS OF TERMS

Abrasion: The mechanical wearing of surface resulting from frictional contact with materials or objects.

Breaking Strength: That total force (lbs. or kg.) at which the sling fails. The total weight strain which can be applied before failure. Usually at five times the rated capacity.

Competent Person: A person designated for inspection who is trained, qualified by knowledge and practical experience and the necessary instructions to enable the required test or examination to be carried out.

Twin-Path® Core: The load bearing multiple fibers of polyester, aramids, or K-Spec® which when wound into the seamless tubes become the load bearing yarns of the sling. If other materials are used follow the manufacturers recommendations.

Twin-Path® Cover: The seamless tubes, usually at least two separate and contrasting colors for easier inspection that contain the cores. Covers may be of polyester, Covermax® nylon, or aramids depending on the desired finished characteristics of the product.

Elongation: The measurement of stretch, expressed as a percentage of the finished length.

Fitting: A load bearing metal component which is fitted to the sling. Can be of steel, aluminum or other material that will sustain the rated capacity of the sling.

Hitch/Vertical: A method of attachment whereby the sling extends from the crane hook to the load in a straight connection.

Hitch/Choker: The sling is passed around the load and back through itself and is connected to the crane hook. The sling then tightens around the load when it is strained.

Hitch/Basket: The sling is passed from the crane hook around the load and attached to the crane hook.

Length: The distance between bearing points of the sling.

Proof Load Test: A non-destructive load test usually to twice the rated capacity of the sling.

Synthetic Fiber: Man-made material used for the cover, the core and the thread of the Twin-Path® sling products.

Tattle-Tails: Tell-Tails which extend past the tag area of each sling. Extension of the load core yarns. When the sling is stretched beyond its elastic limit, they shrink and eventually disappear under the tag. Take out of service if less than 1/2˝ is exposed.

Thread: The synthetic yarn which is used to sew the sling covers and tag and to provide the stitch which separates the individual load cores.

Twin-Path® Sling: A patented and trademarked product which is composed of two separate load cores and two contrasting color covers.

DEFINITIONS

RATED LOAD VALUE-RATED CAPACITY	The maximum recommended load that should be exerted on the item. The following terms are also used for the term Rated Load: "SWL," "Safe Working Load," "Working Load," "Working Load Limit," and the "Resultant Safe Working Load." All rated load values, unless noted otherwise, are for in-line pull with respect to the centerline of the item.
PROOF LOAD	The average load to which an item may be subjected before visual deformation occurs or a load that is applied in the performance of a proof test.
PROOF TEST	A term designating a tensile test applied to the item for the sole purpose of detecting injurious defects in the material or manufacture.
ULTIMATE LOAD	The average load at which the item is being tested fails or no longer supports the load.
SHOCK LOAD	A resulting load from the rapid change of movement, such as impacting or jerking, of a static load. A Shock Load is generally significantly greater than the static load.
DESIGN FACTOR	An industry term denoting theoretical reserve capability. Usually computed dividing the catalog stated ultimate load by the catalog stated working load limit and generally expressed as a ratio, for example 5 to 1.

CAUTIONS OR WARNINGS

All ratings shown in this literature are based upon the items being new or "in as new" condition. Catalog ratings are considered to be the greatest load that should be applied to the item; therefore, any shock loading must be considered when selecting the item for use in a system.

The products shown in this literature are subject to wear, misuse, overloading, corrosion, deformation, intentional alteration and other usage factors which may necessitate a reduction in the products Rated Capacity or a reduction in its Design Factor. Therefore, it is recommended that all products be regularly inspected to determine their condition as a basis for deciding if the product may continue to be used at the catalog assigned. WL, a reduced WL, a reduced design factor, or removed from service.

SUMMARY OF COMMON CONVERSIONS

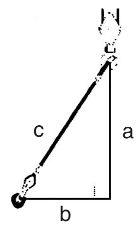
FACTORS

If you know:	Multiply by:	To find:
inches	25.4	millimeters (mm)
inches	2.54	centimeters (cm)
feet	0.30	meters (m)
yards	0.9144	meters (m)
miles	1.61	kilometers (km)
millimeters	.0394	inches
centimeters	.39	inches
meters	3.28	feet
meters	1.09	yards
kilometers	.62	miles
metric tons	1.102	U.S. tons
U.S. tons	.9072	metric tons
kilograms	2.204	pounds
pounds	.453	kilograms
metric tons	2204.62	pounds
metric tons	1000.0	kilograms
Fahrenheit (temp.)	5/9 (after subtracting 32)	Celsius (temp.)
Celsius (temp.)	9/5 (then add 32)	Fahrenheit (temp.)

DECIMAL / METRIC EQUIVALENT TABLE

FRACTION (IN.)	DECIMAL (IN.)	METRIC (MM.)
1/16	.0625	1.588
1/8	**.1250**	**3.175**
3/16	.1875	4.762
1/4	**.2500**	**6.350**
5/16	.3125	7/938
3/8	**.3750**	**9.525**
7/16	.4375	11.112
1/2	**.5000**	**12.700**
9/16	.5625	14.288
5/8	**.6250**	**15.875**
11/16	.6875	17.462
3/4	**.7500**	**19.050**
13/16	.8125	20.638
7/8	**.8750**	**22.225**
15/16	.9375	23.812
1	**1.0000**	**25.400**

Finding the Hypotenuse

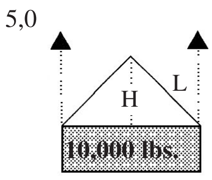


To find c (hypotenuse)

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

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

Load Angle Factors



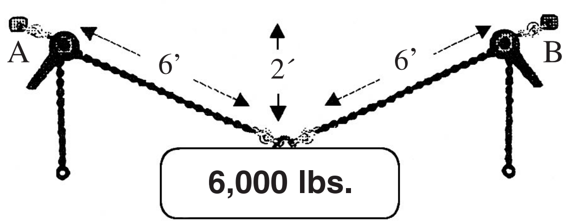
H = 10´ L = 15´

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

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

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

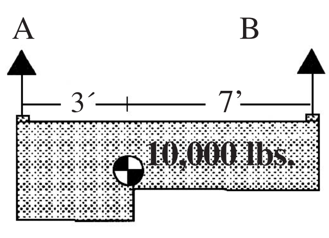
Tension in Overhead Hoists



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

(As load moves tension changes)

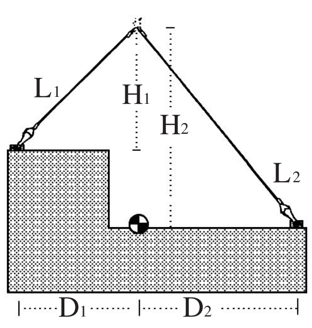
Off-set Center of Gravity (Share of the Load)



Inverse Proportion To Distance

Lift Point A	Lift Point B
7 + 3 = 10, $\frac{\quad}{10}$ = .70	7 + 3 = 10, $\frac{\quad}{10}$ = .30
.70 x 10,000 = 7,000 lbs.	.30 x 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
- L_1 = Length Leg 1
- L_2 = Length Leg 2
- H_1 = Vertical Height 1
- H_2 = Vertical Height 2
- D_1 = Horizontal Distance 1
- D_2 = Horizontal Distance 2

Materials and Liquids – Pounds / cu. ft.			
Aluminum	165	Granite	96
Asbestos	153	Iron Casting	450
Asphalt	81	Lead	710
Brass	524	Limestone	95
Brick, Soft	100	Lumber – Fir	32
Brick, Medium	115	Lumber – Oak	62
Brick, Hard	130	Lumber – RR Ties	50
Bronze	534	Marble	95
Coal	56	Oil, Motor	60
Concrete, Reinforced	150	Paper	58
Copper	556	Portland Cement, Loose	94
Crushed Rock	95	Portland Cement, Set	183
Diesel	52	River Sand	120
Dry Earth, Loose	75	Rubber	94
Dry Earth, Packed	95	Steel	490
Gasoline	45	Water, Fresh	63
Glass	160	Zinc	437

Materials – Pounds / sq. ft.			
Steel Plate		Aluminum Plate	
1/8″	5	1/8″	1.75
1/4″	10	1/4″	3.50
1/2″	20	1/2″	7.00
3/4″	30	3/4″	10.50
1″	40	1″	14.00

Formulas and Information

H = Height **W** = Width **L** = Length **d** = diameter **r** = radius (1/2 dia.)
π = 3.14 (rounded 3.15) [area of a square or rectangle = HW]
[Vol of cube = HWL] [Circumference of circle = πd] [area of a circle = πr^2
or the approximate are of a circle = 80% of the dia^2 (dia x dia x .80)]