# Engineering Data & Design

**Horsepower —** equals 33,000 foot pounds per minute, or 550 foot pounds per second. In terms of chain load and speed.

$$HP = \frac{\text{Working Load x Ft. Per Min.}}{33,000}$$

$$\text{or } HP = \frac{\text{Working Load x T x P x R.P.M.}}{396,000}$$

Where T = number of sprocket teeth
P = chain pitch

**Chain Working Load —** when the horsepower input is known and the chain working load is desired, this can be calculated as follows:

$$\text{Working Load} = \frac{\text{HP x 33,000}}{\text{Ft. Per Min.}}$$

$$\text{or} = \frac{\text{HP x 396,000}}{\text{T x P x R.P.M.}}$$

**Chain Speed —** can be determined from the following formula:

$$\text{Chain Speed (Ft. Per Min.)} = \frac{\text{T x R.P.M.}}{K}$$

where T = number of sprocket teeth

Constant K (Pitches of Chain Per Foot)

| PITCH | 3/8″ | 1/2″ | 5/8″ | 3/4″ | 1″ | 1 1/4″ | 1 1/2″ | 1 3/4″ | 2″ | 2 1/2″ | 3″ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| K | 32 | 24 | 19.2 | 16 | 12 | 9.6 | 8 | 6.85 | 6 | 4.8 | 4 |

## Approx. Wt./Ft. of Standard Roller Chain

| Number | Single | Double | Triple | Quadruple |
|---|---|---|---|---|
| 25 | .08 | .18 | .27 | .35 |
| 35 | .23 | .46 | .69 | .92 |
| 41 | .28 | — | — | — |
| 40 | .41 | .82 | 1.23 | 1.64 |
| 50 | .69 | 1.38 | 2.07 | 2.76 |
| 60 | 1.04 | 2.08 | 3.12 | 4.16 |
| 80 | 1.77 | 3.54 | 5.31 | 7.08 |
| 100 | 2.59 | 5.18 | 7.77 | 10.36 |
| 120 | 4.05 | 8.10 | 12.15 | 16.20 |
| 140 | 5.10 | 10.20 | 15.30 | 20.40 |
| 160 | 6.85 | 13.70 | 20.55 | 27.40 |
| 180 | 9.30 | 18.20 | 27.20 | 36.30 |
| 200 | 10.20 | 21.00 | 31.50 | 42.00 |
| 240 | 16.90 | 33.40 | 50.00 | 66.50 |

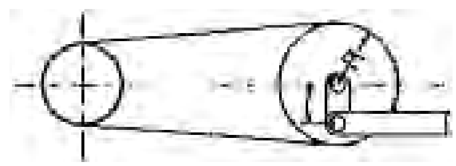
**Factor of Safety —** is determined as follows:

$$F.S. = \frac{\text{Chain Ultimate Strength}}{\text{Chain Working Load}}$$

**Shaft Torque —** Ordinarily is greater for the driven shaft than for the driving shaft due to the difference in sprocket sizes and R.P.M. Torque is usually expressed in inch pounds.

$$\text{Torque (Driving Shaft)} = \frac{\text{HP x 63,000}}{\text{R.P.M}}$$

$$\text{Torque (Driven Shaft)} = \text{Working Load} \times R$$



Where a crank arm is used the load transmitted by the arm can be determined as follows:

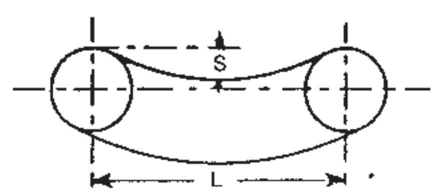
$$\text{Crank arm Load} = \frac{\text{Driven Shaft Torque}}{r}$$

$$\text{or} = \frac{\text{Chain Working Load x R}}{r}$$

**Catenary Tension —** imposed by reason of the weight of chain can be approximated as follows:

$$\text{Catenary Tension} = \frac{W \times L_2}{8 \times S} + (W \times S)$$

where W = weight of chain (lbs. per ft.)
S = chain sag (feet) = 2% to 3% of shaft centers approx.
L = Shaft centers in feet.



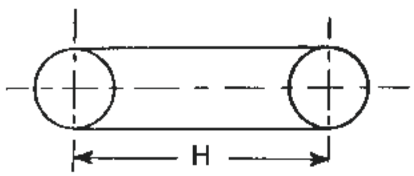
# Engineering Data & Design

## Conveyor Chains

Chains used in the design of conveyors should be selected on the basis of the **chain pull** imposed by the application and the permissible or **maximum working load** of the chain.

In some instances a larger pitch chain than is necessary may be selected due to the desired attachment spacing, and the effect in this case would be to increase the life of the conveyor.

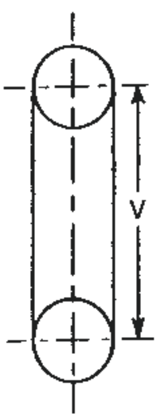
**HORIZONTAL CONVEYORS**




Total pull of chains = f H (W + P)

NOTE: When lower strand of conveyor drags on runway above formula becomes f H (W + 2P).

**VERTICAL CONVEYORS**




Total pull of chains = V (W + P)

H (feet) = Horizontal projection of conveyor length.

V (feet) = Vertical projection of conveyor length.

W (pounds) = Weight of material handled per foot of conveyor length.

P (pounds) = Weight per foot of all moving conveyor parts (single or two strand).

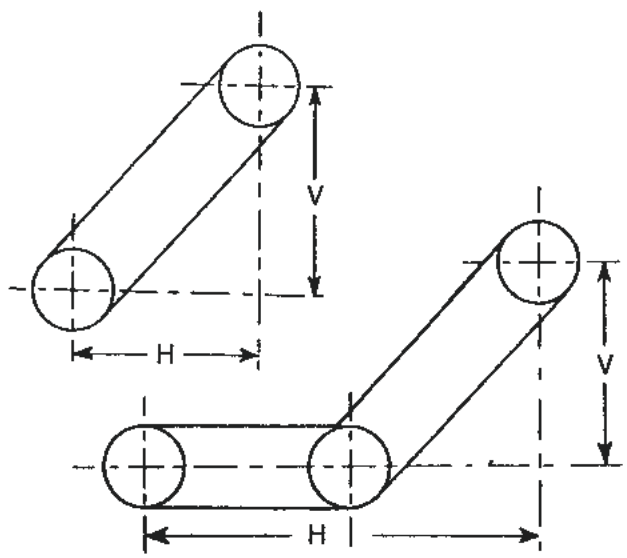
f = Coefficient of friction of chain on runway.

## Chain Pull

The force or pull required to move a conveyor includes the pull necessary to move the weight of chain and material and the frictional resistance of the chain parts on the runways. The following formulas may be used in calculating the total chain pull. The same formula applies in the case of single or parallel strand chain conveyors, but in the case of parallel strand conveyors, the pull per chain is one-half of the figure calculated from the formula.



**INCLINED CONVEYORS**




Total pull of chains = f H (W + P) + V (W + P)

NOTE: When lower strand of conveyor drags on runway the factor P (f H – V) should be added to above formula unless V is greater than f H.

## Value of Coefficient F

Sliding steel on iron or steel ............................................25%
Rolling friction ...................................................................15%

(If material or other than the usual chain parts are in contact with the runway, the coefficient should be increased to compensate for the added resistance.)

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SPROCKETS

## Chain Drive Selection

***Step 1:***

Prime Driver: ______ Type & Description ______ Rated - H.P. ______ R.P.M.

Driven Comp: ______ Type & Description ______ R.P.M. ______ Hours/Day

Center Distance: ______″ Maximum ______″ Minimum ______″ Nominal

***Step 2:*** ______ Service Classification (Step I Page E-162)

***Step 3:*** ______ Service Factor (Include additions to basic factor) (Step II Page E-162)

***Step 4:*** Determine Design H.P. ______ H.P. × ______ Service Factor = ______ H.P. Design

***Step 5:*** Speed Ratio ______ RPM Faster Shaft ÷ ______ RPM Slower Shaft = ______ Ratio (E-172)

***Step 6:*** From selector chart, select proper chain pitch & driver sprocket. (check Martin Catalog page E-184)

A. ______ Chain Pitch B. ______ Driver Sprocket ______ Maximum Bore (Pages E-16 thru E-112)

***Step 7:*** From ratio chart, select proper driven sprocket.

C. ______ Driven Sprocket ______ Maximum Bore

***Step 8:*** Check manufacturer's catalog for maximum bore recommended & final stock selection. (Pages E-16 thru E-112)

***Step 9:*** Review Horsepower table for type of lubrication required.

| | | | | | |
|---|---|---|---|---|---|
| | TYPE: | A | B | C | (Pages E-161 and E-186 thru E-192) |
| OR | TYPE: | 1 | 2 | 3 | (Pages E-191 and E-192) |

***Step 10:*** ______ Center Dist. (inches) ÷ ______ Chain Pitch ______ Center Dist. (pitches)

***Step 11:*** Formula for chain length

$$= 2C + \frac{N+n}{2} + \frac{A}{C}$$

Where:

| | | |
|---|---|---|
| C | = | Center Dist. in pitches |
| N | = | Number of teeth in Driven Sprocket |
| n | = | Number of teeth in Driver Sprocket |
| A | = | Value from table tabulated for N - n values |