## Shaft Selection

**Important factors to consider when calculating shaft size**

(a) shafting is subject to a **bending moment** and a **torsional moment.**

(b) bending moment is that force which tends to **bend** a shaft.

(c) torsional moment is that force which tends to **twist** a shaft.

(d) shaft size is determined by the **combined action** of the bending and torsional moments.

Refer to Shaft Selection Charts 2 and 3 developed by the American Society of Mechanical Engineers to simplify selection. The charts should be used in conjunction with Service Factors (Table 1) to modify the selection for conditions under which the shaft will operate.

L = Unbalanced load in pounds

W = Suspended weight of elevator (chain, buckets, etc.) in pounds

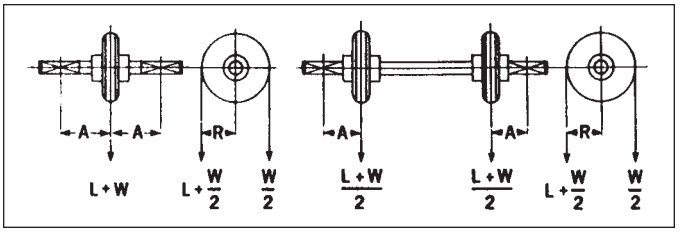
R = Radius of wheel in inches

B = Bending moment

T = Torsional moment

$B = A \frac{L + W}{2}$ inch pounds

T = R x L inch pounds




## Selection Procedure

1. compute the Bending Moment from the above formula.
2. determine the Service Factor for bending that will suit conditions from Table 1.
3. compute the Torsional Moment from the above formula.
4. determine the Service Factor for torsion that will suit conditions from Table 1.
5. draw a horizontal line across Selection Chart 2 or 3 on pages L-10 and L-11, from the point where the **torsional moment intersects** its selected Service Factor line.
6. draw a vertical lineup Selection Chart 2 or 3 from the point where the **bending moment intersects** its selected factor line.
7. intersection of above lines will give required shaft size.
8. for shafts not weakened by keyways, multiply the shaft size obtained by .91 for the corrected shaft size. See note at the bottom of Selection Chart 3.

Horsepower required may be computed directly from the right-hand side of Selection Charts by correcting the figure in line with the horizontal torsional moment line by the speed in RPM.

## Table 1 • Service Factors

| Type of Loading | Service Factor | |
|---|---|---|
| | For Bending | For Torsion |
| Stationary Shafts – | | |
| Gradually applied loads | 1.0 | 1.0 |
| Suddenly applied loads | 1.5 to 2.0 | 1.5 to 2.0 |
| Rotating Shafts – | | |
| Gradually applied or steady loads | 1.5 | 1.0 |
| Suddenly applied loads – | | |
| Minor shock only | 1.5 to 2.0 | 1.0 to 1.5 |
| Suddenly applied loads – | | |
| Heavy shock | 2.0 to 2.5 | 1.5 to 2.5 |

## Selection Example:

Select shaft size for head shaft of chain conveyor subject to following requirements:

(a) Torsion (inch/lbs) — 20,500
(b) Bending moment (inch/lbs) — 13,300
(c) Service Factors:
torsion — 1.0
bending — 1.5

At the extreme left on Selection Chart 2, the torsion moment may be found for the Service Factor of 1.0. Draw a horizontal line to the right from the 20,500 point. The bending moment is given at the bottom of the chart. Find the 13,300 point; draw a line from this point to the right on the diagonal until it intersects the 1.5 Service Factor line, then project the line upward vertically until it intersects the horizontal line drawn from the 20,500 torsion point. At this intersection point, it is found that a shaft of approximately $2^{13}/_{16}$″ diameter is required.

Select the nearest standard size shaft which is $2^{15}/_{16}$″.

For a shaft subjected to the same conditions, but not weakened by keyways, the size of the shaft required would be (.91 x 2.8125) or 2.56 ($2^{9}/_{16}$″). See note at the bottom of the charts.

On this same chart at the right, the horsepower ratings at 100 RPM are given based on the formula:

$HP = \frac{TS}{63{,}000}$

T = Torque in inch-pounds
S = Speed in RPM
The horsepower is directly proportional to the speed of the shaft in RPM.