

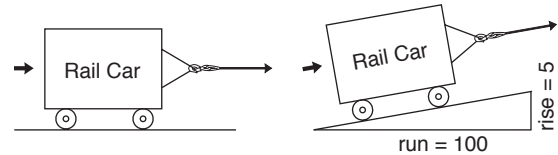
LINE PULL CALCULATIONS RAIL CAR PULLING

Rail Car Pulling Calculations

Calculating Line Pull

Line pull must be calculated by accounting for track curvature, track slope, and ambient temperature. Line pull may be roughly estimated from the tables and diagrams on this page, assuming the track is smooth, clean and in good condition and rail car wheels are well lubricated

We recommend that you have your rail car pulling application carefully reviewed by the factory or a qualified sales person before selecting a winch.



The amount of line pull due to slope is dependent on the percent of slope, calculated as follows:

$$\text{slope as percent} = (\text{rise} \div \text{run}) \times 100$$

$$\text{example: } 5 \div 100 \times 100 = 5\%$$

Line Pull Required Based on Temperature Effect (lb/ton)

| ambient temp. below 32° F | ambient temp. above 32° F |
|---------------------------|---------------------------|
| 21 | 18 |

Line pull shown is for each 2000 lb of total gross load weight.

Line Pull Required Based on Curvature and Slope (lb/ton)

| Track Curvature | | | Track Grade | | | | | | |
|-----------------|-----------------|--------------------|-----------------|----|----|-----|-----|-----|--|
| radius of curve | degree of curve | chordal distance A | percent of rise | | | | | | |
| | | | 0% | 1% | 2% | 3% | 4% | 5% | |
| 0 ft | 0° | 0 in | 0 | 20 | 40 | 60 | 80 | 100 | |
| 1146 ft | 5° | 3-1/2 in | 5 | 25 | 45 | 65 | 85 | 105 | |
| 573 ft | 10° | 6-1/2 in | 10 | 30 | 50 | 70 | 90 | 110 | |
| 388 ft | 15° | 9-3/4 in | 15 | 35 | 55 | 75 | 95 | 115 | |
| 288 ft | 20° | 13 in | 20 | 40 | 60 | 80 | 100 | 120 | |
| 231 ft | 25° | 16-1/2 in | 25 | 45 | 65 | 85 | 105 | 125 | |
| 193 ft | 30° | 20 in | 30 | 50 | 70 | 90 | 110 | 130 | |
| 166 ft | 35° | 23-1/5 in | 35 | 55 | 75 | 95 | 115 | 135 | |
| 146 ft | 40° | 27 in | 40 | 60 | 80 | 100 | 120 | 140 | |

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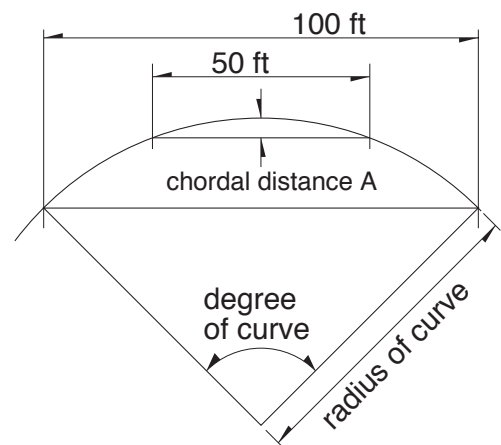
Example: 2 loaded rail cars weighing 120 gross tons each are pulled 800 ft on a track with a curvature of 5° and a slope of 2%. The track is in good clean condition, wheels are well lubricated, and the ambient temperature is frequently below 32° fahrenheit.

From Table 1: line pull required based on temperature effect = 21 lb/ton (factor 1)

From Table 2: line pull required based on curvature and slope = 45 lb/ton (factor 2)

Total Line Pull Calculation (Running Pull):

(gross weight per car) x (number of cars) x (factor 1 + factor 2) = total line pull
 (120 tons) x 2 x (21 lb/ton + 45 lb/ton) = (240 ton) x (66 lb/ton) = 15,840 lb (line pull)
 800 ft of travel puts us at mid drum: 4HS16M mid drum running line pull = 11,000 lb
 This application would require a 4HS26M (mid drum running line pull = 19,000 lb)



Curved sections of track place side forces on the load which must be overcome by the winch. The amount of line pull due to track curvature is dependent on the sharpness of the curve.

