

# Winch and Hoist Application Guidelines

## Calculating Line Pull to Move Railcars

### Quick Calculation

To estimate line pull requirements, add appropriate factors below. Allow up to 50% additional line pull for dirty or uneven track.

$$(30 \text{ lbs. Per Ton of Car}) + (20 \text{ lbs. Per 1\% of Grade}) + (20 \text{ lbs. Per Degree of Track Curvature}) = \text{Line Pull}$$

The following guidelines can be used to estimate line pull requirements for railcar moves. As the results are based on calculated values, APPI recommends that actual line pull be measured with a dynamometer as additional line pull may be required given soft ballast, uneven ties, deteriorating ties, debris on track, etc.

#### 1. Calculate the Load

The total weight in tons of all loaded railcars that are to be moved simultaneously, for the maximum number of railcars anticipated to be moved at one time.

#### 2. Calculate the Rolling Resistance

Resistance to rolling is influenced by the condition of the wheel journals, type of journal lubrication, and ambient temperature. Assuming the journals are in good condition and well lubricated, select the running line pull from Table 1.

#### 3. Calculate the Grade Resistance

For each 1% gradient (a rise of 1' for each 100' of track) the running line pull must be increased by 20 lbs/ton.

#### 4. Calculate the Track Curvature Resistance

Select the correct additional running line pull from Table 2, using either radius or degree of curvature. Interpolate for a measure of curvature not shown.

#### 5. Calculate the Total Running Line Pull

Total Running Line Pull = Load X (Rolling Resistance + Grade Resistance + Track Curvature Resistance)

#### Example:

Four railcars each weighing 85 tons fully loaded. The lowest anticipated temperature is 32°F. The track has a 1.5% grade. The track has a chordal factor of 12" over 50'.

$$\begin{aligned} \text{Load} &= 4 \times 85 \text{ tons} = 340 \text{ tons} \\ &= 340 \text{ tons} \times (15 \text{ lbs/ton} + 30 \text{ lbs/ton} + 15 \text{ lbs/ton}) \\ &= 340 \text{ tons} \times 60 \text{ lbs/ton} \\ &= 20400 \text{ lbs.} \end{aligned}$$

**Table 1: Rolling Resistance**

Temperature	Running Line Pull (lbs/ton)
< -20°F (< -29°C)	25
-19°F to 0°F (-28°C to -17°C)	20
1°F to 31°F (-16°C to -1°C)	15
> 32°F (> 0°C)	12

**Table 2: Track Curvature Resistance**

Radius (ft)	Degree of Curvature (degrees)	Additional Running Line Pull (lbs/ton)
1146	5	3.75
573	10	7.50
383	15	11.25
288	20	15.00
231	25	18.75
193	30	22.50
166	35	26.25
146	40	30.00