

MULTIPLE-PART WIRE ROPE REEVINGS

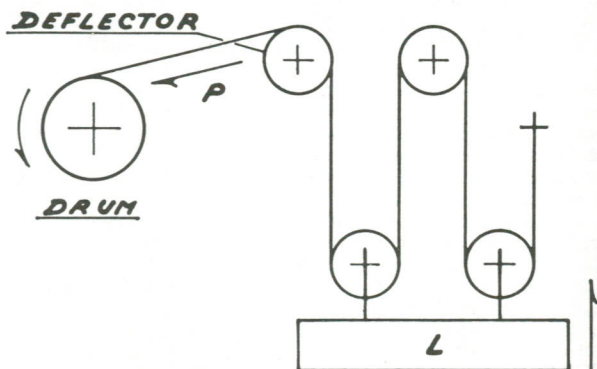
When a load is statically supported by multiple-part wire rope reevings, the load on each rope part is equal to the weight of the load supported, divided by the number of parts of rope supporting the load. But, when a load so supported is raised, the stress in each rope part increases progressively from the dead end to the lead line. This increased stress is due to the cumulative effect of friction in the sheave bearings, and the force required to bend the rope around the sheaves.

Because of this and in order to have equilibrium, those parts of a multiple reeving nearest the hoisting drum will have slightly more than their proportionate load, while those farthest from the drum will have less, and the sum of the stresses in all parts supporting the load will be equal to the load. (The forces of acceleration and retardation are not included in the foregoing discussion.)

The chart illustrates three types of wire rope reevings and a table is appended giving efficiency and lead line pull factors for reevings having from one to fifteen parts of rope.

TYPICAL FOR
TACKLES, CRANES, DERRICKS, BOOMS, ETC.

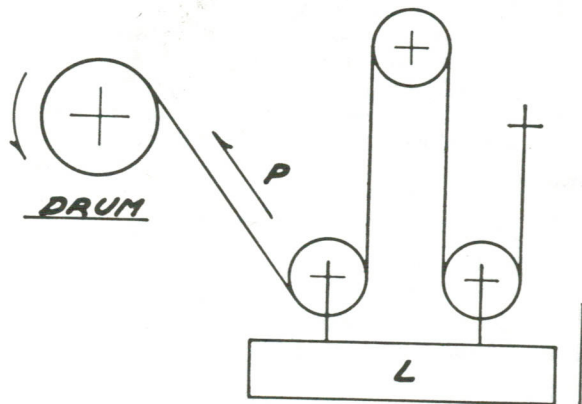
CASE 1



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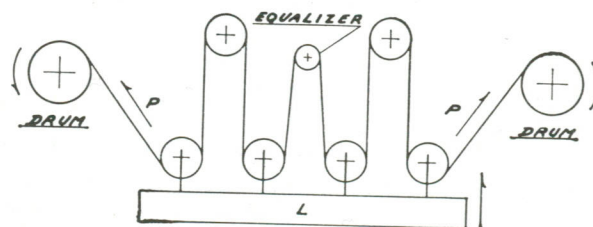
TYPICAL FOR
OVERHEAD HOISTS AND TRAVELING CRANES

CASE 2



Single Drum

CASE 3



Double Drum

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Multiple-part Wire Rope Reeving Cont'd

Nomenclature

- L = Load lifted, lbs.
 N = Number of rope parts supporting load
 S = Number of revolving sheaves in system (including deflectors but not equalizers)
 K = Ratio of stress in rope leading off of sheave to that in rope leading on to sheave
 E = Efficiency of the system
 P = Maximum rope stress, lbs. (occurs on rope part going to the drum, i.e., on the lead line)

Formulae

$$E = \frac{(K^N - 1)}{K^S N (K - 1)} \text{ for single drum systems}$$

$$\frac{2(K^{N/2} - 1)}{K^{S/2} N (K - 1)} \text{ for double drum systems}$$

K = 1.09 for plain bearing sheaves
 1.04 for roller bearing sheaves

$$P = \frac{L}{N \times E}$$

N	PLAIN BEARING SHEAVES K = 1.09						ROLLER BEARING SHEAVES K = 1.04					
	EFFICIENCY			MAX. ROPE STRESS			EFFICIENCY			MAX. ROPE STRESS		
	Case 1	Case 2	Case 3	Case 1	Case 2	Case 3	Case 1	Case 2	Case 3	Case 1	Case 2	Case 3
1	.917	1.000	—	1.090L	1.000L	—	.962	1.000	—	1.040L	1.000L	—
2	.880	.959	1.000	.568L	.522L	.500L	.943	.981	1.000	.530L	.510L	.500L
3	.844	.920	—	.395L	.362L	—	.925	.962	—	.360L	.346L	—
4	.810	.883	.959	.309L	.283L	.261L	.908	.944	.981	.275L	.265L	.255L
5	.778	.848	—	.257L	.236L	—	.890	.926	—	.225L	.216L	—
6	.748	.815	.920	.223L	.204L	.181L	.874	.909	.962	.191L	.183L	.173L
7	.719	.784	—	.199L	.182L	—	.857	.892	—	.167L	.160L	—
8	.692	.754	.883	.181L	.166L	.141L	.842	.875	.944	.148L	.143L	.132L
9	.666	.726	—	.167L	.153L	—	.826	.859	—	.135L	.130L	—
10	.642	.700	.848	.156L	.143L	.118L	.811	.844	.926	.123L	.119L	.108L
11	.619	.674	—	.147L	.135L	—	.796	.828	—	.114L	.110L	—
12	.597	.650	.815	.140L	.128L	.102L	.782	.813	.909	.106L	.101L	.091L
13	.576	.628	—	.133L	.122L	—	.768	.799	—	.100L	.096L	—
14	.556	.606	.784	.128L	.118L	.091L	.755	.785	.892	.095L	.091L	.080L
15	.537	.586	—	.124L	.114L	—	.741	.771	—	.090L	.086L	—

NOTES: 1. For case 1 there may be more than one deflector sheave. For each additional deflector sheave reduce the efficiency factor by: (a) 8% for plain bearing sheaves; (b) 4% for roller bearing sheaves and increase the maximum rope stress

factor by: (a) 9% for plain bearing sheaves; (b) 4% for roller bearing sheaves.

2. Case 3 may be divided at the equalizer and each half of the system can be considered as case 2.

3. The factor "K" accounts for the friction at the sheave and for the resistance of the rope to bending.

The practical application of these charts, tables and formulae can best be illustrated by the following several examples:

Example 1: What is the maximum load that can be handled by a $\frac{3}{4}$ " 6 x 25F PREformed Monarch Whyte Strand rope used as a hoist rope on a derrick when reeved 4 parts over 4 revolving sheaves (case 1)? Sheave bearings are plain and required factor of safety is 5.

Solution: Breaking strength of $\frac{3}{4}$ " 6 x 19 Monarch rope (from catalog) is 47,600 lbs. With a factor of safety of 5, the maximum allowable rope stress = $\frac{47600}{5} = 9520$ lbs. (P).

Number of rope parts supporting load = 4 (N). From table, efficiency of system = 0.810 (E). Substituting these values in the equation:

$$9520 = \frac{L}{4 \times .810}$$

or L (maximum load to be lifted) = $9520 \times 4 \times 0.810 = 30845$ lbs.

Example 2: What is the maximum load that can be handled in the above problem when the rope is reeved over two additional plain bearing deflector sheaves?

Solution: Corrected efficiency $E = 0.810 \times .92 \times .92 = 0.6856$ (See note 1). Therefore "L" (maximum load to be lifted) = $9520 \times 4 \times .6856 = 26100$ lbs.

Example 3: A reel of rope weighing 20,000 lbs. is handled by an overhead traveling crane having case 3 reeving with 8 parts of rope supporting the load and 6 revolving roller bearing sheaves. What is the maximum rope stress? Is $\frac{5}{8}$ " 6 x 36 Warrington Seale PREformed Monarch Whyte Strand rope strong enough if the desired factor of safety is 8.

Solution: From the table, maximum rope stress = $0.132 \times L = 0.132 \times 20,000 = 2640$ lbs.

Breaking strength of $\frac{5}{8}$ " 6 x 37 Monarch rope (from catalog) is 31,600 lbs.

Allowable rope stress, factor of safety of 8 = $\frac{31600}{8} = 3950$ lbs.

Therefore, the $\frac{5}{8}$ " 6 x 36 Warrington Seale PREformed Monarch Whyte Strand rope is suitable for strength.