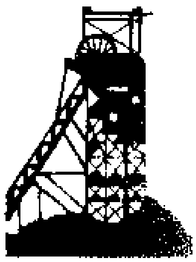
"Haggie Hints"



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Rope Stretch Estimation

DISCUSSION:

Rope Stretch (Elongation) results for a variety of reasons however there are two scenarios listed below that are most commonly monitored.

1. "Constructional" or "Permanent" Stretch is a result of the wires and the strands bedding down.
2. "Elastic" Stretch results when a load is applied to a rope.

Other reasons for rope length change can be:-

- As a result of Thermal expansion/contraction.
- Allowing the end of a "rotating" type rope to be released when suspended.
- Severe corrosion or inter wire nicking.
- If a rope is loaded beyond its yield point.

These are considered unusual situations and except for the effect on a rope due to temperature change, they cannot be predicted.

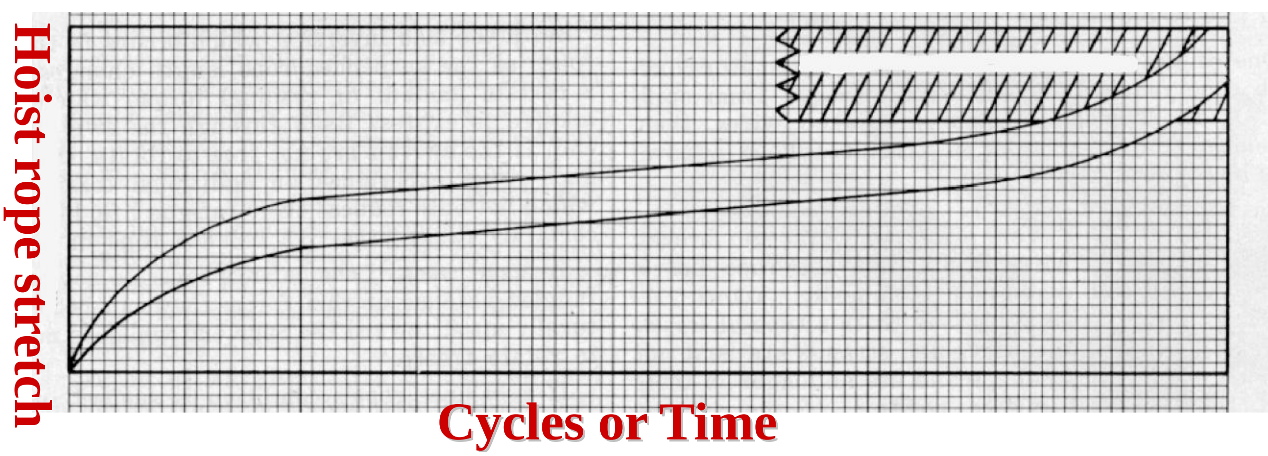
Constructional Stretch:

Constructional stretch takes place almost immediately after a rope is suspended in the shaft and will initially occur at a greater rate.

Most rope constructions are designed with an "over size" tolerance which normally is in the range of 2% to 3-1/2% and as the wires and strands bed down, rope stretch occurs and the rope diameter will approach the nominal value. This stretch is permanent and does not recover but the rate of occurrence will reduce with time and use.

Ropes with galvanized coated wires may stretch slightly more than their bright or non-galvanized counterparts.

The following graph illustrates the normal fashion in which this stretch will occur and shows that most of the stretch or elongation takes place initially. Factors such as load and operating conditions will have an influence on the rate at which it will occur.



As a point of interest, this graph was or is used in some jurisdictions to signal rope removal when the hoist ropes on a Koepe or Friction winder are approaching the end of their life. The majority of the constructional stretch takes place during the initial time in service. Following this, the stretch reduces but in addition to the continuing bedding down, fatigue cracks may start to form throughout the rope. If the application subjects the rope primarily to a fatigue situation, these fissures will start to propagate with the cracks widening which results in a sudden and steady increase in rope stretch. Following this, broken wires will start to occur throughout the rope length.

With conventional drum applications, this sudden increase in stretch is not normally noticed since the ropes are removed from service for reasons other than fatigue i.e. as a result of wear and/or corrosion.

Obviously, ropes with a greater number of wires/strands and with fiber cores will stretch more than a coarser construction. The following formulas can act as a guideline for estimating the amount of Constructional Stretch in a few of the more common rope configurations.

As mentioned, this stretch comes out over time but to simplify the projection, we normally break it down into 3 parts with the "immediate" portion coming out fairly quickly i.e. in about one month depending on working conditions with the remainder occurring at a reduced rate.

Full Locked Coil (FLC)

Immediate = 0.14% of length in the first 25% of estimated rope life
Intermediate = 0.1% of length in the next 60% of rope life
Final = 0.05% of length in the final 15% of rope life

Half Locked Coil (HLC)

Immediate = 0.15% of length
Intermediate = 0.1% of length
Final = 0.05% of length

6 Round or Flattened Triangular Strand ropes with Fiber cores

Immediate = (1.2% ÷ FOS) x length

Intermediate = (0.8% ÷ FOS) x length

Final = (0.04% ÷ FOS) x length

Note – use ⅔ of these values when using ropes with an IWRC.

Conventional Non-Spin ropes

Immediate = 0.4% of length
Intermediate = 0.2% of length
Final = 0.05% of length

34LR Non-Spin Hoist ropes (compacted strands)

Immediate = 0.3% of length
Intermediate = 0.15% of length
Final = 0.05% of length

Elastic Stretch:

When a load is applied to the end of a rope, it will stretch in a fashion that approximates "Hookes Law" i.e. stress is proportional to strain. This applies as long as the yield point, which is approximately 65% of the rope's strength, is not exceeded

Unlike a steel rod, the Modulus of Elasticity of a wire rope is not precise and varies with rope construction. Some formulas used to estimate the amount of stretch requires knowing the actual cross-sectional steel area, however, in the attached "Excel" Spreadsheet, the area is equal to a circle having the same diameter as the rope. The Modulus values have been modified to accommodate the area mentioned.

The Imperial formula is $\Delta L = PL/NEA$

where ΔL = Stretch (inch),
P = Load (lbs),
L = Suspended Rope length (ft)
N = Number of ropes
E = Modulus of Elasticity (PSI)
A = Area of a circle the same diameter as the Rope (in^2)

See the associated "Excel" spreadsheet titled **"Elastic Stretch Calculation 2015"** which will predict the Elastic stretch due to an end load using either Imperial and Metric units.

As with any of these formulas for estimating stretch, the prediction is only an approximation but it is sufficiently accurate for most practical situations.

Thermal Expansion / Contraction:

$\Delta L = L \times \Delta T \times (6.7\times10^{-6})$
where L= rope length in ft and ΔT=change in temperature (^{0}F)

or in Metric $\Delta L = L \times \Delta T \times (12.25\times10^{-6})$
where L= rope length in Meters and ΔT=change in temperature (^{0}C)