Rope Tensioning – A thing of the past!

By Roland Stawinoga/ Fredrick von Maltzahn - CTV (Componentes de Trafico Vertical)

According to EN 81-1 (clause 9.1.3) it is mandatory to have at least 2 suspension ropes on a traction lift. Usually 4 to 12 ropes are employed, which are run over the same traction sheave and divertors. EN81-1 (clause 9.5.1) calls for an automatic device to equalize rope tension, at least at one of their ends. In the vast majority of cases, this is achieved by springs as detailed in EN81-1 (clause 9.5.2). The tendency in design of lifts is increasingly moving away from a few thick ropes with big traction sheaves in a 1:1 suspension configuration, towards many thinner ropes in 2:1 suspension configuration on small traction sheaves; mainly due to space and cost restrictions.

The more ropes we have in a system and the smaller the D/d ratio becomes, the more important it is to ensure the correct load distribution between ropes; and as a result, equal rope tension is of ever increasing importance in order to achieve long lasting cost effective solutions.

The following system related situations can result in rope lenghth differentials:

1. The grooves on traction sheave and divertors should have identical diameters.

   The common tolerance on groove depth can be as much as 0,1 mm. On a 2:1 roped installation with a 320 mm traction sheave diameter with a 180^{o} wrap, the parallel rope elements have a maximum difference in length of 0.314 mm (i.e. 0.1 x π). For a travel of 25 m, we have aproximately 50 revolutions of the sheave, which could produce a length difference of as much as 30 mm. Only a part of this difference is to be absorbed by springs as the rope itself has a „spring“ effect. A spring stroke of 15 mm on the rope anchors will probably compensate this length difference, raising the spring tension on the specific rope in question.

2. If two divertors (or a traction sheave and one divertor) are positioned close to each other the respective axles have to be totally in parallel.

If the axles are not totally in parallel, the rope on one side of the rope groove is travelling a different way than the one on the opposite side. This difference is compensated through slip in the groove.

3. The rope diameters of all ropes shall be as identical as possible.

   To reduce length differences caused by diameter related tolerances, it is important to use adequate lift ropes with reduced tolerances from the same manufacturing batch. If ropes are changed the entire group of ropes should be changed and not just the damaged rope. Whilst roping, all ropes will have to be treated the same way and hung for the same time, etc.

The rope length differences, resulting from the above situations, can be reduced by correct selection and handling: however, all remaining rope length differentials have to be compensated at the hitch points.

If the rope length differences in a rope group are significant, these differences are automatically compensated by partial rope slip in the grooves of some of the ropes. This leads to noise and wear on ropes and sheaves/divertors and the lift requires more energy to operate.

The rope length differences can be observed on the spings of the rope anchors. More compressed springs mean higher tension on the rope. The bending under higher tension of the specific rope will cause more rope and sheave wear than a less tight rope next to it. Therefore it is important to check and adjust if needed the spring tension on the rope anchors on a regular basis. If it becomes apparent over time that the same spring is adjusted again and again, it is likely that there is a system related error, which has to be analysed and corrected; either by changing the damaged traction sheave or changing the roping (rope crossing) and hitching.

The relation of rope tension and rope life can be calculated according to the approach of Feyrer (Stuttgart University). Studies by major European rope manufacturers have shown, that rope life increases significantly when differences of rope tension in a rope group are reduced.

The importance of equal rope tension on elevators, especially on multiple suspension (2:1, 3:1 and 4:1) and on high rise and/or high speed applications is beyond question. It is also becomming increasingly important with the recent tendency in lift system designs to use smaller traction sheaves and larger numbers of smaller diameter ropes. Studies by major European rope manufacturers over recent years have indicated that a 50-60% extension of rope life span can be achieved when ropes are equally tensioned.

Unequal rope tension has three undesired effects; excessive rope wear, excessive sheave wear and noise through slapping or vibrations of lift suspension rope. The first two effects, due to their nature, will undoubtedly have a cost implications for the lift owner or service company (if a fully comprehensive maintenance contract is in place).

Historically, rope tension was checked by the "feel" of the installer, which is more an art/gift than a learned skill. Other methods are also used now, which probably are no more accurate than the traditional tactile method. The entire rope tensioning process is complex, time consuming and due to the fact that it is performed on a static system, the outcome is questionable.

Many articles in the specilist media have analised this serious problem and the industry has responded to the subject by bringing out a broad variety of measuring devices, trying to achieve equal rope tension in lift systems. All these devices on the market share on thing in common; they are all diagnostic and not remedial tools of a "static" state (i.e. the rope tension is diagnosed, whilst the lift is on stationary and adjustment needs to be carried out manually to equal rope tension). This approach has serious limitations, reducing accuracy as, under dynamic conditions with the lift running

through a few traffic cycles with different load conditions, the individual rope tension start to deviate from the recently set ones to worse one. Reeving factors (2:1, 4:1, etc.), high travel and high speed will worsen this deviation considerably. "Static" adjustments also do not allow for natural stretch on installation (ropes are not allowed an equal amount of time to stretch naturally) and constructional rope stretch over time.

Whilst these systems certainly produce better results than by tactile method, they are far from being perfect; still requiring a substantial amount of time, especially on systems that have a large number of ropes. Re-calibrating as often as twice a year on high traffic or high quality installations is inevitable for responsible maintenance companies.

Back in 2008 the first, 100% dynamic rope equalising system named "Balance" was developed in Germany and its patented version presented at the Interlift 2009 in Augsburg, where it raised a great deal of interest, especially on the German market. Since then it has been independently assessed with positive results by lift rope maker PFEIFFER DRAKO as well as by important final clients such as Daimler and BASF on their respective lift portfolios; it is now being specified for their new lifts and major modernisations.

The "Balance" consists of stainless steel rods, continuosly moving in a closed hydraulic maintenance-free system of interconnected cylinders, in a high grade alloy block, which is introduced as a permanent device into any roped lift system. The rope anchors are attached to the

rods and following the basic physical principle of connected vessels, the rope tension is 100% equal under any static and dynamic circumstances, automatically and continously compensating any deviation for the entire life span of the ropes. Time consuming rope tensioning on new lifts or re-ropes as well as time-to-time rope tension checks and retensioning become issues of the past.

The “Balance” is not a diagnostic tool; in fact the exact rope tension value becomes totally secondary as this system rectifies the problem straight away, improving ride comfort, system performance and rope lift expectancy by providing a 100% accurate, continuous monitoring and adjustment process under all circumstances, avoiding costly initial and over time rope tension adjustments and expensive component wear.

The “Balance” system is not the only hydraulic system on the market but the only one that actually remains on the installation to continuously equalise the rope tension automatically under any load, speed, rise and position conditions, obtaining a 100% true rope tensioning throughout any given time, including allowance for rope stretch over time. This cost saving system, charged with biodegradable oil (0,85 l) is maintenance-free and beats any other system available on the market.

Optional slack rope and load weiging devices can be fitted to the “Balance”, taking advantage of an all-in-one solution.

This device is manufacturered exclusively for Vertima/CTV (Componentes de Trafico Vertical) by well-known German manufacturer Walter Mayer, who has a prooven record in hydraulic systems, including the manufacture of hydraulic parts for the aeronautical industry.

“Made in Germany” with the highest level of competence and quality.