Elevator Rope Slippage

For proper operation, the modern mid- and high-rise traction elevators in service today depend on the friction between the hoist ropes and the drive sheave. The cars of these traction elevators are raised and lowered by hoist ropes attached to the car head frame. The ropes wind around the secondary and drive sheaves one or more times, then move down to the counterweight. The elevator cab, with its load, is suspended from one end of the hoist ropes, with the counterweight on the other end. The driving force required to raise and lower the car is solely dependent upon the traction between the ropes and drive sheave.

There are basically four factors which determine and control the driving force of traction elevators: (1) traction ratio, (2) area of contact of hoist ropes on the drive sheave, (3) coefficient of friction between the hoist ropes and drive sheave, and (4) rate of acceleration/deceleration. The designer determines these factors for the specific application, and the manufacturer checks them to ensure proper operation of the installed machine.

Improper operating practices are most often the cause of rope slippage. Following are some of the causes of slippage.

Excessive Counterweights

The general rule is that the counterweights equal the weight of the car and attachments, plus 40% of the rated capacity. In some cases, to economize, a designer will use a motor which is too light for the service. Extra counterweights are then used to compensate for the light motor. It is easy to see what will happen when an empty car with an overloaded counterweight is driven downward—slippage.

Hard Braking

Hard braking may cause the car to jolt, and in turn may result in rope slippage. In this case, adjust the braking to provide for a smooth or “soft” stop.

Overloading

Exceeding the rated capacity is particularly serious on traction-type elevators. Overloading results in an increased traction ratio, and the traction of the ropes on the drive sheave may be insufficient to lift and control the loaded car. Most cars have the rated capacities noted and those capacities should not be exceeded.

Increasing Acceleration

In some cases, the acceleration rate is increased beyond the designed figure to increase the number of trips an elevator makes. This also causes slippage.

Wirerope Works, Inc.
100 Maynard St. Williamsport, PA 17701 USA tel 570-326-5146 fax 570-327-4274 www.wireropeworks.com

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Fit Factor

The fit of the hoist ropes in the grooves of the drive sheave is very important. If the rope does not fit with sufficient clearance to seat properly, the area of contact between the rope and groove decreases below the design value and slippage may, and probably will, occur.

Unequal Tensions

Unequal tensions of the hoist ropes are another cause of rope slippage. Most elevator systems are roped with four to eleven ropes operating in parallel and driven by a multi-groove sheave. Having improperly tensioned ropes, and/or nonuniform tensioning within a set of ropes, affects operating rope diameters, sheave groove wear and rope stretch, and will, over time, cause rope slippage and an array of other problems. It is of the utmost importance that ropes are properly tensioned during installation. (Please refer to Bethlehem Elevator Rope Technical Bulletin 8, *Tensioning*.)

Lubrication

Excessive lubrication on hoist ropes reduces the coefficient of friction between the ropes and the drive sheave, and is another cause of slippage. This is more often the case on U-grooved sheaves, where traction is dependent upon the friction of the rope in the bottom of the groove. V-grooved machines are not as easily affected since traction is increased by the pinching action of the sides of the groove. (Please refer to Bethlehem Elevator Rope Technical Bulletin 2, *Lubrication*.)

Insufficient Counterweights

If the counterweight is insufficient for the designed load, slippage occurs. An inadequate counterweight increases the traction ratio beyond the value for which the elevator is designed.

One method for determining rope slippage is to run the car for one cycle, then mark the ropes and drive sheave with chalk while the car is at one of the terminal landings. Have the car make two complete trips, ending at the original starting point. Compare the chalk mark on the ropes with that on the sheave. If the differential is 1" to 2", this is normal and can be considered creepage. Anything over should be treated as slippage.

Rope slippage on traction elevators may be due to a number of causes. When slippage is detected, it should be traced to its source and corrected. If left uncorrected, rope slippage can become expensive since it causes excessive wear of the ropes and sheave grooves. Re-roping and re-grooving are costly. In addition, slippage can result in unsafe operation of the elevator.

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