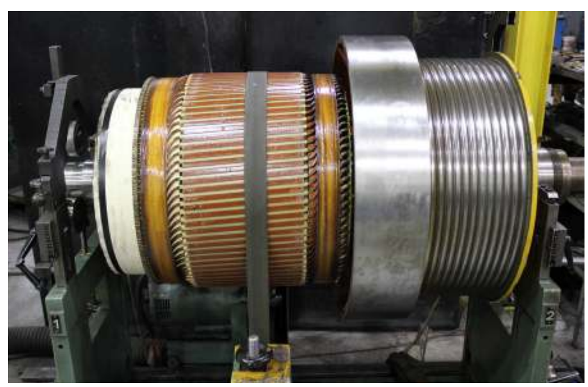
Technical Bulletin:
Regrooving Elevator Sheaves

It’s an exciting time to be in the elevator business. The pace of technological change that has revolutionized industries like communications and transportation has also come to our trade as well. With new developments in computerization and materials science playing an increasingly greater role in elevator design and construction, we are seeing more and more requests to provide on-site services to make many fixes that we never expected to have to make until recently. One of these involved regrooving sheaves for a customer who complained, “They don’t make ropes like they used to.”

One of the ongoing trends in elevator manufacturing in recent years is a movement toward decreased power consumption, reduced equipment costs, and increased space utilization. Newer building designs that place a premium on using every bit of floor space profitably have helped spur the rise of machine-room-less system designs, as well as a move toward installing fewer elevators in some commercial buildings. While this is a boon to building planners and architects, this move to do more with less requires the use of smaller components, correspondingly aggressive sheave groove profiles, greatly increased elevator start cycles, tighter bend radiuses for ropes, and the use of sheaves requiring multiple angles of deflection—which all place significant demands and stresses on the ropes and ancillary equipment.

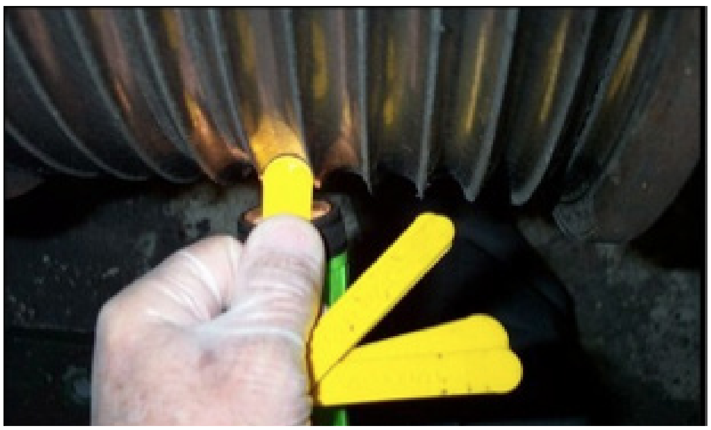
Additionally, elevators themselves have evolved from being used sporadically in facilities to functioning nearly continuously, due to increased demand and the result of changing societal factors. This increased usage has meant that professionals have had to cease measuring rope longevity by time frame only. Instead, they now gauge how many starts the rope in the installation has delivered. These factors have combined to create installation environments that have moved from being somewhat unfriendly to ones that are decidedly hostile to hoist rope.



Sheave regrooved on dynamic balancer

Many professionals are coming to the opinion that a key contributing cause behind "early" hoist rope failure is potentially related to calculations that do not consider how newer, faster accelerating and decelerating elevators are placing far greater strains on older, long-established rope selections (such as standard 8 X 19 sisal varieties)—strains that those ropes were not originally created to handle.

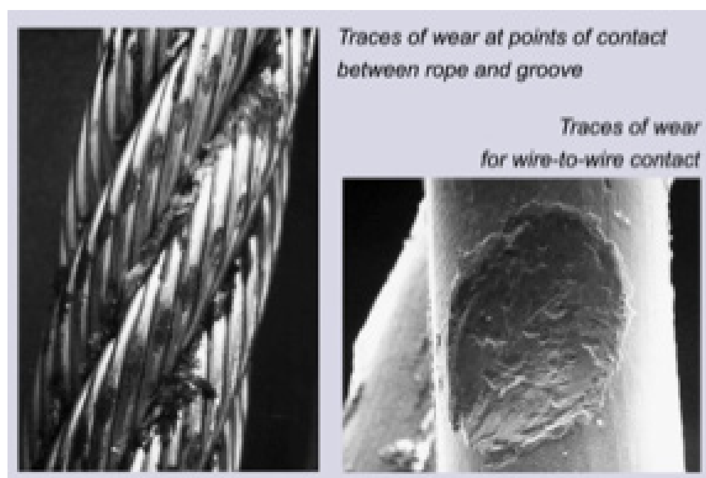
Worn sheaves place additional wear on ropes, which in turn add wear onto sheaves, setting up a cycle of destruction for both. Replacing or regrooving sheaves may be necessary to prevent this. Check groove profiles annually to verify the fit between ropes and the sheave. A proper fit means good traction. Without good traction, you're either sacrificing rope life, sheave wear, or both. Take the time to perform a quick check and measure whether all the ropes sitting in their sheave grooves are at equal height.



Grooves being checked with groove gauges

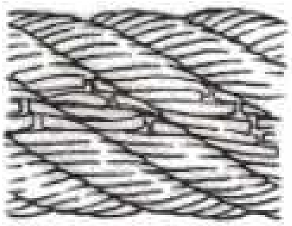
Rope measuring

Rope gauge

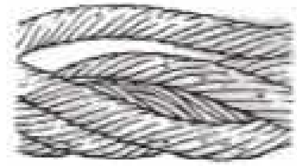


Example of rope damage

Examples of Wire Rope Damage

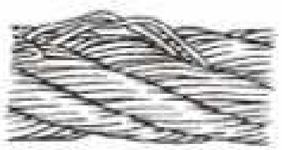


Narrow path of wear resulting in fatigue fractures, caused by working in a sheave groove that was too wide or over small support rollers.



Break up of strands resulting from high stress application. Note nicking of wires in outer strands.

Two parallel paths of broken wires indicative of bending through a sheave groove that was too narrow.



Wire fractures at the strand, or core interface as distinct from crown factures, caused by failure of core support.

An example of fatigue failure of a wire rope that has been subjected to heavy loads over small sheaves. The usual crown breaks are accompanied by breaks in the valleys of the strands, these breaks being caused by strand nicking resulting from the heavy loads.

Wire rope that shows wear and fatigue from operating over small sheaves with heavy load and severe abrasion.

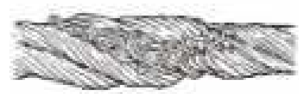
A rope failing from fatigue after bending over small sheaves.

Snagged wires resulting from drum crushing.

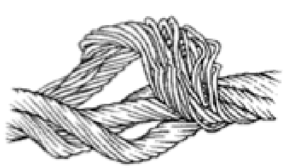
Mechanical damage due to rope movement over sharp edge projection while under load.

Rope break due to excessive strain.

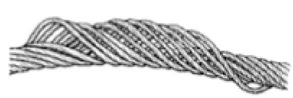
A wire rope that has jumped a sheave. The rope itself is deformed into a "curl" as it bent around a round shaft. Close examination of the wire shows two types of breaks - normal tensile "cup and cone" breaks and shear breaks which give the appearance of having been cut on an angle with a cold chisel.



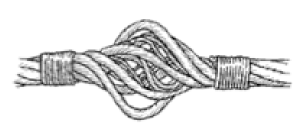
A rope that has been jammed after jumping off a sheave.



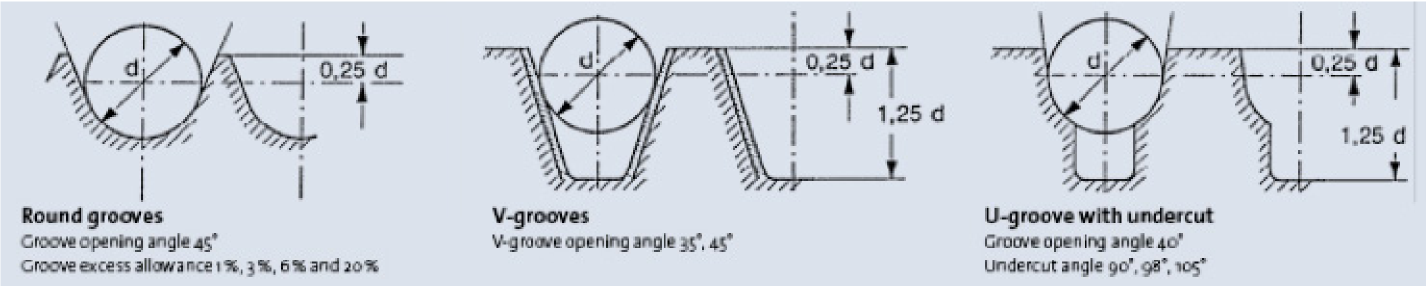
A "bird cage" which has been forced through a tight sheave.



Multi-strand rope "bird cages" due to torsional unbalance. Typical of build-up shown at anchorage end and of multi-crane application.



A "bird cage" caused by sudden release of tension and resultant rebound of rope from overloaded condition. These strands and wires will not return to their original positions.



Sheave groove profiles

Sheave on lathe in Renown's shop

The U-groove sheave, found predominantly in older installations, is the sheave of choice for optimum rope life. Its large size (when compared with the drive sheave diameters in newer installations) in combination with its supportive grooves minimizes abrasion and fatigue. Unfortunately, the U-grooved sheave with its large diameter also provides the least amount of traction. Hence, the U-grooved sheave, the favorite among wire rope manufacturers, has lost popularity in favor of other types of grooved sheaves that can increase traction and be downsized at the same time. In general, the modern grooves—Undercut U and Progressive V—increase traction by increasing groove pressures. The benefit of these groove types is that the diameter of the sheave utilizing this modern groove design can be reduced. Due to an increase in rope-to-sheave contact pressure, created by the gripping action (or rope pinching) of the groove, a large arc of contact is not needed to sustain traction.

Generally, all sheaves will need to be regrooved at least once during their service lives, but the frequency of regrooving depends upon a number of factors, including groove type and number of cycles. Grooves designed to increase traction (i.e., Undercut U- and V-grooves) wear more quickly and, therefore, require more maintenance. The gripping (pinching) action of these groove types causes the ropes to seat themselves into the groove at an accelerated pace. V-grooved sheaves require more attention than Undercut U-grooved sheaves.

Renown Electric Motors offers highly trained and skilled personnel to provide on-site elevator repair and maintenance services such as sheave regrooving. Contact a representative (416-742-3665) to learn more about how we can be of service to you.

Please utilize caution and follow all safety protocols when performing all elevator repair services, such as sheave regrooving.

Image credits:
Sheave Groove Profiles
www.lift-report.de

Drive sheave grooves being checked with groove gauges for 5/8" rope
http://wireroperestoration.com/mycustompage0004.htm

Rope Damage
http://www.lift report.de/index.php?mact=News,cntnt01,print,0&cntnt01articleid=128&cntnt01showtemplate=false&cntnt01returnid=393

Rope Gauge
http://wireroperestoration.com/mycustompage0019.htm
http://www.lustreproducts.biz/gauges

Types of Rope damage from Alberta Occupational Health and Safety Code
http://humanservices.alberta.ca/SearchAARC/767.html