

Moisture

Excessive moisture and/or water in an elevator shaft can cause a multitude of wire rope related problems.

Please remember that initially we will be discussing moisture caused by accidental means such as broken water pipes, sprinkler systems or possibly a heavy rain during the construction phase when the system could be open to the elements. Other moisture related concerns will be addressed later in this bulletin.

The rope's metal wires are affected as any bare steel product would be. Lubricants used in the manufacture of wire ropes perform the same function as in other 'machines', allowing movement of the various parts in relation one to another with minimized friction and wear. However, this lube is not designed to protect against conditions simulating total emersion. The moisture will produce rust (oxidation and pitting of the wires) which will deteriorate the metal, both externally where it can be seen, and internally where the extent of the damage cannot be seen. Because of this rust, the constant movement of the wires against each other as they traverse the sheaves will result in increased wear and decreased service life. Lubricating the ropes may help in some situations, but it is difficult to get the lubricant into the interior of the strands where it is most needed. Most often these ropes need to be replaced. Governor ropes are not to be field lubricated under any circumstances and, therefore, would need to be replaced.

Of greater concern is the sisal core. Sisal, used in most elevator wire ropes, is both organic and hygroscopic (it attracts moisture from the air). Excessive moisture generally brings about two problems: First, it causes the core to swell and; secondly, it displaces the core's lubricant. The swollen core forces the rope to increase in diameter and, therefore, decrease in length. This now 'fat' rope is pinched running through proper sized sheave grooves. The resultant mismatch will cause

premature wear and reduced service life not only to the rope, but ultimately to the sheave as well. If the cause of the moisture problem is discovered and corrected, hoist ropes, depending upon length of time they were exposed to moisture, the tensile load exerted on the ropes and other system parameters, may or may not return to their original diameter. Often the heavier loads placed on hoist ropes help keep core swelling to a minimum. The lightly loaded compensating ropes usually remain in the oversized condition as would a governor rope. (For proper calliper of wire rope please refer to Bethlehem Elevator Rope Technical Bulletin 1, *Nomenclature*.)

The second concern is the displaced lubricant. This will ultimately allow the sisal core to thoroughly dry, lose its integrity and fail to properly support the outer strands thus allowing a reduction in the diameter of the wire rope. The first sign of this condition may be the formation of rouge along with a measurable reduction in the rope diameter and again the result is decreased service life. Rouge is iron oxide that develops when the lack of lubricant allows fretting (abrasion between two or more un-lubricated wires), the resultant fine steel dust turns 'red' and gives the rope a rusty appearance. (Please refer to Bethlehem Elevator Rope Technical Bulletin 3, *Rouging*.)

Lubricating the ropes may help, but again it is even more difficult to get the lubricant inside of the core. It should be noted that lubricants, used during the manufacture of the core, and accounting for 10% to 15% of the cores actual weight, surround the fibers and fill in the void spaces between them. The lube is not absorbed into the core's fibers and it is not a waterproof barrier. Conversely, moisture is absorbed into the fibers of the core and swells the fibers which effectively displaces and pushes out the lubricant. Lack of lubricity causes premature core failure.



Wire Rope Works, Inc.

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

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Loss of core integrity can also promote valley wire breaks which are defined as wire breaks in between two adjoining strands as opposed to a crown break which occurs on the top surface of a wire. (Please refer to Bethlehem Elevator Rope Technical Bulletin 9, *Fatigue*.)

For hoist, compensating and governor ropes being installed in systems that typically exhibit wet or overly moist conditions, such as in mine shafts or elevators on the outside of structures that are exposed to the elements, Syncore® ropes are recommended. The strands of these ropes are manufactured with steel wires, however, the cores in these ropes are manufactured with synthetic fibers that are not subject to moisture absorption. Yet another safeguard would be to specify wire ropes made with galvanized steel wire.

Excessive moisture can also result from high humidity or condensation due to an influx of cooler air into the warm hoist way during cold weather or from air conditioning in the machine room during hot weather.

To prevent adverse effects to the ropes working in a covered hoist way yet experiencing differing air temperatures and the subsequent moisture build-up, proper lubrication procedures should be followed. Begin by using light viscosity Spindle type oil. Bethlehem Elevator Rope does not recommend the use of lubricants containing solvents at any time. (Please refer to Bethlehem Elevator Rope Technical Bulletin 2, *Lubrication*.)

All of these issues require increased scrutiny during inspections because of the possibility of failure of one or more strands in a rope with these conditions.

In many instances the extent of the damage is not known or cannot be determined without destructive analysis. An elevator inspector can cite "unusual conditions" or simply demand removal of the ropes because of safety concerns. As a manufacturer of elevator rope, whenever the integrity of the rope is in question, it has always been suggested that the ropes be replaced.

For further information please contact WW's Sales or Engineering Departments.

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