Rope Failure
Causes and Cures

Editor's Note: Rope failure in the tree care industry is one of the greatest hazards tree climbers face. Yet, with proper care, accidents involving ropes can be minimized. In an exclusive interview with Karel H. Liebenauer, sales manager, Lanphear Supply, Div. of Forest City Tree Proteciton Co., Cleveland, Ohio, WEEDS TREES AND TURF asked about different kinds of ropes and the advantages of certain newer materials used in rope construction over the older and better known manila rope. We present this interview in question and answer form to help you better understand the care and treatment of ropes.

WTT: Rope condition has always been an important item with the professional arborist. As a safety standard, the American National Standard Z133.1 specifies certain precise details about ropes. Why is there so much attention directed to ropes?

Liebenauer: Two recent rope accidents by tree climbers bring into sharp focus the answer. In one instance manila rope at least three years old broke at a knot causing the climber to fall from the tree. In the second case, a rope was stored near a storage battery. Acid fumes disintegrated the rope fibers. Accidents such as these can be prevented. Proper care and handling of rope is vitally important.

WTT: What is manila rope and why is it used by the arborist?

Liebenauer: Manila rope is basically composed of selected manila fibers which are twisted together to form rope. The clinging together of these fibers in close proximity gives the rope its strength. But remember that manila rope is organic, that is, coming from a plant. It is not able to withstand a lot of flexing. If you tie a knot in the rope and leave it there for a long period of time, the fibers are bent sharply and eventually the knot will break.

Arborists use manila rope because until recently it was the best rope available for the job. It gave the climber greater freedom while in a tree. It could withstand loads such as lowering tree limbs and tree climbers. And with proper care it could last for a period of time.

In years past, a tree climber's rope was a very personal item. It was essential to his work. He kept it with him and frequently checked it for even minor cuts. He would never consider leaving it to the elements.

Modern equipment has falsely lessened the importance of rope. Bucket trucks and cranes have replaced life lines and lowering ropes. Chain saws have enabled the climber to make many cuts that have reduced the size of limbs that heretofore needed careful rigging and powerful ropes to lower the whole limb.

Today we've found the tree climber's attitude has become more casual about the condition of ropes. Instead of hanging the rope up and hanking it, some tree climbers will throw a coiled rope onto a truck bed; they'll throw tools on it, sometimes sharp tools; they'll throw gasoline cans on it (The gas could spill out and enter the rope fibers); tar can get on it; and the rope can get wet. Moisture in the case of manila fibers is fatal.

WTT: So while rope is still an important item with the tree climber, its relative importance in relation to other items in use has diminished. Is this correct?

Liebenauer: The advent of the bucket truck and the crane made the job of the arborist somewhat easier. It required less skill to operate this type equipment than to rig a series of ropes in limb removal.

There is a tremendous turnover of help in the tree care business. Arborists have been forced to use other equipment and do less training in order to get the job done. Consequently, the importance of rope as far as the demand of substance is concerned isn't as great as it used to be. However, it is still important, because once a climber depends on a piece of rope for his life it is the most important thing in the world.

WTT: Let's get back to the rope itself. Earlier you mentioned that manila rope was composed of fibers. How long are these fibers? And as these fibers wear, does this cause the rope to break?

Liebenauer: Fiber length is difficult to determine in any given rope. This is because different manufacturers use different lengths of fibers and also, the final size of the rope will govern the size of the fibers. A manufacturer will select fibers that are compatible to the size of the rope. For an average climbing rope fibers can vary from eight inches up to two or three feet in length. By checking ropes regularly, you want to see when those fibers start to break down into shorter lengths. As the rope wears, the fibers break. When enough fibers break in a given area, the strength of the rope is reduced.

WTT: How do you test the condition of a rope? In other words, how can you tell if a rope is safe?

Liebenauer: The condition of manila rope is pretty hard to determine. A man would have to examine a manila rope inch by inch by inch and untwist it and examine the fibers. Regular visual inspection of the rope as a whole is important, however. A man who regularly uses his rope will recall how it was used and prevailing environmental conditions when it was used. He will know how it has been stored and how old it is. A man who regularly uses his rope will keep all these things in mind when examining the rope.

The second way to test a rope

(continued on page 34)

ROPE SAFETY *(from page 12)*

is by actually loading it. But if a rope is getting weak and you put weight on it, you'll weaken it further. So that system wouldn't be very fair. As far as a rule of thumb on use life of a rope, I would not consider using a rope as a safety line that was over a year old. A brand new manila rope, of course, if it's stored properly has almost an indefinite life. But proper storage is a pretty hard thing to come by, particularly in a smaller business.

WTT: Is manila rope treated?

Liebenauer: Since manila rope is an organic material, it's self-

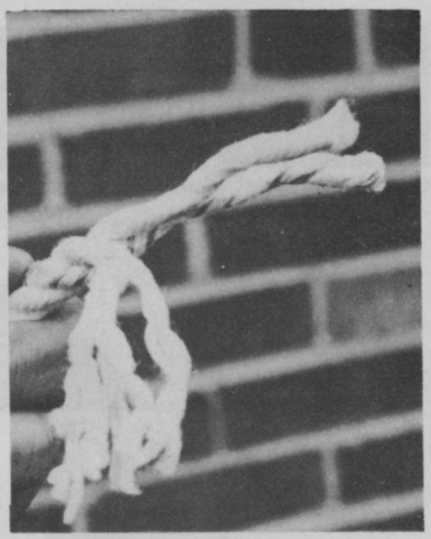
(continued on page 36)

Table of characteristics in the comparison of one inch rope made from manila, nylon Dacron polyester and Esterlon polyester.*

Description	Manila	Nylon	Polyester Dacron	Polyester Esterlon
Strength Characteristics				
Tensile Strength Dry	9,000 lbs.	25,000 lbs.	22,000 lbs.	20,000 lbs.
Working Strength	1,800 lbs.	2,890 lbs.	2,450 lbs.	2,220 lbs.
Repeat Loading	Poor	Good	Excellent	Good
Elasticity-Stretch				
Permanent Elongation At Working Loads	4.8%	8.0%	6.2%	6.0%
Temporary Stretch Under Load	5.0%	16.0%	5.9%	6.5%
Water Absorbed Into Fiber	Up to 100% of weight of rope	Up to 9%	Less than 1%	Less than 1%
Resistance to Rot, Mildew & Marine Organisms	Poor	100% resistant	100% resistant	100% resistant
Deterioration				
Due to Aging	About 1% per year	Zero	Zero	Zero
Due to Sunlight Exposure	Some Slight	Some Slight	Almost None	Almost None
Resistance to Chemicals			Very good to	Very Good to
To Acids	Very Poor	Fair	Excellent	Excellent
To Alkalis	Very Poor	Excellent	Very Good	Very Good
To Solvents	Good	Good	Very Good to Excellent	Very Good to Excellent
Wear				
Resistance to Surface Abrasion	Good	Very Good	Excellent	Excellent
Resistance to Internal Flexing Wear	Good	Excellent	Very Good to Excellent	Very Good to Excellent
Resistance to Cutting	Good	Excellent	Very Good to Excellent	Very Good to Excellent

* This table was compiled from "Table of Natural and Synthetic Fiber Characteristics" developed by Wall Rope Works, Beverly, New Jersey.

Manila rope is composed of fibrous strands that can break or become worn. Safety lines should be inspected daily and stored properly at night.



This is Esterlon polyester rope. Note the frayed strands. They tend to stay together to form a tight bundle of fibers. Color is lighter than manila.

recycling. That's a problem. Rope is usually treated to reduce rot and internal friction. This treatment lengthens its life but constant flexing of the rope tends to break the fibers and reduce their size. In addition, by flexing, a rope has the tendency to wear the edge of the fiber making each fiber smaller. Smaller fibers won't cling together quite so tightly and thus the rope loses it's strength. A rope manufacturer treats manila rope to reduce the moisture absorption of the rope and also lubricate the fibers. (If a rope absorbs water and swells, it is difficult to tie and untie knots.)

WTT: Up to now, manila rope has been somewhat the standard of ropes for arborists. Has the advent of synthetics made inroads into this field?

Liebenauer: Rope manufacturers looked around to find a better rope to the inherent weaknesses of manila. They initially tried nylon rope. At first it looked like it was going to be an ideal rope. Very quickly it became obvious that nylon had many shortcomings. Nylon is elastic; it'll stretch. When a climber tied himself into a spot he found out that he was sagging. Or if he was out on a limb with the idea of making a cut, he couldn't hold himself in a particular position. The elasticity did offer the safety advantage of a cushion effect in case of a fall. But nylon rope didn't handle as well as manila rope. It also had a tendency to glaze through a crotch in a tree. Eventually nylon rope almost dropped out of the picture completely.

But the rope companies didn't give up. They developed polyester fibers that more nearly suited the job. The two most commonly used polyester fibers are Dacron and Esterlon. These seem to be the answer to the rope problem for the arborist. The various characteristics of polyester rope fibers are very similar to manila rope.

WTT: Are combinations of polyester filament fibers used in rope manufacture?

Liebenauer: Sometimes other synthetic fibers are blended in the rope to alter the handling and feel characteristics. These ropes have all proved to be satisfactory in tree care work. The big problem, however, is user resistance to synthetics.

WTT: Can you explain that more fully?

Liebenauer: A man becomes used to using manila rope. He doesn't want to change. There's always some resistance to change, regardless of what the change may be. Early nylon rope was not satisfactory as far as the tree care business was concerned. Many arborists still recall the deficiencies of nylon. Modern synthetic ropes are actually far superior to manila rope. But because they don't look or feel like manila users have a resistance to them.

(continued on page 44)

ROPE SAFETY *(from page 36)*

WTT: Let's look at some of the advantages of modern synthetic rope. How does it compare in strength, wearability, temperature, water absorption and use life?

Liebenauer: Let's compare a one-inch diameter standard manila rope with a one-inch diameter rope made of polyester filament fibers. Dry tensile strength of manila is 9,000 pounds compared to 22,000 pounds for Dacron and 20,000 pounds for Esterlon. This makes the polyester rope over twice as strong.

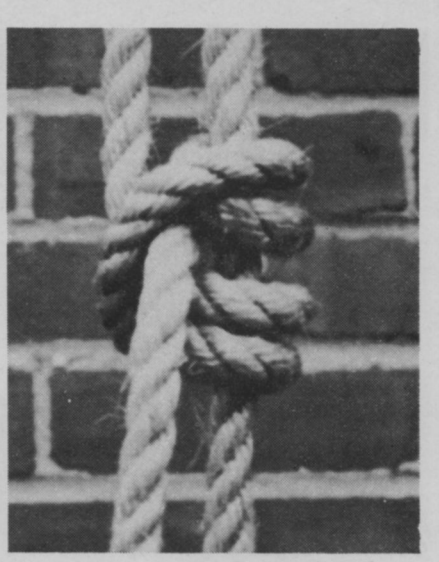
In terms of wear, manila is good, but polyester is excellent. It can absorb shock loads far better than manila and the repeat loading characteristics of polyester make it ideal for use in lowering limbs.

Temperature properties of polyester are far superior to manila. A manila rope running quickly through the crotch of a tree will rapidly heat up. It loses strength in the rope as it heats, but you don't see this and think that nothing has happened. Polyester fibers resist high temperatures. The tendency to glaze a tree with a polyester rope will be less because there is less heat generated.

Manila rope is poor in terms of water absorption. It will take up to 100 percent of it's weight in water where polyester rope will absorb less than one percent.

Use life of manila rope is generally poor. It's affected by rot, mildew and other organisms. Polyester rope is essentially 100 percent resistant. It's use life is practically indefinite.

Even new Esterlon rope makes a knot that holds. Polyester fibers can be flexed many times without damaging the rope.



Manila rope has been the standard among arborists for years. Newer fibers such as Dacron and Esterlon are beginning to replace manila rope.

WTT: What about color? Does that make a difference?

Liebenauer: Synthetic ropes are mostly white, whereas manila ropes have a golden color. The dark brown manila rope has been treated with more oil than a natural manila rope.

I think it is fair to mention at this time that management should insist that the worker give synthetics a fair trial. The men who use this rope should be educated to the fact that synthetic is so superior to manila that they shouldn't consider anything but changing over.

OSHA laws are going to require that a man use this type of rope. I am quite certain that this ruling is coming very soon.

WTT: What other advantages are in store for the user of a synthetic rope?

Liebenauer: A climber who uses a three-fourths inch manila lowering line will find that a one-half inch synthetic rope will hold the same load. In other words, a man can work with a smaller rope and have greater strength plus the fact that synthetic rope will take repeated loading shock.

A polyester rope used for climbing has a sort of tacky feel on the outside surface. Actually

(continued on page 46)

it is a wax used to lubricate the rope, but this wax gives this tacky feeling and allows a man to hang on to the rope more easily. After the rope has been used a bit it gets a slightly fuzzy surface which makes it excellent to handle. A manila rope after the same amount of use develops little slivers of fiber which can get into a climber's hands.

WTT: Can you use synthetic ropes in the construction of saddles?

Liebenauer: This gets back to one of the accidents which I mentioned earlier in our discussion. You recall that a man fell from a tree because his manila rope broke at a knot. Actually this knot was located on the man's saddle where it had been continuously tied since the saddle was constructed. When the knot broke the saddle failed and the man fell. Saddles are made out of leather with a rope reinforcement. In our business we haven't sold a saddle or let our own men use one that had any manila rope in it for over three years. We insist on saddles with synthetic rope reinforcement. Nobody can afford to have an accident.

WTT: Does synthetic lend itself to leather better than manila?

Liebenauer: Not necessarily. We have found no difference between the two. The single factor against using synthetics is in braiding the eyes or the temples at the end of the rope. You can't braid synthetic ropes, quite as readily as you can manila. When you finish a braid, you must hold it together with a wire clip and fiberglass tape to keep it from unraveling.

Synthetic rope has a memory. It does not want to have to change in lay other than when it was made. This is the nature of most plastics — they revert back to the original form or twist. We have never had any trouble, however, with a failure where any eye was braided into a synthetic rope.

WTT: What is the maximum length of life of synthetic rope when used in normal day-to-day operations?

Liebenauer: We don't know how long they will last. Some of the early users of nylon ropes are still using these ropes. The biggest factor affecting the use of synthetic rope is cost. This rope is more expensive. (In the case of accidental cutting with a saw or axe, a climber quickly finds that synthetic rope cuts just as easily as manila.) Synthetic ropes cost between 2½ to 3 times as much as manila rope initially. But at the same time they have 2½ times as much initial strength which remains constant. And the life expectancy is indefinite. So actually it is a better investment.

WTT: We take it that you are an advocate for synthetic rope. Does this mean that more arborists should be considering this type of rope?

Liebenauer: More arborists are definitely moving to synthetics. The only resistance is change itself and the fact that some arborists are working on a limited budget and cannot afford the added initial investment. However, the added investment in a period of two years will more than pay for itself. At the end of two years, unless you have physically damaged synthetic rope, it will still be good. Anyone who has used a manila rope over a year is out of their mind. I wouldn't trust it longer than that.

WTT: You have given us a convincing argument for using synthetic rope. Thank you for your interest and your concern for safety in the tree care industry. □

Is Parker Sweeper Booklet "Lawn Grooming Made Easy"

Parker Sweeper Company has prepared an eight-page booklet entitled "Lawn Grooming Made Easy."

The booklet was written for Parker Sweeper by Dr. Robert W. Schery, director of the Lawn Institute.

The booklet contains information on new varieties of grasses and how to cope with common maintenance problems. Reviewed are such areas as fertilization, watering and pest control.

The booklet also gives instructions on how to best use mechanical aids in lawn care, particularly in controlling thatch.

"Lawn Grooming Made Easy" is available without charge by writing Parker Sweeper Company, P. O. Box 720, Springfield, Ohio 45501.