

Taking Advantage of Synthetic Rope Technology Includes Hardware Maintenance

By Merry Schnell

In a 2007 interview, Tom Crowley Jr., CEO of Crowley Maritime, said that the most significant technical advance to effect efficiency in the tanker escort business has been synthetic rope. However, to many, the differences between steel-wire rope and high-performance rope may not

Proper Line Installation

The first defense in the service life of a new rope is at installation, when all hardware surfaces are exposed and can be properly prepared against wear caused by abrasion. While properly designed and engineered ropes made of



A crewmember adds back tension during the installation of rope onto a winch. Photo courtesy of Samson.

be well known; nonetheless, they are clear-cut.

Steel-wire ropes are heavy on the deck and hard on the crew; they abrade and wear machinery and equipment; and depending on the application, they have a limited service life. On a size-for-size basis, ropes made of high-modulus polyethylene (HMPE) are as strong as wire; they are one-seventh the weight; easier on deck machinery and crew; and, with proper care, they can outlast wire three to one.

Indeed, HMPE lines can make a huge difference in the lives of owners, operators, and crewmembers; however, every precaution available should be taken to ensure the long and safe service life of high-performance lines. These include proper installation; chock and line protection; and handling, inspection, maintenance, and repair of both the hardware and the lines used on it.

HMPE fiber take maximum advantage of the cut and abrasion resistance, the way in which they wear can be accelerated by rough surfaces.

Often, fibers are found on hardware surfaces that caused the abrasion, and the external surface of the rope readily shows abraded yarns. In order to avoid this type of wear, all surfaces that come in contact with the HMPE line must be smoothed to within a surface roughness of 300 microinches, as measured by a surface comparator gauge. For tugboats, this means bull nose, capstan, H-bitt, and winch surfaces must be made and kept as smooth and rust free as possible.

Installing Rope on the Winch

After surfaces have been prepped, the line may be wound onto a winch. The working line should be installed with tension and in a close, tight wind on the

drum to prevent rope diving or burying into the lower wrap layers. Tension can be created by running the rope around a newly resurfaced capstan, bollard, or pin. Another common method to produce significant back tension is to rig a rope stopper onto the line being installed. The friction between the two ropes creates the appropriate tension. However back tension is created, the rope should be led through or around something that is directly in line with the winch so it can be loaded evenly. However, the surface of the device used to create the tension should not be abrasive to the rope and the installation speed or tension applied should not generate excessive heat build up on the rope.

Back tension is intended to help eliminate the rope's tendency to bury itself on the winch drum, but how the line winds onto the winch can help as well. The line should be wound onto the winch in a closely packed formation to minimize areas where the rope may "dive" or bury into the layers of the wind. Each layer should be installed in the valleys of the previous layers or crossed over each other to support each subsequent layer. Layers should never be stacked on top of each other.

How Will the Hardware Perform?

During installation of high-performance synthetic ropes, it is also a good time to consider how well hardware will perform in conjunction with the new lines. HMPE ropes are as strong as the wire ropes they replace, which can dangerously emphasize the underdesigned, worn or damaged hardware on a ship's deck that may break or pull free.

When Ed McCain, marine operations manager of Hawaiian Tug and Barge/Young Brothers (HTBYB) replaced their traditional heavy polyester lines with Samson's Quantum-12, they found that they needed to overhaul their hardware too.

"Moving away from the traditional synthetic lines was a process. Because

the lines were no longer the weak link in the chain of equipment, we had to upgrade our hardware—the lines were outperforming it,” said McCain.

For optimum performance of the synthetic lines, hardware and their attachments should be maintained and replaced when necessary as part of the ongoing maintenance of the vessel. Abrasion to high-performance lines can lead to ropes parting, and while HMPE may part less violently than wire rope, it can still be life threatening. But perhaps even more dangerous is a piece of hardware that breaks or detaches while under tension from a high-performance line.

Closed or Roller Chocks?

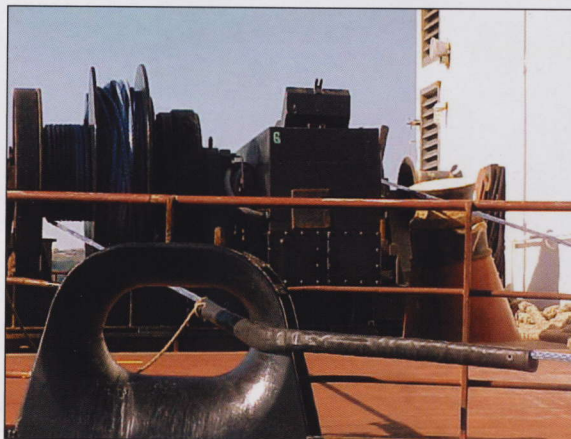
There is some question as to whether closed chocks or roller chocks work better with HMPE lines. Most users assume that roller chocks are best simply because the chock rolls with the line, thereby mitigating abrasion. This is true in theory. However, due to the low coefficient of friction in many

HMPE lines, the amount of friction required to “roll” the chock cannot be created. Instead, the line simply slides over the roller.

Also, special attention is needed where the rope might exit the roller chock at a sharp angle, creating “pinch points” that can lead to rope damage. This is common on spring lines, where, depending on the varying heights between the ship and berth, a mooring line can get “jammed” between the horizontal and vertical rollers. Roller chocks require additional maintenance to the bearings and the positions at which the rollers are set in an effort to keep the rollers moving smoothly.

Based on trials conducted by Samson on both types of chocks, it was concluded that properly maintained closed chocks provide a longer service life

and offer significant advantages over roller chocks, which include easier maintenance and reduced abrasion on high-performance lines.



A closed chock and line with chafe protection. Photo courtesy of Samson.

Both closed and roller chocks require basic maintenance, which includes keeping the contact surfaces free from rust and damage. Conversion

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A severely abraded bullnose on a tugboat. Photo courtesy of Samson.

to high-performance synthetic lines is a costly expenditure, but when considering hardware replacements, installing new closed chocks, instead of new roller chocks, can provide significant savings. Standard steel closed chocks are relatively inexpensive, and maintenance costs are low. Another option is stainless steel closed chocks, which, although more expensive upfront than plain carbon steel, are still much

less expensive than roller chocks and have low maintenance costs. This long-term cost savings can be a big advantage when converting a vessel from wire to HMPE lines.

Chafe Protection for Hardware and Lines

Typically, the constant movement between the rope and hardware can actually keep the hardware smooth. But even what appears to be the smoothest hardware will cause some damage to the rope. While the most obvious abrasion damage to the rope is external, internal abrasion is more difficult to observe since it is caused by the movement of the internal stands relative to each other. Internal abrasion occurs when the external strands pass over a rough surface, slowing them relative to the internal strands next to them. Heat is created in the process— and heat is among the biggest enemies of synthetic ropes.

Because it is difficult to judge damage to the rope caused by internal abrasion, and because lines are often subjected to surfaces not under your control, such as mooring bollards roughened and scored by wire ropes, proper chafe gear is the second line of defense to ensuring the longevity of the synthetic high-performance line. Chafe gear is essential in preventing both external and internal abrasion. Properly designed chafe gear acts as a sacrificial layer for external abrasion from rough surfaces, and reduces internal abrasion by keeping relative fiber movement at the surface of the rope to a minimum. Chafe gear is a lifeline to HMPE ropes.


Rope Handling, Maintenance, Inspection, and Repair

Once your high-performance ropes are in place and ready to use, the crew should be trained on handling and safety procedures, rope inspection procedures, use of chafe gear to protect rope in the chocks, and rope repair and splicing techniques. Not all rope manufacturers offer thorough training and follow through in these areas, so purchasing decisions should be made based on a few considerations:


- All synthetic and wire ropes gradually lose breaking strength during use due to factors such as cycle loading, shock loading, abrasion wear, cutting, and fiber fatigue.
- Most injury-related accidents occur because of parted ropes and wires. In fact, the UK P&I Club estimates that 53% of personal injuries in mooring operations are caused by parted ropes and wire.
- Simple steps that include training, inspection, and safe retirement guidelines can be taken to lower the risk to crewmembers.

The vessel's officers and crewmembers should be vigilant in routinely inspecting and maintaining all metal surfaces, making sure they remain rust free and smooth. It is also important the crew be trained on rope inspection procedures and splicing techniques. The crew should be responsible for replacing worn or cut chafe gear and making sure it is properly positioned. Safe retirement of the lines can be established based on the needs of the vessel, and technical support should be provided by the rope manufacturer. **PMI**


Merry Schnell is the marketing communications specialist for Samson and has extensive experience in technical writing and editing in the sciences and engineering.



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