SAMSON
TECHNICAL
BULLETIN

HMPE Ropes: Design vs. Performance

Overview Selecting a rope for any application involves evaluating several performance characteristics. These characteristics include, but are not limited to, minimum breaking strength, weight specifications, and elongation. These factors also play a critical role in the field performance of such ropes.

Not all high modulus polyethylene (HMPE) ropes are created equal. This study demonstrates the importance of detailed design factors to performance and service life of a rope. In this Technical Bulletin, we compare the performance characteristics among different HMPE rope designs to analyze and report the advantages, considerations and the long-term behavior of HMPE mooring lines.

After testing, the following conclusions have been made:

- **Rope design is critical to service life**
- **Longer braid cycle lengths decrease abrasion resistance**
- **Longer braid cycle lengths decrease tension fatigue life**
- **Longer braid cycle lengths can increase strength efficiency**

Rope Construction vs. Performance

Fig. 1 compares three HMPE ropes with different braid cycle lengths, as marked by the arrows. Sample A is Samson's *AmSteel®-Blue,* a 12-strand single braid made with Dyneema®. Sample B shows a longer cycle length. Sample C shows an even longer cycle length. The difference in braid cycle length is shown in Fig. 1—relative to Sample A.

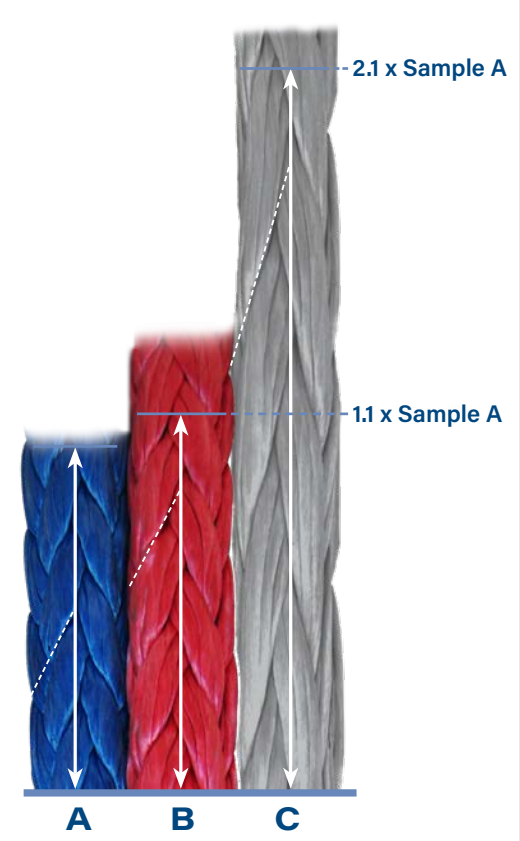

FIGURE 1 Construction comparison

Aside from performance differences, these ropes have qualitative differences that affect how they will handle in operation. Shorter cycle lengths and more tightly twisted yarns will create a firmer rope which would typically be less likely to snag on sharp objects. It is important to balance all of these elements in order to create the best rope for each application with not only high strength, but long service life as well.

Fig. 2 compares breaking lengths, a commonly used parameter to describe the efficiency of rope. The breaking length is the calculated length of a rope whose weight is equal to its breaking strength. The comparison of the three samples shows a higher efficiency in a more loosely braided rope.

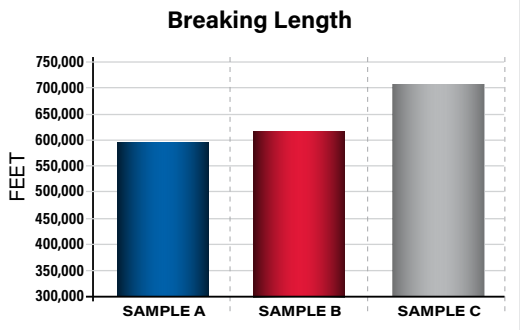

FIGURE 2 Breaking length comparison

HMPE Rope: Design vs. Performance

Although a loose braid leads to higher efficiency, the abrasion resistance of the rope will suffer significantly, as shown in Fig. 3. Field observation of rope also confirms this conclusion as the longer cycle length will result in more snagging and wear of the surface of the rope, which is the leading factor of strength decay of HMPE rope in service [1].

Thousand cycle load level (TCLL) testing is used to determine the theoretical load at which a rope would fail at the 1,000th cycle [2]. Testing found that in addition to the lower abrasion resistance, a loosely braided rope also has much lower tension fatigue resistance, as shown in Fig. 4.

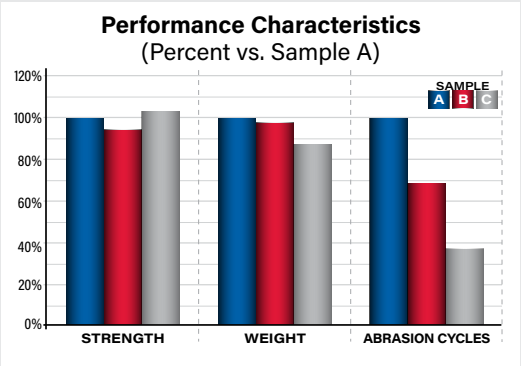

FIGURE 3 Comparison of HMPE rope constructions

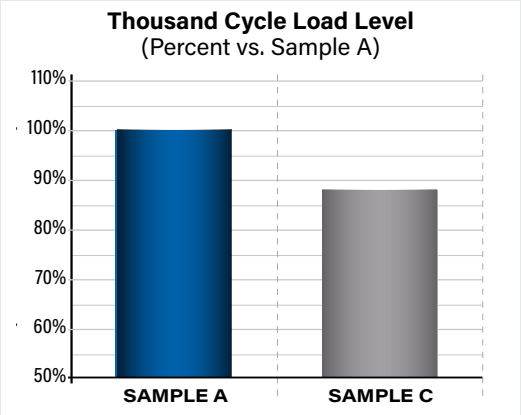

FIGURE 4 Tension fatigue performance

Conclusion

Rope design is critical to the service life and performance of any rope. Extended service life can be achieved by improving rope design, as demonstrated in this study, to properly address the strength deterioration mechanisms. Improper product selection is a risk that could result in unsatisfactory performance in the field.

For additional information on this subject and other available Technical Bulletins, please contact your Samson representative or visit our website: ***SamsonRope.com***

REFERENCES

[1] McCorkle, E., Chou, R., Stenvers, D., Smeets, P., Vlasblom, M., & Grootendorst, E. (2003). *Fatigue and Residual Strength of Fiber Tug Lines.* San Diego, CA: Oceans 2003 Proceedings, 1058–1063 Vol. 2.

[2] Oil Companies International Marine Forum (OCIMF). (2000). *Guidelines for Purchasing and Testing SPM Hawsers* (1st ed.). Livingston, UK: Witherby Seamanship International.

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