Rope Basics

Versatile equipment in the hands of a knowledgeable, experienced professional can drive improved efficiency in both time and material costs while ensuring a safe working environment. Versatile equipment in the hands of a novice, without clearly defined policies and procedures, can create dangerous situations. One of the more widely-used and versatile products in the telecommunications industry, synthetic rope, is also one of the most misunderstood and misused. Effective training to help enhance the competency of all involved in the selection, use, and care of synthetic rope is critical.

Understanding the existing regulations, standards, and best practices is a good place to start in the development of training based on sound operating procedures and equipment selection. This article provides insight on the individual characteristics of the different types of rope most prevalent in the industry. It also contains best practice information which can be used regardless of the rope's function.

Please note, this article is not intended to be an all-inclusive list and does not attempt to cover all synthetic rope, jobsite-safety, or rigging fundamentals. For means and methods it is recommended that the ANSI/ASSP A10.48 be consulted along with other standards and regulations that may apply.

Terminology is often confused and there are many slang words that are used within our industry. Here are the common terms used with synthetic rope that will be referenced. Please note it is not an exhaustive list:

Average Breaking Strength (ABS) – The average force at which a new rope, tested under factory conditions, breaks during documented testing.

Break Strength (BS) – Also referred to as tensile strength: the amount of force at which a rope is expected to break.

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Factory Termination – A manufacturer-integrated connection point at the end of a synthetic rope rather than a plain end, popular examples include sewn eyes with and without integrated thimbles or other hardware.

Minimum Breaking Strength (MBS) – The minimum force at which a new rope, tested under factory conditions, breaks during documented testing.

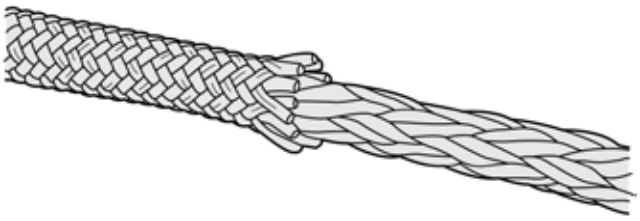
Safety Factor – A mathematical ratio for the breaking strength of a rope vs the maximum force to which it can be subjected. (For example – the ANSI A10.48 Standard recommends a 10:1 safety factor, meaning a rope with a 10,000 pound MBS would have a 1,000 force limit).

Splice – Forming a joint between two ropes or two parts of the same rope by interweaving the strands.

Working Load Limit (WLL) – The maximum capacity of a synthetic rope after applying the appropriate safety factor.

The most common rope constructions in telecommunications work and their characteristics:

Double Braid



Double braided rope, as the name implies, has a braided core which is surrounded by a braided sheath. The inner and outer braids are designed to share the load with low elongation, allowing for a higher minimum breaking strength with less material. The small amount of space between the core and the sheath, as a result of the internal structure being braided rather than stranded, allows for a softer hand for this rope construction. This facilitates easier knotting. Double braid flattens ever so slightly - more than a kernmantle or twisted braid, but significantly less than a hollow braid. This helps improve grip on the drum of a hoist without flattening to the extent to cause excessive inefficiency when passing through the sheave of a block or pulley.

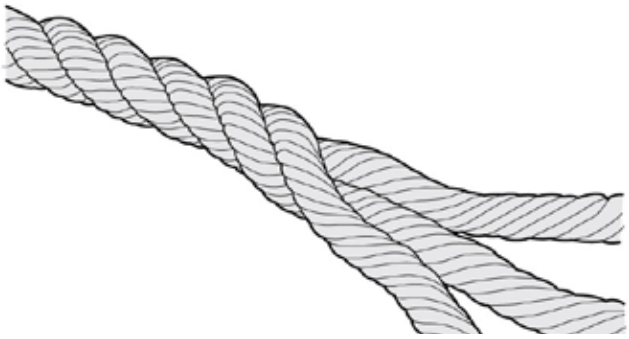
Benefits:

- High tensile strength
- Pliability simplifies tying knots and passing through sheaves
- Grips the drum of a hoist effectively
- Can be spliced

Detractors

- Can be susceptible to abrasion
- Limited versatility

Three-strand Twisted Braid



Three-strand twisted ropes have long been a staple in American at-height industry. The tightly-twisted fibers feeding the twisted braid ensure a low amount of stretch under load. That said, this approach does lead to a sacrifice in breaking strength. Because of this, the diameter requirements of the rope are higher than alternative products to function as a lifeline. The majority of three-strand ropes today are 5/8" diameter in order to achieve a minimum breaking strength which typically exceeds a minimum of 5,000 pounds.

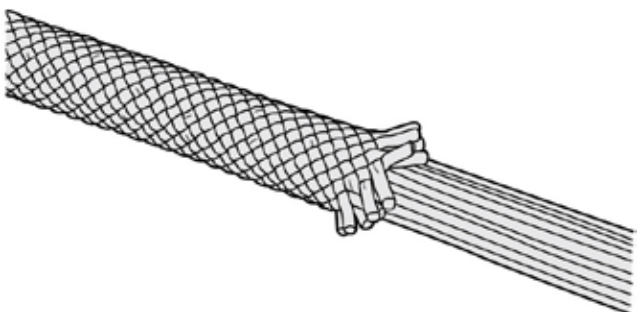
Benefits:

- Widespread availability
- Economical
- A significant number of compatible and compliant products based on the amount of time it has been in the market

Detractors:

- Less strength requiring bulkier product for compliance
- Even the most effective compatible devices don't track as smoothly as product designed for use with kernmantle rope

Static Kernmantle



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Kernmantle rope consists of parallel fibers (the kern) surrounded by a tightly braided sheath (the mantle). With this tight braid, the core fibers provide the majority of the rope's strength. Kernmantle rope is frequently split into two categories: static and dynamic. As the names imply, the amount of stretch which the rope sees when put under load are the defining characteristics. For professional applications, static kernmantle is preferred. The low-stretch characteristics diminish concerns with fall arrest systems deploying and decrease the risks associated with fall clearance. The most frequent kernmantle rope diameters purchased are 11mm (~7/16") and 12.5-13mm (~½").

Benefits:

- High tensile strength
- Excellent abrasion resistance
- Easily inspectable
- Low stretch enables new, more efficient work positioning techniques in cluttered environments

Detractors:

- More expensive than other constructions
- Stiffness can make knotting and passing through sheaves a challenge
- Not as many ANSI-compliant compatible devices

What is the appropriate rope for my application, and what do I need to consider to perform my job safely, effectively, and comply with regulations and standards?

The different synthetic rope types listed above most frequently perform one of four functions on a telecommunications jobsite: Lifting (load line), Safety/Fall Arrest (lifeline), Work Positioning/Controlled Descent, or Material Stabilization (tagline). Understanding the purpose of the rope, the standards that govern each application, and the characteristics of the product are crucial to getting selection and deployment correct.

Factors to consider which apply to all synthetic ropes, regardless of construction or use:

<u>Termination</u>

Rope is at its strongest when pulled straight between two points. Any introduction of additional friction to a point in a rope will diminish the breaking strength of the rope. This is true of any type of termination, factory

or otherwise. For example, Sterling Rope estimates the maximum strength degradation with a sewn eye termination at 15%. While not a tremendous decrease, it is a factor that must be considered.

Termination plates are another option for decreasing the risk associated with improper knots. However, the strength reductions exceed those of a factory termination. MSA, for example, publishes a revised breaking strength of 7,300 pounds on a 5/8" kernmantle rope when used with their termination plate. This represents a ~43.85% reduction from the rope's original 13,000 pound MBS.

<u>The Effect of Knots</u>

The ability to tie knots is an important skill to have when working with rope. It is important to understand the effect that knots have on your rope, both immediate and long-term. The additional friction and twisting at the point of the knot reduce the MBS of the rope. It is generally agreed that a presumed 50% strength reduction is sufficient. The decrease in strength can be irreversible, depending on the stress applied to the twisted fibers. This provides even more reason for a thorough inspection of your ropes before each use.

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Storage

Ropes should be stored away from dirt, moisture, and sunlight. Introducing excessive sediment into your ropes imparts additional friction points which speed up fiber degradation and can contribute to strength reduction. Excessive moisture can result in mold. The risk of this varies by textile, but avoidance is a best practice unless the rope was intended for extended use in wet environments. UV rays degrade fiber strength over time. Storing your ropes out of the sun will extend their lifetime.

Cleaning

Keeping ropes free from debris helps increase their strength and longevity by decreasing the amount of abrasion caused by foreign objects. Cleaning ropes is an effective way to see these benefits after a rope has been used. Common recommendations for cleaning rope are to use warm (not hot) water, use a mild detergent (there are options that are specifically designed for rope), swish the rope around while completely submerged, pull the entire length of the rope through your hands, rinse thoroughly until water runs clean, and dry completely before use. Please reference the manufacturer's cleaning recommendations for your rope.

Inspection

Prior to each use, the full length of a rope should be inspected. If your rope has any of the following problems, it should be removed from service:

- Hard or glossy areas - could be associated with heat exposure or overuse
- Inconsistent diameter - any lumps, bumps, flat spots, or bulges could indicate core or internal damage due to an overload or a shock load
- Discoloration due to exposure to the sun, chemicals, etc.
- Inconsistent texture or stiffness - a potential sign of kinks or improper twisting in storage or during use
- Any burns, cuts, nicks, or significant frays in the sheath

One way to ensure that rope inspection becomes routine is to document it with a rope inspection log, and to incorporate checking the rope inspection log into your daily routine. ■