

Ropes are used to raise, lower, and traverse, provide safety and construct mechanical advantage systems. To perform these functions, a ropes specific type, construction, strength and durability must be carefully considered.

Types of Ropes

Although there are several types of materials used to make ropes, each type can be classified into two basic categories: Natural Fiber and Synthetic.

Natural ropes include Manila, Hemp, Jute, Cotton and Sisal. Natural ropes are not recommended for rescues due to the low strength to weight ratio, and the tendency to rot, mold and mildew.



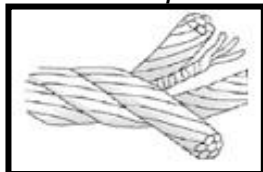
Synthetic ropes include Nylon, Dacron, Polypropylene and Kevlar. These ropes have superior strength and provide good chemical, abrasion and improved heat resistance while being impervious to rot, mold and mildew.



Construction

Ropes can be constructed using various methods for strength and durability. Some types include Laid, Braid on Braid and Kernmantle.

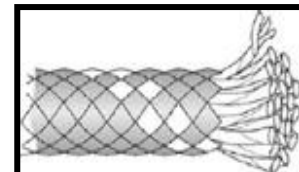
Laid Rope



Braid on Braid



Kernmantle



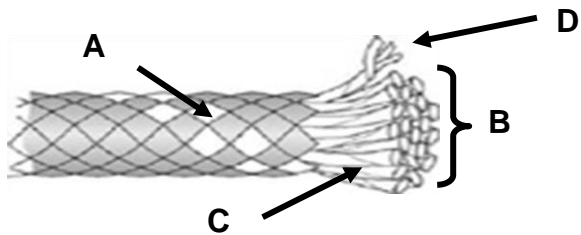
Kernmantle

The construction of Kernmantle rope identifies a high strength and continuously stranded inner core (**kern**) protected by an outer braided protective sheath (**mantle**). The braided nature of the outer sheath makes Kernmantle easy to use. The kern consists of parallel filaments often running the entire length of the rope. This is known as *Block Creel* construction. The kern carries the majority of the load, or about 75% - 90% of the rope's strength. The mantle is a tight weave of nylon that provides the remaining strength and protects the kern from abrasion and contamination. It is very difficult to damage the core without obviously disrupting the sheath weave.

There are two different types of Kernmantle ropes: Low Stretch (**Static**) and High Stretch (**Dynamic**).

Low Stretch/Static Ropes

Static lines are more appropriate for fire service applications such as raising and lowering. Static lines allow very little stretch when loaded, less than 5% @ 450 lbf. (pounds force) with minimum elongation of not less than 15% @ 75% of the breaking strength, and a maximum elongation of 45% @ 75% of breaking strength (NFPA 1983, 1995 edition). Static lines are temperature rated to perform efficiently up to 250° F. The minimum melting temperature is 400° F.

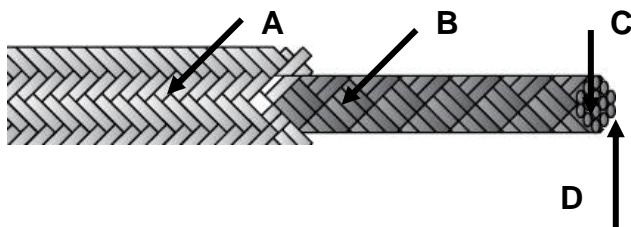


- A. Outer Jacket
- B. Parallel yarn bundles
- C. Yarns
- D. Fibers

High Stretch/Dynamic Ropes

Dynamic ropes are common in climbing operations when a person must work in an unsafe position (e.g., above a belay or in positions that there is a likelihood of falling). If the climber falls, the rope stretches, absorbing the shock, and breaking the fall when the individual reaches the end of the line. Dynamic ropes stretch at least 10% at 450 lbf. And may stretch as much as 60% of their length before breaking. This is to absorb the shock of a falling load and reduce the impact on the falling person and their anchor system. Dynamic ropes act like a rubber band when loaded, which is a definite hazard and disadvantage when raising or lowering a heavy load.

- A. Outer Jacket or Sheath
- B. Diamond Braided yarn bundles
- C. Yarns
- D. Fibers



Classification of Ropes

The Zone Fire Departments primarily carry 1/2" Static Kernmantle ropes as Lifelines. These Lifelines are for rescue or rescue training only and should not be used for any other purpose. Firefighters should not use any other rope for life safety or rescue purposes unless specifically approved by the Safety Officer, Chief Officer or IC. All care and maintenance procedures must be strictly adhered to due to the important function of this rope.

Life Lines

Life safety rope falls into one of two categories: one-person life safety rope or two-person life safety rope. NFPA 1983 is the standard for life safety rope and identifies the rope strength by the number of persons the rope is intended to support.

One-person life safety rope has a maximum working load of at least 300 lbs. and is also referred to as Class I rope. The rope diameter is usually less than ½”.

Two-person life safety rope has a maximum working load of at least 600 lbs. and is also referred to as Class II rope. The rope diameter is usually ½” or more.

The working load is the amount of weight the rope is designed to support (with a large safety factor). These figures are determined by dividing the minimum breaking strength (MBS) of the new rope by 15. An example follows: a rope that has a minimum breaking strength of 9450 lbs. is divided by 15, therefore it has a maximum working load of 630 lbs. Stated differently, the NFPA specifies the strength of life safety rope to be 15 times the working load. This is considered a safety factor of 15:1. This safety factor used by the NFPA is not intended to apply to the entire rescue system. It is used for the life safety rope to provide a margin of safety that takes into account rope wear, rope aging, knots, and the effects of bending over edges. The NFPA uses different safety factors for other groups of equipment such as drop bags, harnesses and hardware.

Based on the NFPA safety factor, a one-person life safety rope has a MBS of at least 4500 lbs. and a two-person life safety rope has a MBS of at least 9000 lbs.

Auxiliary Rope Bags: Personal Escape Lines - Drop Bags - RIT Lines – Throw Bags

Auxiliary rope bags come in a variety of configurations to meet the needs of the various departments. These bags can be on mounted tool belts, suspended from an SCBA or part of a RIT system. These ropes provide a variety of choices for bailout, building search, water rescue and RIT team operations. Some Zone Departments use a multi-use “drop bag” for search and hauling tools, knowing it will also hold their weight for an emergency evacuation. Emergency evacuation ropes or escape lines can be configured for immediate deployment. All auxiliary ropes used for rescue are normally less than 1/2” diameter and should follow the Class 1 rope requirements with a NFPA 10:1 safety factor. Webbing specifically designed for personal rescue may also be used. The care and maintenance is the same as lifelines.

Utility Lines

Utility lines are used for situations other than rescue or life safety. Although these ropes may be new or downgraded rescue ropes, never use them in a rescue function. Utility lines are used for hauling, raising equipment aloft, securing loads, crowd control barriers, etc. Utility

lines can be used in various situations but should be suitable for the load and job. The care and maintenance of these ropes is the same as lifelines.

Identification of Ropes

Zone Fire Departments keep each rope in a bag to protect them from damage and for ease of deployment. The color of the bag may or may not identify the color of the rope. The ends of each rescue rope have a band that indicates the date put in service, diameter, length and 3-letter Department identifier. All Class II ropes will have an identification number to assist with documenting its use.



Rope Bag Color Codes

Any Color	=	Life Line
Black Only	=	Utility Line

All rope bags have the 3-letter department identifier, rope identification number, and the length of the rope stenciled on the bag. Examples for the 3rd 300' rope is: VTA 300'-3 or CBD Rope 3, 300'. Every Zone apparatus that carries rope should have a Rope Log Sheet for each rope. Rope logs should be readily available on the apparatus.

Additional bags carry other rope related equipment. An example is the rescue litter equipment bag that contains a pre-rig, webbing and victim rescue harnesses. These bags should be clearly labeled to avoid confusion.