## The Manufacturing Process

Fibers and filaments are first formed into yarn. The yarn is then twisted, braided, or plaited according to the type of rope being made. The diameter of the rope is determined by the diameter of the yarn, the number of yarns per strand, and the number of strands or braids in the finished rope.

### Processing the fibers and filaments

If the rope is to be made from raw natural fibers, the fibers are first lubricated with natural oil. They are then fed into a series of machines that remove any dirt, straighten the fibers, spread them apart, and comb them with several sets of steel-toothed combs. Each set of combs has the teeth set closer together as the fibers proceed through the process. This produces a loose, continuous ribbon of fibers called a sliver. The fibers in the sliver have been aligned along the long axis of the ribbon. Synthetic fibers follow a similar process, but tend to align more easily.

If the rope is to be made from long filaments of synthetic material, several filaments are grouped together in a process called doubling or throwing. This produces a sliver of multiple plies of filaments.

The sliver is run through the rollers of a drawing machine to compress it before it is twisted into yarn. Yarn that has a right-hand twist (to the right and up) when viewed from the end is said to have a "Z" twist, and yarn that has a left-handed twist (to the left and up) is said to have an "S" twist. Sometimes this is referred to as right-hand laid yarn and left-hand laid yarn. The finished yarn is wound on spools called bobbins. At this point, the yarn may be dyed various colors to

produce a strand, or an entire rope, of a particular color. This is especially helpful in finding a specific line in a maze of rigging on a sailboat.

**Forming twisted rope**

The bobbins of yarn are set on a frame known as a creel. For three-strand, right-hand twist rope, Z-twist yarns would be used to make each strand. The ends of the yarns are fed through a hole in a register plate which keeps the yarns in the proper relation to each other. The ends of the yarns are then fed into a compression tube. As the yarn is pulled through the compression tube, the tube twists it in the S-twist direction, opposite of the yarn twist, to produce a tight strand.

The strands are either transferred to strand bobbins or fed directly into the closing machine. For common three-strand rope, three S-twist strands would be used. The closing machine holds the strands firmly with a tube-like clamp called a laying top. The end of each strand is then passed through a rotating die which twists the strands in the Z-twist direction, locking them together. This process is called closing the rope.

The finished rope is wound onto a reel. When the end of the strands has been reached, the finished coil of rope is removed from the reel and tied together with bands of smaller rope. The ends are either taped or, if the rope is a synthetic material, melted with heat to prevent them from unraveling.

**Forming braided rope**

Braided ropes are commonly made from synthetic materials. The bobbins of yarn are set up on several moving pendants on a braiding machine. Each pendant travels in an oscillating pattern, weaving the yarn into a tight braid. A set of rollers pulls the braid through a guide to lock, or set, the braid and keep tension on the rope. In

some machines the braiding process is accomplished by feeding the yarns through separate counter-rotating register plates. One yarn is woven in one direction followed by another in the opposite direction, and so on, to form an interlocked braid.

If a double-braided rope is being formed, the first braid becomes the core, and the second braid is immediately woven on top of it to form the outer covering, called the coat.

As the rope emerges from the rollers, it is taken up on a reel. The finished coil is then removed and banded, and the ends are taped or melted.

**Forming plated rope**

Eight-plaited rope consists of four S-twist strands and four Z-twist strands. The strands are paired together with one S-twist and one Z-twist in each pair. These pairs are then held together and braided with the other pairs. The manufacturing process first follows the twisted rope process to make the strands, then the braided rope process to form the final rope.