

# Northend Rental & Construction Supply

13927 Highway 99 #2 • Lynnwood, WA. 98087

Phone: (425)745-5690 • Fax: (425)742-4848 • Toll Free: (800)613-4096  
www.NorthendRental.com • e-mail: Rentals@NorthendRental.com

Thursday, May 26, 2011

## Choosing the Right Pulling Rope

## What's Tied Up In Your Pulling Rope?

By Daniel A Green Jr

Around **Northend Rental**, we see it far too often. In the back of our customer's truck, a spool of brownish-yellow polypropylene rope, intended for use with a cable puller they are renting. Dirty, faded, fuzzy and usually woefully undersized – especially considering the capacity of the cable puller they will be using!

It's time to go over some things everyone should consider when it comes to choosing a rope for pulling cable – or any other high-force pulling application. The first and most important rule about rope is simply to know your rope. The material, the configuration, the condition and the size of the rope are all equally important when it comes to picking the right rope for a job.

### Materials

Every type of rope material has its' particular strengths and weaknesses and is designed for specific types of applications. Some materials, such as **polyester**, are excellent for pulling applications. **Polyester's** high strength, low-stretch (15% - 20% @ break) and excellent abrasion resistance make it good for what can be an extremely dangerous operation.

Some are ropes, especially **polypropylene**, are most definitely not designed for high-force pulling. **Polypropylene** is not a particularly high strength material, has poor abrasion resistance and worse yet, it stretches. A lot. As it loads up, **polypropylene** rope begins to stretch, essentially becoming a very long spring. And what is a spring but a device for storing energy? The higher the load, the more the stretch – up to 10 times its original length in places. The more it stretches, the thinner it gets. The thinner it gets, the weaker it gets, until it breaks – releasing all its stored energy back towards the puller. This can have disastrous effects on both the pulling equipment and the people around it. If you are lucky, the result will be broken equipment or painful welts. If you are not so lucky – lost fingers or eyes are not unlikely.

Some other rope materials are:

- **Nylon**: High strength combined with high stretch (30% - 35% @ break) and excellent abrasion resistance. **Nylon** is excellent for shock absorption but not recommended for continuous high-force pulling due to its stretching characteristic.
- **Spectra®**: Very high strength, very low stretch. (6% - 8% @ break) and superior abrasion resistance. Spectra® is an excellent material for a pulling rope, but is more costly than equivalent-strength polyester ropes.
- **Plasma®**: Highest strength, lowest stretch. (4% - 5% @ break) and superior abrasion resistance. **Plasma®** is the best material for a pulling rope but costs more than **Spectra®**.

**Rental • Sales • Service • Manufacturing**

# Northend Rental & Construction Supply

13927 Highway 99 #2 • Lynnwood, WA. 98087

Phone: (425)745-5690 • Fax: (425)742-4848 • Toll Free: (800)613-4096  
www.NorthendRental.com • e-mail: Rentals@NorthendRental.com

Thursday, May 26, 2011

## Choosing the Right Pulling Rope

### Configurations

The next important consideration in choosing a pulling rope is its configuration or how the fibers of material are combined to form the rope. When most people visualize rope, they tend to think of a three-strand configuration. A strand is formed by essentially twisting a bundle of fibers together. In a three-strand rope, these strands are then twisted together to form the rope. This is not the best configuration for a pulling rope. As force is applied, three-strand rope tends to untwist – or torque – itself and, unless you are using a swivel, transfers its former twist to the cables being pulled. Also, as the strands untwist, the rope starts elongating. This problem is addressed by using more strands, typically 8 or 12, and braiding – or plaiting – half of them clockwise and the other half counterclockwise. The twist of one set of strands is offset by the opposite twist of the other.

Another concern with braided rope – any number of strands – is abrasion. As the fibers wind their way throughout the strands and the plaiting, each one ends up on the outside of the rope any number of times. Then, sooner or later, as the rope gets abraded, you end up with no continuous fibers. In fact, each fiber can be broken many, many times over the length of the rope, greatly decreasing the overall strength. This problem is addressed by using a double-braided jacket over a large inner-core of straight fibers. The core provides the strength of the rope and has no twist to give torque under a load. This is then covered by a jacket composed of pairs of smallish strands braided in opposite directions. These pairs allow the strands to sit flatter and have more surface area than single strands with the same number of fibers, resulting in a smoother, better handling exterior, less material used in the jacket and a smaller diameter rope. This jacket has two main functions; it contains the core fibers and, most importantly, it takes all the abrasion allowing the strength of the core fibers to remain undiminished.

The two parts of a double-braided rope can be made of similar or dissimilar materials, depending on what you are trying to accomplish. Ropes made of differing materials are referred to as *composite ropes*. These ropes have the strength characteristics of the core fibers with the abrasion and handling characteristics of the jacket fibers. Since the jacket is basically a wear layer, it is often comprised of less expensive fibers than the core. For a continuous high-force pulling operation, it is best if the core material has an equal or lesser stretch factor than the jacket material. If the core fibers have a higher stretch factor than the jacket and begin to elongate, the strength of the rope would then begin to come from its (potentially abraded) jacket, thereby defeating the entire purpose of double-braiding!

Some composite ropes are:

- **D/S Composite:** The inner core is made of **Spectra®** and is jacketed by a sleeve made of **polyester**. It is characterized by high strength and low stretch (6% - 8% @ break) with excellent abrasion resistance. **D/S Composite** makes a very good pulling rope.
- **D/N Composite:** This is the type of rope Greenlee® sells for cable pulling. The inner core is made of **nylon** and is jacketed by a sleeve of **polyester**. We do not recommend this type of rope for continuous high-force pulling as the **nylon** core stretches much more (30% - 35% @ break) than the **polyester** jacket. (15% - 20% @ break)

**Rental • Sales • Service • Manufacturing**

# Northend Rental & Construction Supply

13927 Highway 99 #2 • Lynnwood, WA. 98087

Phone: (425)745-5690 • Fax: (425)742-4848 • Toll Free: (800)613-4096  
www.NorthendRental.com • e-mail: Rentals@NorthendRental.com

Thursday, May 26, 2011

## Choosing the Right Pulling Rope

### Condition

The overall condition of your rope is as important as anything else. Obviously, cuts and abrasions are going to effect the tensile strength of any rope, but other factors such as age, dirt, heat, UV exposure and chemicals are all going to act to decrease the overall strength of a rope. Knots and kinks create stress-risers that can further reduce the tensile strength by up to 50%. A loop in the end of the rope should always be a properly woven eye; never knotted!

Anything you can do to keep a rope clean (or cleaner) is going to increase its usable life. As your rope is coming off the capstan of the cable puller, I suggest letting it fall onto a tarp or large piece of cardboard rather than straight on to the ground. Even letting it hit a floor that has been vacuumed or swept would be better than nothing. Any grit or dirt that gets between the fibers of a rope act like mini-saws or mini-files the next time you pull with it, abrading the fibers shortens the life of your rope. Also, don't store your rope in direct sunlight as UV tends to breakdown the materials used in most pulling ropes. Think about this; which part of the rope would be getting the most UV? The end you usually attach to the cable! You know, the end that endures the most force for the longest periods? (It's usually the dirtiest end too!) The best practice would be to rewind the rope in the opposite direction on its spool each time it was used.

### Size

Choosing the size of a rope should take the least amount of thought. It is best determined by taking the maximum expected load and multiplying it by a safety factor. Then, you simply look on a chart for the type of rope you want to use and it will show the proper size. This is really a no-brainer. Someone else has already done the work for you.

Unfortunately, many references tend to focus on the *average breaking strength (ABS)* of a rope. Simply break a bunch of ropes and add up the loads at which each one broke, divide by the total number of ropes tested and you have the *ABS*. The upside is that half of the ropes tested took more force than the *ABS* to break. The downside is that half the ropes took less. Which rope would you rather have? How can you know which one you **do** have? A number that is much more meaningful is the *minimum breaking strength (MBS)*. This is defined as two standard deviations (approximately 10%) below the average. All ropes will break above their *MBS*. However, neither the *ABS* nor the *MBS* alone should ever be used to select a rope to handle an equal load. You need to include a safety or *design factor (DF)*. A good typical *DF* is 4:1, or 4 times the maximum expected load. For example; if you are using an 8000 lb. cable puller, multiply 8000 x 4 and you come up with 32,000. Therefore, you want a rope with a *MBS* of approximately 32,000 This figure can also be mitigated by knowledge of what you are pulling. Obviously, pulling four 1/0 cables is not going to take nearly as much force as pulling four 750MCMs! If all you ever do is pull 1/0 cables, you can probably buy a smaller rope and be fine. However, if you do go smaller, you should seriously consider using a break-away swivel. What happens if the cable gets stuck? The force will continue to rise up to and above the maximum capacity of the puller until either the puller breaks, the rope breaks, the cable comes unstuck or the operator gives up. In the end it is safer to base your rope purchase around the capacity of the machine.

**Rental • Sales • Service • Manufacturing**

# Northend Rental & Construction Supply

13927 Highway 99 #2 • Lynnwood, WA. 98087

Phone: (425)745-5690 • Fax: (425)742-4848 • Toll Free: (800)613-4096  
www.NorthendRental.com • e-mail: Rentals@NorthendRental.com

Thursday, May 26, 2011

## Choosing the Right Pulling Rope

### Safety

As always, safety should be everyone's primary concern on the jobsite. You should always read, understand and follow your equipment manufacturers' setup and use instructions. When combined with proper safety gear, choosing the correct rope will help ensure that the job gets completed and everyone goes home with all their body parts intact.

### Rope Minimum Breaking Strength Comparison (Pounds)

Size	Polypropylene	Polyester Double Braid	D/N Composite (Greenlee®)	D/S Composite Double Braid	Spectra 12-Strand	Plasma 12-Strand
1/2"	3400	8400	11,100	13,950	22,500	31,300
9/16"	4350	10,750	14,400	18,800	27,700	37,900
5/8"	5000	12,300	16,500	24,600	36,600	51,400
3/4"	6885	17,400	23,400	31,500	43,200	68,500
7/8"	9490	24,000	28,800	44,800	61,000	92,600
1"	11200	31,200	37,400	51,600	72,000	110,000
1 1/4"	15860	48,100	57,800	72,700	102,000	165,000

### What's the Right Rope for My Cable Puller?

First, consider how various cable pullers are marketed. Greenlee® uses the continuous-duty capacity as the rating on their cable pullers. Other companies, such as Ensley Tool Co, used the peak capacity as a rating. However, Ensley used accessories in their 8000 lb cable puller that were interchangeable with Greenlee's 4000 lb model. Both used 3/4" pins for all of the sheaves, which would suggest similar capacities.

### Minimum Rope Size for Cable Pullers (Diameter)

Capacity	Polyester Double Braid	D/N Composite (Greenlee®)	D/S Composite Double Braid	Spectra 12-Strand	Plasma 12-Strand
1500#	7/16"	3/8"	3/8"	1/4"	3/16"
2000#	1/2"	7/16"	7/16"	5/16"	1/4"
4000#	3/4"	9/16"	9/16"	7/16"	3/8"
6500#	7/8"	3/4"	5/8"	9/16"	1/2"
8000#	1"	7/8"	3/4"	5/8"	1/2"
12,000#	1 1/4"	1 1/4"	1"	7/8"	5/8"

**Rental • Sales • Service • Manufacturing**