

## **A History of Roundslings**

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Dennis St. Germain

2000 BC to 2007:

Since the beginning of large projects requiring rigging expertise, there has been a form of roundsling employed for some of the lifting and pulling. The early slings were multiple wraps of material consisting in the earliest days of just vines. The more the vine was wrapped around a load the heavier the load it could carry or drag. This idea of multiple wraps making a stronger lifting or dragging sling was also used for manila and hemp ropes and after the 1850's with wire rope. Early projects that incorporated these primitive roundslings were the Pyramids in Egypt, the religious artifacts called Stonehenge in England, the Roman Aqueducts and the Statutes on Easter Island. All of the various projects from far flung parts of the world used essentially the same construction of multiple wraps of whatever material was available to connect force to load.

None of the early roundslings looked anything like current day products because none had covers. Yes some would have wrapping or serving of areas exposed to wear. These servings or wrapped sections would also help to hold the multiple parts together making a homogeneous sling product.

In my youth, during the late 1950's, I had the privilege of manufacturing a roundsling product which we referred to as a "Luffing" sling. This was made with multiple wraps of sisal and had the bight or ends wrapped for several inches with sisal material to preclude abrasion wear at the points of contact with the crane hook or the load.

Early machinery for the fabrication of these products consisted of a pair of nails driven half-way into a 2" x 4" piece of lumber with the spacing appropriate to the length of the finished sling. The sling material, in the above case sisal, was then wrapped a certain prescribed number of times and the ends tied together to complete the circuit. Later advances had the 2" x 4" attached to a machine that would wind the wraps using an electric motor. Counting of the correct number of turns was facilitated by attachment of a playing card to one end of the 2" x 4" which would make a noise slapping against the floor on each rotation. Counting the number of slapping sounds resulted in a correctly made finished product.

In the late 1960's a very smart man named Ruben Henry Norrman, of Malmo, Sweden invented a roundsling which used a seamless cover and involved a secret process for filling this cover or tube with multiple strands or wraps of continuous polyester fiber. The machinery and the technique he developed for this product was unique and much like the famed Rubik's Cube was nearly impossible to figure out.

In 1972, Ruben Henry Norrman was granted a United States Patent covering his invention. Subsequently, this patent was licensed by the LiftAll Company of Landisville,

Pennsylvania. They began producing the new roundsling product and are still making and selling this invention in the United States and Canada as of this date.

In Europe, Ruben Henry Norrman licensed the invention to Spanset Inter AG of Basel, Switzerland and they in turn make and sell the products world wide to this day.

When the patent application for this seamless roundsling product was filed in the United States a very brief description was given of the product but there was no indication of how the product was fabricated. The application read: "A strap consisting of a core of one or more skeins (wraps) and a protective covering of flexible material around the core, said covering consisting of a hose or tube with an unbroken seamless wall." This lack of definitive information for the manufacturing procedure was intentional and intelligent business strategy. If a competitor had no idea how to make the product it was unlikely the process could be developed without help from Mr. Norrman or a licensed fabricator. The machinery was sophisticated and expensive providing a cosmetically attractive finished product.

Anyone who asked for a tour of a roundsling facility to view the process of making a seamless tube roundsling according to the patent of Ruben Henry Norrman would be shuttled through the plant with no opportunity to view the machinery. It was off limits to anyone that wasn't an employee of the licensed fabricator. As a visitor you would be told: "The process is a secret - no one is allowed to see how hundreds of meters of polyester core yarn are introduced into the tube or sling cover."

The patent for the seamless tube round sling expired in the United States in 1989 but even today in 2008 there are very few manufacturers who have succeeded in figuring out the machinery necessary to duplicate or improve on this product. Until 1996 all of the slings made to this license were made using polyester core material. In 1996 aramid fibers were introduced in some products resulting in a lighter, stronger sling with less stretch. Familiar trade names for aramid fibers are Kevlar®, Twaron® and Technora® fibers. Later, high molecular polyethylene like Spectra® and Dyneema® became popular either singly or in combination with other fibers.

In 1980, another inventor in Sweden, Bengt Lindahl, produced two other types of roundslings which did not infringe on the patent of Ruben Henry Norrman. These were roundslings that had the cover wrapped over the core yarns and sewn down either the side or the middle of the sling. These products were called either middle seam or side seam roundslings. The former was the first one that Mr. Lindahl developed but there is a slight problem with the fabrication process because sewing the seam down the center of the sling is difficult and the needle penetrates the core yarns. Approximately four months after the center seam sling was invented the side seam product was produced and this proved to be the easier of the two to fabricate. In July of 1980 the middle seam round sling received a United States patent and in November of the same year the side seam sling was patented. Both patents on side seam and center seam roundslings are expired.

Bengt Lindahl worked for the Svensk Lasthantering AG Company in Sweden when he assigned them the inventions and he was also a stockholder in the company. In fact, he held a controlling interest. Later this company was purchased by the Bridon Group and became a part of Bridon Scandinavia.

In the United States several companies began to produce the side seamed roundsling including Liftex; Kinedyne; Universal; Wire Rope Corporation of America; and others. To this day the material for the core yarn in these slings continues to be almost exclusively polyester. The machinery for the production of the side seamed roundsling is less sophisticated than that required for the seamless type of sling and therefore these seamed products are easier to duplicate.

In 1987, Dennis St. Germain of SLINGMAX® Inc. built machinery for the production of a new roundsling product that was different than any of the preceding inventions. This was the Twin-Path® sling which had a seamless cover divided in the center so two separate and independent cores were used to form the load carrying portion of the sling. The original core yarn was 100% polyester but within a year of the development of the Twin-Path® high performance core yarns were tested and used in some finished products. The high performance core yarn was much lighter than either polyester or steel giving riggers in the field a new tool for increased safety and productivity. Another feature of the Twin-Path® was the double cover with a red inner and contrasting gray or green outer cover.

In 1989 the Twin-Path® sling was patented in both the United States and Canada and other countries around the world. The product was also trademarked for protection of its unique name and fabrication techniques. Licensed franchises were developed in over thirty geographical locations to service customers everywhere. Today the SLINGMAX® dealer group consists of more than seventy sales locations and thirty seven fabrication centers which have the capacity to deliver products to customer's world wide. Included are the United States, Canada, Mexico, Japan, Australia, India, England, Italy, Singapore, China, and South America.

The machinery for producing Twin-Path® slings was developed by Dennis St. Germain and is provided to the licensed fabricators. Some of the strongest and longest roundslings ever made were produced on these machines using the Twin-Path® technology. Slings are commonly fabricated from 18" to over 100' in length with capacities to 1,000,000 lbs.

In 1997 a new patent covering Twin-Path® innovations included the new overload Tell-Tail indicators and an internal fiber optic inspection system. The core yarns can now be inspected using the fiber optic system for crushing, chemical damage, cutting, and abrasion damage. The fiber optic inspection is activated using external light sources or a dedicated flashlight beam. The shrinking of the overload Tell-Tails indicates severe overload. Current Patents covering the Twin-Path® sling will be valid until 2017.

Core yarn advancement for the Twin-Path® sling began almost immediately after the first sale was made using polyester. High Performance Fiber which consists of synthetic

yarn with 15 or more grams per denier was first used in Twin-Path® slings in 1988. (Polyester and nylon have a GPD of 8-9.) Later, high molecular polyethylene (HMPE) was used either alone or in combination with aramid yarn to form the load bearing cores of Twin-Path® slings. The use of these high performance fibers provided higher strength and lower weight.

Experimentation with different combinations of HPF fibers lengthened the life of the slings by creating tension members resistant to fiber on fiber abrasion and fatigue. The life of a single strand in laboratory testing went from 300 to 18,600 cycles. The new high performance composite core yarn was given a new trademarked name, K-Spec® fiber. This name represented the town where it is produced, Kernersville, NC, and the “special” nature of the material. Slings made with K-Spec® fiber are 1/7<sup>th</sup> the weight of chain or steel wire rope and 1/3 the weight of polyester slings. Advantages include greater productivity, less workers compensation claims, lower transportation costs and storage improvements.

Twin-Path® slings with K-Spec® core yarn were put through rigorous cycle testing to determine their resistance to fatigue and fiber on fiber abrasion damage. Three slings were used for the most recent testing program. Each was six feet in length with a rated capacity of 25,000 lbs and a designed breaking strength of 125,000 lbs. The slings were attached to the bow of a 13.5 ton shackle and pulled 50,000 times to 37,500 lbs representing a 50% overload. Each sling was then examined for external damage and nothing was found. The exterior covers were intact. One sling was then pulled to destruction on the same shackle bows with a failure point of 118,000 lbs or nearly the same breaking strength as a new sling.

The patent for the Twin-Path® sling states that: “The lifting sling of this invention comprises multiple discrete sling cores formed from a plurality of longitudinally extending parallel segments which are each contained inside separate cover material which form paths or channels arranged in an endless tubular loop. At least two separate longitudinal endless paths of cover material which is sealed or fastened to prevent contact between the sling cores.”

The Twin-Path® sling like the original seamless round sling patent is hard to duplicate and the machinery is technically superior. The Twin-Path® equipment differed from the existing technology because it permitted the use of thicker, longer wearing, and stronger covers on the finished products.

Because the technology of the roundsling provides the end user with significant advantages this synthetic rigging product has taken a large share of today’s market for lifting slings. Up until 1970 most lifts over 20 tons were performed with wire rope or chain. Since the invention of the roundsling significant changes have occurred in the world of heaving lifting using synthetics in place of steel.

During the 1990’s lifts that would have been done with large capacity and very heavy wire rope slings were performed with Twin-Path® slings with K-Spec® core yarn. These

products develop enormous strength yet have very low weight and can be made in matching lengths. Another major benefit is the low stretch of HPF yarn, nearly identical to steel wire rope. These new products give the rigger a great tool for accomplishing their tasks.

On the following page there is an attempt to show the reader the increases in tonnage associated with lifts using the latest advances in technology. In the past thirty years the use of synthetic round slings for heavy lifts has continued to grow. The realization that heavy steel slings can be replaced with these new inventions has become a reality around the world. Certainly the originators, Messieurs Norrman, Lindahl and St. Germain had no idea of the significance of their inventions.

**Chronology of lifting with roundslings:**

2000 BC – 1970 Lifts up to 20 tons

1971-1988 – Lifts up to 50 tons accomplished with polyester core yarn

1989 – Introduction of High Performance Core Yarn – 450 Ton lift with three Twin-Path® slings at the Lantana, Florida shipyard.

1990 – 500 ton lift at the St. John Shipyard in St. John, New Brunswick – Followed by 60 more 500 ton lifts and many smaller lifts.

1994 – Several lifts in New York City between 650 and 850 tons.

1995 – 850 ton lift in St. John, NB followed in subsequent years with lifts to 1,000 tons using the same set of four slings.

1998 – 1,050 ton lift of a nuclear reactor in Portland, Oregon

2002 - 1,080 ton lift of an oil rig drilling unit in Halifax, Nova Scotia

2004 – to present, many more successful lifts to 1,000 tons.

Many other special tasks have been performed with roundslings made by various manufacturers. High performance roundslings used for deep sea recovery work have allowed large loads to be raised from great depths. Using remote operated vehicles (ROV) the U.S Navy has been able to bring up 30 ton F15 Fighters from as deep as 5,000' in the Pacific Ocean. Today plans are in place to use these products for lifts up to 2,000 tons in the Gulf of Mexico.

Since HPF synthetics become stronger when exposed to extreme cold the products have also proved useful in heavy lifting tasks in an arctic environment. They have been used to wrap around ice burls and tow them out of shipping channels. They are used for towing heavy mining vehicles when they become stuck in temperatures down to -50 degrees.

Currently there is only one International Standard covering all types of roundslings including High Performance Fiber roundslings. This was introduced by the Cordage Institute in 2007 and is referred to as 1905-07. The Japanese Industrial Standard effective in 2008 was partially based on the CI 1905-07 and has specific reference to High Performance fibers for roundslings.

Plants with down time associated with machinery replacement and repair have found their facility can be back on line faster with lighter rigging slings made with high performance fiber. Nuclear energy plants can save up to \$1 million for every day they are back on line ahead of schedule.

The age of synthetic roundslings is here and the future will hold many more great ideas that will improve the lives of riggers everywhere. If you have an invention to contribute to the process make sure that you bring it to the world's attention. Do it now while it is fresh in your mind! Most of the history of roundslings is yet to be written.

Dennis St. Germain