Innovative Rigging Products:
Yesterday, Today, & Tomorrow

By Dennis St. Germain

Although the wire rope, cordage, chain, and hardware industries gradually made improvements and innovations from around 1850 to 1950, the greatest and most significant advances in lifting gear has occurred within the last half century.

Yesterday: 1850-1950
The story of rigging gear innovation is mainly confined to the last fifty years. The first 100 years from 1850 to 1950 was dominated by wire rope, manila cordage, and chain. There were few significant changes affecting the skilled rigger or Millwright during this period. Sure, there were some innovations like the development of braided wire rope slings that afforded greater flexibility, but for the most part, everything was as heavy and awkward to use as it would ever be.

Wire rope was strengthened by using different methods to heat treat and draw the wire. Pre-forming of wire rope to keep the strands in position without serving was a great improvement.

Wire and manila rope slings were terminated with hand splices that were labor intensive especially in the larger sizes. Workers using manila rope spent the evening removing splinters from their hands. Chain slings were made from wrought iron and were nearly twice as heavy as modern chains for the same capacity.

Major employers like steel companies, shipyards, and refineries had their own on site rigging loft where slings were fabricated. Blacksmiths made most of the hooks, shackles, and chain connectors. Shortly after WWII these company owned and operated rigging lofts began to give way to local family owned sling fabricators. Hardware manufacturers replaced the home made fittings with properly tested connectors. Wire rope clips were invented and fittings were standardized and made to a design factor.

A new industry was born; the fabricated sling industry consisting of hundreds of small companies serving local areas surrounding their facilities. These companies would be the nucleus of the Associated Wire Rope Fabricators, the Web Sling and Tie-Down Association, and other industry groups.

If wire rope slings had been used for this 760 ton lift, they would have added approximately ten additional tons to the load. Since this lift was made back in 1994, several more in the 1,000 ton range have been safely accomplished.

1960-1970
In the decade of the 1960's, the first breath of change whispered across the landscape as new terminations for wire rope replaced hand splicing. Talurit aluminum sleeves appeared and shortly after came the steel sleeve Flemish Eye splice. Synthetic cordage in the form of nylon, polypropylene, polyethylene and polyester began a slow replacement of manila rope. These new inventions were conceived long before the marketplace was ready to accept them and the initial reaction was negative.

Swaging machines were marketed complete with dies and sleeves for wire rope termination. Those who could afford these new tools were able to gain market share in their respective cities.

A brand new lifting sling made from nylon webbing was introduced to the market by pioneers like Liftex® Inc, Wearflex® Inc, and LiftAll® Inc. These synthetic slings became instantly popular as replacements for wire rope and chain slings. Features of web and cordage synthetic slings were easier handling, flexibility, cleanliness, competitive pricing, and longevity. Web slings did not kink like wire rope and were preferred over chain for many of the lighter lifts. New sewing skills had to be learned to fabricate these new products.

SLINGMAX® Solutions Begin! Today:

Dennis St. Germain began working in the sling fabrication industry in 1959 as a splicer for the Henry Stewart Company in Philadelphia. In 1963 he began I&I Sling Inc. and in 1987 founded SLINGMAX® Rigging Products. During his 45 years in the industry he has tried to work with new and existing materials and processes to find solutions for rigging problems. Working with Dennis, his son Dennis A. St. Germain, Ken Coe, and Tom DeSoo, solved problems that have nagged at riggers over the years. The following solutions incorporate only those that were commercially successful and do not include many one time or limited applications that did not have universal significance.

1974 Tri-Flex® Sling Development: Large diameter single strand wire rope slings with mechanical splices created problems for fabricators and end users alike. On the fabricators side of the equation was a large investment in big swaging machines, dies, handling equipment, and inventory. The customer had to contend with very heavy steel wire rope slings that were not matched in length, stiff, hard to handle, and required an extra crane or whip line to rig them. When attached in a choker hitch a wire rope sling would kink, or take a “set”. Large wire rope slings made from a single piece of wire rope were much heavier than necessary because they had large steel sleeves for the splice connection and more material in the loops than needed to support the strength of the body.

To counteract these deficiencies in wire rope slings, Dennis St. Germain developed and patented the Tri-Flex® wire rope sling. This was made from a single piece of wire rope that was helically wrapped around itself to form a three part body. The splice connection was consummated with a steel sleeve approximately one-third the size and weight of a sleeve used on a traditional single part wire rope sling. The Tri-Flex® sling could be made in matching lengths to conform to the requests of riggers in the field. The finished product was three times more flexible than the traditional product it replaced and 10-20% lighter.

For example:

• Traditional 4" x 50' wire rope sling, 6x37 = 222 wires - weighs: 2,230 lbs.

• Tri-Flex® 2-3/8" x 50' wire rope sling, 3x6x37 = 666 wires - weighs: 1,850 lbs.

The beauty of the Tri-Flex® sling for the fabricator was the ability to make big slings using existing swage machines and inventory. For the end user, the sling was easier to handle, store, and competitively priced because lower weight translates into less material cost. For example, a Tri-Flex® sling with 145 tons vertical rated capacity could be made on a 1,000 ton swaging press. Previously, a swaging machine of 4,000 ton capacity was required to make single part wire rope slings with this capacity.

Prior to the development of the Tri-Flex® wire rope sling, Jim Mazzella, of Cleveland, had patented a three part flexible sling terminated with hand splices. This product could be made using up to 1" diameter wire rope. He also held patents on several other types of multi-part helical wound slings. When lifts got heavier and larger capacity slings were required, the natural process was to find a way to make bigger slings using mechanical splices. The Tri-Flex® sling answered the question of how to make big wire rope slings that were user and fabricator friendly.

1978 Tri-Flex® Wire Rope: A Tug and Barge company was having problems with winches containing 7/8" wire rope. The hubs were too small in diameter for the stiffness of the wire causing a jumble of cross overs and premature failure. The idea for Tri-Flex® wire rope, a product that was very flexible and easily manufactured in lengths to 200', was the solution to this problem. The technical term for this application was Tri-Flex® Pusher Cables, a product that sold all over the East Coast of the United States.

1979 Tri-Flex® Sling System: Some rigging customers asked for a wire rope sling that could be used for heavy lifts and somehow made into slings for smaller subsequent lifts. Many big lifts were accomplished with large wire rope slings that had no useful purpose after the initial lift was completed. After a period of discussion and trials, the Tri-Flex® sling system was invented and patented. This product allows the formation of a nine-part body wire rope sling that is made from three Tri-Flex® slings. When the heavy lift is finished, the three individual components can be separated and used as stand alone slings for smaller lifts. An example: A 5-1/2" Tri-Flex® Sling System with 130 Ton VRC is composed of three 2-3/4" Tri-Flex® slings with 46 Ton VRC.

1980 Chain Saddle Ring: Adjustable chain slings were marketed that allowed a customer to adjust leg lengths to meet various requirements to balance loads. Sometimes a load has uneven lifting points, or the weight is unbalanced, and to lift level requires shorter and longer chain legs. These assemblies were heavy and expensive, so the situation demanded a product that would do exactly the same job but one that would be lighter and less expensive. The solution was an invention called the Chain Saddle Ring. Dennis St. Germain devised a product that had a saddle support under a single chain link so the chain could be shortened on one side of the ring while it was getting longer on the other side. The saddle imparted a foundation to maintain the strength of the link. At the same time this invention was coming to market, the same saddle support idea was developed separately at Columbus-McKinnon Corporation for a “cradle grab hook”.

1982 Gator-Laid® Wire Rope Slings: Larger heavier lifts required fabrication of higher capacity multi-part lifting slings. Rigging engineers wanted multi-part slings that could be used on small pins at a 1/1 D/d ratio where D is the pin and d is the sling body. Traditional multi-part wire rope slings were all made using a single piece of wire rope. They did not have enough material in the eyes to support their rated capacity at a 5-1 design factor when used on a 1/1 D/d ratio. For example, the traditional nine part sling had ten pieces of wire rope in the loops, five on each side of the eye. Compounding this weakness was the cross overs of the eye components. When tested on a pin with a 1/1 D/d ratio, the sling would only develop 60% of the component breaking strength instead of the required 70%. The same deficiency existed in six part and eight part braided slings made with a single piece of wire rope. Dennis St. Germain addressed this problem with the development of the Gator-Laid® wire rope sling made from three separate pieces of wire rope. The finished nine-part sling has twelve parts of wire rope in the eyes, six on each side. Further, these wire ropes in the eyes are laid parallel without cross overs imparting greater strength. Actual testing of nine-part slings with 4" bodies on a 4" pin indicated the Gator-Laid® design had over 100,000 lbs higher strength than the traditional nine-part sling.

1984 Gator-Flex® Slings and Grommets: Some customers did not approve of the Gator-Laid® design because the sling eyes were wrapped with material to maintain the integrity of the parallel design. These riggers wanted a multi-part sling that would allow visual inspection of the eye and sling body components. The Gator-Flex® was developed for these customers to provide a sling without the need for wrapping of the eyes. However, the wire ropes in the eyes do cross over each other requiring a 5% strength deduction from the Gator-Laid® design. The Gator-Flex® design was useful in construction of multi-part wire rope grommets that had much greater flexibility than traditional strand laid or cable laid grommets. The Gator-Flex® grommet is 9 x 6 x 37 compared to 6 x 37 for the traditional strand laid grommet or 6 x 6 x 37 for a cable laid grommet.

1985 T&D Ultra Flex Slings: Utility companies require strong and flexible wire rope slings to be used for stump pulling. When poles are damaged the stumps must be pulled out of the ground and the pole replaced with a new one. Standard wire rope slings could not choke tight enough and still be strong enough to pull the stump from the ground. Dennis St. Germain worked with a line crew to invent the Transmission and Distribution (T&D) Ultra-Flex wire rope sling. This product is similar to a Gator-Flex® design except it is finished with swaged sleeves instead of hand splices. The construction is 9 x 6 x 37 or 9 x 7 x 7 x 7 when extra flexibility is desired. These slings are the most flexible wire rope slings ever made for lifts up to ten tons in a choker hitch.

1987 The Invention of Twin-Path® Slings: Twin-Path® slings and the production machinery to fabricate them were developed in 1987. However, a little history on the invention of the round sling is in order. In the late 1960's, Ruben Henry Norrman, of Malmo, Sweden invented a round sling which used a seamless cover. In 1972, Mr. Norrman was granted a United States Patent on his round sling product which he licensed to LiftAll Inc. In 1980, Bengt Lindahl, also of Sweden patented two round sling products, one with a side seam and the other with a center seam. Neither of these products was made with seamless tubes. The center seam round sling proved difficult to make so the side seam sling became the main product of Bengt Lindahl. Bengt licensed his patent to Svensk Lasthantering AG of Sweden, who eventually licensed other companies including Universal, Kinedyne, and Bridon.

Dennis St. Germain questioned riggers who were using round slings to find out how the products could be improved. The Twin-Path® sling with two separate slings between the hook and the load, a double cover with a red cover underneath the outer cover, and overload indicators, were the main considerations for the new invention. Riggers also desired a sling that could be repaired and wanted tougher covers made from heavy duty material. Dennis developed all of these features and a machine that could produce the products. The machinery developed for the production of Twin-Path® slings represented a significant improvement because any cover material could be used to make round slings on this new type of machine. These inventions along with many others were the nucleus of the SLINGMAX® organization that today fabricates patented and trademarked slings around the world.

1988 First use of High Performance Core Yarn: Polyester fiber was the core yarn used in all round slings prior to 1988. New high performance fibers were just gaining popularity in the cordage market, and in 1988, Dennis St. Germain began making Twin-Path® slings using high performance fiber in place of polyester. The result is a sling product that is 1/3rd the weight of polyester, and up to 90% lighter than wire rope or chain. High performance fibers have little stretch, only 1% at rated capacity compared to 3% for polyester round slings. The use of high performance fiber greatly expanded the range for synthetic slings raising the bar against wire rope slings.

1989 Heavy Lifts with Twin-Path® Extra slings: The first really heavy lift using synthetic Twin-Path® high performance round slings was made in 1989. This was a ship lift at the Lantana, Florida shipyard using three slings to lift 450 tons. On October 13, 1990, another significant lift of 500 tons was made using four Twin-Path® Extra slings at the St. John Shipyard in New Brunswick, Canada. Prior to these lifts using the new high performance yarn, the largest lifts using synthetic slings had been less than 100 tons. In 1994 several 800 ton lifts were performed in New York City by Canron Construction Company of Toronto. In later years, several lifts to 1,000 tons have been completed successfully leading to a whole new market for synthetic slings. The advantages include lower boom tip weight, greater productivity, lower job cost, safer job sites, easier handling and storage, lower transportation costs, and happy riggers at the end of the day.

1991 K-Spec® Core Yarn: Dennis St. Germain began experimenting with other types of high performance core yarn including HMPE, high modulus polyethylene. Working in conjunction with his son, Dennis A. St. Germain, the work proceeded to a successful conclusion. Various types of high performance fiber became available. Each had different characteristics and by blending them into a composite, each of the fibers provided benefits to the other. Thus was born K-Spec® core yarn, a product used around the world today in Twin-Path® slings. K-Spec® is a combination of Kernersville, North Carolina where it is made, and Special for the characteristics that separate it from all other round sling core fibers. In a finished sling cycle test, a Twin-Path® 2,000 x 6' sling was pulled 50,000 times to 30,000 lbs and still developed 100% of its original designed breaking strength. The 30,000 lbs represents a 50% overload because the sling was designed for a 20,000 lb rated capacity at a 5-1 Design Factor.

1992 Sparkeater® Slings: Some customers had heat problems that could only be solved with special application synthetic slings. Aramid yarn had a principle feature besides strength, and that was great heat resistance. Nomex® fiber had been used for years to make fire resistant clothing and combining a Nomex® cover with an aramid core made a fire resistant sling up to 300 degrees F. The new product was named a Sparkeater® synthetic sling and sales have reached $200,000 annually in the years since its development. This was the first heat resistant synthetic round sling in history.

1993 Synthetic Sling Shackles: Dennis St. Germain realized that all of the fittings, shackles, rings, hooks, etc currently on the market were created for wire rope or chain. To develop the full strength of synthetic slings, a different geometric shape was in order for hooks and shackles. Synthetic round and web slings present a flat surface to a connector and all of the connectors at this time were round. Initially, Dennis heated shackles until they were glowing red, then placing them in a swaging press, forced them into a flat geometric shape, cooled the piece, and attached a synthetic sling. The flat shape of the fitting increase the breaking strength of the synthetic sling compared to standard shackles. Dennis then approached the Crosby Group and working with them developed factory made synthetic sling shackles that first came to market in 1993. Since then other manufacturers have joined the fray creating a plethora of connectors that have grown the synthetic sling market.

1994 Fiber Optic Inspection System: During seminars, the question would invariably be raised by attendees regarding the inspection process for the inside of round slings. The lamentation was that the cover precluded visual inspection therefore the slings could not be trusted. Chemicals, heat damage, and crushing of the core yarns could not be detected from the outside. This idea was entrenched in the minds of many people so Dennis St. Germain looked for a solution to the problem. The answer was a fiber optic cable that could be inserted with the core yarn and travel around the inside of the Twin-Path® round sling. At first, fiber optic cables were thought to be a poor choice because they were made using glass. However, 2% of all fiber optics are made with polyethylene, a material that is similar chemically to the K-Spec® core yarn used to make Twin-Path® slings. The polyethylene fiber optic also has the same temperature limits, from -40 to +180 degrees F. This became the perfect solution for quick efficient inspection of the inside of slings, detecting damage from chemicals, heat, or crushing. If the fiber optic continuity was interrupted, the sling could be taken out of service and returned to the manufacturer for repair evaluation. A patent for the fiber optic inspection system was issued in the United States in 1997 and other countries soon followed.

1995 Twin-Path® Adjustable Bridles: Many lifts require riggers to spend time adjusting the length of slings trying to lift a load level. This is a problem associated with unbalanced loads and different height lifting points. To address this issue with synthetic Twin-Path® slings, a special ring was developed that would allow a load to be lifted level without specific input from the riggers. The device has a double sling on one side and a single sling on the other. The double sling is attached to the heavy side of the load and the single sling to the lighter side. When force is applied the ring moves over the center of gravity and causes the load to rise evenly. This product is called a Twin-Path® Adjustable Bridle sling.

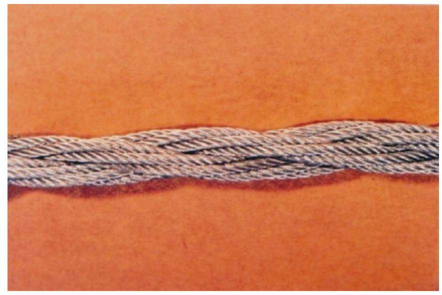
1996 Synthetic Armor Wear Pads: To keep load edges from damaging a synthetic sling, many types of wear pads made from various materials were tried. It was thought

Pads used for abrasion protection were long thought to also provide cut protection. Recent testing has proven this theory wrong, and dangerous.

that the magic bullet material could prevent cutting and protect both the load and the sling. Several styles were developed including removable and sliding wear pads. However, subsequently it was determined through testing by Dennis A. St. Germain, that another invention would be necessary to actually protect slings from cutting. The synthetic armor pads worked well against abrasion damage, but cuts were something else entirely. (see 2001 CornerMax® pads)

1997 G-Link® Connectors: This is a single piece steel fitting that fulfills many functions. It is designed to be used on web, round, and Twin-Path® slings. The G-Link® is patented in many countries. It functions as a choker hook, for connecting two slings together, for connecting hooks and rings, and to adjust the length of a web sling. The criteria for the design included the following: A one piece fitting that could do all of the above, rather than the four - five piece fittings necessary under current technology. Currently, the Caldwell Company manufacturers this revolutionary hardware for the industry, including SLINGMAX® Dealers.

1997 Gator-Max® Wire Rope Slings: This product is a nine-part body sling with twelve parts in the loop and a magical termination. To fabri-



9-part braided body of a Gator-Max sling.

12-part "parallel laid" eye on a Gator-Max sling.

cate this product requires knowledge, skill, and very few tools. The sling finishes with a hand splice at both ends, but requires no splicing. The tools required consist of a tape measure, wire rope cutter, and marking crayon. In testing for the US Navy, two slings fabricated from ½" EIP IWRC wire rope broke within 100 lbs of each other at over 220,000 lbs. Traditional nine-part slings made from the same material only reached 170,000 lbs. All testing on 2" pins, 1/1 D/d ratio.

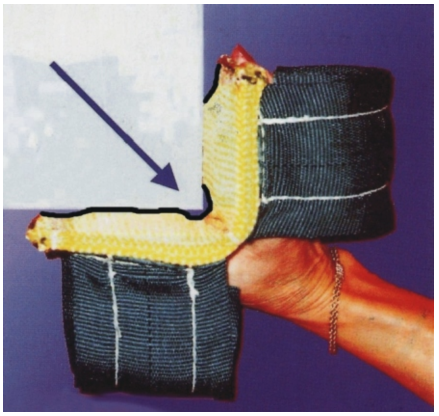
1998 Twin-Path® Two Leg Bridle and Eye & Eye Style: Ken Coe of American Wire Rope in Indianapolis, Indiana patented a method for the construction of a Twin-Path® Two Leg sling that required no steel ring. The lightness of this invention further enhanced the Twin-Path® product line and gave riggers new advantages of safety and productivity. Kenny also developed a more traditional eye and eye sling that fulfilled the wishes of many riggers in the field for something other than an endless style Twin-Path® sling product.

1999 Pad Eye Tester: Working with riggers in a shipyard Dennis St. Germain discovered that when making critical lifts, they were required to use only tested rigging gear. However, many times the tested gear would be connected to welded pad eyes on ship bulkheads, pad eyes that could not be tested before the lift was made. The workers asked if a machine could be invented that would be light and portable, but could test pad eyes in place with a force up to twenty tons. Working with design engineer Dave

Frelke, Dennis developed the Pad Eye Tester, a machine that can test pad eyes welded in place to twenty tons, but weighs only forty pounds. These testing devices are currently in use around the world to make work places safer and prevent accidents.

2001 CornerMax® Wear Pads: It was discovered through testing that no natural or synthetic material used for wear pads would resist cutting if exposed to a pressure of more than 7,000 lbs, directly against a sharp edge. Of course steel in the form of wire mesh, or a half-round, could prevent cutting, but these were heavy and created other dangers if they fell on a job site. Since many synthetic slings were exposed to edges, and workers wished to continue using synthetic slings, it was imperative that a better method or tool be invented to prevent cutting. The CornerMax® Wear Pad is an engineered softener that provides a space between the load edge and the pad so cutting cannot occur. This invention has been tested to 100,000 lbs of pressure with no cutting indicated. It is also lightweight and is connected directly to the synthetic sling so it is always in place when and where it is needed. This single invention has created an entirely new market for the use of synthetic slings lifting concrete and steel beams on construction projects. It is also used to protect synthetic slings when lifting rolls of steel used for automobile manufacturing.

First: Wear Pad (for abrasion).



Second: CornerMax® Wear Pad (for cut protection).

2002 Shackle Pin Pad Protector: Tom DeSoo, a product advisor for I&I Sling Inc. recognized that connecting a synthetic sling to the pin area of a shackle could cause the sling to cut if it was exposed to the sharp area between the pin and shackle ear. Tom developed a synthetic protector that can be applied to the shackle pin to provide protection from cutting. Many customers who must rig a synthetic sling in the pin area of a shackle are finding the Shackle Pin Pad Protector a useful product providing increased job site safety.

2004 "TWISTER" SLING: (Patent Pending) This is an experimental product, a method of fabrication to increase the capacity and reduce the footprint of high performance fiber round slings. Currently, a 300,000 lb rated capacity Twin-Path® extra sling is 12" wide. It has a 12" footprint. The "Twister" design will enable us to build a sling with 600,000 lbs of rated vertical capacity and still be only 12" wide.

Tomorrow: A young inventor has found a way to install any required fitting on the ends of High Performance Fiber ropes. This new technology will lead to rapid replacement of wire rope in all types of standing rigging on cranes, bridges, aircraft, and automobile controls. We are continuously searching for improved rigging tools to make job sites safer, more productive, and more profitable. SLINGMAX® Rigging Solutions start with problems. Without the problem, there is no solution. WRN