Rigging conundrums

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Conundrum: something that is puzzling or confusing.

It is always interesting to read standards and recommended practices published by the various organizations around the world as they pertain to lifting slings. The work of these groups is time consuming and everyone involved has a certain interest in making the written edifice as clear and accurate as they possibly can. Everyone participating is doing so to make the industry safer for the end users who benefit from standardization. With that being said, it does not mean that everything contained in these many tombs is clear, correct or meaningful. It is a fact that many groups are engaged in creating rigging conundrums.

In basic chemistry classes everyone is taught to use the pH scale when describing acid's and bases. The scale ranges from 1-14 with 1-6 representing acids and 8-14 bases. The further the chemical is from 7 the stronger reaction it has. 7 on the scale represents neutral or pure water. The highest concentration of acid is represented by the numeral 1, and the highest concentration of a base is represented by the numeral 14. Examples would include stomach acid at 2 on the pH scale and Drano at 12.

Organic solvents and alcohols are other chemical agents that may affect the strength of a roundsling product. Organic solvents are commonly used in dry cleaning, and slings I have exposed

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to this have shown no decrease in strength. Roundslings washed in typical detergents showed no strength loss if they were air dried. However, using a commercial dryer at a high temperature did decrease the slings strength. Testing of roundslings after exposure to chemical environments is the simplest method of determining residual strength and deterioration.

Some roundsling standards include a statement that the core be the same as the cover and thread material. The reason given by the standard writers is to prevent chemical deterioration of the core that can't be easily observed by an inspection of the cover. It makes more sense to have the cover and thread of different materials. For example, a polyester cover should be closed with nylon thread. The polyester is resistant to acids; damaged by bases, and the nylon thread is just the opposite. As long as the cover and thread represent different chemical responses, it doesn't matter the composition of the core, because either the cover or the thread will be representative of possible core damage.

When designing a roundsling the components should be made from the synthetic material that will give the rigger long service life and ease of use. The core should be resistant to wear, abrasion, fatigue, and provide the user with a high strength to weight ratio. Synthetic cores may also be resistant to acids, bases, organic solvents, and alcohol, making the cover theory archaic. The cover should provide protection from ultra violet, abrasion, entry of sand and metal particles, and cutting. The synthetic materials that provide these benefits for the core and cover should be the first choice for the roundsling fabricator. The closing of the cover should be performed with a thread that represents the opposite chemical reaction to the cover, unless the sling is designed for a particular chemical exposure.

Designing a roundsling with an aramid core, cover and thread would conform to some standards, but give the end user a product with a short life span at a much higher initial cost. The aramid cover would be susceptible to abrasion wear and ultra violet deterioration while costing five times more than a bulked nylon or polyester cover that could provide the necessary protection. The lightest weight, longest lasting, roundsling design would have a core made from high performance fiber and a cover of bulked nylon.

There is no scientific reason to make the core and cover the same. There is no safety rationale or inspection justification to make the core and cover the same. Chemical damage to roundslings is exceedingly rare. The core and cover should be made from whatever materials will provide the end user with the

CHARACTERISTICS OF NATURAL AND SYNTHETIC FIBERS

	K-SPEC®	ARAMID®	NYLON	POLYESTER	HMWPE	POLYPROPYLENE
			FILAMENT TYPE			MULTIFILIMENT
STRENGTH (GRAMS PER DENIER)	27	23	8.0 - 9.0	6.5 - 9.0	27	6.5 - 8.0
SPECIFIC GRAVITY	1.2	1.44	1.14	1.38	.97	.92
ABILITY TO FLOAT	SINKS	SINKS	SINKS	SINKS	FLOATS	FLOATS
ELASTICITY AT STRETCH BREAK	3.6%	3.6%	16%	10 - 12%	3.6%	22 - 28%
MOISTURE ABSORBENCY	.2% OF WEIGHT	.5% OF WEIGHT	9% OF WEIGHT	1% OF WEIGHT	ZERO	ZERO
EFFECT OF HEAT	MELTS AT 300°F	DECOMPOSES AT 800°F	MELTS AT 482°F	MELTS AT 482°F	MELTS AT 297°F	50% TENSILE AT 200° MELTS AT 330°F
EFFECT OF SUNLIGHT ON SLINGS	TPX NONE	TP & SE NONE	WEB UP TO 50%	WEB UP UP TO 50%	TPX NONE	UP TO 50%
EFFECT OF AGE	NONE	NONE	NONE	NONE	NONE	NEGLIGIBLE
RESISTANCE TO CHEMICALS AND ACIDS	EXCELLENT	GOOD	FAIR	VERY GOOD	EXCELLENT	EXCELLENT
TO ALKALIS	EXCELLENT	GOOD	EXCELLENT	VERY GOOD	EXCELLENT	GOOD
TO SOLVENTS	EXCELLENT	GOOD	GOOD	VERY GOOD	EXCELLENT	GOOD
RESISTANCE TO ROT AND MILDEW	100% RESISTANT	100% RESISTANT	100% RESISTANT	100% RESISTANT	100% RESISTANT	100% RESISTANT
IDENTIFICATION	LIGHT STRONG	DOES NOT BURN	MELTS BEFORE BURNING. FORMS HARD BEAD. CELERY ODOR.	MELTS BEFORE BURNING. FORMS HARD BEAD. PUNGENT ODOR.	MELTS BEFORE BURNING. HARD TO CUT.	FLOATS. MELTS BEFORE BURNING. BURNING ASPHALT ODOR.
ABRASION RESISTANCE	EXCELLENT	GOOD	GOOD	GOOD	EXCELLENT	FAIR

greatest benefits. The choice should be up to the roundsling fabricator based on customer requirements. A roundsling should be designed by the manufacturer when it will be used in chemical environments. The best roundsling may have a different core, cover and thread. An HMPE core with a polyester cover would not meet the requirement but would offer great resistance to acidic conditions. An HMPE core with a nylon cover would have significant advantages over anything else when exposed to numbers 8-12 on the pH scale but would not meet the requirement for the core and cover to be the same.

The United States federal government agency OSHA recently issued a new "Guidance on Safe Sling Use" where they also stated the cover and core must be the same in chemically active environments. There is no indication that the core and cover should resist the chemical environment. They also do not use the correct word for roundsling preferring the incorrect "round sling."

At the beginning the document opens with a statement that it is advisory in nature, not a standard or regulation and implies no new legal obligations. They also say the roundsling may be nylon or polyester which may be a big surprise to those in the industry who have never heard of nylon roundslings. OSHA also states there is no requirement to document inspection or to show the manufacturers name on some types of slings. These latter two statements are in direct contradiction to ASME B30.9-2003 and the Cordage Institute International roundsling Standard 1905-07.

Cordage slings and wire rope slings must be tagged with the manufacturers name according to the new OSHA requirements, but chain, wire mesh, synthetic web and roundslings may not be.

For many years the Associated Wire Rope Fabricators (AWRF) Technical Committee has tried to sit down with the representatives of OSHA to make sure any new material issued by the government agency on slings was technically correct and compatible with existing standards like the American Society of Mechanical Engineers (ASME) B-30.9. The new document from OSHA has created unnecessary confusion among riggers and fabricators in the United States because it differs so much from ASME.

In ASME B30.9-2003 every type of sling product must be identified with the manufacturers name and a documented periodic inspection must be performed. In the new OSHA sling "suggestion" - documented periodic inspections are not mandatory and the manufactures name is not required on the sling product. Why is that? OSHA also makes the number of chain sling legs as an option on the sling tag. If the sling is composed of four legs rated at 20,000 lbs and two legs go missing, the user may put 20,000 lbs on two legs and think they are making a safe lift.

One of the key features of the newest addition of B30.9 was the paragraph in the beginning of each sling section that states: "(Alloy steel chain) sling users shall be trained in the selection, inspection, cautions to personnel, effects of environment, and rigging practices as covered by this Chapter." That is a key element missing from the new OSHA document, namely the training part. If safety is the bottom line then training should be in the top line.

Currently the Web Sling and Tie-Down Association recommended standard for polyester roundslings requires periodic testing to failure and the European EN 1492 – norm requires periodic testing of synthetic web and roundslings. Mandated testing on a periodic basis is a waste of resources and imposes higher costs on end users.

Recently, I was given a copy of a recommended standard that is in the early stages of discussion. It requires 29 different pin sizes to be used for testing 29 different capacity finished high performance roundsling products to prove they have a 5-1 design factor. This proposal indicates these tests must be done on a periodic basis on all capacities. The slings to be tested to meet this requirement have breaking strengths up to 3,000,000 lbs and testing of all capacities could cost $100,000. This expenditure will eventually be borne by the customer and the customer should decide if they want this testing performed.

The requirement to use a different pin diameter and jaw span for each of more than 29 different capacity slings imparts an unnecessary burden on the manufacturer while not providing any proof the sling will perform to a 5-1 design factor under field conditions. The result of testing on straight pins has no direct relationship to field use. A roundsling tested on a small diameter pin will develop a higher breaking strength when tested on a larger diameter pin. Testing a few slings should result in an engineered formula that can be used to calculate the breaking strength of slings that are not tested.

After the initial testing of roundslings to meet a particular standard, more testing at periodic intervals should not be necessary if there are no changes in the material or process used to produce the slings. This is especially true if the manufacturer is basing their procedures on a registered ISO quality program and the associated design control requirements.

If HPF roundslings are singled out for this egregious testing program in the USA, the question follows; why not nylon and polyester web slings as required in Europe? Chain, wire rope, cordage slings, and other rigging tools would follow. All of this at great expense to the end user who should get a vote.

Over the years, it has been sufficient to test the fabrication technique of various sling designs on a limited basis to validate the efficiency and establish the design factor required. This protocol has proven itself. It gives the end user a quality product and I see no reason for this to change because of roundslings. All types of finished sling products are routinely proof-tested or pulled to some multiple of their rated capacity. This proof-test can be performed at the customers request or established as part of the manufacturer's quality control system. A proof-test is generally twice the rated capacity but can be three times depending on what the manufacture and customer decide. The proof-test is verification of the rated capacity.

Roundsling failures are usually the result of inadequate protection from edges, improper use, or from lack of proper inspection. It would be more appropriate for any new standard to emphasize training, inspection and protection to prevent accidents than to require annual break testing by the manufacturer. The tipping point is not at the manufacturers' plant – it is in the field!

If testing is required it should be on edges to confirm protective pads provided by the roundsling manufacturer will actually keep their slings from damage. How many roundsling manufacturers have developed proper protection or have tested their covers to find out bursting strength or whether the cover resists cutting? Improvements in this area would certainly make products safer when used in the field.

Fabrication of rigging products with a 5-1 design factor is quite arbitrary. There is no factual information that a 5-1 design factor prevents accidents better than 4-1 or 3-1. In fact, no one even knows where 5-1 came from.

Some national standards specify a 7-1 or 8-1 design factor for synthetic slings as a result of accidents caused by inadequate edge protection. A higher design factor is not the answer to cut slings. It won't help, but proper protection and training will. Chain slings are sold with a design factor of 4-1 and some wire rope slings are used at 3-1. To my knowledge, lower design factors than 5-1 have not been the cause of any rigging accidents. Certain industries require a 10-1 design factor, especially after they have had an accident. What they fail to realize is the accident was caused by improper rigging practices, not an arbitrary design factor. There has never been an accident when the rigging job was performed properly with slings in good condition used at their rated capacity. No matter the design factor!

When I first began making and selling roundslings, I performed break testing on all types of synthetic combinations and used different types of connections to establish parameters. Testing was performed using curved shackle bows, straight small diameter pins, large diameter pins, and the results recorded. We broke slings with more than 1,000,000 lbs of strength and slings at the lower end of the scale. Testing was performed in vertical, choker, and basket hitches. Testing was done over edges to evaluate sling strength reduction and protection. The end result was an average breaking strength for the different core fibers under foreseeable conditions of use. Procedures to fabricate all of our different roundsling products were formulated using this information and everything was based on the strength of new core yarn certified by the manufacturer.

From our testing results an efficiency factor was established for our roundsling products as a percentage of the new core yarn breaking strength. This is the same basic formula that is used by the wire rope industry to establish design factors for finished hand spliced, machine spliced, braided slings, and socket assemblies. Once the foundation for a sling product is laid further break testing is a waste of money unless something in the process changes.

It must be presumed that all current roundsling fabricators have performed testing to assure their products meet the 5-1 design factor in ASME B30.9-6 or the Cordage Institute CI 1905-07 International Roundsling Standard. Any new testing criteria from another organization must contain language that does not compromise or undermine the validity of previous results confirming any manufacturer's products. Customers should have input into the testing criteria used to substantiate the design factor of their roundsling purchases, since ultimately they will pay for it.

Core yarn used in all of our roundsling products has a certified breaking strength. Our slings are made using written ISO procedures designating the number of strands required to meet the rated capacity of the finished product at a 5-1 design factor. The strand count is the result of a known efficiency factor developed from rigorous testing on various fittings including straight pins. Unless our customer requests more testing, and is willing to underwrite the cost, we do not feel more testing is necessary.

In 2006 our company performed audit break tests on over fifty roundsling products produced in different facilities using identical procedures, equipment, and materials. All reached a 6-1 design factor when tested on straight pins. These tests confirmed the material and procedures we use to produce our products. There is no need in our case for any new requirements for testing all sizes of roundslings produced on an annual basis and I am sure this statement would apply to other roundsling fabricators.

We also perform cycle testing on our roundsling products to confirm the strength of used slings. This is far more important than annual break testing. Pulling a roundsling 50,000 times at a 50% overload on shackle bows and then performing a break test indicating the sling still has a 4.5 – 1 design factor, and no cover damage, is a better confidence builder for the customer than a break test on a new sling.

Our company is in a unique position to conform to whatever standards are published. If the end result is testing everything every month to meet a new standard, we have the ability to comply. We currently have six testing machines with 300,000 lbs of capacity, a 400,000 lb machine, and a 1.2 million lb. machine on order to be installed by early 2008. However, if all this testing does not provide a higher margin of safety and reliability for the end user, then it just adds to the expense of the product for no reason. If you are among those that think break testing 29 capacities on 29 different pins and 29 different jaw spans on an annual basis is warranted - please explain why we shouldn't be doing this with all the other rigging products we sell.

The rigging conundrums presented here are not the only ones nor will they be the last. It is a fact that as long as folks gather to discuss and clarify they tend to leave a trail of confusion and obfuscation which I will discuss at a later date. **WRN**