## Synthetic Lifting Slings: Facts and Fiction

Presented by: Isaac Rosenberg

November 25, 2014





- Qualifications and corporate background
- Constructions designed for specific attributes
- Previous experience
  - Custom solutions for specific technical requirements
- Inspection & retirement
- Sling standards
- Sling considerations
- Heavy lift project



- Bachelor of Science in Plastics Engineering Technology from Western Washington University
- Application Engineer with Samson since 2012
- MSHA art 48 certified
- Active ASME and SME member

## **Corporate Background**

- Founded in 1878 in Boston
- History of innovation
- Oldest active trademark in the U.S.
- Largest high performance rope producer in the world
- Headquarters in Ferndale, WA
- Manufacturing locations in Lafayette, LA and Ferndale
- 300 employees worldwide



## History of Innovation

- 1884: 1<sup>st</sup> reinforced core sash cords
- 1957: Invented the double braid
- 1972: 1<sup>st</sup> synthetic offshore tanker mooring
- 1996: 1<sup>st</sup> tanker fleet converted from wire (Chevron)
- 2002: Highest strength synthetic rope size-for-size
- Patents
  - 13 active patents on rope and associated technology
  - 2003: DPX<sup>™</sup> fiber technology
  - 2004: Reduced recoil rope
  - 2006: Heat-resistant rope
  - 2008: Deep Cool technology (CBOS)
  - 2011: Rope for contaminated marine environments







## **High-Performance Fibers**

- Variety of high-performance fibers
  - HMPE (Dyneema®, Spectra®)
  - Aramid (Technora®, Kevlar®, Twaron®)
  - LCP (Vectran®)
  - PBO (Zylon®)
- Increased anisotropic nature of fiber as compared to traditional fibers
  - Controlled drawing process to enhance molecular alignment
  - Increased tenacity
  - Reduced elongation



## **Fiber Comparison**



Fiber	Specific Gravity	Melting Temperature (°C)	Tenacity (gpd)	Elongation at Break (%)
Nylon	1.14	218° – 279°	7.5 – 10.5	15 – 28%
Polyester	1.38	254° – 260°	7.0 - 10.0	12 – 18%
Olefin	0.91 - 0.99	140° - 196°	6.0 – 7.5	12 – 24%
HMPE	0.97	144° – 155°	32 – 44*	2.8 - 3.9%
Aramid	1.39 – 1.47	Does not melt; Decomposes @ 500°C	18 – 29	1.5 – 4.6%
LCP	1.40	330°	23 – 29	3.3 - 3.6%
РВО	1.54 – 1.56	Does not melt; Decomposes @ 650°C	42	2.5 – 3.5%

\*Specialty grades of this fiber also exist with higher tenacities

- •Specific Gravity: Ratio of yarn density to that of water
- •Tenacity: Ratio of yarn strength per weight; tested per ASTM D885
- •Elongation at Break: Percent of length change; tested per ASTM D885



- Dyneema®
  - High modulus polyethylene (ultra high molecular weight PE)
  - Positive buoyancy (floats, SG < 1)
  - Chemical resistant
  - Good UV resistance
  - Excellent flex fatigue characteristics
  - Low elongation (comparable to steel-wire rope)
  - 10x stronger than steel pound-for-pound
    - Comparable strength size-for-size to wire
    - 1/7<sup>th</sup> the weight of steel-wire rope
  - Low coefficient of friction (highly abrasion resistant)

## **Environmental Considerations**



- Temperature
  - Do not use over 140°F
  - Avoid high heat sources
  - Avoid welding within 5 feet
  - Synthetic fibers gain strength in cold temperatures



- Chemical
  - Highly chemical inert
  - Not affected by common acids, bases or oils

Chemical	<b>Chemical Resistance</b> (EFFECT ON FIBER TENSILE STRENGTH)
Acetic Acid	++
Acetone	++
Calcium Hydroxide	++*
Common Detergent	++
Ethanol	++
Hydrochloric Acid	++
Nitric Acid	++
Oil	++
Sodium Hydroxide	++*
Sulfuric Acid	++
Toluene	++
Water	++

\* Tensile strength is significantly reduced (to --) as time and temperature are increased

- Shell's Perdido Spar Traction Winch
- World's deepest oil production facility
  - 9,200' water depth
  - Onboard winch to reduce reliance on support vessels
    - Steel wire not viable
  - Quantum-12 solution
    - 85% less weight
    - Neutral buoyancy
    - Patented DPX<sup>™</sup> fiber technology
      - Traction
      - Bend fatigue
    - Complete rope and winch
      package



- TARDEC USMC first light armored recon battalion
- Reduced weight
  - 200 lb. wire rope replaced by 25 lb. Samson product
  - Less manpower required
- Reduced risk to back, hands, and recoil
- Less personnel exposed to enemy during combat recover operations
- Improved duty cycle
- Full article





- Alyeska Seafoods, Inc. F/V Sea Wolf Trawl Main Warp
- Weight savings / deck stability
  - 4,500' of 1-1/8" rope
  - Steel wire would be 17,000 lbs. vs. 3,400 lbs. of synthetic
  - Improved handling/installation for crew
- Spooling performance essential
  - 10+ layers on winch
  - Rope construction designed with firm control core
  - Uneven spooling causes level wind issues
  - Inconsistent back tension can cause issues



- Seaway Heavy Lifting Greater Gabbard Wind Farm project construction
- 140 wind turbine monopiles installed using 2" AmSteel®-Blue slings
- Installation time reduced and safety increased due to ease of handling







Types of damage

**CUT STRANDS** Any cut strands should be reported to a qualified person

**COMPRESSION** Visible sheen, stiffness reduced by flexing the rope, not to be confused with melting, often seen on winch drums

**PULLED STRAND** Strand pulled away from the rest of the rope, is not cut or otherwise damaged

**MELTED OR GLAZED FIBER** Fused fibers, visibly charred and melted fibers, yarns, and/or strands, extreme stiffness, unchanged by flexing









Types of damage

DISCOLORATION/DEGRADATION Fused fibers, brittle fibers, stiffness

INCONSISTENT DIAMETER Flat areas, lumps or bumps

**ABRASION** Broken filaments and yarns









#### Abrasion measurement



- Visual comparison guide
  - 1 million+ individual filaments per rope
  - Operator can effectively rate level of rope wear
- Retirement or required action to be determined by qualified person based on:
  - Internal/external abrasion level (higher than 3)
  - Excessive twist in braided rope (greater than 2 turns/meter)
  - Gross damage or deterioration of the end connections



- ASME B30.9 (American Society of Mechanical Engineers)
  - Standard used most in North American slings
- ISO NP 18624 (International Standards Organization)
  - Under development
- Governmental organizations (OSHA, MSHA)
  - Relies on industry standards such as B30.9
- Marine standards (DNV, Lloyd's, IMCA, OCIMF)
  - Engineered lifts and project-based lifting



- ASME B30.9
  - Covers nylon and polyester rope
  - Defers to manufacturer for other materials to provide specific data (9-4.2.4 Other Materials)
  - Manufacturer is considered the sling fabricator

- Samson and distributors
  - Sling brochure specifies use in accordance with ASME B30.9-4.2.4
  - To cover the information gap further:
    - Sling configurator
    - Technical sales
    - Application engineers

# Sling Standards

- Samson's sling brochure provides information about:
  - Standard hitch setups
    - Single leg and grommet
    - Vertical and basket choker
  - D/d ration ratings
    - D: pin or object diameter
    - d: rope diameter
    - Rated capacity: basket rating x efficiency
  - Other relevant information
    - Chemical resistance
    - Temperature
    - UV resistance



### Sling Standards: Basket Lift Example

- AmSteel®-Blue eye-and-eye sling
  - 1" diameter
  - 98,000 lb. MBS
- Lift
  - Basket configuration
  - 12" object diameter
  - 5:1 safety factor

- Rated capacity
  - Vertical
    - 98,000 / 5 = `9,600 lb.
  - Basket D/d = 25:1
    - 19,600 x 2 = 39,200 lb.
  - Reduction for D/d = 12:1
    - Reduction factor of 0.85
    - 39,200 x 0.85 = 33,300 lb.

#### Formula for calculating rated capacity (single-leg slings)

D/d	20	10	5	2	1
Retained Strength	95%	85%	75%	60%	50%



- Customer supplies
  - MBL: required breaking strength
    - Working load required x safety factor
  - Bend diameter of connecting hardware
  - Fit on rigging: min/max diameter requirement (to fit on hardware)
  - Length: min/max effective length
- Manufacturer supplies
  - Ideal sling configuration (grommet or single leg)
  - Length and fit confirmation
  - Breaking strength
    - Accounting for necessary de-ratings (bend, etc.)

## Sling Considerations: Single-Leg vs. Grommet Slings

- La Lifuera
- Impact of bend
  - Sling leg
    - *Minimum D/d* = 1:1
    - No strength impact for any D/d > 1:1
  - Grommet
    - Recommended minimum D/d = 3:1
    - Minimum D/d = 1:1
    - Strength de-rating for D/d < 8:1





Schematic of failure zone comparison



## Sling Considerations: Single-Leg vs. Grommet Slings

#### Single-leg slings

- Pros
  - Efficient use of fiber
  - Less impact of small bend diameter
- Cons
  - Larger diameter (fit on hardware)
  - Longer minimum length requirement

#### Grommet slings

- Pros
  - Can build shorter lengths
  - Small diameter fit on hardware
- Cons
  - Usually higher price (per ton MBL)
  - Less efficient use of fiber

## **Sling Considerations**

- Grommet splice location
  - Recommended splice locations
    - Centered on one leg (A)
    - Centered on one bearing point (B)
  - Not recommended
    - Splice tail "pinched" on bearing point
- Options A and B offer full strength efficiency
- Option B will create large "effective diameter"
- Option C can create unpredictable results



## **Sling Considerations**

- Protection jacketed vs. single braid
- Single braid (non-jacketed)
  - Pros
    - Easy inspection
    - Flexibility
    - Efficient (\$/ton)
    - Proven
  - Cons
    - May require cover
    - Too flexible?
- Jacketed
  - Pros
    - Abrasion protection
  - Cons
    - Stiff (difficult to handle)
    - Cannot inspect
    - *\$/ton*



## Heavy Lift Project

#### CNOOC/COOEC

- Project: jacketed heavy lift
- Location: South China Sea
- Product: AmSteel®-Blue (178mm)
- Details
  - Jacketed heavy lift
  - MBL: 2,850t (basket)
  - Certification: ABS
  - Weight reduction needed to suit crane capacity





## **Sling Configurator**



Units:      Metric (mm)      mm        Product:      Amsteel Blue      12,000 mm      mm        Overall Length      12,000 mm      mm      4,625 mm        Pin Liength      150,000 mm      SRT MBS      3,173,779 lbs        Minimum Eye (Right)      150,000 mm      5,299.78 MT      Mm        Minimum Eye (Right)      450 mm      4,722 mm      mm        Eye Size (Right)      450 mm      4,722 mm      mm        Eye Size (Right)      450 mm      Mm      Grommet - Splice Centered on (1) teg      mm        Eye Size (Right)      450 mm      Minimum Length      15.2491 ft      mm        Breaking Strength      1,500 MT      Minimum Length      12.2 mm      minimum Length        Tool Load Requirements      Minimum Length      9,218 mm      minimum Length      9,218 mm        Matched Sings OAL      %      Minimum Length      9,218 mm      mm        Matched Sings OAL      %      Minimum Length      12.2 mm      mm        Matched Sings OAL      %      Minimum Length      12.2 mm      mm        Splice Method      Min Tolerance, %	INPUTS	Grommet - Splice Center	ea on pin		and the second s
Product:      Amsteel Blue      4.625      in        Overall Length      12,000 mm      ISO MBS      1,599.78      MT        Pin Diameters      SRT MBS      3,727.79      ISO      MI        Pin (Right)      150.000 mm      4,722      m        Minimum Eye (Right)      450 mm      4,722      m        Eye Size (Left)      450 mm      15.040      m        Eye Size (Left)      450 mm      15.040      m        Eye Size (Left)      450 mm      15.040      m        Eye Size (Left)      450 mm      Min Tolerance, %      12.2      m        Breaking Strength      1,500 MT      56      150 MBS      1,599.78      MT        Foos      150 MBS      1,599.78      MT      13.225      m        Proof Load Requirements      Foos      Min Tolerance, %      100      mm        Matched Sings OAL      %      %      Single Leg - Staight Pul      140      mm        Splice Method      Tuck-Bury      %      Strengt      130.99.000      Ibs        Splice Method      Tuck-Bu	Units: Metric (mm)		Rone Diameter	112	mm
Overall Length      12,000 mm        Pin (Left)      150,000 mm        Pin (Left)      150,000 mm        Pin (Left)      150,000 mm        Minimum Eye (Left) =      450 mm        Eye Size (Right)      450 mm        Single Leg - Staight Pull      112 mm        Will      300 MT        FoS      500 MT        Standard/Guidenlines      1130 mm        Breaking Strength      1,500 MT        Minimum Length      51,550 mi        Minimum Length      51,550 mi        Standard/Guidenlines      51,550 mi        Breaking Strength      51,550 mi        Matk che O Simete	Product: Amsteel Blue		Rope Diameter	4.625	in
Pin Diameters      SRT MBS      3,173,779      Ubs        Pin (Left)      150.000      mm      4.222      m        Minimum Eye (Left)      450      mm      5.64.91      ft        Minimum Eye (Left)      450      mm      6.79.91      ft        Eye Size (Right)      450      mm      6.79.91      ft        Load Requirements (Enter 2 of 3)      Breaking Strength      1.500      MT      6.62.91      ft        Breaking Strength      1.500      MT      5.67.81      m      6.22.81      m        Proof Load Requirements      6.000      MT      5.178.779      lbs      Minimum Length      9.21.81      m        Standard/Guidenlines      -      -      Minimum Length      9.21.81      m        Matched Slings OAL      %      %      Matched Slings OAL      %      Minimum Length      1.25.06      MT        Splice Method      Tuck-Bury      Minimum Length      1.25.06      m        Matched Slings OAL      %      %      Minimum Length      1.25.06      m        Mathold Slings OAL	Overall Length 12,000 mm		ISO MBS	1,599.78	MT
Pin (Left)    150.00 mm      Minimum Eye (Right)    150.00 mm      Minimum Eye (Right)    450 mm      Eye Size (Left)    450 mm      Eye Size (Right)    450 mm      Breaking Strength    1,500 MT      WLL    300 MT      Foo    150 MBS      Proof Load Requirements    9.218 m      Proof Load Good MT    30.245 ft      Standard/Guidenines    Min Tolerance, %      Max Rope Diameter Requirement    %      Max Rope Diameter Requirement    %      Max Rope Diameter Requirement    Min Tolerance, %      Max Rope Diameter Requirement    Min Tolerance, %      Max Rope Diameter Requirement    Min Tolerance, %      Min Tolerance, %    Min Tolerance, %      Splice Method Tuck-Bury    Single Leg- Basket Lift      Minimum Length    1.525.0 m      (Eyes 3 & Pin Dia)    41.129 ft      Min Tolerance, %    Min Tolerance, %      Min Tolerance, %    SRT MBS      Min Tolerance, %    12.536 m <td>Pin Diameters</td> <td></td> <td>SRT MBS</td> <td>3,173,779</td> <td>lbs</td>	Pin Diameters		SRT MBS	3,173,779	lbs
Pin (Right)    150.00 mm    15.491    ft      Minimum Eye (Right)    450 mm    Min Tolerance, %    image: ft total state	Pin (Left) 150.00 mm		Minimum Longth	4.722	m
Minimum Eye (kight) =      450      mm        Minimum Eye (kight) =      450      mm        Eye Size (kight)      450      mm        Load Requirements (Enter 2 of 3)      mm      8        Breaking Strength      1,500 MT      4.625      in        FoS      112      mm        Proof Load Requirements      600 MT      587 MBS      3,173,779      bs        Proof Load Requirements      600 MT      510gle Lg - Staight Pull      140      mm        Standard/Guidenlines      5750      in      140      mm        Max Rope Diameter      mm      5,750      in      112.9      mm        Max Rope Diameter      mm      5,750      in      160 MT      5,750      in        Splice Method      Tuck-Bury      %      100 MT      5,750      in      12.536      m        Minimum Length      12.536      m      12.536      m      12.536      m        Max Rope Diameter      mm      500 MS      1,599.78      MT      12.536      m        Splice Method      Tuck-Bur	Pin (Right) 150.00 mm		Winimum Length	15.491	ft
Minimum Eye (Right) ±      450 mm      Grommet - Splice Centered on (1) Leg        Eye Size (Left)      450 mm      Rope Diameter      1.12 mm        Breaking Strength      1,500 MT      1.500 MT      1.500 MT        WLL      300 MT      SRT MBS      3,173,779      Ibs        Proof Load Requirements      Minimum Length      9,218 m      m        Proof Load Requirements      Min Tolerance, %      Ibs      1      1        Standard/Guidenlines      Min Tolerance, %      Ibs      1      1      m        Maxched Slings OAL      %      SRT MBS      3,509,000      Ibs      1      12.536 m        Splice Method      Tuck-Bury      Minimum Length      12.536 m      1 <t< td=""><td>Minimum Eye (Left) = 450 mm</td><td></td><td>Min Tolerance, %</td><td></td><td></td></t<>	Minimum Eye (Left) = 450 mm		Min Tolerance, %		
Eye Size (Left)    450 mm      Eye Size (Right)    450 mm      Load Requirements (Enter 2 of 3)    ISO MS    1,500 MT      Breaking Strength    1,500 MT    ISO MS    1,599,78    MT      Keye Diameter    300 MT    9,218    m      Proof Load Requirements    Minimum Length    30.245    ft      Proof Load Requirements    Min Tolerance,%    Min Tolerance,%    iso MBS    1,520.00      Rope Diameter Requirement    %    Min Solute 0AL    %    iso MBS    1,520.00    MT      Splice Method    Tuck-Bury    %    Misso ME    1,520.00    MT      Splice Method    Tuck-Bury    Min Tolerance,%    iso MBS    1,520.00    MT      Splice Method    Tuck-Bury    Min Tolerance,%    iso MBS    1,520.00    MT      Splice Method    Tuck-Bury    Min Tolerance,%    iso MBS    1,529.78    MT      Splice Method    Tuck-Bury    Single Leg - Basket Lift    iso MBS    1,599.78    MT      Splice Method    Tuck-Bury    Single Leg - Basket Lift    iso MBS    1,599.78    MT      Splice	Minimum Eye (Right) = 450 mm	Grommet - Splice Centere	d on (1) Leg		
Eye Size (Right)      450 mm      4.625 in        Load Requirements (Enter 2 of 3)      ISO MBS      1,599.78      MT        Breaking Strength      1,500 MT      SR MBS      3,173.779      Ibs        WLL      300 MT      -      Minimum Length      -      -        Fos      -      Minimum Length      -      -      -        Proof Load Requirements      -      Min Tolerance, %      -      -        Proof Load Requirements      -      Min Tolerance, %      -      -        Absolute OAL      %      -	Eye Size (Left) 450 mm		Rope Diameter	112	mm
Load Requirements (Enter 2 of 3)      ISO MBS      1,599,78      MT        Breaking Strength      1,500 MT      3,173,779      Ibs        WLL      300 MT      9,218      m        Fos      Minimum Length      9,218      m        Proof Load Requirements      Minimum Length      9,218      m        Proof Load Requirements      Minimum Length      9,218      m        Length Tolerance      Minimum Length      9,218      m        Absolute OAL      %      Minimum Length      9,218      m        Absolute OAL      %      Minimum Length      140      mm        Absolute OAL      %      Minimum Length      140      mm        Splice Method      %      Minimum Length      12.536      m        Splice Method      Tuck-Bury      Minimum Length      6.578      m<	Eye Size (Right) 450 mm		Rope Diameter	4.625	in
Breaking Strength    1,500 MT      WL    300 MT      Fos	Load Requirements (Enter 2 of 3)		ISO MBS	1,599.78	ΜT
Will    300    MT    9.218    m      FoS    Minimum Length    9.218    m      Proof Load Requirements    Min Tolerance, %    m      Proof Load Go0    MT    Minimum Length    9.218    m      Standard/Guidenlines    Min Tolerance, %    m    m      Absolute OAL    %    Matched Slings OAL    %    Rope Diameter Requirement    140    mm      Max Rope Diameter Requirement    %    SRT MBS    3,099,000    lbs      Minimum Length    12.536    m    12.536    m      Splice Method    Tuck-Bury    Min Tolerance, %    thin Tolerance, %    thin Tolerance, %      Single Leg - Basket Lift    Minimum Length    12.536    m      Splice Method    Tuck-Bury    Min Tolerance, %    thin Tolerance, %      Single Leg - Basket Lift    Minimum Length    4.625    in      Splice Method    Tuck-Bury    String Ligs 3, 173, 779    Bis      Single Leg - Basket Lift    String 3, 173, 779    String 3, 173, 779    String 3, 173, 779      Splice Method    Splice Method    Strin Dia)    21.584	Breaking Strength 1,500 MT		SRT MBS	3,173,779	lbs
FoS    30.245    ft      Proof Load Requirements    Min Tolerance, %    1      Proof Load 600    MT    Min Tolerance, %    1      Standard/Guidenlines    Min Tolerance, %    140    mm      Absolute OAL    %    150 MBS    1,562.00    MT      Matched Slings OAL    %    SRT MBS    3,099,000    lbs      Splice Method    Tuck-Bury    Min Tolerance, %    41.129    ft      Min Tolerance, %    Min Tolerance, %    12.536    m      Matched Slings OAL    %    Min Tolerance, %    12.536    m      Splice Method    Tuck-Bury    Min Tolerance, %    1    1      Splice Method    Tuck-Bury    Single Leg - Basket Lift    112    mm      Single Leg - Basket Lift    SRT MBS    1,599,78    MT      Min Tolerance, %    SRT MBS    1,599,78    MT      SRT MBS    1,599,78    MT    150 MBS    1,599,78    MT      Minimum Length (Eyes = 3x Pin Dia)    6.578    m    12.584    ft      Min Tolerance, %    Min Tolerance, %    Min Tolerance, %	WLL 300 MT		Minimum Length	9.218	m
Proof Load Requirements    Min Tolerance, %    Min Tolerance, %      Proof Load    600 MT    Single Leg - Staight Pull    140 mm      Standard/Guidenlines    %    150 MBS    1,5750 in      Absolute OAL    %    %    150 MBS    1,500 MIS      Matched Slings OAL    %    %    180 MBS    1,500 MIS    1,500 MIS      Max Rope Diameter Requirement    mm    12.536 m    1	FoS		Winning Cengen	30.245	ft
Proof Load    600 MT    Single Leg - Staight Pull      Standard/Guidenlines    Ital    mm      Length Tolerance    N    Stondard/Guidenlines    Ital    mm      Absolute OAL    %    Stondard/Guidenlines    Ital    mm      Matched Slings OAL    %    Stondarder    Minimum Length    12.536    m      Max Rope Diameter Requirement    Mm    Stondarder    Minimum Length    12.536    m      Splice Method    Tuck-Bury    Mini Tolerance, %    Minimum Length    41.129    ft      Minimum Length    Standarder    Minimum Length    12.536    m    12.536    m      Splice Method    Tuck-Bury    Minimum Length    12.536    m    140    mm      Splice Method    Tuck-Bury    Minimum Length    12.536    m    140    mm      Splice Method    Tuck-Bury    Minimum Length    12.536    m    140    140    140    140    140    140    140    140    140    140    140    140    140    140    140    140    140    140    140	Proof Load Requirements		Min Tolerance, %		
Standard/Guidenlines    140    mm      Length Tolerance    5.750    in      Absolute OAL    %    150 MBS    1,562.00    MT      Matched Slings OAL    %    SRT MBS    3,099,000    lbs      Max Rope Diameter Requirement    mm    12.536    m      Splice Method    Tuck-Bury    41.129    ft      Minimum Length    41.129    ft      Min Tolerance, %    112    mm      Splice Method    Tuck-Bury    140    mm      Splice Method    Tuck-Bury    41.129    ft      Min Tolerance, %    112    mm      Splice Method    Splice Intervention    112    mm      Intervention    Splice Intervention    112    mm      Splice	Proof Load 600 MT	Single Leg - Staight	Pull		<u> </u>
Length Tolerance    5.750    in      Absolute OAL    %    ISO MBS    1,562.00    MT      Matched Slings OAL    %    SRT MBS    3,099,000    lbs      Max Rope Diameter Requirement    Minimum Length    12.536    m      Splice Method    Tuck-Bury    Min Tolerance, %    41.129    ft      Minimum Length    12.536    m    12.536    m      Splice Method    Tuck-Bury    Min Tolerance, %    m    46.25    in      Single Leg - Basket Lift    46.25    in    46.25    in      SRT MBS    3,173,779    lbs    150 MBS    1,599.78    MT      SSRT MBS    3,173,779    lbs    150 MBS    1,599.78    m      SRT MBS    3,173,779    lbs    150 MBS    1,593.6    m      SRT MBS    3,173,779    lbs <td>Standard/Guidenlines</td> <td></td> <td>Rope Diameter</td> <td>140</td> <td>mm</td>	Standard/Guidenlines		Rope Diameter	140	mm
Absolute OAL    %      Matched Slings OAL    %      Rope Diameter Requirement    Minimum Length      Max Rope Diameter    mm      Splice Method    Tuck-Bury      Splice Method    Tuck-Bury      Single Leg - Basket Lift    41.129      Rope Diameter    112      Minimum Length    4.625      ISO MBS    1,599.78      Minimum Length    6.578      ISO MBS    3,173,779      ISO MBS    1,299.78      Minimum Length    6.578      ISO MBS    1,259.78      Minimum Length    21.584      ISO MBS    1,259.78	Length Tolerance	AXXXXXXX AXXXXXXXXXXXXXXXXXXXXXXXXXXXX	hope blameter	5.750	in
Matched Slings OAL    %      Rope Diameter Requirement    Minimum Length      Max Rope Diameter    mm      Splice Method    Tuck-Bury      Splice Method    Tuck-Bury      Minimum Length    12.536      Min Tolerance, %    41.129      Minimum Length    112      Minimum Length    4.625      ISO MBS    1,599.78      MT    SRT MBS    3,173,779      ISO MBS    1,599.78    MT      SRT MBS    3,173,779    Ibs      Minimum Length    6.578    m      (Eyes = 3x Pin Dia)    21.584    ft      Min Tolerance, %    t    Min Tolerance, %	Absolute OAL %		ISO MBS	1,562.00	MT
Rope Diameter Requirement    Minimum Length (Eyes = 3x Pin Dia)    12.536    m      Max Rope Diameter    mm    (Eyes = 3x Pin Dia)    41.129    ft      Splice Method    Tuck-Bury    Min Tolerance, %    112    mm      Single Leg - Basket Lift      Min Son MBS      Single Leg - Basket Lift      Min Son MBS      Single Leg - Basket Lift      Min Son MBS	Matched Slings OAL %	$\sim$	SRT MBS	3,099,000	lbs
Max Rope Diameter    mm      Splice Method    Tuck-Bury      Image: Constraint of the synthesis o	Rope Diameter Requirement		Minimum Length	12.536	m
Splice Method    Tuck-Bury    Min Tolerance, %    Min Tolerance, %      Single Leg - Basket Lift    112    mm      Single Leg - Basket Lift    4.625    in      Single Leg - Basket Lift    4.625    in      Single Leg - Basket Lift    6.578    m      SRT MBS    3.173.779    lbs      Minimum Length    6.578    m      (Eyes = 3x Pin Dia)    21.584    ft      Min Tolerance, %    1    1	Max Rope Diameter mm		(Eyes = 3x Pin Dia)	41.129	ft
Single Leg - Basket Lift        Rope Diameter      112      mm        4.625      in        ISO MBS      1,599.78      MT        SRT MBS      3,173,779      lbs        Minimum Length (Eyes = 3x Pin Dia)      6.578      m        21.584      ft        Min Tolerance, %      in	Splice Method Tuck-Bury		Min Tolerance, %		
Rope Diameter      112      mm        4.625      in        ISO MBS      1,599.78      MT        SRT MBS      3,173,779      lbs        Minimum Length (Eyes = 3x Pin Dia)      6.578      m        21.584      ft        Min Tolerance, %      in		Single Leg - Basket	Lift		
Image: None of all received and the strength      4.625      in        ISO MBS      1,599.78      MT        SRT MBS      3,173,779      Ibs        Minimum Length (Eyes = 3x Pin Dia)      6.578      m        21.584      ft        Min Tolerance, %      in	A LEA		Rope Diameter	112	mm
ISO MBS      1,599.78      MT        SRT MBS      3,173,779      Ibs        Minimum Length (Eyes = 3x Pin Dia)      6.578      m        Z1.584      ft        Min Tolerance, %      I				4.625	in
SRT MBS      3,173,779      Ibs        Minimum Length (Eyes = 3x Pin Dia)      6.578      m        Z1.584      ft        Min Tolerance, %      Min			ISO MBS	1,599.78	MT
Minimum Length      6.578      m        SCINCE      (Eyes = 3x Pin Dia)      21.584      ft        THE STRONGEST NAME IN ROPE      Min Tolerance, %      Image: Contract of the strength of the strengt of the strenge strength of the strength of the strength of the st			SRT MBS	3,173,779	lbs
(Eyes = 3x Pin Dia)  21.584  ft    THE STRONGEST NAME IN ROPE  Min Tolerance, %  Min Tolerance, %	Contraction Pro-		Minimum Length	6.578	m
THE STRONGEST NAME IN ROPE Min Tolerance, %	sanson		(Eyes = 3x Pin Dia)	21.584	ft
	THE STRONGEST NAME IN ROPE		Min Tolerance, %		



- Technical bulletins
  - Industrial Rope Selection, Usage, and Retirement
  - Inspection and Retirement Pocket Guide
- Inspection and Retirement Pocket Guide
  - Field-use pocket guide
  - Field-use iPhone app





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