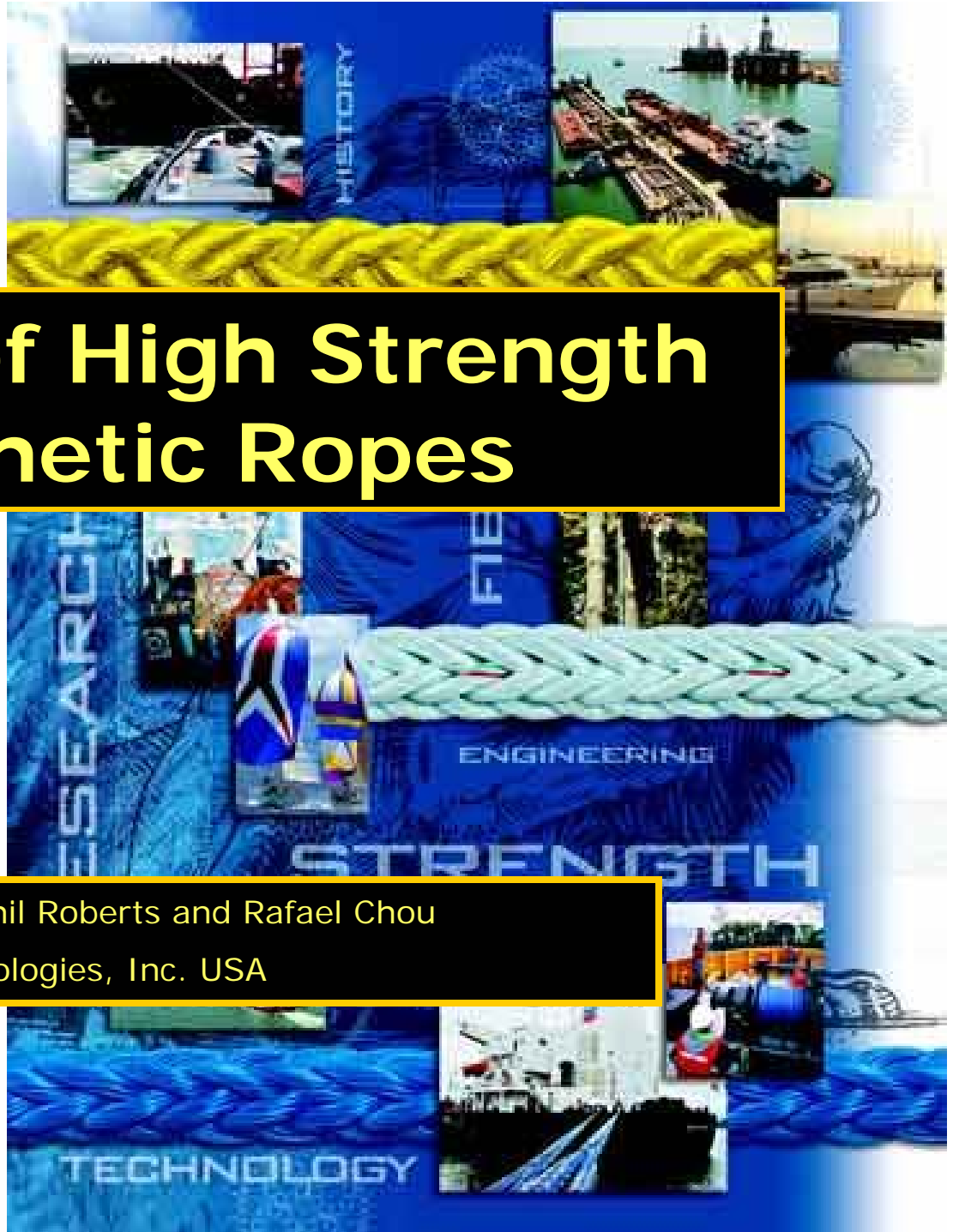


# Testing of High Strength Synthetic Ropes

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# Present Testing Standards

- ❖ **CI-1500 – Test Methods for Fiber Rope**
- ❖ **ASTM4268 – Standard Test Methods for Testing Fiber Ropes**
- ❖ **EN919\* – Fiber Ropes for General Service – Determination Of Certain Physical And Mechanical Properties**
- ❖ **ISO/DIS 2307 – Ropes – Determination of Certain Physical and Mechanical Properties**
- ❖ **OCIMF - Prototype Rope Testing**

*\*Note: EN 919 replaces BS 4928*

# Detailed Comparison of Testing Standards

Standard		SRT	CI-1500	ASTM 4268	ISO/DIS 2307	BS 4928 (refer to BS 5053)	EN-919
Type of rope it pertains to		All			Nylon, PET, PP,PE, Nature	3 - PET or nylon 8 - PET or nylon double braided - nylon	All
Initial Tension		lb = 200 d2			refer to table	NA	NA
Pre Test Cycles	Nylon	10@20%; 10@50% for high performance	10@20% 10@50% optional	10 at 20%	None		
	Polyester				None		
	High Modulus				None		
Testing speed		cycle to 20% in 2 - 200 sec			NA	75 +/- 25mm/Min	
Strength		breaking strengths			Allows 10% to meet spec.  Allows calculation from yarns with realization factors		
Linear density @ tension		lb = 200 d2	Lb = 50 d2	lb = 200 d2	Refer to table	t(kg) = D2/8	t(kg) = D2/8
Note		Spliced sample if possible			can overestimate strength:  1. Capstan break 2. 10% addition 3. Realization factor computation		

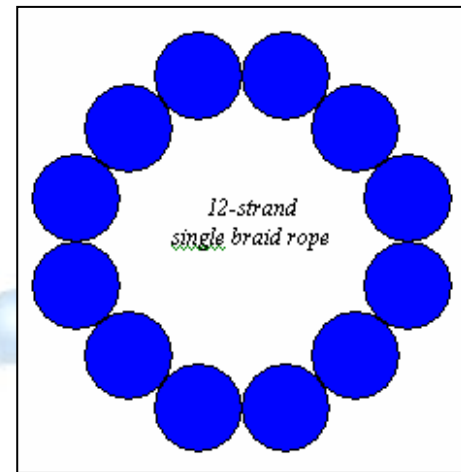
# Properties of Textiles

	<b>Dyneema Sk-75</b>	<b>Nylon (Type 66)</b>	<b>Polyester</b>	<b>Vectran (T-150)</b>
Manufacturer	<b>DSM</b>	<b>Dupont</b>	<b>Allied</b>	<b>Celanese</b>
Tenacity (gpd)	39	9.8	9.2	23-26
Elongation	3.80%	18.70%	14%	3.3 - 3.7%
Spec. Gravity	0.97	1.14	1.38	1.4

Per manufacturer's specifications

# Rope construction

1/2" dia



# SRT Test Machine Specifications

- ❖ **Capacity:** 4000lb - 1.1 MM lb
- ❖ **Dimensions:** 106 ft. long x 6 ft. wide
- ❖ **Length:** 50ft with 16 ft stroke
- ❖ **Speed:**
  - 0-12 ft/min up to 100,000 lbs
  - 0-10 ft/min up to 275,000 lbs
  - 0-2 ft/min up to 1.1 MM lbs
- ❖ **Capabilities:**
  - Automated Cycle Loading
  - Precise Elongation Measurements
  - Computer Controlled
  - Data Acquisition, Storage, Calculations & Results Reporting

# Samson 1.1 MM Ib. Test Machine



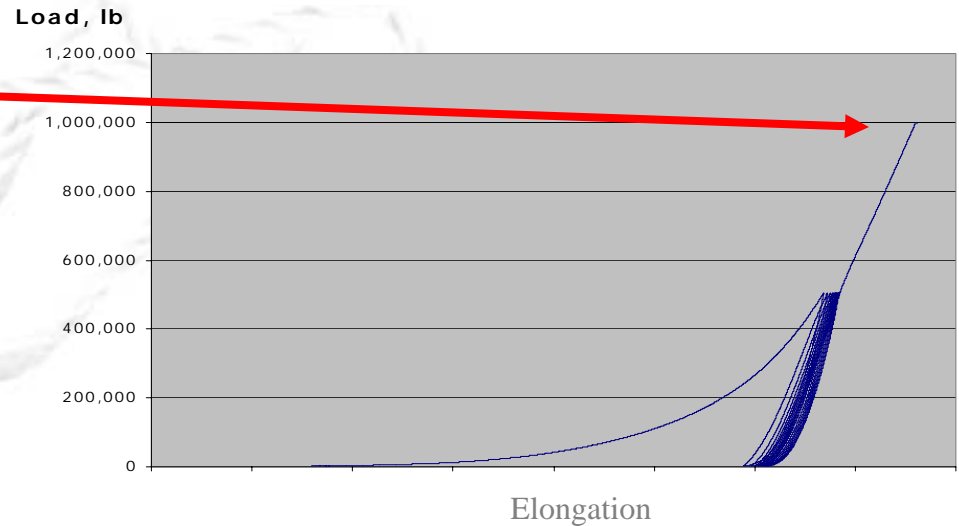
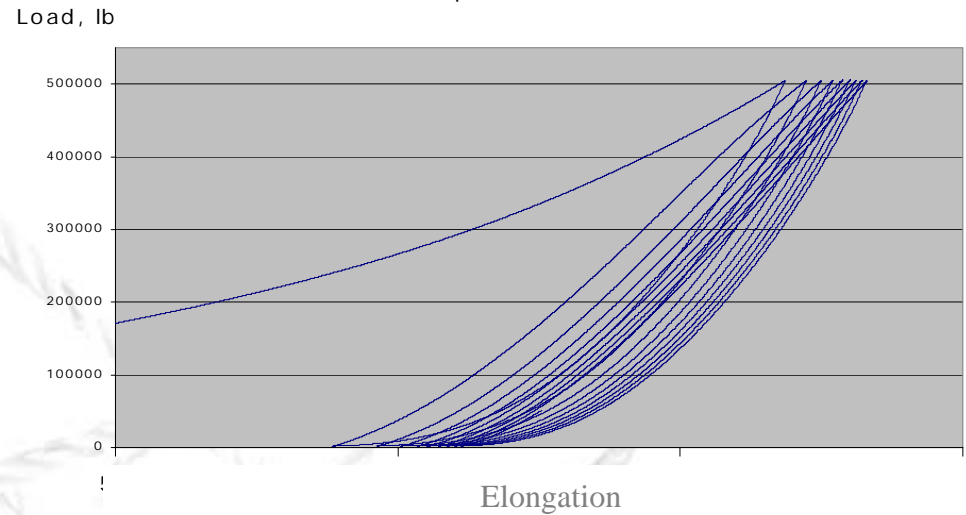
# Pre-cycling the Rope Before Breaking

Pre-cycling to "set" the rope

Note the "constructional elongation"

Final breaking of rope after the 10<sup>th</sup> cycle

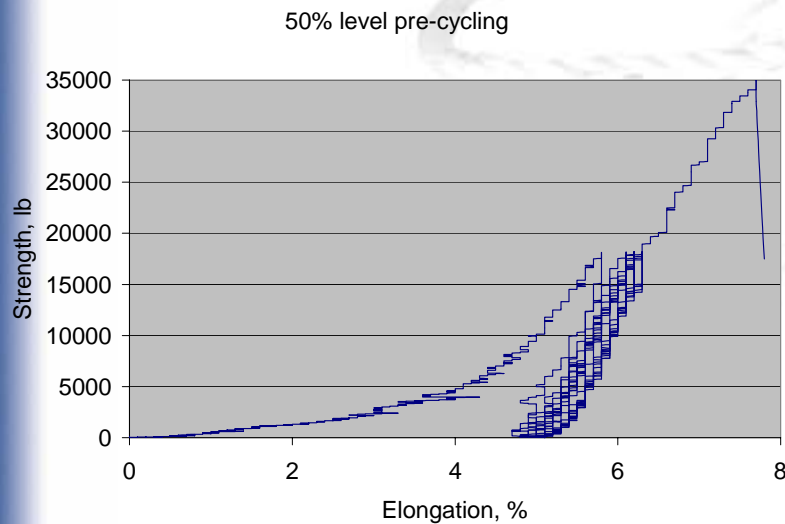
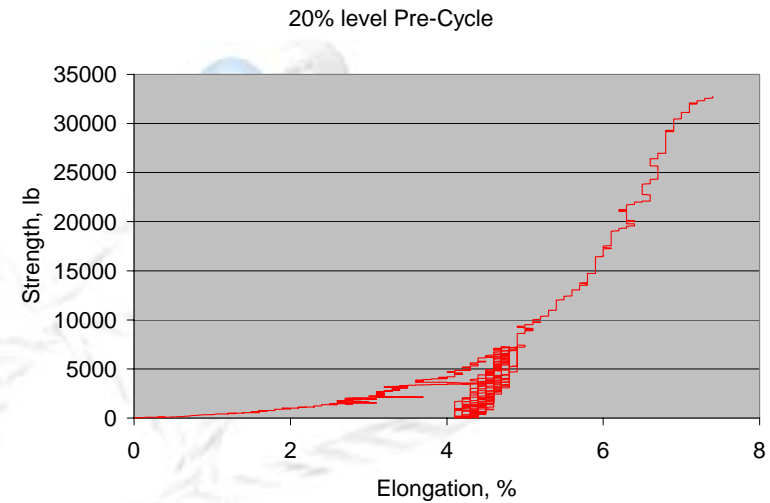
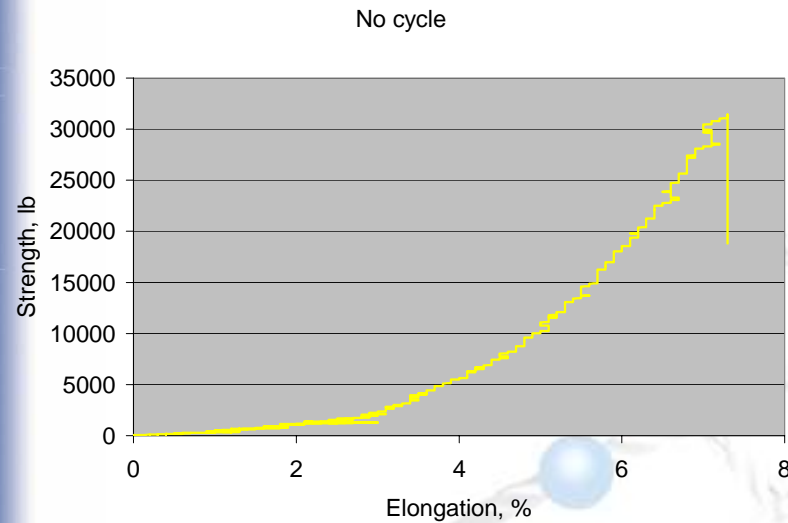
Condition the rope to "set" construction





# Synthetic Rope Testing

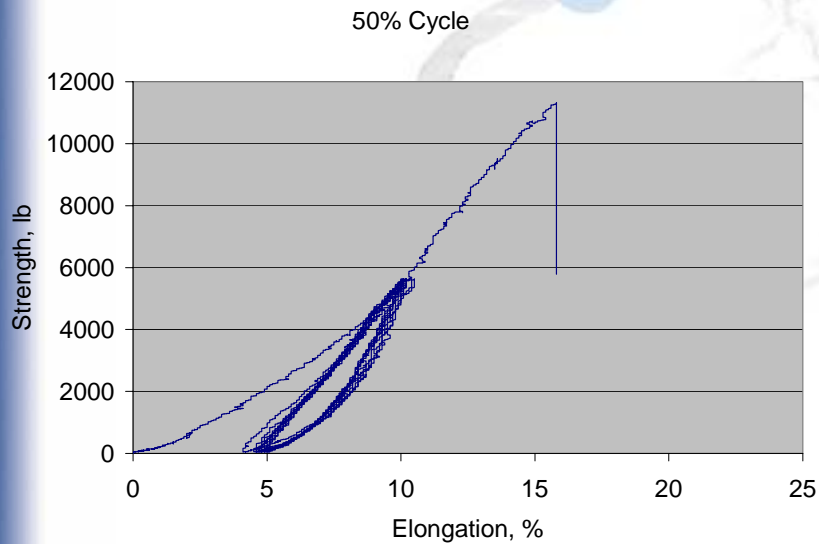
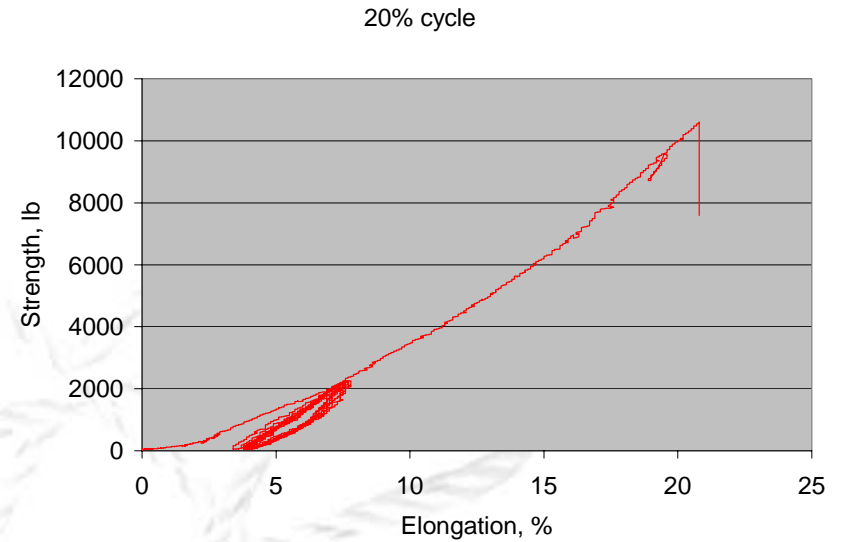
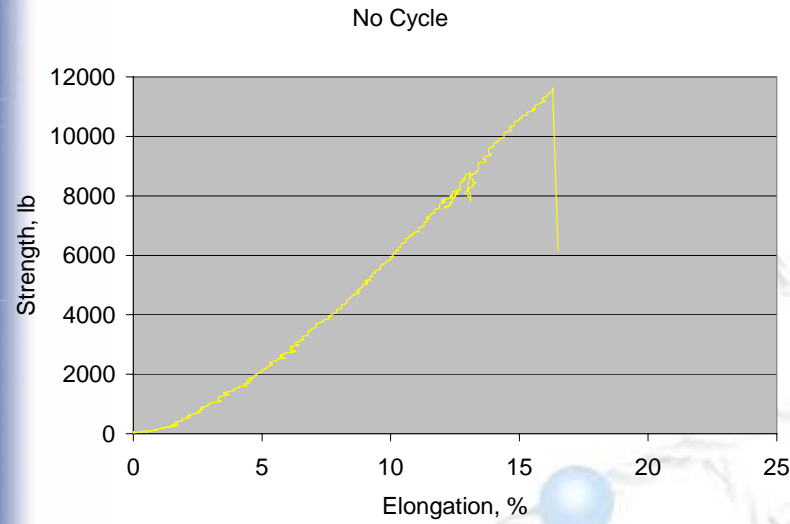
## HMPE Rope with and without precycling



HMPE Rope	Strength, lb
No cycling	31,782
20% cycling	32,734
50% cycling	34,652

# Synthetic Rope Testing

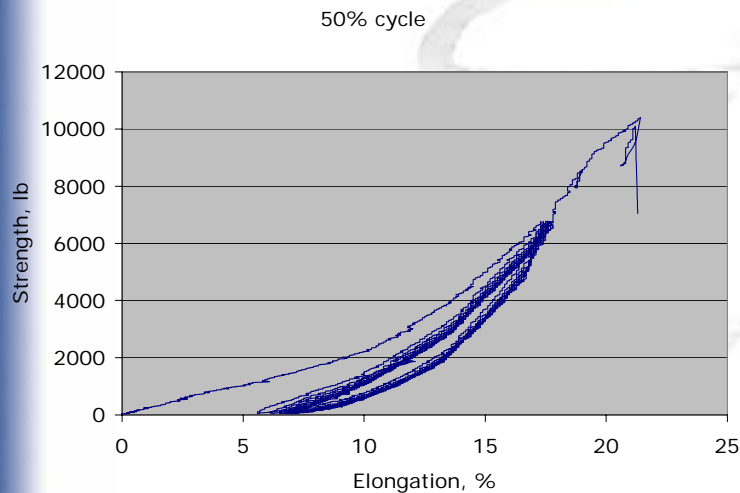
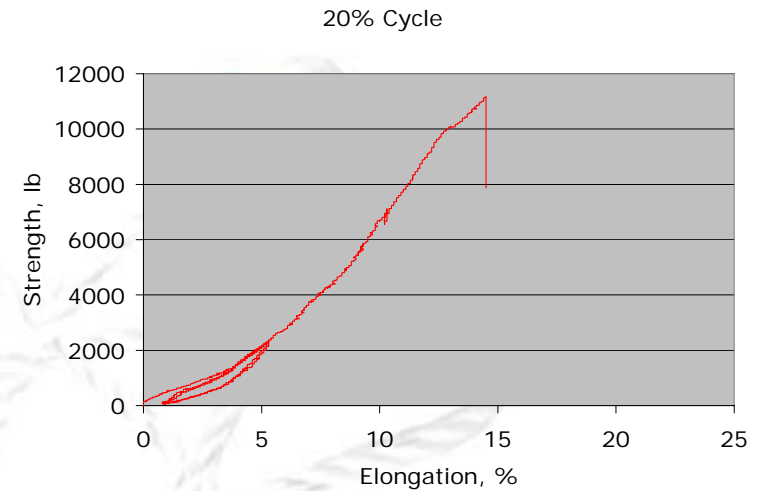
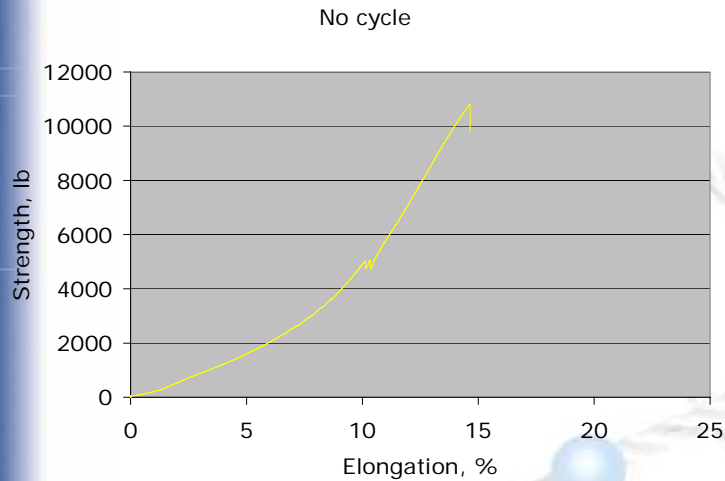
## Polyester Rope with and without precycling



Polyester Rope	Strength, lb
No cycling	10,221
20% cycling	11,048
50% cycling	11,146

# Synthetic Rope Testing

## Nylon Rope with and without precycling

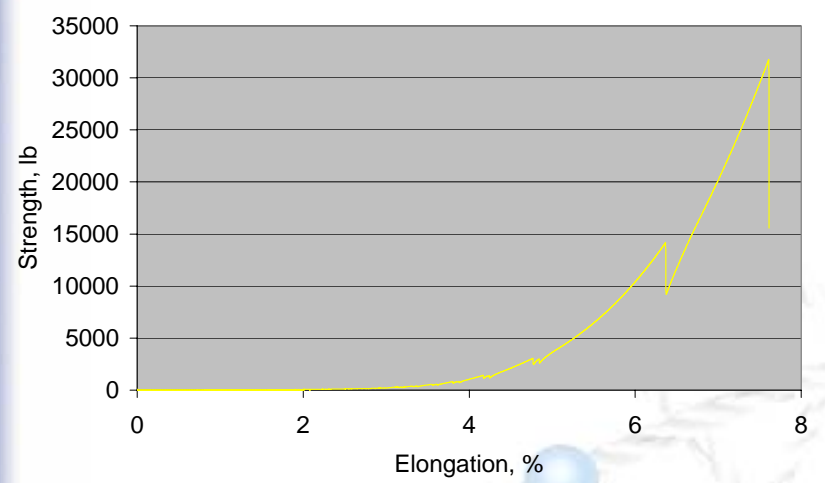


Nylon Rope	Strength, lb
No cycling	11,565
20% cycling	10,436
50% cycling	10,196

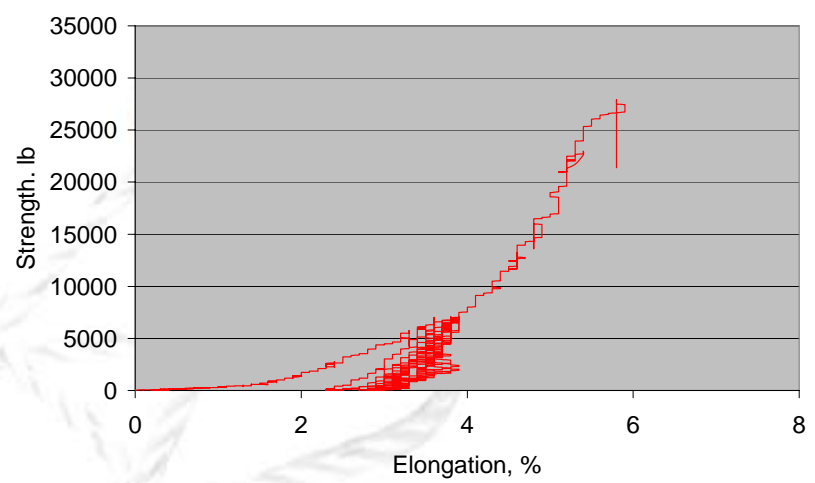
# Synthetic Rope Testing

## Vectran Rope with and without precycling

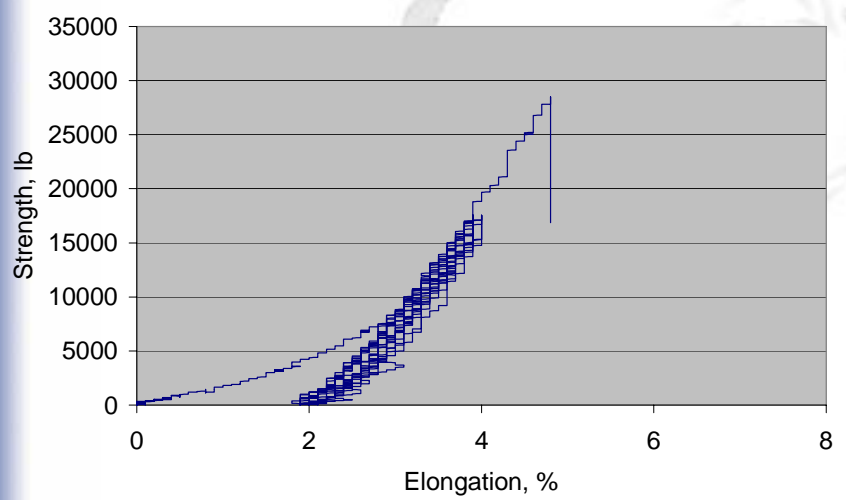
No Cycle



20% Cycle



50% Cycle

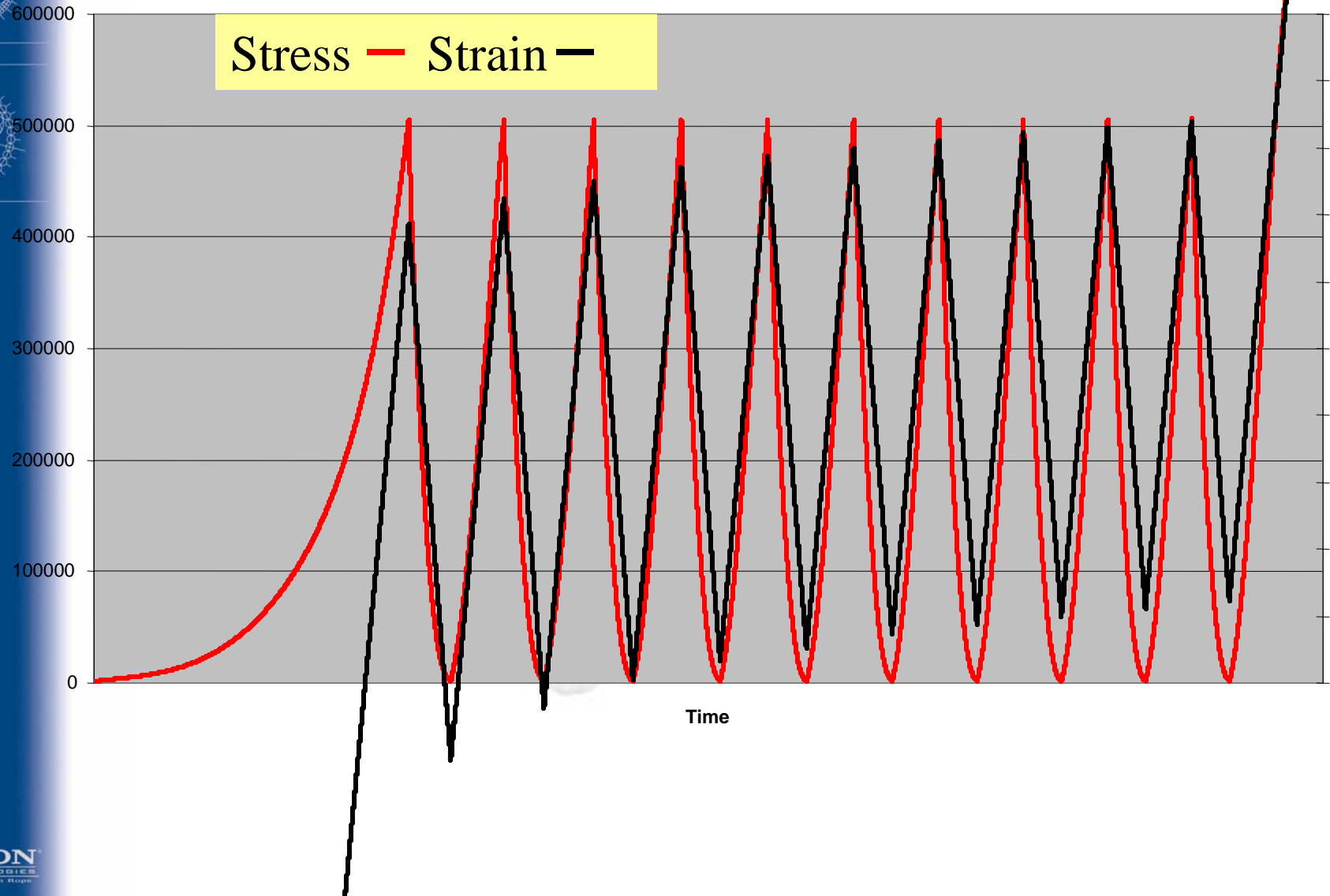


Vectran rope	Strength, lb
no cycle	32,600
20% BS	34,900
50% BS	37,200



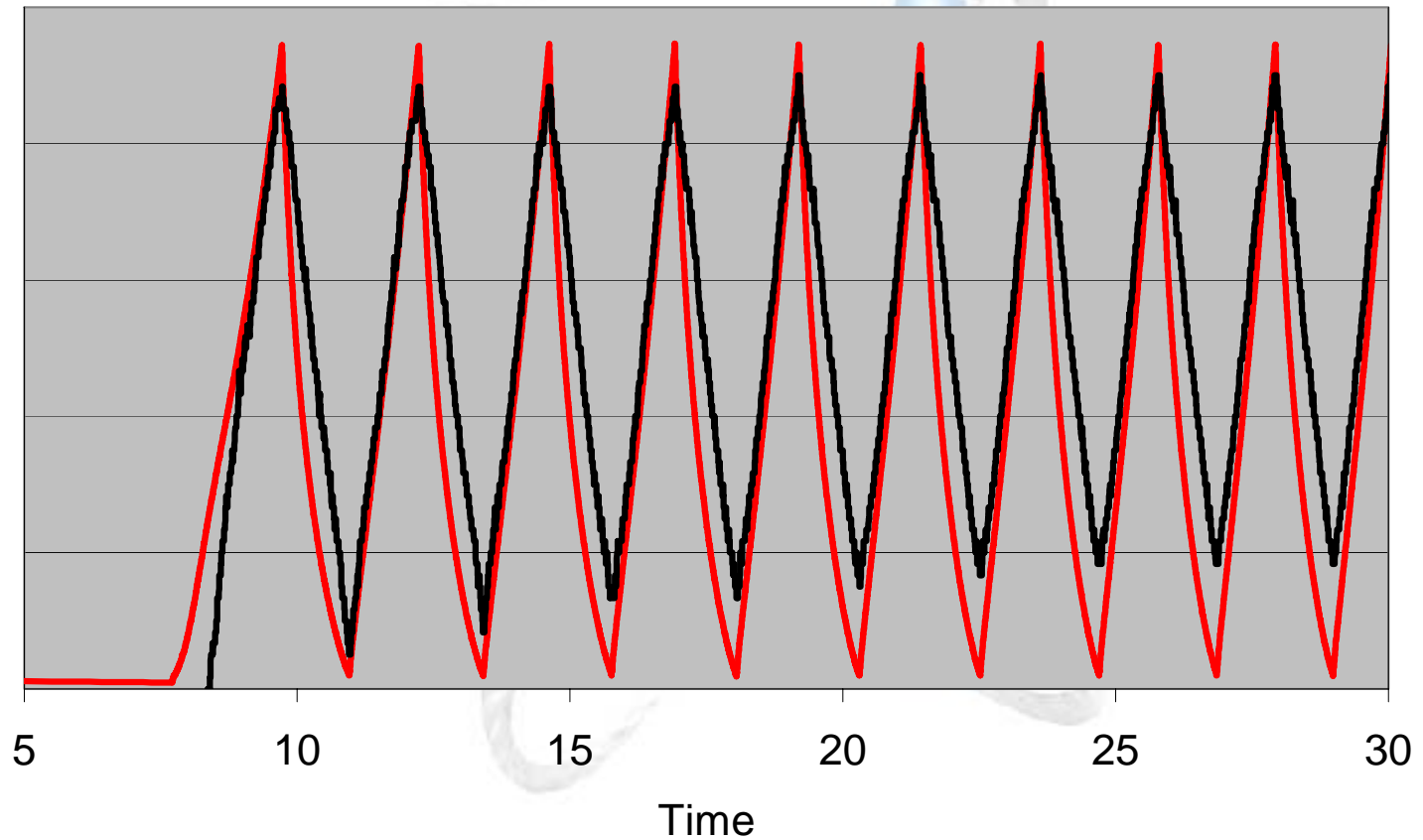
# Synthetic Rope Testing – HMPE rope

Damping effect – low stress/strain lagging



# Synthetic Rope Testing – Nylon rope

Some Phase Lag



Stress — Strain —

# Synthetic Rope Testing Strength Data Comparison

	ASB	PTS	Tenex	Validator 12
Spec. Avg.	32,600	11,250	11,800	35,000
no cycle	31,800	10,200	10,200	32,600
20% BS	32,700	11,000	11,100	34,900
50% BS	34,700	11,100	11,200	37,200

# CONCLUSIONS

- Rope strength and total elongation are function of how they are measured
- Data collected so far show consistent trend of the effects of pre-cycling of high modulus fiber ropes
- High elasticity fiber may result strain-stress phase lag
- Real time elongation measurement is important to understand dynamic rope behaviors
- For some fibers 10 cycles does not remove all the constructional elongation