Twisting Phenomena

PELLOW ENGINEERING SERVICES INC
DONALD L. PELLOW, P.E.

July 24, 2002

Mr. Jeff Susman
Slingmax
P.O. Box 2423
2626 Markat Street
Aston, PA 19014

Dear Jeff:

As we discussed, a series of "twist" tests have been conducted on six TPXC 1000 slings recently shipped to me. The actual data is attached, but two important discoveries were made. First, the sling tested in a straight pull to destruction was observed at 10,000# increments up through 40,000#, and then again at final breaking strength, for slippage of the tell-tails or other distortion. Although the tell-tails did pull into the cover as the load was increased, it was not that obvious from a distance of several feet until 40,000# was achieved. A scale was used to measure movement of these tell-tails at various loads.

Second, slings with twists actually show a dramatic increase in strength up to .8 twist/ft. or 288 degrees/ft.. Above 288 degrees/ft., the sling strength began to decrease; however, even at 1.2 twists/ft., or 432 degrees/ft., the sling retained more strength than the original sling without twisting.

After you have had the opportunity of reviewing this data, let's discuss these findings and decide if more testing is required, or if we can use the increase in strength to our advantage.

Yours truly,

Donald L. Pellow - P.E.

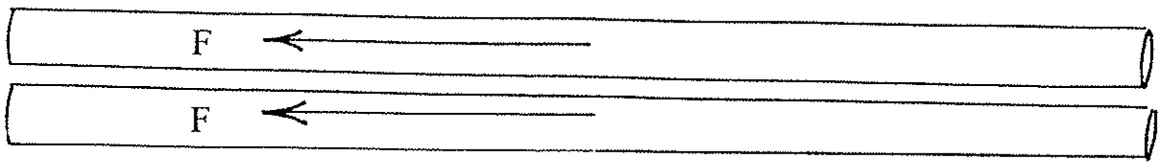
c.c. Dennis St. Germain

"TWIST" TESTS
TPXC 10000 SLINGS

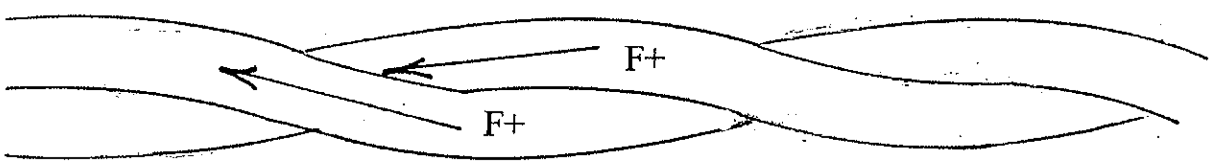
A series of ultimate breaking strength tests was conducted on six, 5' TPXC 1000 slings. One exemplar breaking strength test was conducted to determine actual ultimate strength in an untwisted condition, while the remaining five slings were pulled to breaking strengths with varying amounts of twists.

SAMPLE	NO. OF TWISTS	EXPOSED LENGTH OF TELL-TAILS	TENSILE LOAD
B062402092	NONE	3.5"	0#
		3.5"	10,000#
		3.5"	20,000#
		3.375"	30,000#
		3.125"	40,000#
		0" &1.75"	ULT. B.S. = 58,093#
B062402094	2 Twists .4 Twist/ft. 144° /ft.	2.75" & 3.0"	ULT. B.S. = 59,504#
B062402095	4 Twists .8 Twist/ft. 288°/ft.	0" & 3.375"	ULT. B.S. = 70,821#
B062402097	4 Twists .8 Twist/ft. 288°/ft.	3.375" & 3.375"	ULT. B.S. = 71,357#
B062402096	5 Twists 1 Twist/ft. 360°/ft.	3.0" & 3.375"	ULT. B.S. = 63,089#
B062402093	6 Twists 1.2 Twists/ft. 432°/ft.	0.75" & 3.0"	ULT. B.S. = 59,300#

Donald L. Pellow - P.E.
Engineering Consultant
July 24, 2002

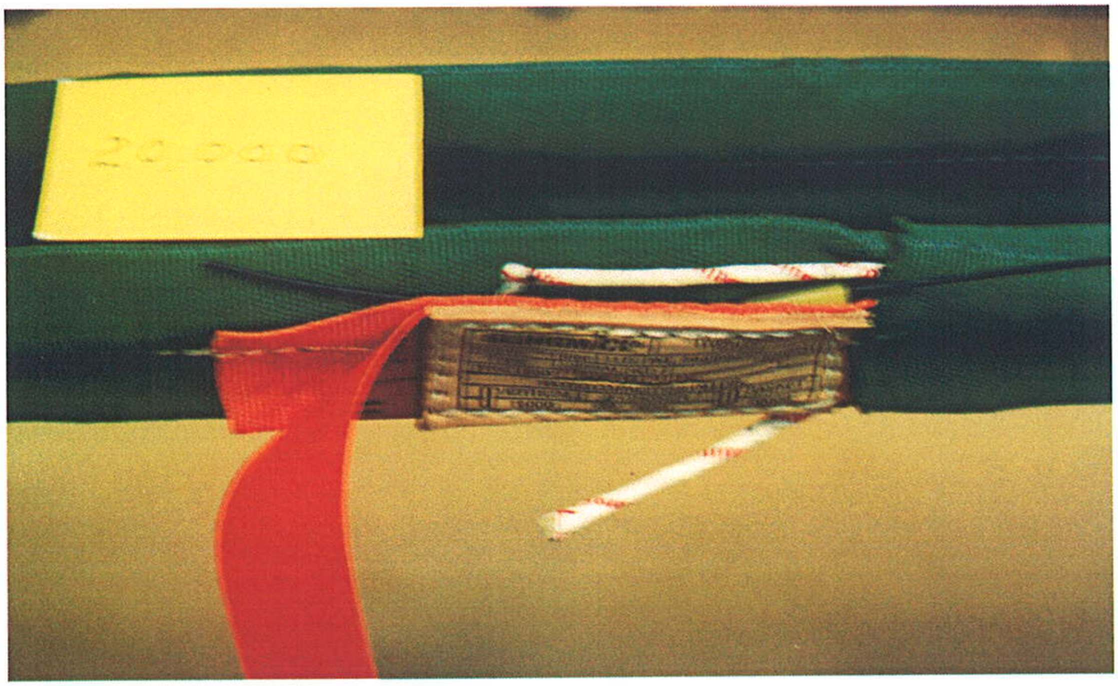


- ALL FORCES ARE ALONG AXIS OF FIBERS
- MAXIMUM STRENGTH OBTAINED ONLY IF FIBER LENGTHS ARE EXACTLY EQUAL - <u>HOWEVER</u>, EQUALIZED LENGTHS ARE IMPOSSIBLE

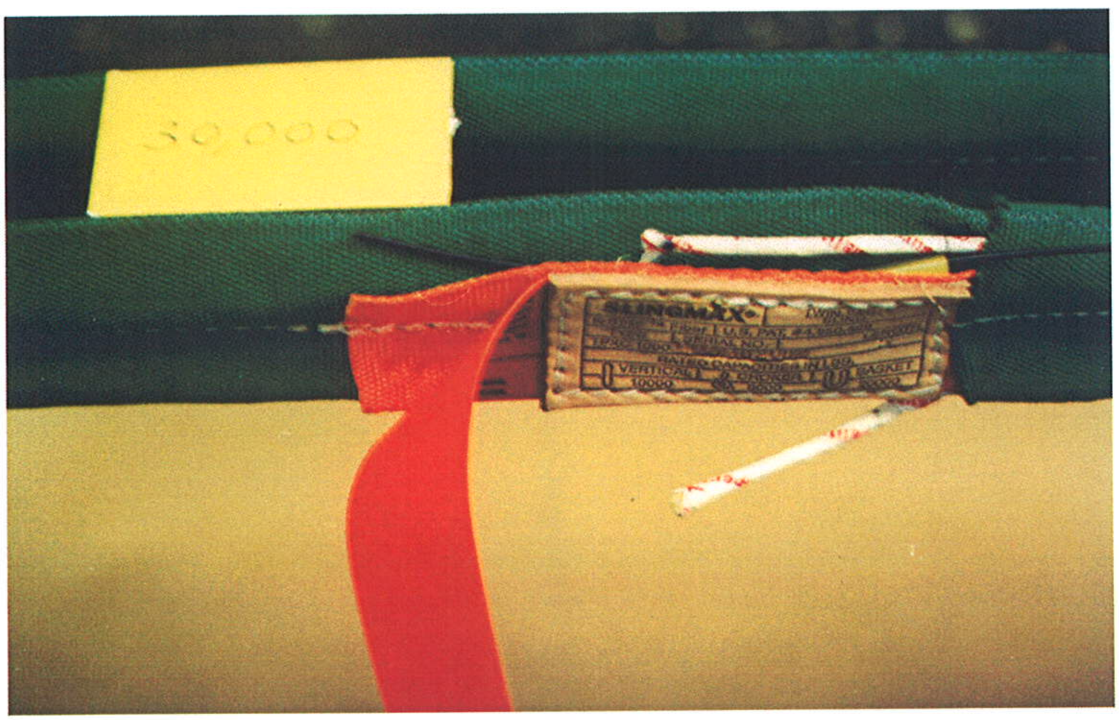


PHOTOGRAPH #1
TPXC 1000 SLING PRIOR TO TESTING

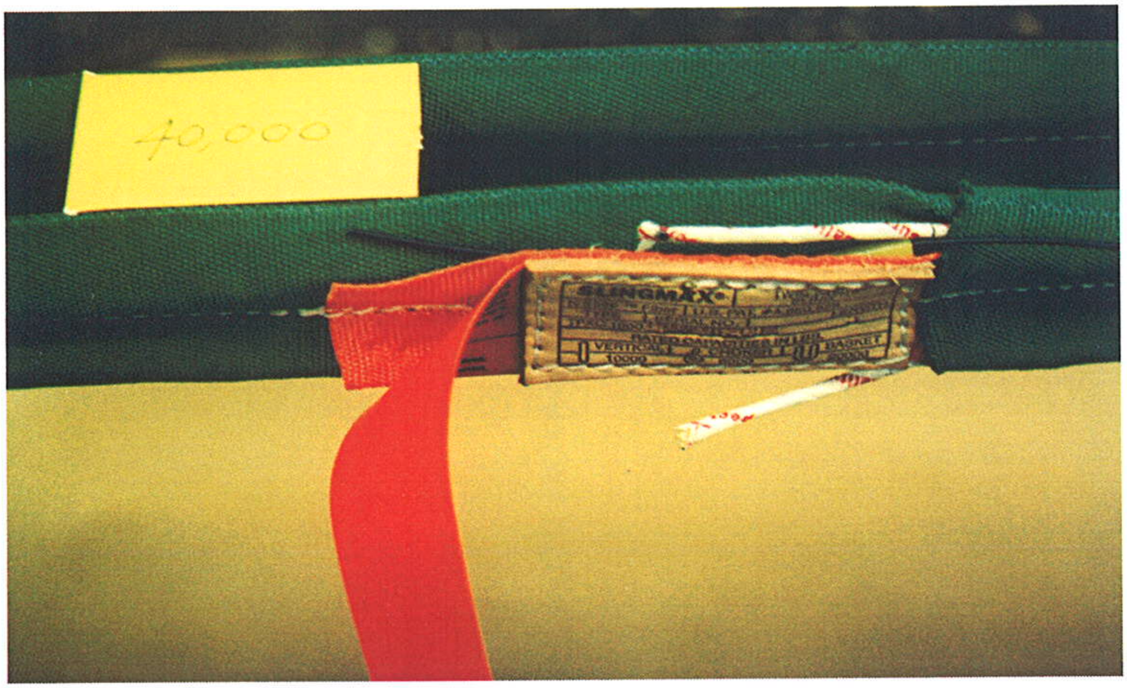
PHOTOGRAPH #2
TPXC 1000 SLING – STRAIGHT PULL @ 10,000#



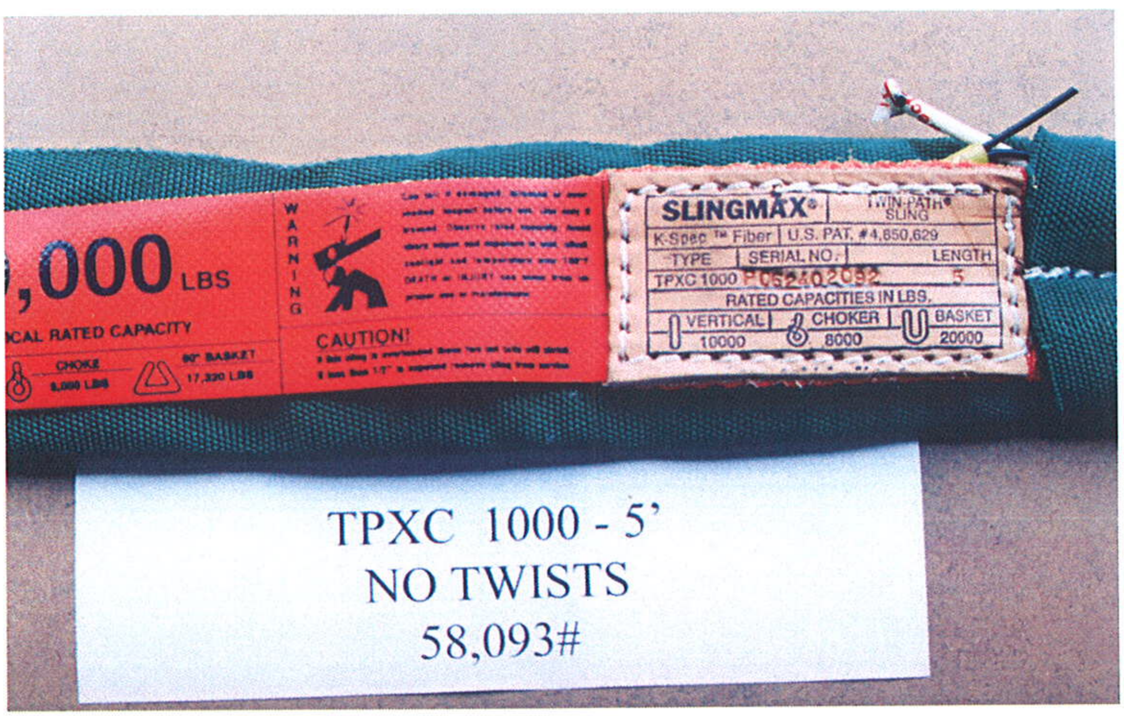
PHOTOGRAPH #3
TPXC 1000 SLING – STRAIGHT PULL @ 20,000#



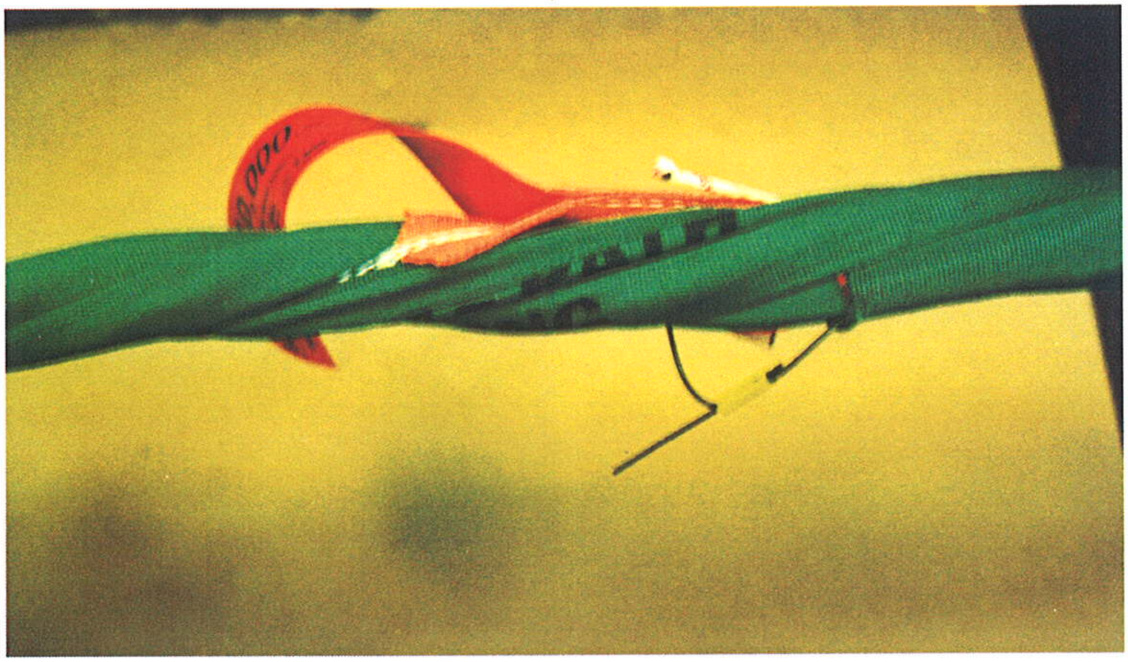
PHOTOGRAPH #4
TPXC 1000 SLING – STRAIGHT PULL @ 30,000#



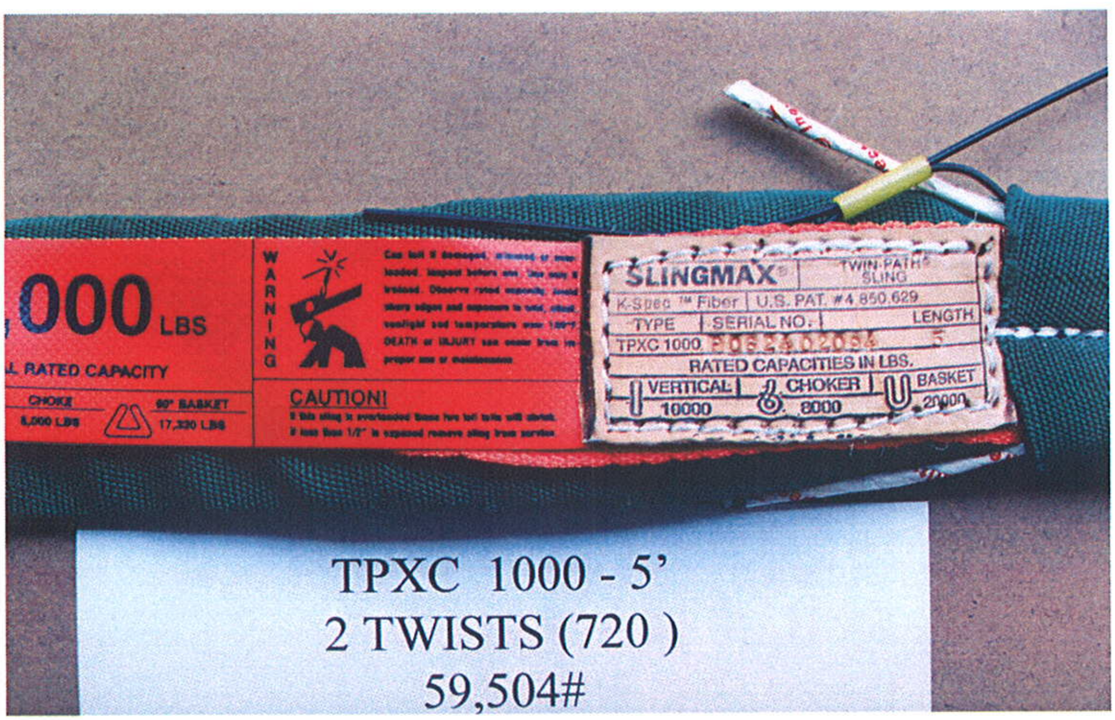
PHOTOGRAPH #5
TPXC 1000 SLING – STRAIGHT PULL @ 40,000#



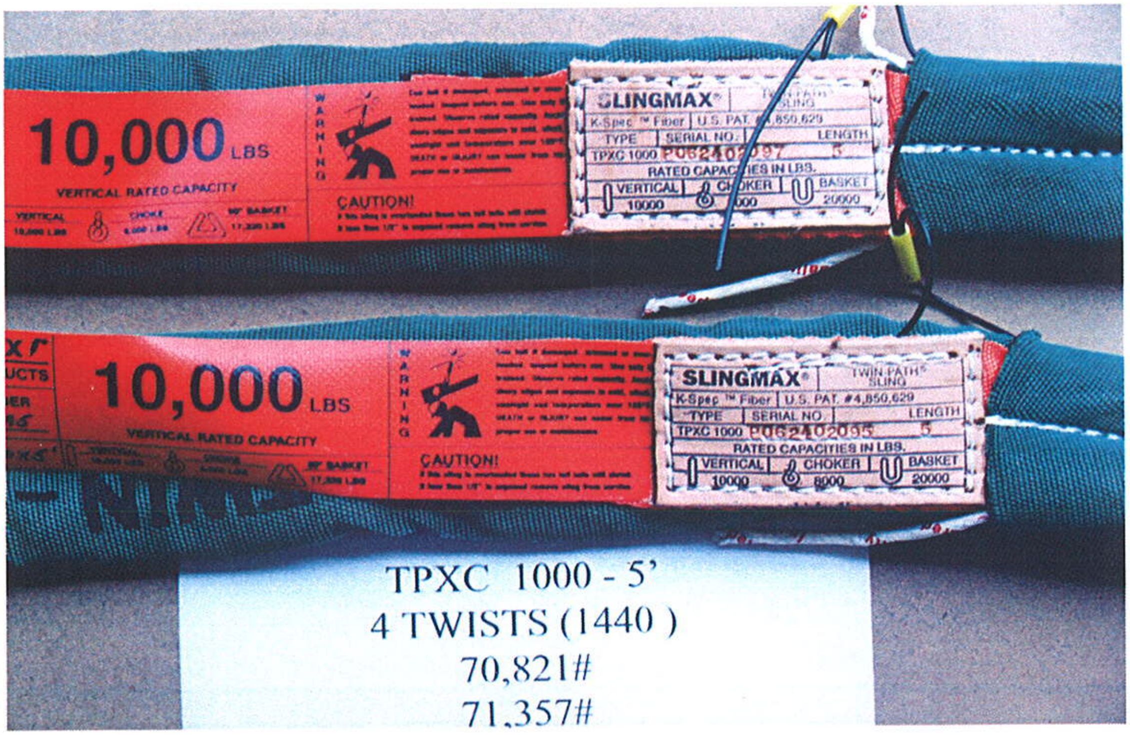
PHOTOGRAPH #6
TPXC 1000 SLING – STRAIGHT PULL @ 58,093# (ULT. B.S.)



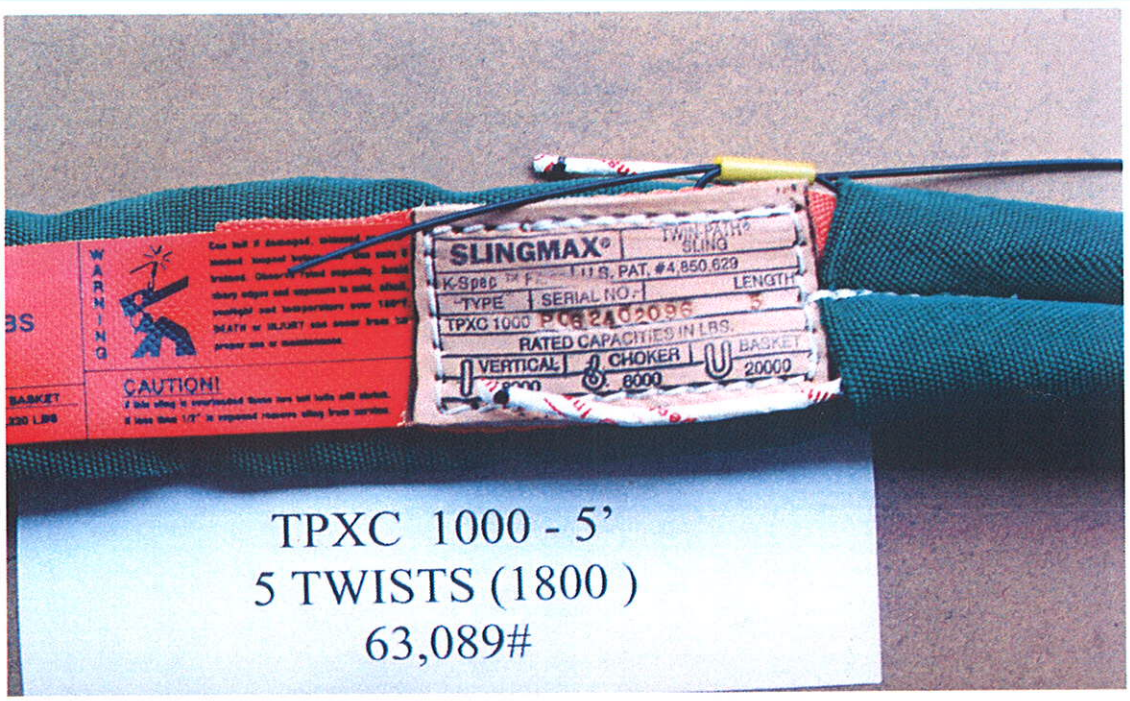
PHOTOGRAPH #7
TPXC 1000 SLING IN TESTING MACHINE WITH 2 TWISTS IN 5'



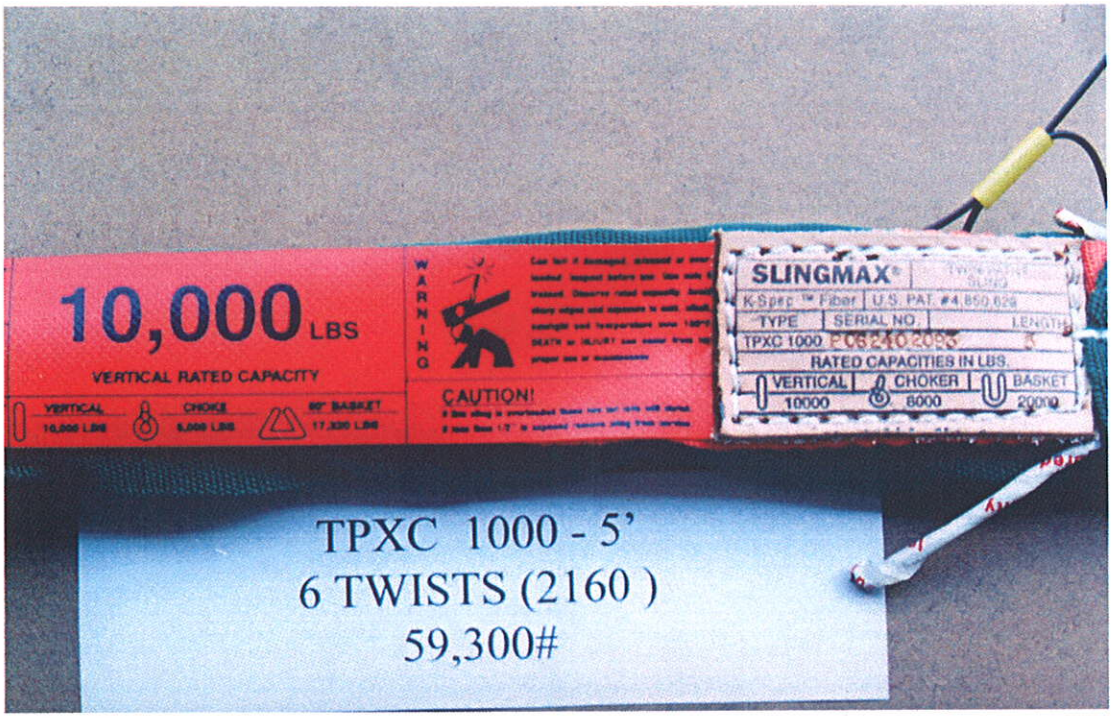
PHOTOGRAPH #8
TPXC 1000 SLING AFTER TESTING – TWISTS IN 5'



PHOTOGRAPH #9
TPXC 1000 SLING AFTER TESTING – 4 TWISTS IN 5'

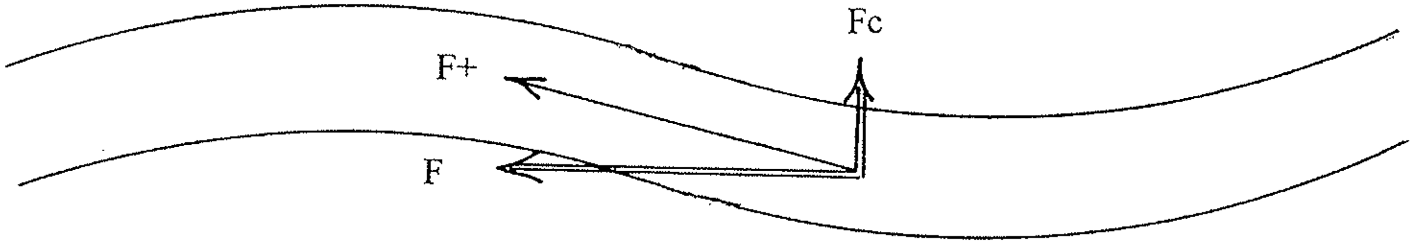


PHOTOGRAPH #10
TPXC 1000 SLING AFTER TESTING – 5 TWISTS IN 5'



PHOTOGRAPH #11
TPXC 1000 SLING AFTER TESTING – 6 TWIST IN 5'

$$F+ = \sqrt{F^2 + Fc^2}$$

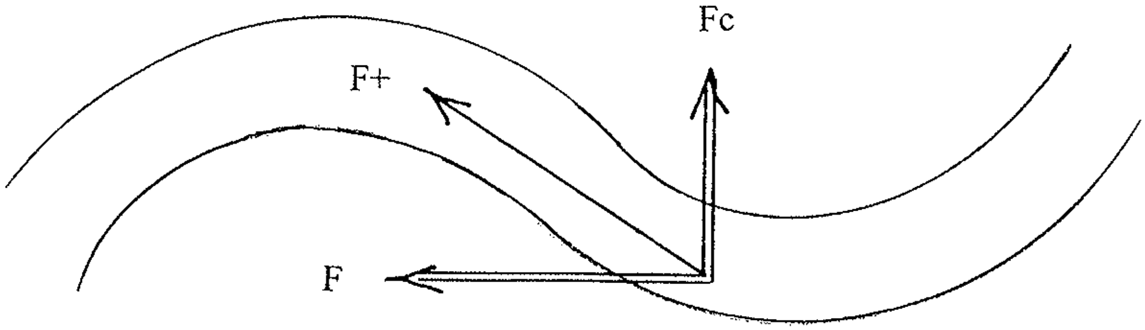


- F+ IS GREATER THAN F BECAUSE F+ IS TENSIONED AT AN ANGLE AND HAS TWO COMPONENTS - ONE PARALLEL TO THE IMPOSED LOAD, F, AND ONE APPLYING A COMPRESSIVE FORCE AGAINST THE ADJACENT FIBER, Fc

- THEREFORE, THERE IS NOW GREATER AXIAL LOAD ON THE FIBERS TO ACHIEVE F NECESSARY TO LIFT LOAD

- Fc IS A COMPRESSIVE FORCE AGAINST THE ADJACENT FIBER AND IS SUPPLYING FRICTION BETWEEN THE FIBERS

- THIS FRICTIONAL FORCE IS ALLOWING BOTH FIBERS TO WORK AS ONE MEMBER IN LIFTING THE LOAD AND IS ACHIEVING EQUALIZATION OF LOAD ON BOTH FIBERS\



- THE COMBINED STRENGTH OF THE FIBERS WILL TEND TO INCREASE UNTIL THE FOLLOWING LIMITS ARE REACHED -

  1. F+ REACHES A LEVEL THAT EXCEEDS THE FIBER STRENGTH WITH COMPRESSIVE FORCES (SHEAR STRENGTH OF FIBER)
  2. Fc BECOMES GREAT ENOUGH TO INHIBIT RELATIVE MOVEMENT BETWEEN THE FIBERS AND HAS A REVERSE EFFECT ON EQUALIZATION OF LOAD

- AFTER THIS LIMIT IS REACHED, THE STRENGTH OF THE COMBINED FIBERS WILL BEGIN TO DECREASE. THIS REDUCTION IN STRENGTH WILL ASYMPTOTICALLY DECREASE AS THE ANGLE OF TWIST INCREASES.