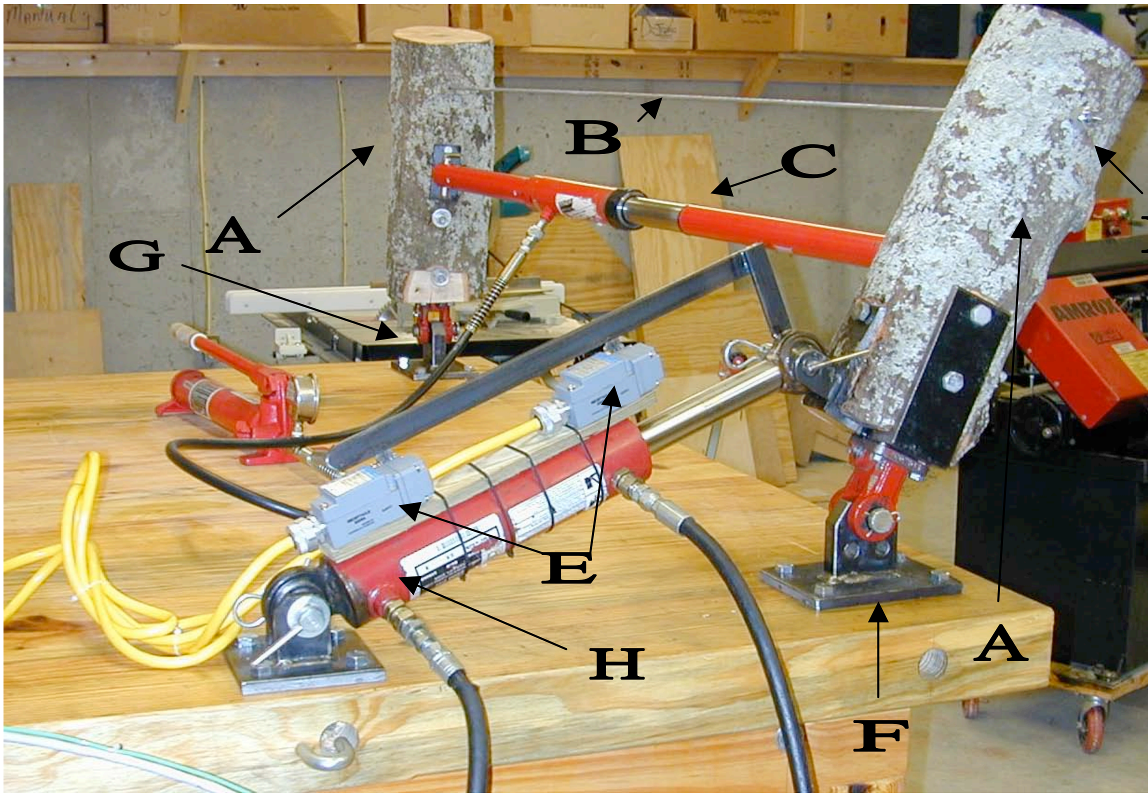
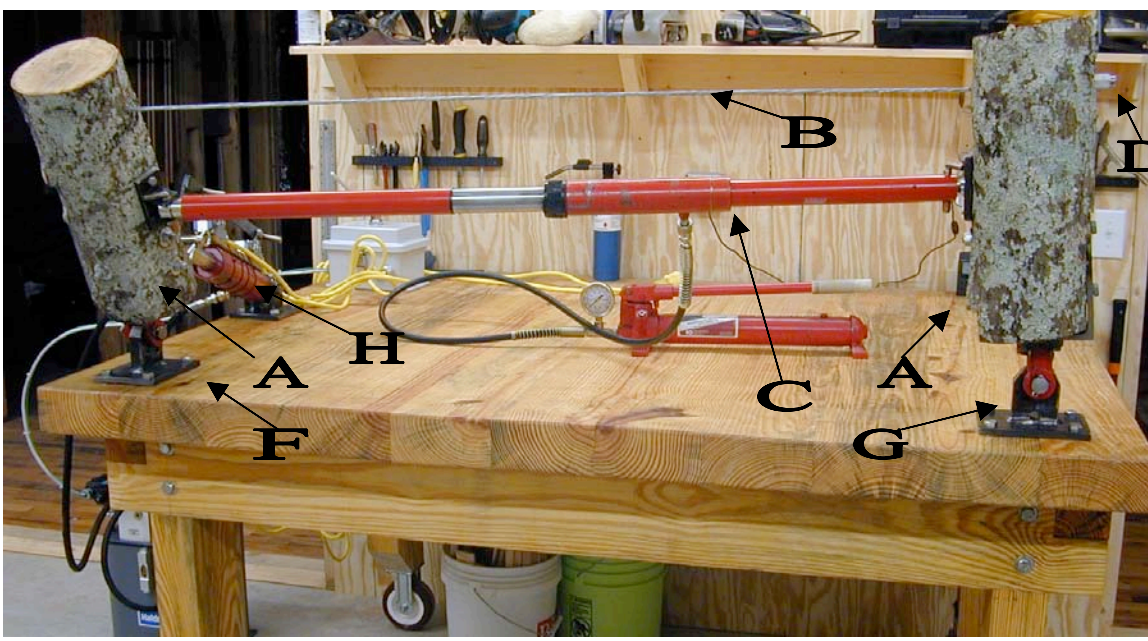
# Wind Simulation Test Bench



## Make up of Test:

a. 10” diameter blocks of water oak mounted on pivot bases.
b. ¼” EHS strand (cable).
c. Manually operated hydraulic cylinder to apply pressure to the strand.
d. Wire Stop terminal hardware or forged eye bolt in control test.
e. Electric switches to toggle cylinder (H) back and forth.
f. Pivot base free to move perpendicular to opposite log but not free to move towards it.
g. Pivot base free to move toward opposite log but not with the sideways movement of the log.
h. Hydraulic cylinder controlled by switches (E) to move attached log back and forth in an 8 second cycle.

## Purpose of Test:

1. To determine the fatigue or wear on the terminal hardware or strand using Wire Stops and a control hardware consisting of Pre-formed wraps, heavy duty thimbles, forged eye bolts, washers, and nuts. This potential fatigue will be produced by simulating wind conditions in a tree.
2. To determine if tightening and loosening conditions produced by simulating wind blowing in trees would effect the hold of Wire Stops on the strand being terminated.

## Procedure of Test:

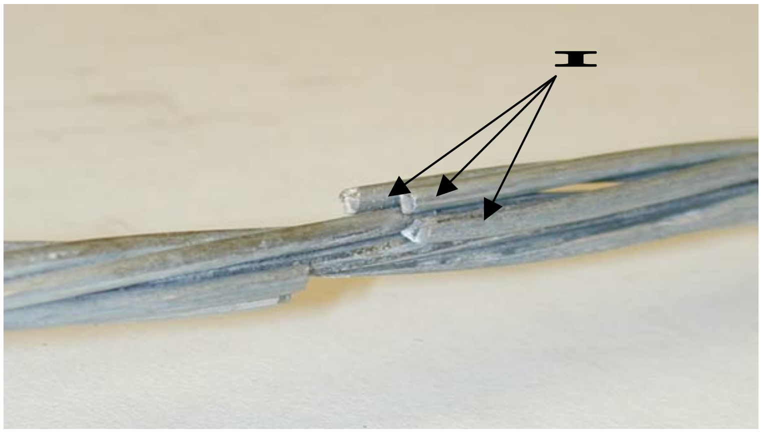
❖ The tests were conducted using the previously described test bench.
❖ The strand and terminal hardware being tested were installed, as they would be in the field using manufactures recommendations.
❖ The length of the test wire (B) including any hardware was 51” to the inside of either piece of test wood.
❖ The manually operated hydraulic cylinder (C) was pumped so that the pressure applied to the strand and terminal hardware would vary between approximately 500 lbs and 2,500 lbs during one complete 8 sec. cycle.
❖ The 8 sec. cycle was produced by actuating the hydraulic cylinder (H) by the electric switcher (E) in such a way that cylinder (H) would be

going continually in and out producing a travel of 20 inches for one of the test logs while the other test log was held to very little movement.

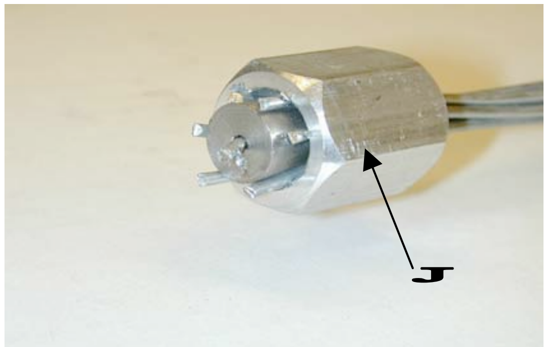
- The tests were run for eight-hour periods.
- Test; runs were stopped periodically to maintain test equipment. The swivel bases (F&G) wore signifantly during the testing. Both swivel bases were rebuilt once over the period of four test cycles.
- Pressure on the strand was monitored and adjusted periodically to compensate for the wear on the test equipment, the stretching and internal wear of the strand itself, and the slight lose of hydraulic pressure from the manual pump.
- Tests were performed using ¼" EHS strand and ¼" Wire Stop terminal hardware. A control test was also run using the above on one end and a ¼" pre-formed wrap, heavy duty thimble, ½" forged eyebolt, washer, and nut on the other end.
- The tests were run until there was a failure of the strand or the terminal hardware.
- Three tests were run using only Wire Stops. One control test was also run using a Wire Stop on one end and a ¼" pre-formed wrap, heavy duty thimble, ½" forged eye bolt, washer, and nut on the other end.

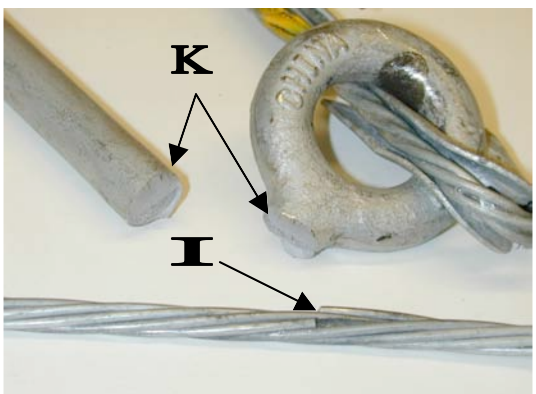
## Findings of Test:

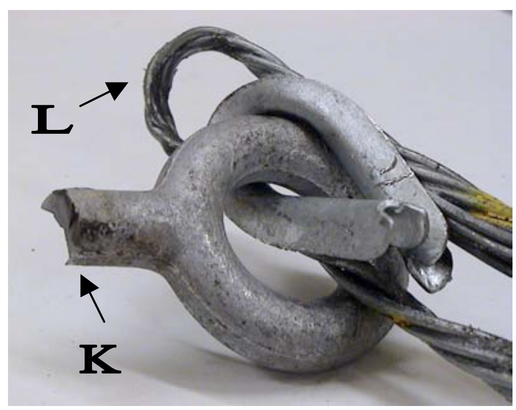
In the first test, three wires of the EHS strand (I) broke after approximately 14,400 cycles or 32 hours of testing. This failure occurred on the inside of the stationary log where the wire exited the test log. The broken wires were found at the end of the fourth 8-hour test period but could have happened and hour earlier after the test was last monitored.




The test was terminated even though the system had not completely failed because this amount of deterioration of the stand was in effect considered a failure. There did not appear to be any change in strand (J) being held in place by the Wire Stops as a result of the tightening and loosing of the of the strand over the test period. This was true of the Wire Stops on both ends. In addition to the actual breakage, there was also blackening on the inside of the strand from the movement of the individual wires against each other. Also, during the tests, the strand would creak as the test log was pushed back and forth by the hydraulic cylinder indicating friction between the individual strands. The other two tests were similar to the first except that in each test it took slightly longer the fatigue the strand. The last test went over 16,000 cycles before the strand fatigued. This, however, is not considered significant because of the before mentioned variances in the pressure on the strand.




The control test ran for 14,600 cycles. The shank (K) of the forged eyebolt that was attached to the stationary log snapped completely in two shortly after the fifth 8-hour test period had started. There was also wear observed on the inside of the pre-formed wrap (L) were it was rubbing against the thimble. The Wire Stop end had one broken wire (I) at the time of the eyebolt failure. As in the previous tests, the strand creaked considerably during the entire test period. There was also the black residue in the strand itself and also where the pre-formed wrap contacted the strand.

# Conclusion of Test:

Metal fatigue is defiantly an issue to be considered in both cabling systems. The fact that both systems failed at the 14,500-cycle mark suggests the temporary life span of systems considered by some to be permanent.

1. These tests were set up to cause these systems to fail. Both systems failed at the point of connection of the stationary log. Either cabling system installed in an actual tree would have more freedom to move making the stationary point where both systems failed harder to establish.
2. The point of focused metal fatigue would be moving every year in an actual tree installation because of the growth of the tree. So in effect the point on the eyebolt or strand that is most susceptible to fatigue would be constantly changing over time.
3. The distances and tension and movement of this test would not likely exist in an actual tree.
4. Most cables are longer than 51 inches. If the cable were 12 feet long, the movement to produce the same amount of fatigue would have to be 56.5" or close to five feet of travel and that at a 500 lb to 2,500 lb force.
5. Cabling applications that would anticipate holding pressures of 2,500 lbs. should be done with larger and stronger strand and terminating hardware.