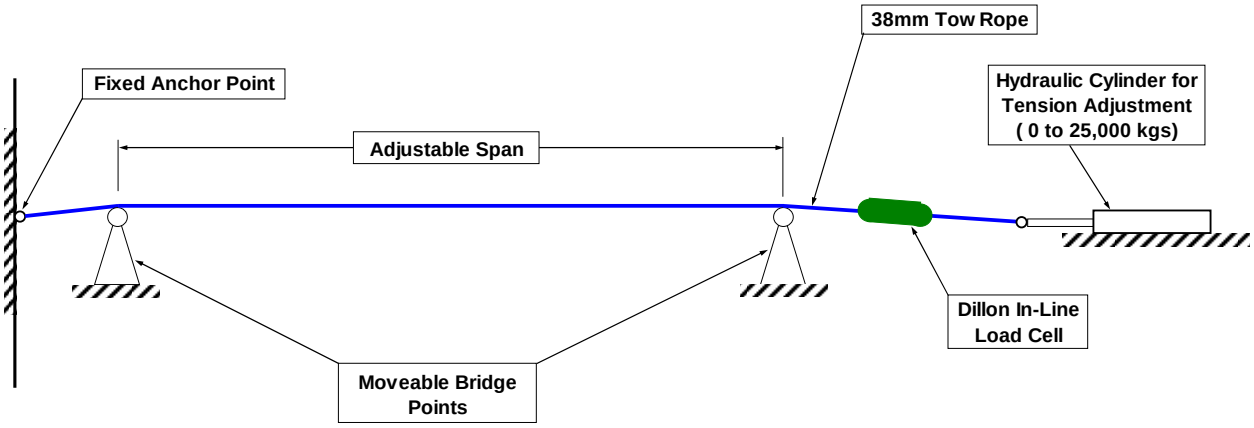
TEST DATA FROM A TENSION TEST SETUP AT SOUTHWEST OCEAN SERVICES

Tests were conducted at Southwest Ocean Services on 6/28/2006 on 38 mm diameter polyethylene tow rope to determine whether a DynaTension Model P1000 tensiometer would be suitable for monitoring polyethylene towline tensions. The tension standard used was a W.C. Dillon Model EDXtreme load cell.

To achieve the objective, a fairly simple test setup was utilized, as illustrated in Figure 1 below (photographs of the setup are also provided in Appendix A).

FIGURE 1
TENSION TEST SET-UP



The Viten P1000 consists of a main electronics box, with a remote single axis accelerometer that gets affixed to the tow rope at any point between the two moveable bridge points. The tow rope is excited manually (using a gentle tap with a rubber mallet), allowing the accelerometer to sense the natural frequency of the vibration response of the rope under tension. From the natural frequency, tension can be inferred as follows:

$$T = 4 L^2 f^2 \rho A - \pi^2 E I / L^2$$

Where, T = tension in the rope,

L = length of the rope between the 2 bridge points,

f = natural frequency response of the rope,

ρA = linear weight of the rope,

E = the modulus of elasticity of the rope,

I = the moment of inertia of the rope.

From the equation above, it can be seen that the second term is independent of frequency, and is in fact a fixed constant based solely on the material properties of the rope and its span between bridge points. For long spans, this constant is often negligible and can be

ignored. However, if the span becomes sufficiently short, the constant must be known and accounted for in order to infer an accurate tension reading. Therefore, the P1000 instrument allows for the input of this constant, if desired, and is referred to by the instrument manufacturer as the K-factor (Kf).

The following graphs and photos document results of tests. Tension in the towline was measured at five plateaus of increasing tension. Then a five pound clump weight was attached near one of the bridgepoints to assess the effect of attaching a sensor assembly that could accommodate moving rope. Tension was then stepped back down through the same plateaus.

The comparative results between the load cell and the P1000 are shown in Figure A1 in the Appendix. Agreement between the two sets of measurements is very close, both with and without the clump weight added. Figure A2 shows the K-factor both before and after correction.

APPENDIX A

PHOTOGRAPHS OF THE TENSION TEST SETUP AT SOUTHWEST OCEAN SERVICES

A.1 P1000 & W.C. DILLON LOADCELL COMPARISON

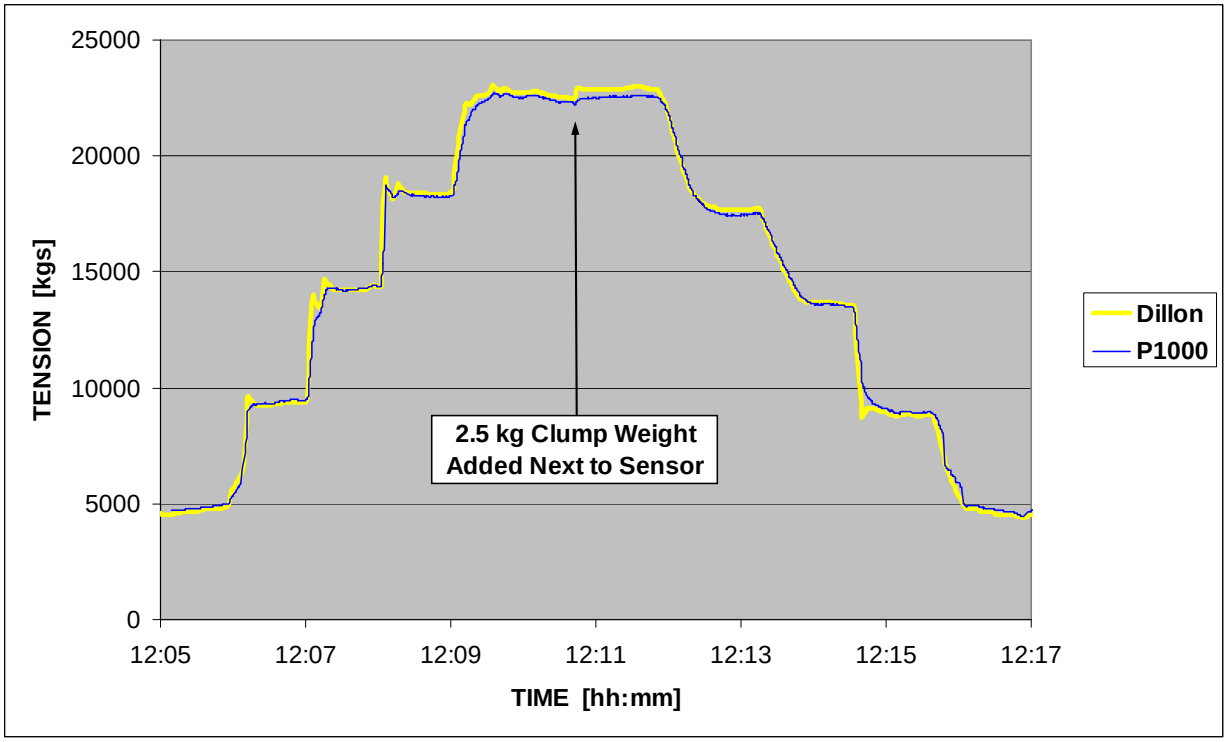
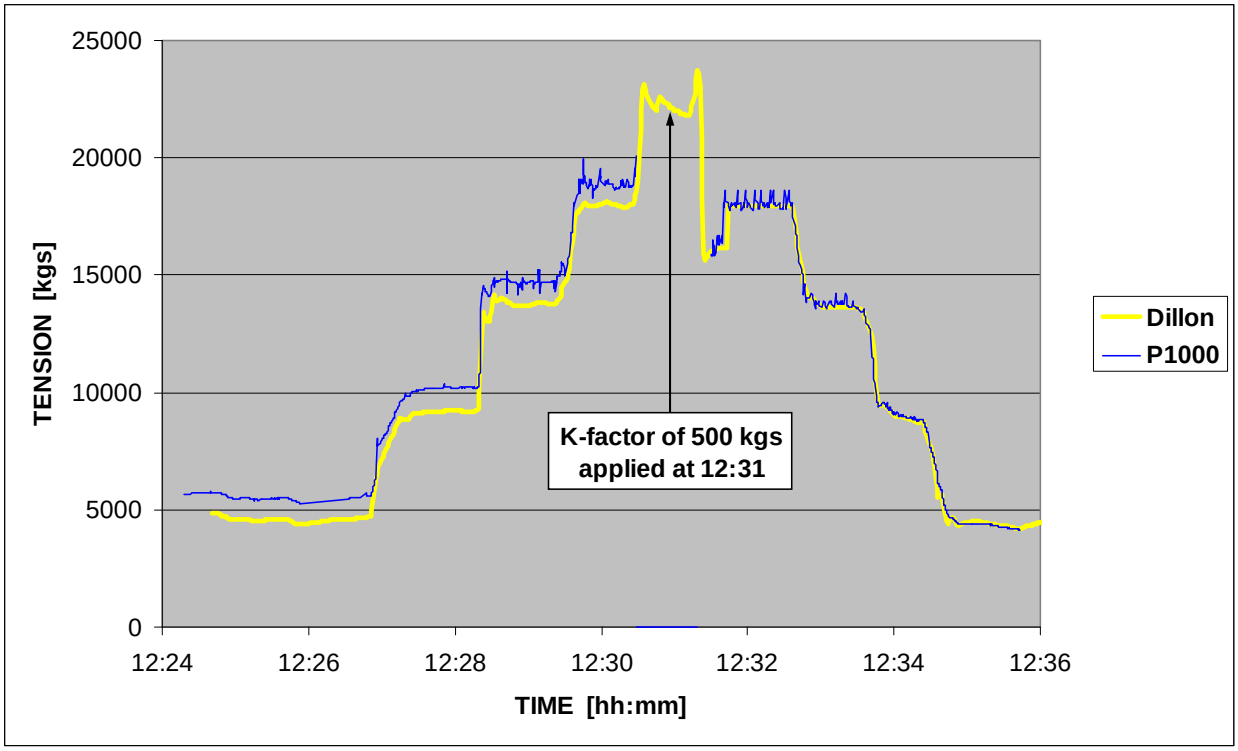


FIGURE 3.7

A.2 K-Factor Measurement and Tension Correction



A.3 The Southwest Ocean Services Test Bed

A.4 Dillon load cell shackled between the hydraulic cylinder and the eye splice of the 38mm diameter tow rope.

A.5 Two Bridge Points with the P1000 Near a Bridgepoint.