SELANTIC

OSCAR

Optical **SC**anning **A**pparatus for **R**opes

By

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State of the Art

- Difficulty in assessment of state of synthetic mooring lines in deep water
- No rejection criteria
- No ability to measure in-situ modulus
- No method of assessing magnitude of cut damage

The solution

The OSCAR Consortium

- BPP Technical Services
- Bexco Ropes
- Leuveco
- Tension Technology International
- Strathclyde University
- Selantic Fibre AS

History of Oscar

UK SMART

- TTI & Strathclyde – Development of Method

EU CRAFT

- Oscar Consortium – Laboratory Trials

Technical Issues

- **Method**
  - Optical Fibre
    - Bragg Grating
    - Standard OTDR (Optical Time Domain Reflectometer)
    - Brillouin Scattering

- **Optical Fibre Elongation**
  - Glass Optical Fibre <2% vs Ropes 10%

Method

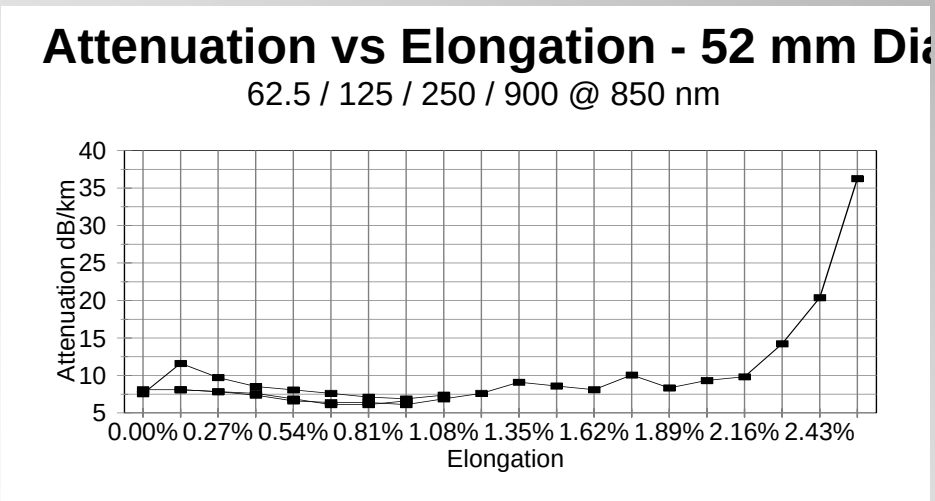
Bragg Grating

- Doses discrete sections of optical fibre
  - Not fully distributed
  - Need very large number of gratings for 5 m resolution (300 for 1000m)
  - Difficulty in processing data
  - High cost of fibre

Method

Standard OTDR

– Results show little dependence on elongation (microbend loss)



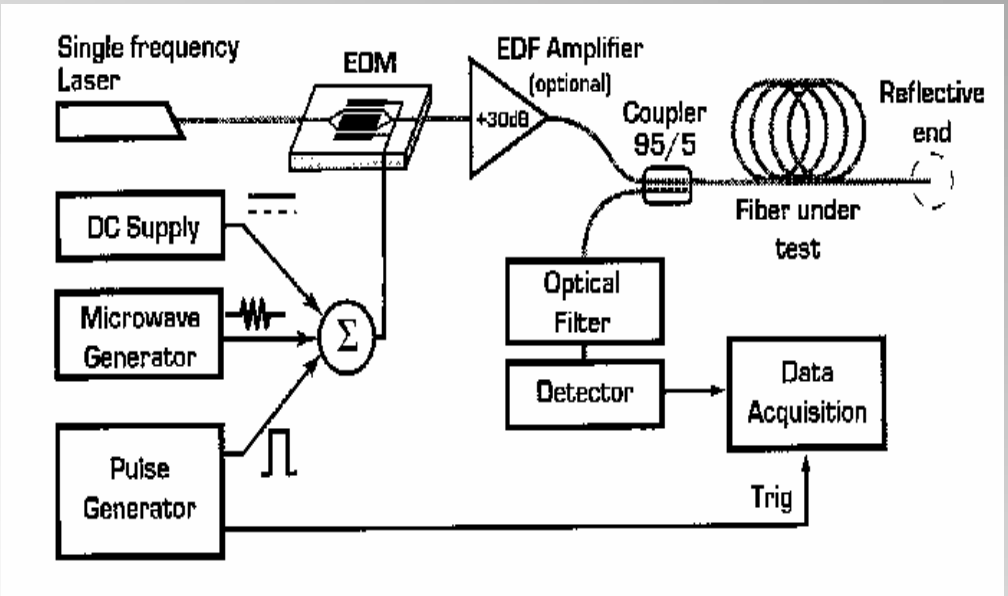
Method

Brillouin Scattering

- Uses standard single mode fibre
- Fully distributed sensing (<5 m resolution)
- Can accept high attenuation (signal loss)
- Expensive processing equipment, BOTDR (Brillouin Optical Time Domain Reflectometer)

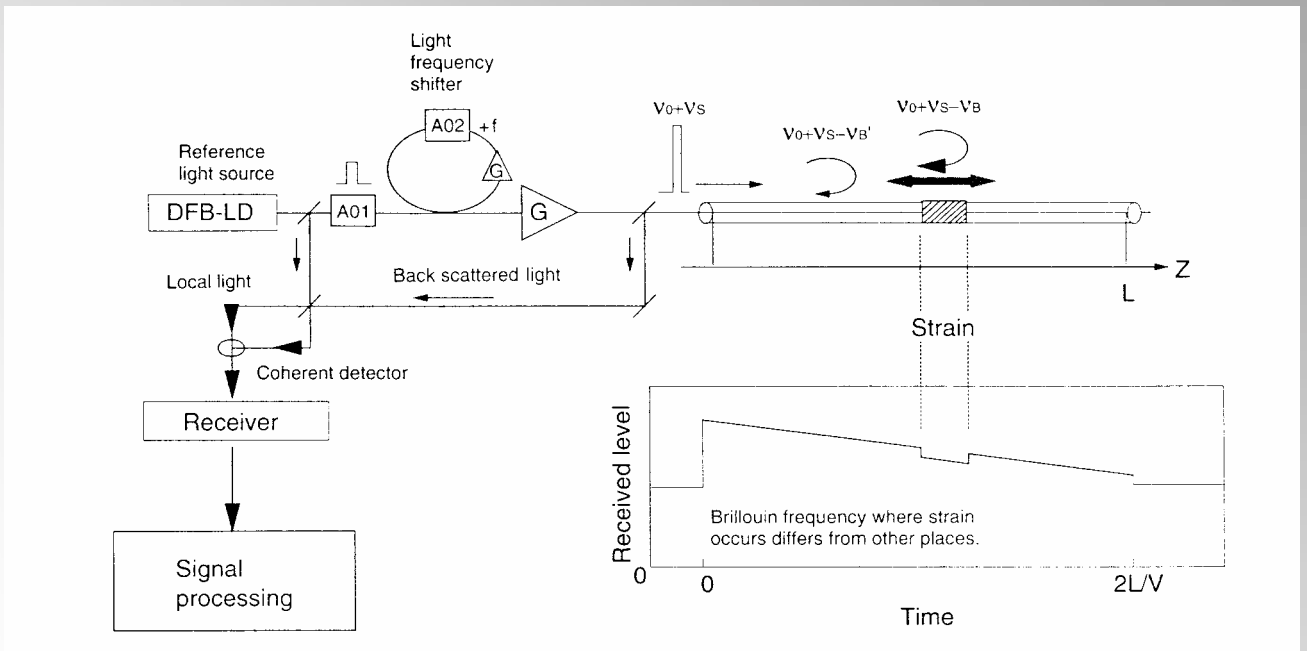
Method

Brillouin Scattering, instrumentation



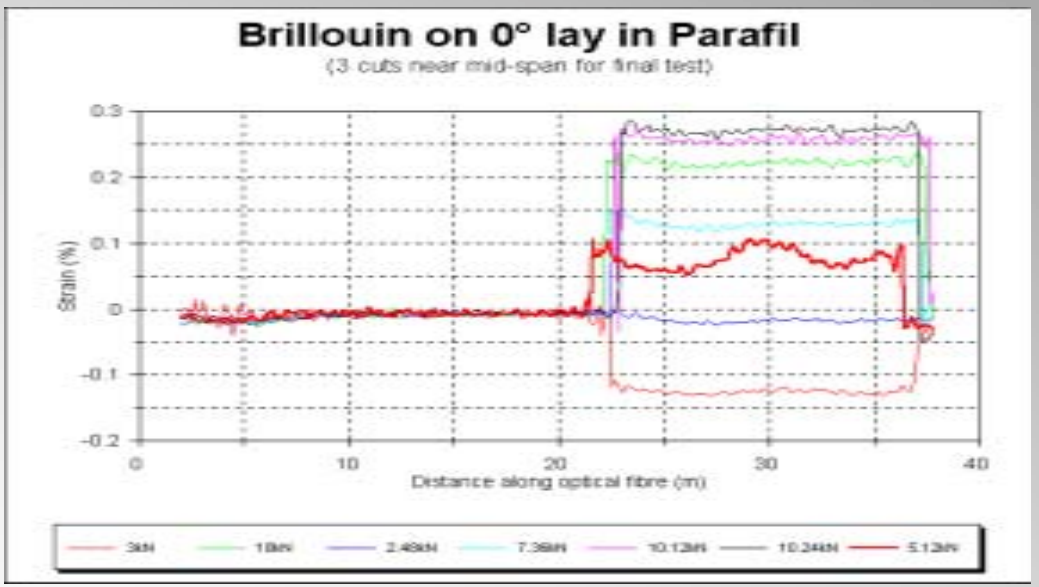
Method

Brillouin Scattering, general principle



Method

- Brillouin Results



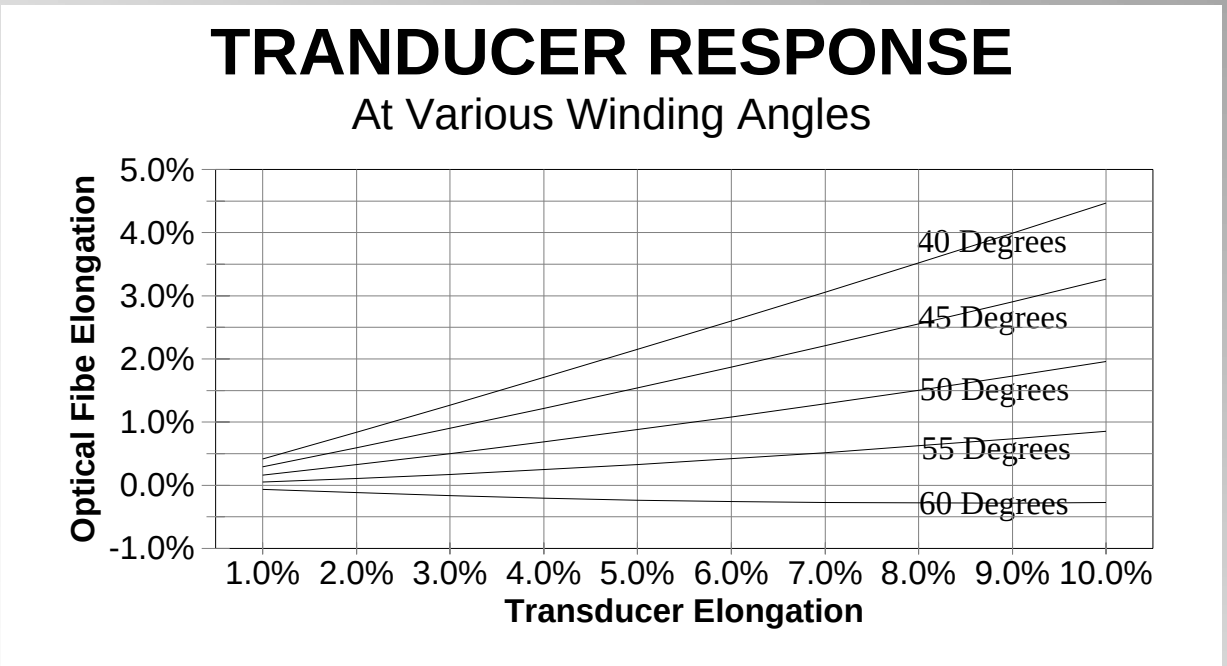
Optical Fibre Elongation

- **Plastic Optical Fibres**
  - **Unacceptably high attenuation (usable up to 100m)**
  - **New experimental fibre (perfluorocarbon) shows great promise**

- **High Wind Angle of Fibre on Rope**

High Wind Angle of Fibre

Theoretical response



High Wind Angle (cont.)

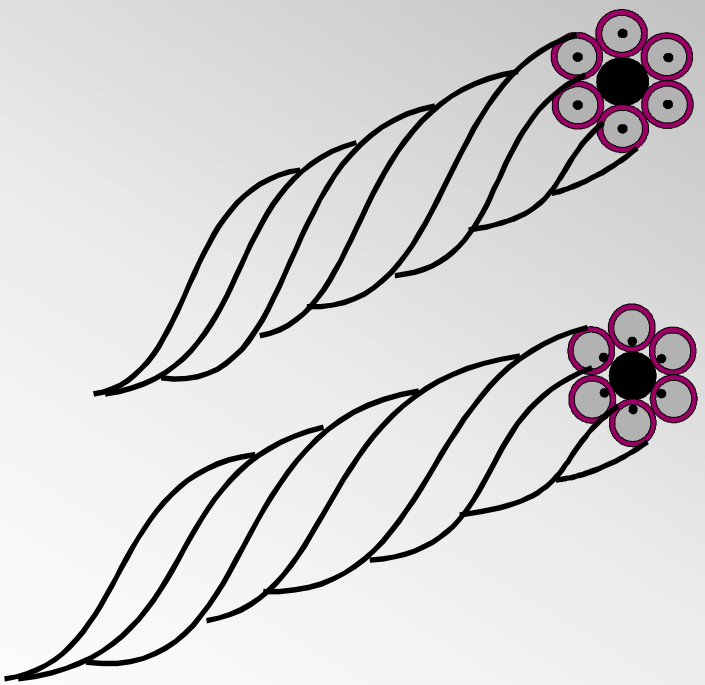
- Extremely Sensitive to Angle
- High Angle
  - High losses due to microbending

OR

  - Very large diameter transducer
  - Very difficult to make (twist in fibre during manufacture)

Transducer Design

TRANSDUCER WITH LOOSE TUBE OPTICAL FIBRES



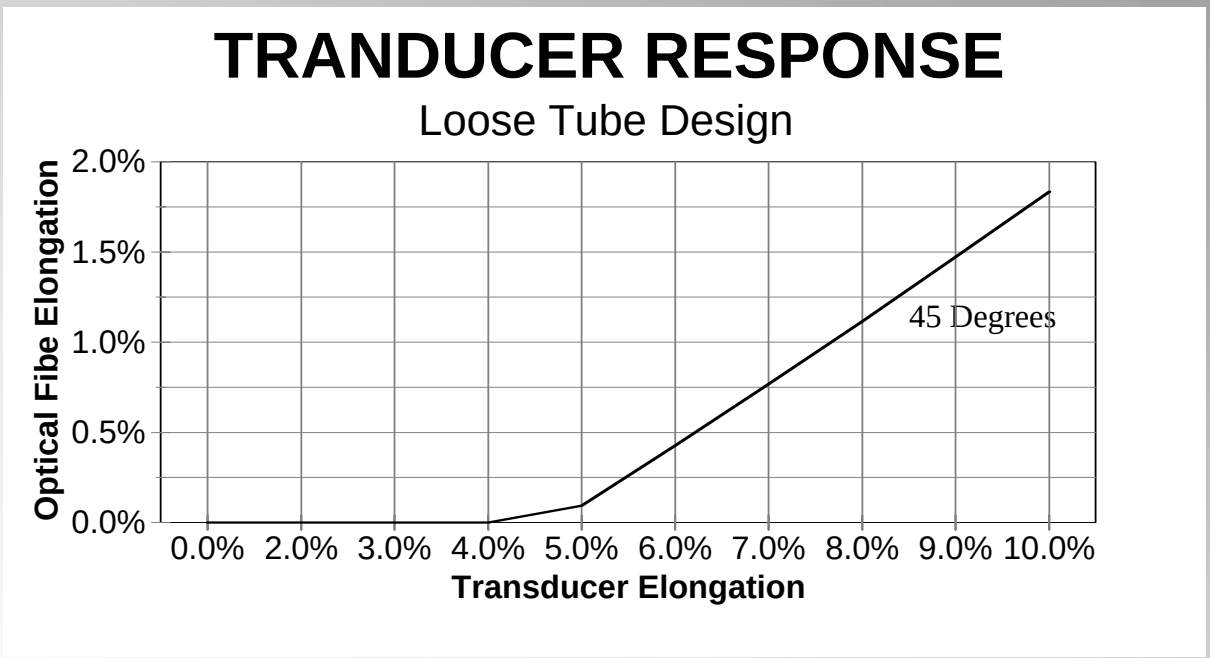
NOT ELONGATED

ELONGATED

FIBRES FLOAT TOWARDS CORE

ONCE ON INSIDE TUBE WALL, FIBRE ELONGATION OCCURS

Transducer Design



Transducer Design

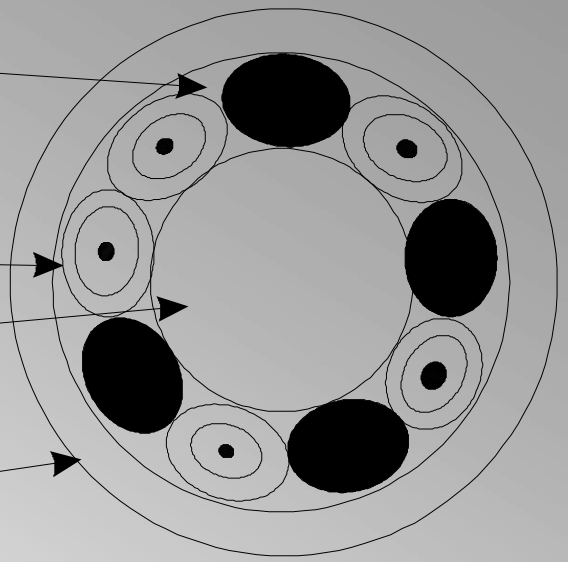
4 Fillers (4.0 mm dia)

5 Single Mode Loose Tube Fibres (4.0 mm dia)
ID 0.50 1.00 1.50 2.00 2.50 mm
Optical Fibre 9/125/250/900

Soft Rubber Core (10 mm dia)

Outer Jacket Soft Polyurethane (23 mm dia)

Helix Angle 34 degrees (lay length 33.5 mm)



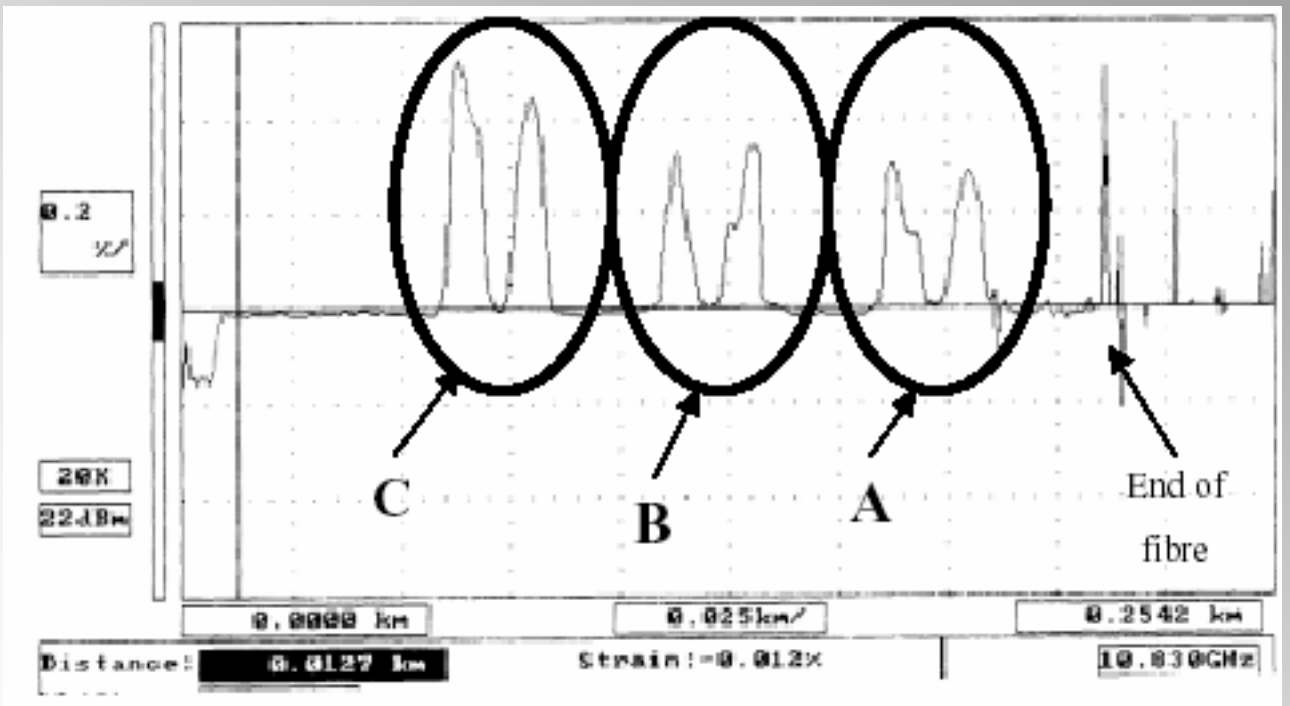
Optical Fibre Strain Transducer (OFST)

OSCAR

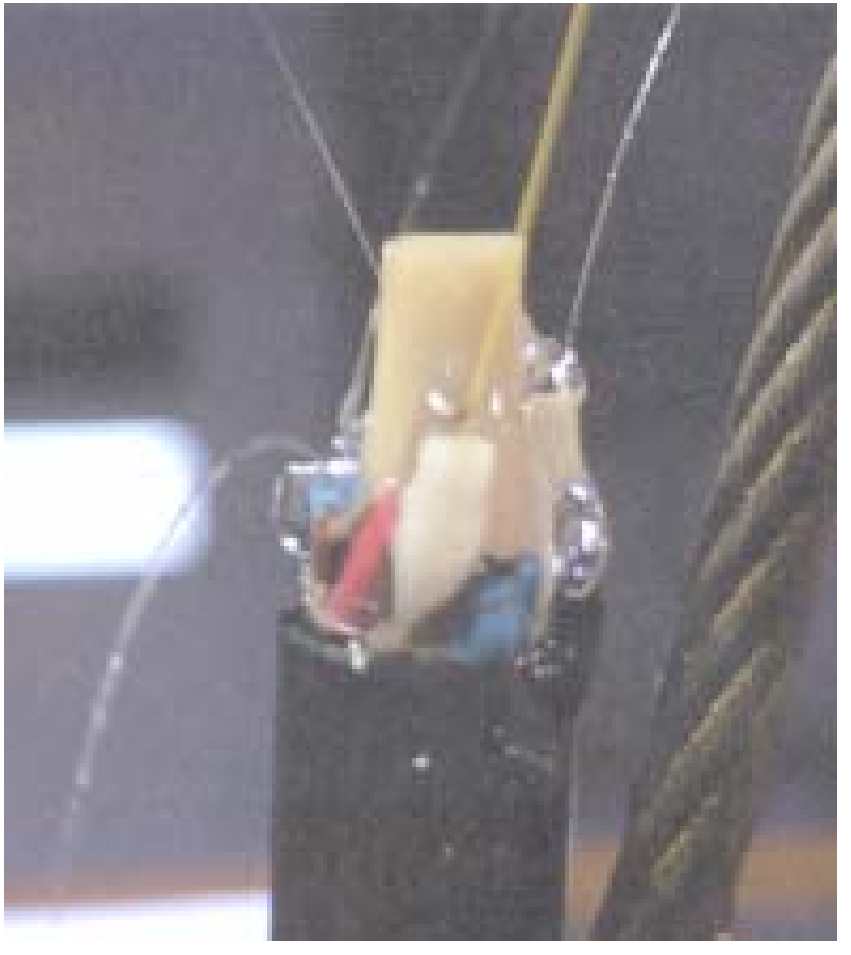
- Optical
- SCanning
- Apparatus for
- Ropes

Rope weakened

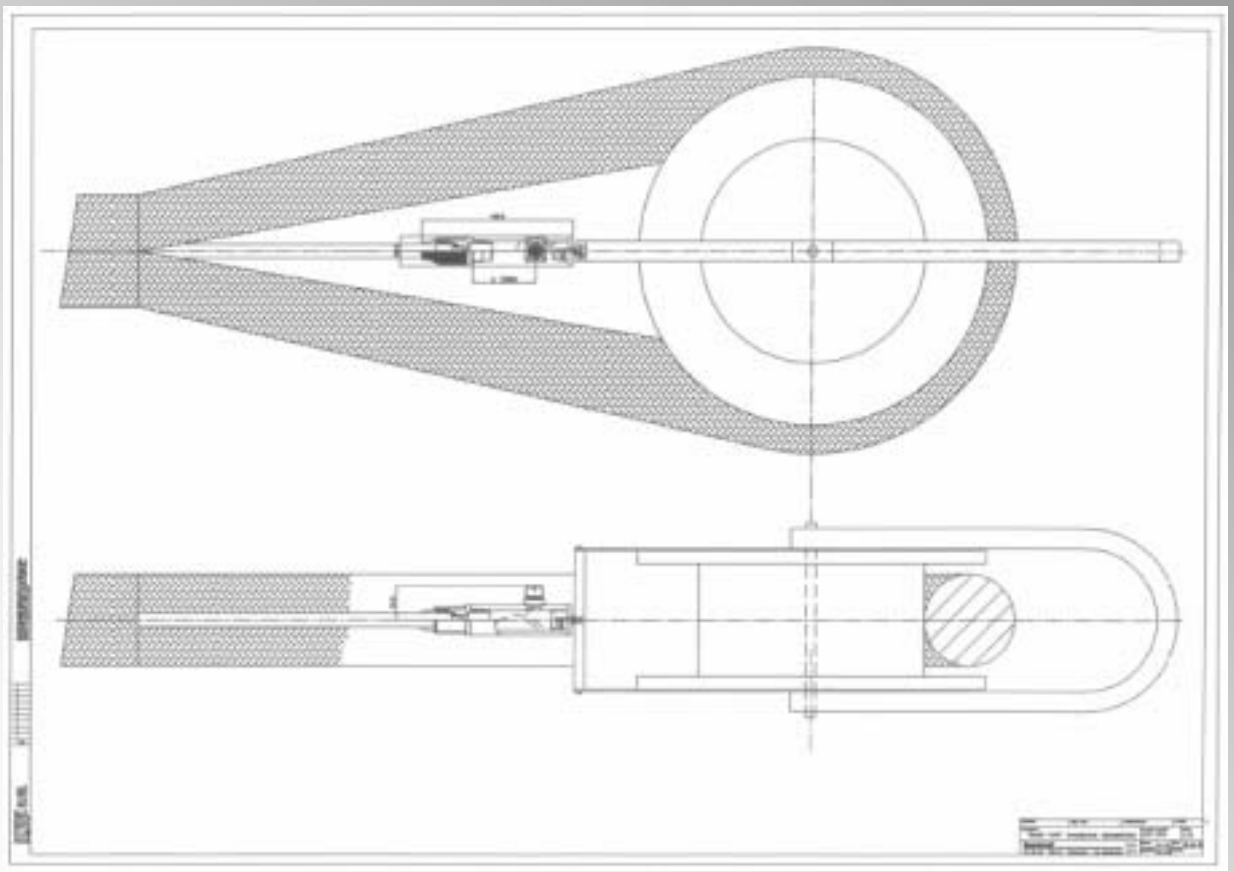
Example Results



Pressure testing of
Transducer
Up to 100bar
Eq. 1000m WD



System Design



Further work

Pressure resistant transducer – 200 bar

Fatigue testing

- Transducer
- Rope

System Design, implementation

- Terminations
- Installation
- Software Integration

Field Trial

Pilot Installation

- Further lab tests will be done in parallell with field registrations
- Complete system integration (Software and Hardware) will be developed with first installation
- First field installation planned 2004

Oscar Summary

Method is commercial available for Continous monitoring of a synthetic mooring system

- Oscar can in situ detect and quantify rope modulus
- Oscar can localise rope damage within less than 5m accurancy
- Integration of historical data

Cost benefits

- Monitoring of rest-lifetime and better utilization of the lines
- Lower risk for line failure
- Inspection savings
- Rest value

For more information, please contact;

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