

MICEDD

DEEPWATER DEVELOPMENT

28 - 30 March 2023 | Millennium Gloucester Hotel | London, UK

ORGANIZED BY



Quest Offshore

World Oil®

ClampOn Subsea
Non-intrusive Flow
Temperature

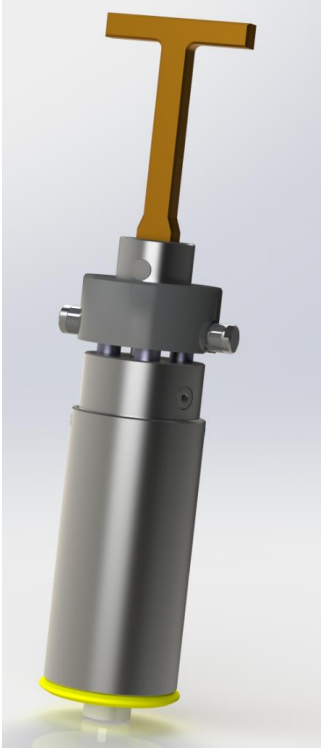
Eirik Walle

Area Sales Manager, ClampOn AS



Always Numero Uno!

Non-intrusive flow temperature measurement

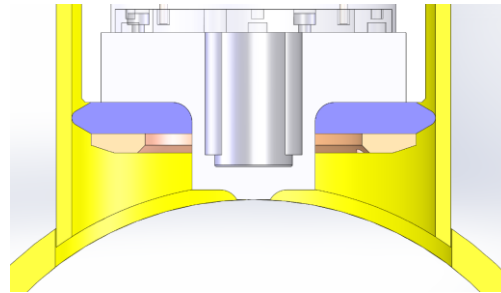
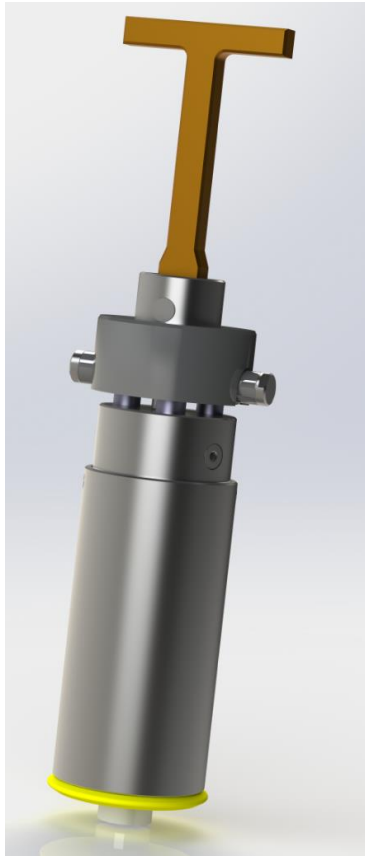


- Monitors flow temperature inside pipes
- Where intrusive P/T instruments may, or have failed
- Insulated pipework only / Oil production
- In combination with Acoustic Sand, Acoustic Pig, Leak or vibration monitor.
- No welding

Changes in instrument

Standard Compact instrument:

- Synthetic seal between funnel wall and instrument
- Temperature sensor places in “nose” of instrument
- Traps the water between pipe and sensor



Qualification / verification

Application:

- Temperature simulation (Solidworks)
 - Find k factor depending on insulation thickness
- Full scale mock-up testing
 - Proof of concept
 - Actual k factor found based on measurement

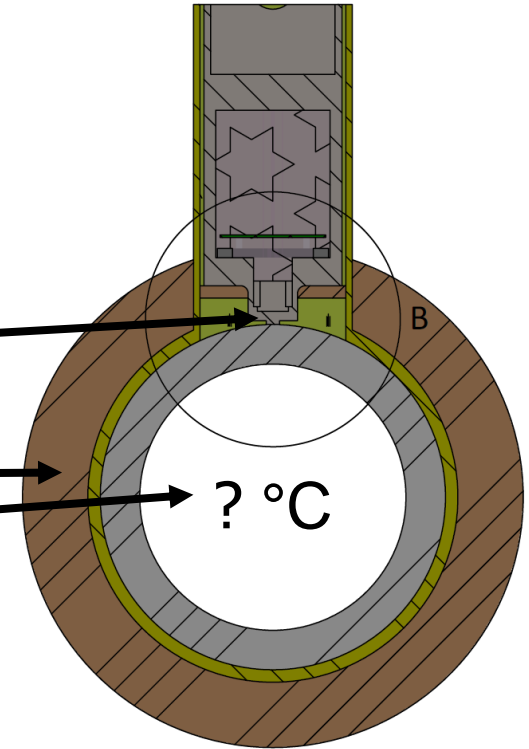
Hardware:

- Standard compact ASD
 - API17F 4th ed.

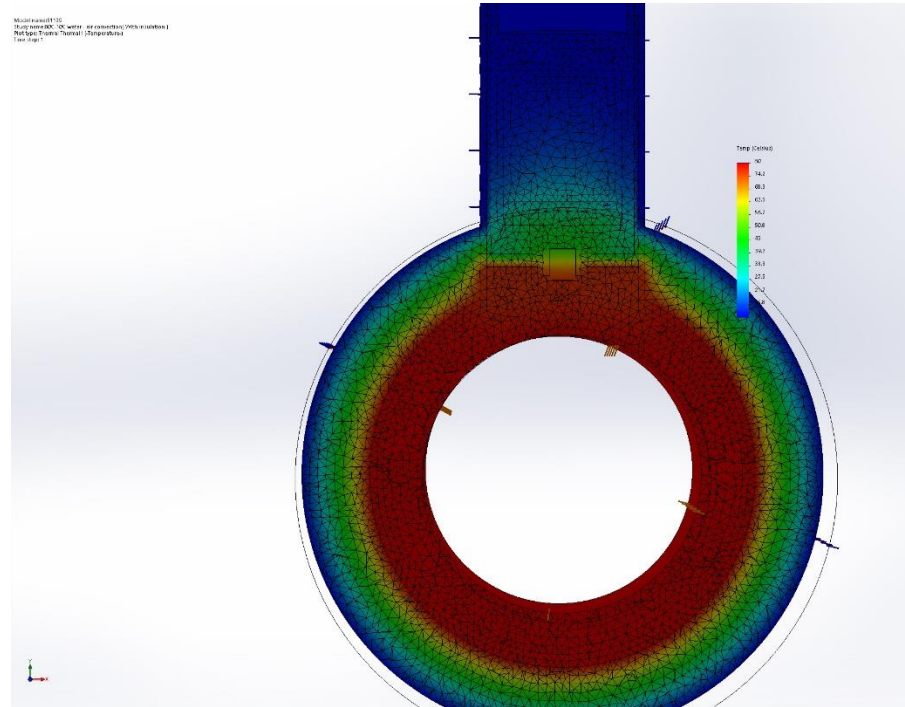
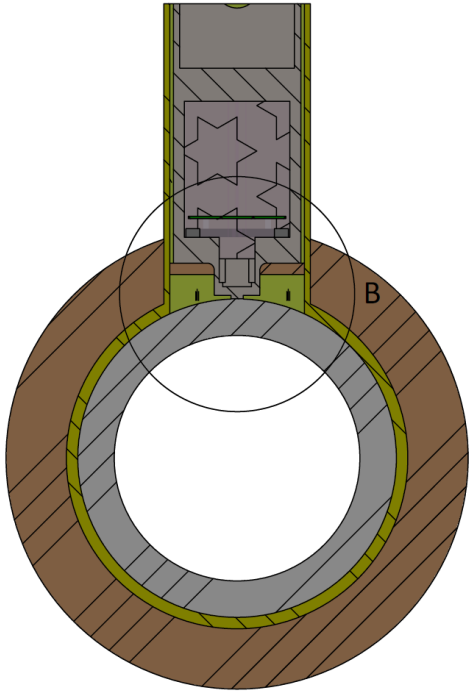
Working principle

Measure skin temperature, calculate flow temperature.

- Measure skin temperature
- Measured or constant ambient
- Factor the insulation
- Calculate Internal flow temperature

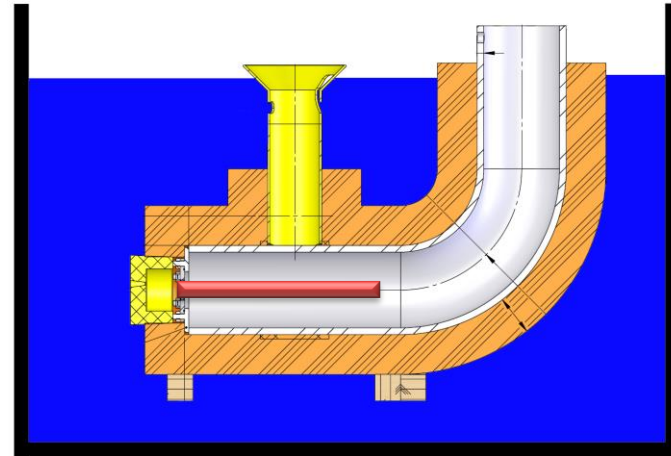


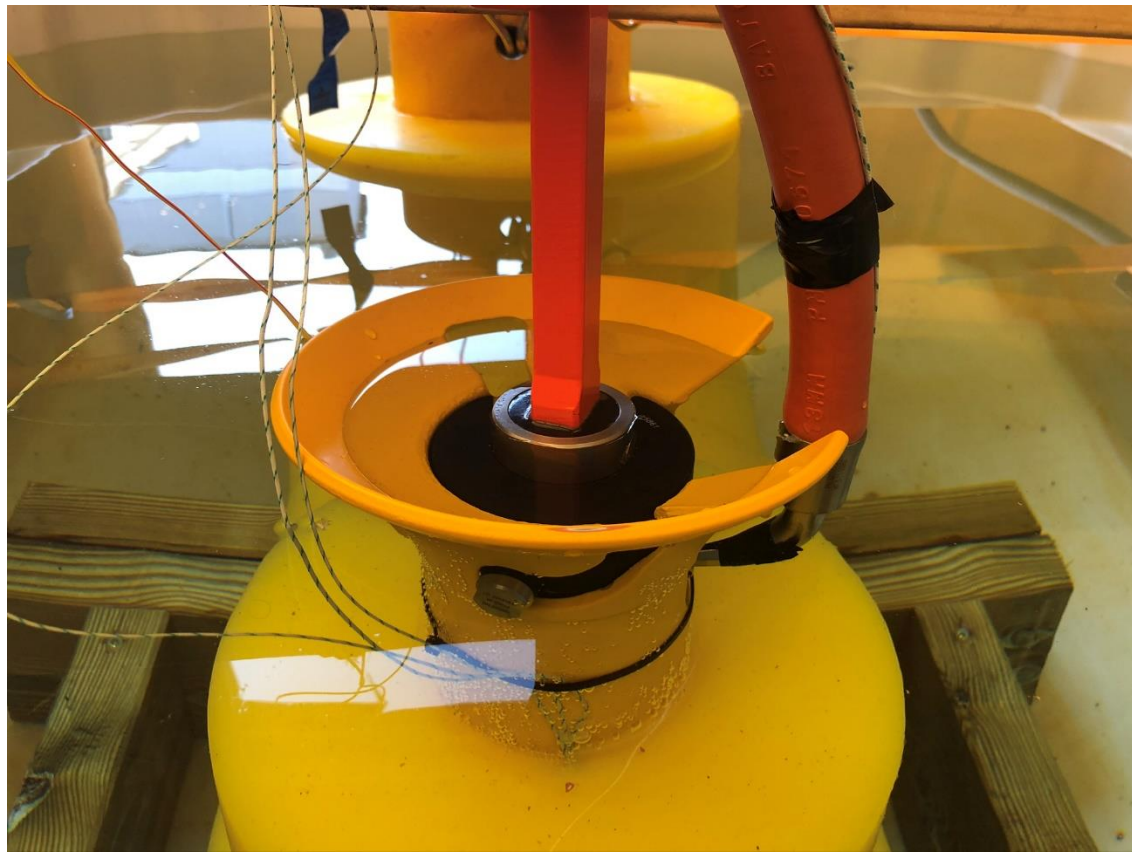
Simulation



Full scale, mock-up test

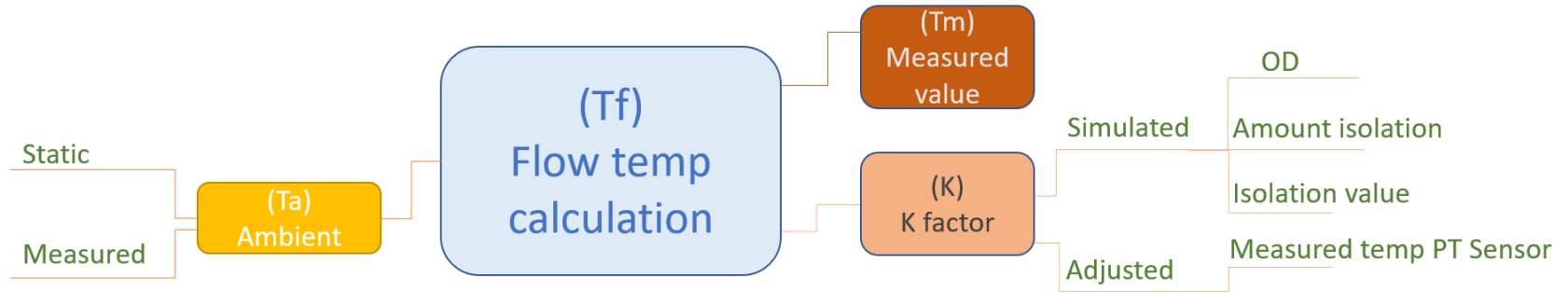
- Oil filled 6" pipework
- 1Kw electric heating element
- 75mm "silicon" insulation
- Standard compact funnel
- Surrounded by circulating water





Formula

$$T_f = kT_m - (k - 1)T_a$$



T_f = Flow temperature

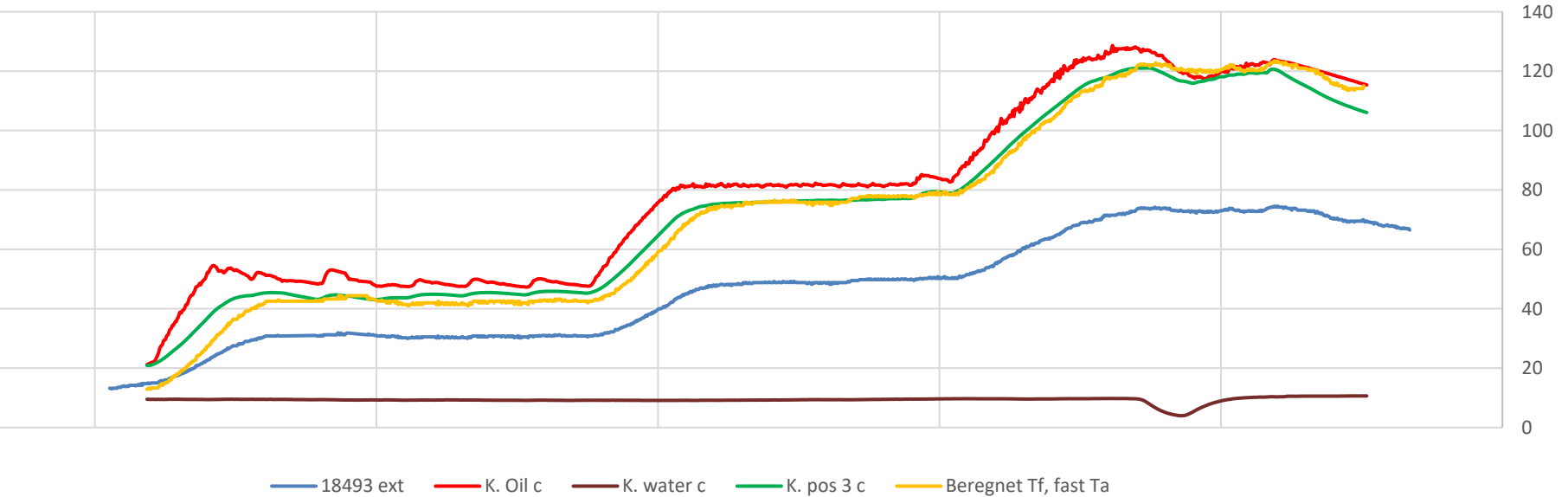
T_a = Ambient temperature

T_m = Measured skin temperature

k = Temperature coefficient

Result

50, 80 & 120 c

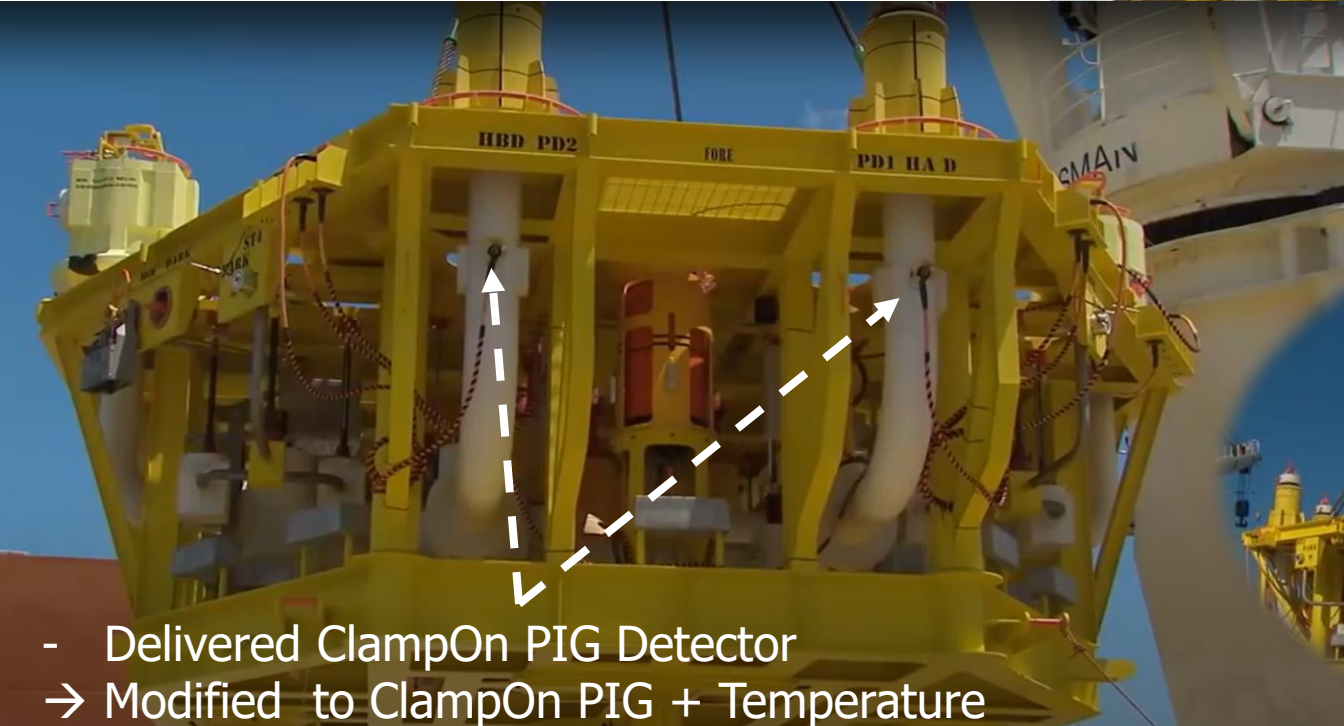


Data

- Accuracy temperature sensor: 0.4°C
- Accuracy temperature calculation*: Typical maximum $\pm 2.0^{\circ}\text{C}$ (20°C - 120°C)
Typical average $\pm 0.5^{\circ}\text{C}$ (20°C - 120°C)
- Response time: Typical 6 minutes in Oil
Typical 15 minutes in Gas

* Dependent on factors such as level and type of insulation, real condition vs. simulated conditions

Combination of instrument



- Delivered ClampOn PIG Detector
- Modified to ClampOn PIG + Temperature

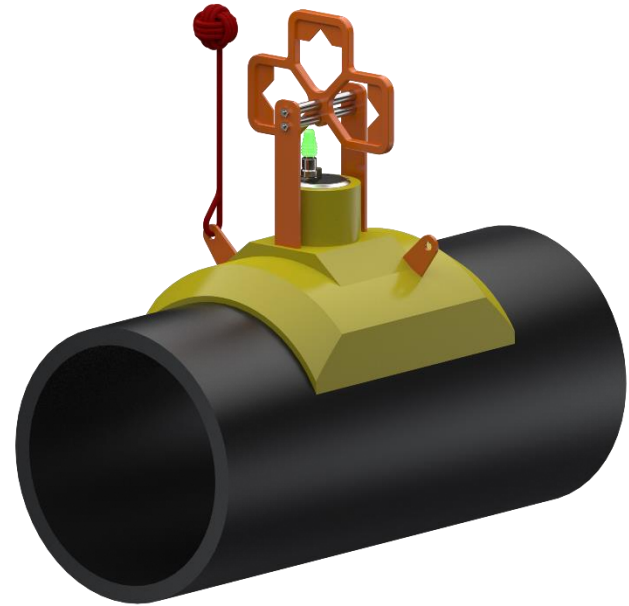
Dew point – where?



Subsea Inspection of pipe Temperature

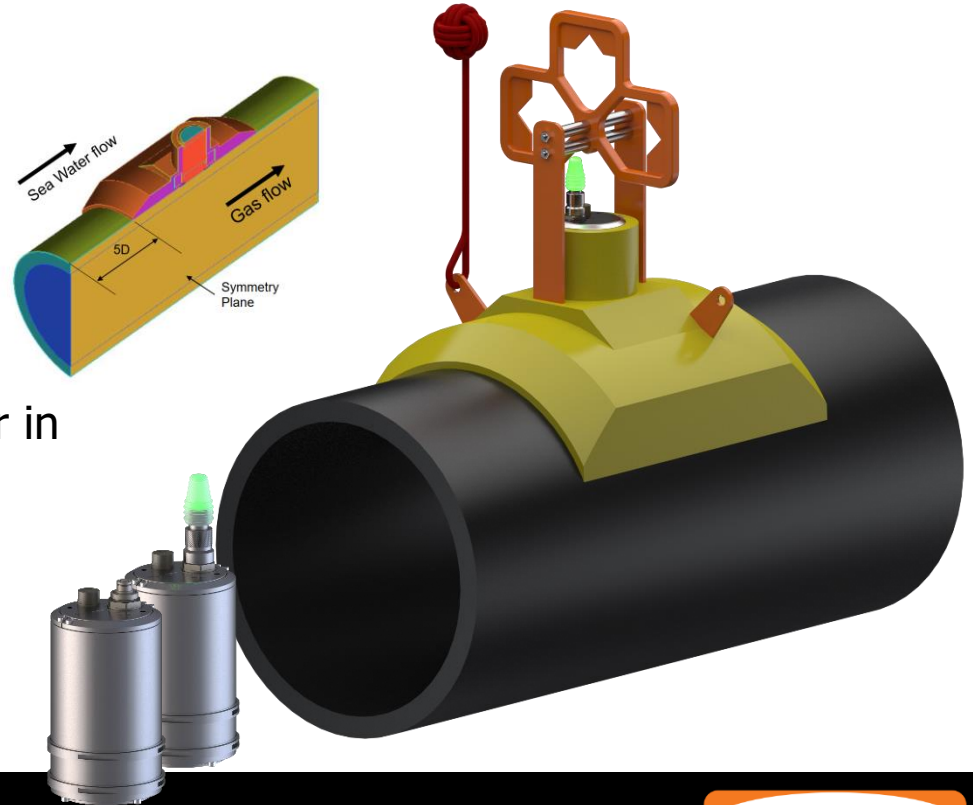
- Magnetic clamp
- Insulated temperature sensor
- Insulated "patch"
- Communication to ROV or memory
- From installation takes typical approx. 15 minutes to achieve stable readings
- Custom design for actual pipe size

Illustration picture is a 16" pipe



Subsea Inspection of pipe Temperature

- Battery operated
- Moved by ROV
- Communication thru ROV or Datalogger (Internal)
- 5 units will be delivered to customer in May 2023
- Will be used to find the DEW point on a 156 km gas pipeline



Conclusion

- Qualification/ verification provided good accuracy and repeatability with insulated pipework
- Actual testing reveal higher k than initial simulation
- Simulation factors improved by actual testing
- Ambient temperature must be known, measured or constant
- More insulation, better accuracy



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Thank you for your attention!

Any questions?

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