

ClampOn Subsea 3D Vibration Monitor

DIGITAL SIGNAL PROCESSING



Short term stand alone kit.

ADVANTAGES

- **On board processing and data storage**
- **Flexible and quick installation and retrieval**
- **3 axis broad range measurements**

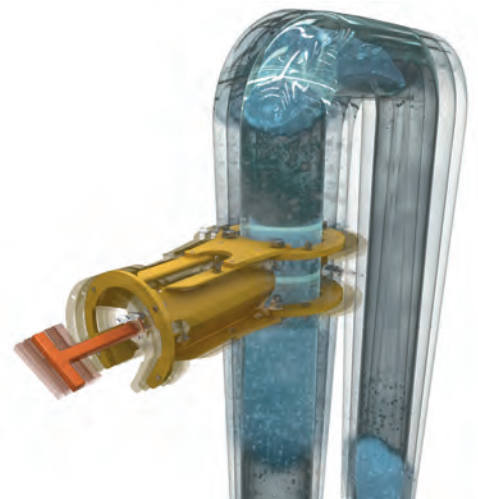
BACKGROUND

In order to minimize risk of fatigue failure of pipes and other structural components, a subsea condition monitoring or inspection tool may be required to keep production at a safe level. The ClampOn DSP Vibration Monitor 3D allows for accurate monitoring of vibration subsea, both on temporary or permanent basis. Typical

sources of vibration include vortex induced low frequency vibration (VIV), flow induced Vibration (FIV), flow induced pulsation (FIP/FLIP), slugging and more. In combination with advanced computer simulations for flow and structure modeling, subsea vibration monitoring has become a valuable tool to monitor the state of subsea pipework and structures. In several cases the application has enabled the operator to safely increase production as the measured level of vibration has been less than conservative models predict.

OPERATING PRINCIPLE

The ClampOn Subsea 3D Vibration Monitor is a flexible tool, designed for temporary or permanent installation on an area



Flow induced vibration on spool piece.

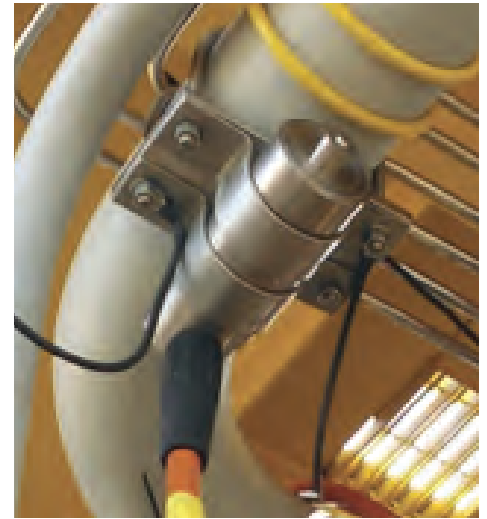
or pipe that should be monitored for vibration. The instrument takes use of 3-axis accelerometers, so that any minor or major movement, at high or low frequency, will easily be detected and reported to the operator. Data can be transferred in real time, or stored locally in the instrument for post-processing and analysis.

INSTALLATION

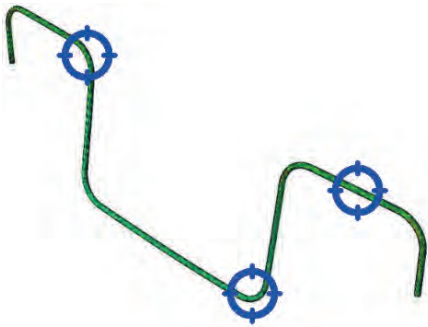
Multiple solutions for installation have been developed: For permanent monitoring the instrument is normally bolted to the pipe or fixture. On temporary inspection type set-up the instrument can be installed in brackets containing powerful neodymium permanent magnets, or by ROV Clamps. The options are many depending on depth, access and requirements.



Magnetic fixture for Valve buckets.



Permanently installed.



Phase Relationship.

INSPECTION MONITORING (SHORT TERM):

- Stand alone or wired to topside
- Battery and data logging option
- Easy installation and retrieval

PERMANENT MONITORING (30-YEAR DESIGN)

- Interface to control system
- Optional retrievable data logger
- Optional wireless communication
- Optional long term battery

PHASE RELATIONSHIP

For more advanced monitoring of i.e. a pipe section, it is often required to use more than one instrument to measure the phase relation between two or more locations. This will provide detailed information of the movement/displacement of the section. To achieve this all the instruments are time synced.

KEY SPECIFICATIONS

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|-------------------------|---|
| • Manner of operation | Real-time measurement |
| • Measurement principle | 3-axis MEMS accelerometer |
| • Design depth | 3048 m (10.000 ft) |
| • Frequency range | 0 Hz to 1000Hz |
| • Sensitivity | 220 mV/g or 660 mV/g |
| • ADC resolution | 12 bits (1.25 mg /LSB / 3.75 mg /LSB) |
| • Antialiasing | Analogue low-pass filter and up to 16x digital oversampling |
| • Sampling frequency | Configurable, up to 2000 Hz |
| • Noise density | 50µg/√Hz |
| • Acceleration range | ±2.5 g or ±7.5 g (Measurement) |
| • Max sensitivity drift | 0.01 %/°C |
| • Internal Data storage | 64 GB (maximum) |
| • TRL Level | 7 |
| • Data format | Continuous raw data from all axes in 16-bit wav format
Averaged FFT spectra with up to 800 lines of resolution and configurable upper and lower frequency limits |



ULTRASONIC INTELLIGENT SENSORS

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