

The Roxar subsea Sand management products portfolio
- Erosion based and acoustic based

Roxar provides two different technologies for monitoring sand production

- Erosion based and acoustic based.

Sand can have a devastating effect on oil and gas production. Sand can clog production equipment and pipelines, erode completion components, impede wellbore access, interfere with the operation of downhole equipment and even lead to wells being prematurely shut in or abandoned.

Management of sand is therefore critical for maintaining integrity of operator assets and optimising oil and gas production.

Roxar provides two different technologies for monitoring sand production; erosion based and acoustic based. Erosion based intrusive sensors measure actual metal loss caused by the impact of sand particles, whereas acoustic based non-intrusive sensors monitor the noise caused when sand particles impact on the pipe wall.



Roxar subsea Sand monitor

Roxar combined sand monitoring system

Roxar acoustic and erosion based sand monitoring sensors can be combined to compliment each other and give the operator the opportunity to have ultimate control over sand production.

When there is a sand event the operator needs to take quick decisions to avoid severe damage to their process system, however at the same time needs to maintain maximum flow rates.

In Roxar's experience operators feel they cannot take decisions on changing flow rates purely on the information from one instrument and hence need a secondary confirmation before taking a potentially costly decision. Combining the two systems means that the operator no longer needs to confirm a sand event using test separators etc. These two different state-of-the art sensor technologies can be used to positively confirm the occurrence and severity of a sand event, giving the operator confidence that the

correct decision is being made. This builds confidence in the sand detection devices with the offshore teams and ensures that the sand management program is effective, with minimal damage caused and maximum flow rates achieved.

The acoustic based sensor will provide an immediate response to the onset of sand production and rapid response to changes in sand production or bursts of sand.

The erosion based sensor will also provide a quick response to the onset or changes to the level of sand production, although not instantaneous response due to that fact that it is monitoring actual damage caused. The erosion based sensor will accurately determine the short and long term effects of damage caused by sand. Both systems also quantify the amount of sand produced when flow velocity information is provided as an input.



Roxar subsea Sand monitor

Erosion based, intrusive sand monitoring

Erosion based intrusive sand monitoring probes work on the principle of detecting the actual damage caused to the metal elements in the probe when they are impacted by sand particles.

The metal loss is monitored by recording the electrical resistance of each of the measuring elements on a regular basis. When metal is lost from these elements, due to the erosive effects of impacts by sand particles, the electrical resistance will increase. This increase in electrical resistance is directly proportional to the amount of metal that has been lost.

Sand production rates can then be calculated by combining this measured metal loss with accurate flow rate information and average sand particle size. This relationship has been determined through flow loop testing conducted by Roxar and Norsk Hydro.

The Roxar sand erosion based sand probes have multiple elements for redundancy and to cover the full diameter of the pipe section. The sensor will measure the sand that impacts it, therefore it is critical to position the sensor in a location where the sand is uniformly distributed in the flow typically at least six ID's (internal diameter) downstream of a bend.

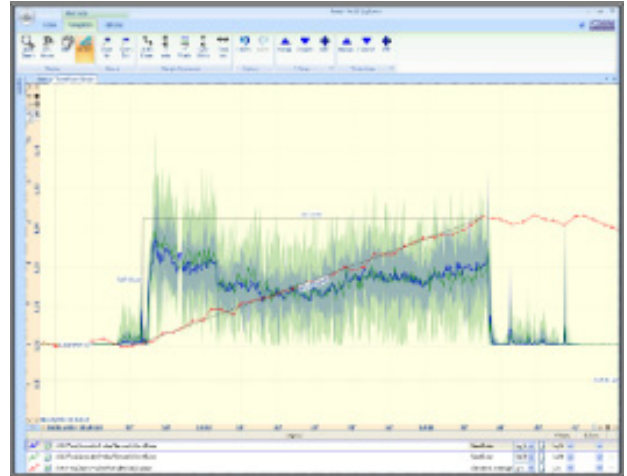


Roxar subsea SenCorr SE sensor

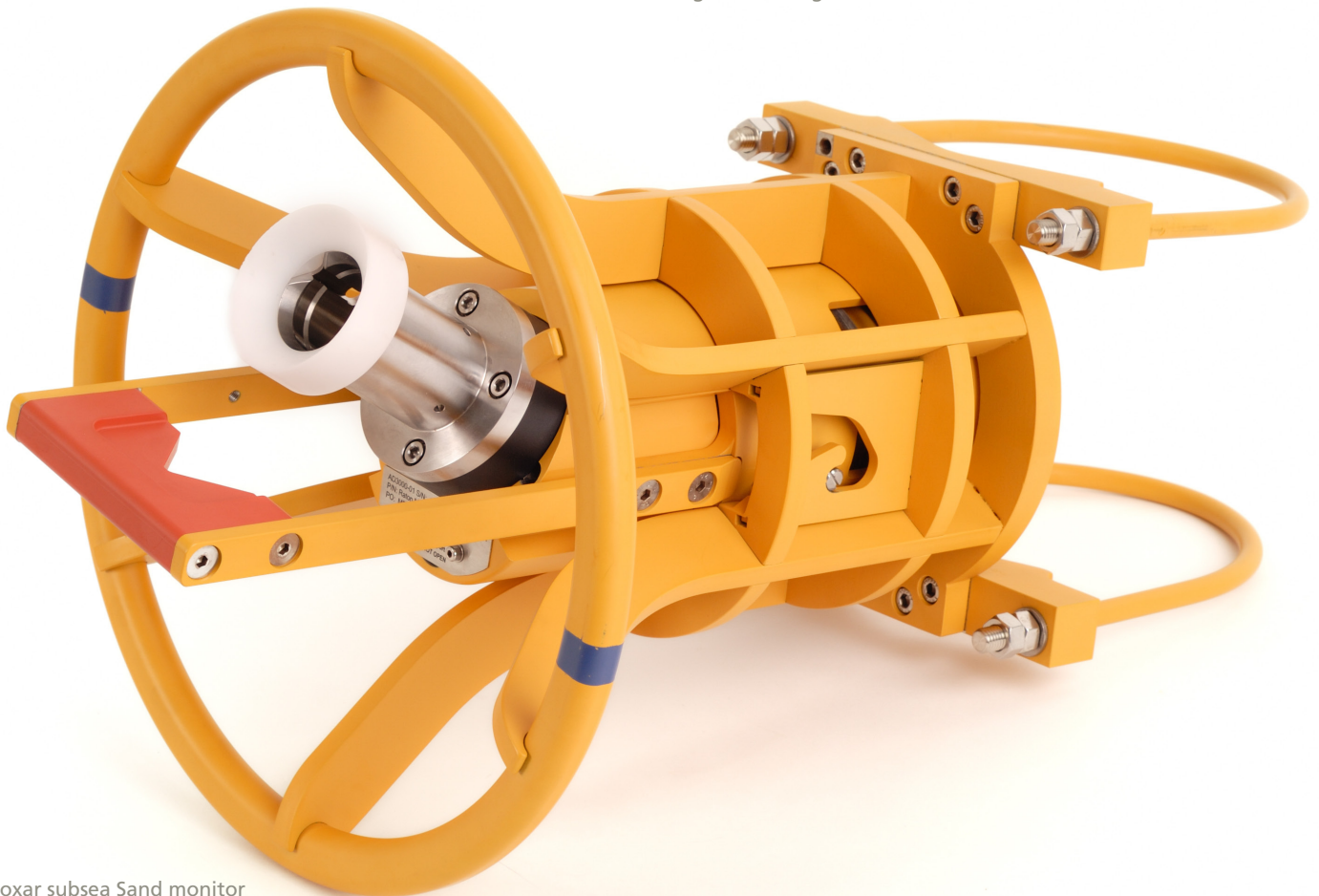
Acoustic based, non-intrusive sand monitoring

Acoustic based non-intrusive sand monitoring sensors work on the principle of detecting the sound created by sand particles when they impact the pipe wall.

The sensor is clamped on to the outside of the pipe, typically downstream of a 90° bend. The sand particles that are transported by the process media hit the pipe wall immediately after the bend due to inertia. These impacts generate sound and this sound is detected by the microphone that is mounted on the tip of the sand monitor. The noise generated is directly proportional to the velocity and the amount of sand in the process media. The fact that this device is monitoring sound means that it will give an immediate response to changes in sand production.



Graph from Roxar Fieldwatch showing trending of both the intrusive sensor (in red) and the 2 acoustic sensors (blue and green) during a sand trial test.



Roxar subsea Sand monitor

Roxar Fieldwatch - next generation monitoring software

Roxar Fieldwatch is Roxar's integrated software system suite for easy handling, monitoring, configuring and operation of Roxar instruments. Roxar Fieldwatch enables a higher level of usability of Roxar's measurement solutions, and integrates the different instruments into a common software system with easy access for operators, production engineers and Roxar service personnel. Roxar Fieldwatch can be used locally in the field and also remotely, enabling better collaboration between the production team.

Roxar Fieldwatch provides state-of-the-art tools for in-depth analysis and investigation of data sets. Built in instant chart analysis tools allow easy trend analysis of different data sets on one plot. In addition related alarms can be made visible in the plot, thus ensuring all information is available when concluding on actions to be taken during a sand event or when

optimising well flow rates. This combined with an extremely fast database ensures a rapid interactive analysis of a situation and results in well made decisions.

The latest release, Roxar Fieldwatch 3, comes with innovative smart alarm software consisting of new filtering and temperature compensation algorithm. The result will be a dramatic reduction in the number of false alarms from erosion probes while retaining all the genuine alarms. The same smart alarms principle is being tested on corrosion monitoring as well. There is also the possibility to have Fieldwatch virtual erosion module which enables operators to install virtual erosion sensors within their production system – particularly to monitor bends, T-bends and reducers in areas where it's difficult to deploy physical sensors.



