



Clarion™ Optical Seismic Instrumentation

Weatherford's *Clarion* seismic system is an advanced, multi-channel optical sensing system that enables reliable, permanent in-well seismic applications. The instrumentation is compatible with the *Clarion* optical seismic accelerometer and combines state-of-the-art optical multiplexing with high-performance seismic recording and flexible interfacing to most conventional seismic acquisition systems. The instrumentation is located at the surface and contains all the electronics for the wellsite optical seismic system.

Applications

- Providing permanent seismic monitoring of onshore and offshore wells
- Providing a link between surface seismic and well information
- Obtaining detailed time-lapse reservoir imaging near the well to track fluid movement and help locate bypassed hydrocarbons
- Imaging thermal fronts and re-injecting waste products, such as carbon dioxide
- Calibrating time-lapse (4D) surface seismic response to better process and understand the data
- Continuously monitoring stress changes in the reservoir to help delineate faults and understand flow paths
- Monitoring compaction that can induce well or casing damage
- Monitoring hydraulic fracturing and stimulation to determine fracture growth during operations



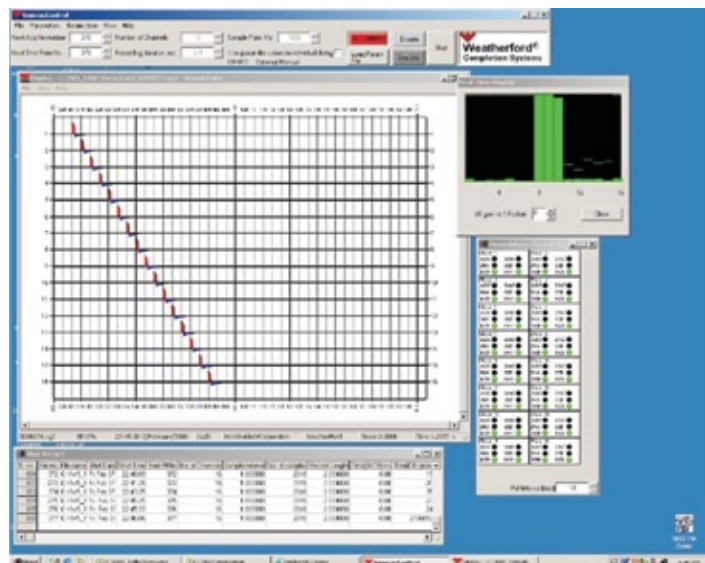
Multi-Channel Optical Seismic Instrumentation



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Features, Advantages and Benefits

- Use of *Clarion* optical seismic instrumentation reduces uncertainties and risk in exploration and production.
- Uniquely packaged, surface-installed, opto-electronic system with multi-wavelength laser source, combined with all-passive fiber Bragg grating (FBG)-based interferometric in-well sensors, enables high-performance demodulation of multiple in-well seismic signals.
- Broadband, wide dynamic range, and low distortion enable high-fidelity seismic data acquisition, covering a wide range of in-well seismic applications. This level of sensitivity contributes to better-informed reservoir management decisions.
- Surface instrumentation accommodates up to 32 optical channels, plus 4 auxiliary reference channels, for pseudo-continuous recording (no inter-record gap); precise time synchronization and accuracy; and storage of simultaneous in-well pressure/temperature (P/T) data in the digital record header. These advantages facilitate post-processing of integrated sensor data.
- Continuous analog data output interfaces to most conventional seismic recording systems for seamless data handoff to third parties.
- Network-capable Windows® PC-based control software, built-in noise monitoring, and data-display functions enable local and remote system operation, control, data quality control, and data access for operational flexibility, efficiency, and data sharing.
- Industry-standard 19-in. (483-mm) rack-mount portable or fixed cabinet accommodates temporary or permanently installed configurations for flexibility and ease of installation—onshore or offshore—and easy integration into existing control-room facilities or rugged use in temporary locations.
- Complex, multi-channel electronic hardware and software are surface based, not exposed to the harsh wellbore environment, so that system components and performance do not degrade over time, ensuring life-of-field reliability and on-demand data acquisition.



Noise Monitoring, Data Display, and Quality Control

Windows is a registered trademark of Microsoft Corporation.



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Specifications

System Performance

Bandwidth	1 Hz to 1.4 kHz
Number of optical channels	Up to 32, 8 per fiber
Number of analog input auxiliary channels	4
Dynamic range	129 dB at 10Hz, 1mS sampling (digital output)
Distortion	0.1% (-60 dB) typical
Interchannel crossfeed	1% (-40 dB) typical
Noise-equivalent acceleration	200nG rms / $\sqrt{\text{Hz}}$ typical, 10Hz to max BW
Analog data output	Continuous differential or single-ended
Analog output sensitivity	Scalable from instrument
Accelerometer	0.2 to 200 V/G
Digital data output	
Data format	SEG-2 with optional P/T data combined
Sample interval	1/4, 1/2, 1 and 2 mS
Maximum record length*	197 sec at 1mS sampling, 16 ch 113 sec at 1/2 mS sampling, 8 ch
Maximum wellpath length	19,686 ft (6,000 m) typical
Maximum offset to wellhead	18.6 mi (30 km) typical without amplification

*Dependent on number of channels and sample interval

Instrumentation

Standard configurations	19-in. (483-mm) rack-mount portable enclosures or fixed cabinet
Optional features	UPS, mass storage, remote access via modem or Ethernet LAN/WAN, direct interface to Weatherford Reservoir Monitoring system P/T data, GPS synchronization
Power	< 600 W at 100 to 240 VAC, 50 to 60 Hz, single phase
Operating temperature	32° to 104°F (0° to 40°C)
Storage temperature	-4° to 158°F (-20° to 70°C)
Space Requirements*	
Height	57.9 in. (147 cm)
Width	21.3 in. (54 cm)
Depth	34.3 in. (87 cm)
Weight	320 lb (145 kg)

*As packaged in 19-in. rack-mount, fixed cabinet



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Sample Configuration

