Well·SENSE TECHNOLOGY LIMITED

FLI FIBERLINE INTERVENTION

Super Fast Leak Detection

PINPOINT WELL LEAKS 60% QUICKER AND 60% CHEAPER

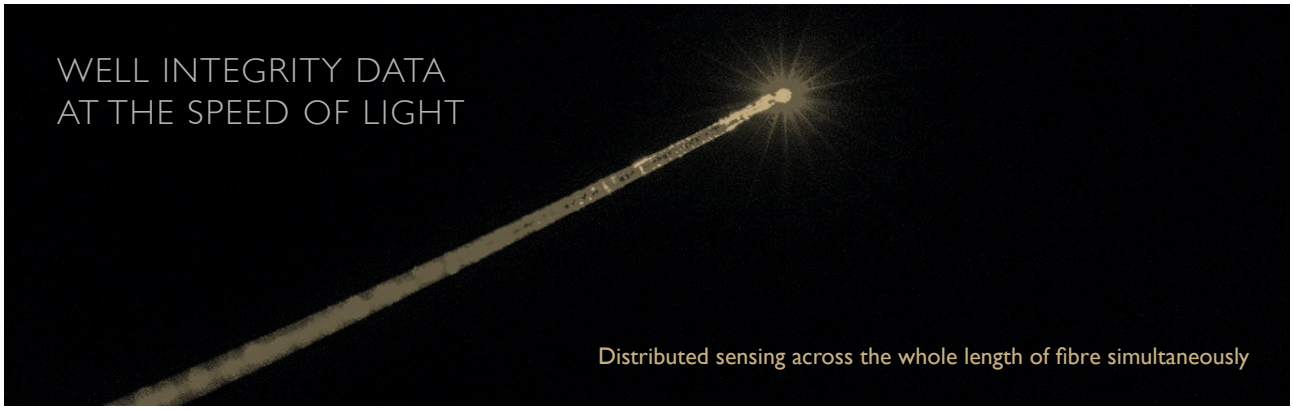
Find your leak in a matter of hours. No need to wait weeks for data interpretation. Low cost. Data rich well integrity intelligence.

FLI is a small, portable and disposable tool that installs bare optical fibre along the whole length of your well to gather instant, distributed data simultaneously from every location. FLI tells you what is happening at all times, everywhere, to give you the complete picture. FLI is highly intelligent and data rich but being compact and disposable is incredibly low cost, low risk and fast to deliver results. One tool, in one box, with one engineer on site gives you results in a matter of hours.

WHY DO YOU NEED FLI?

A common problem in the oilfield, throughout the lifecycle of the well, is identifying the exact location of tubing or casing leaks. This can be problematic when using conventional wireline or slickline techniques as single point instruments only capture measurements at the depth of the tool string. It must be moved up and down the well to identify the depth of the leak and then kept stationary to log and analyse the leak characteristics. This leads to many hours or days of logging to capture the relevant data and understand the leak conditions.

The distributed temperature and acoustic measurements captured by FLI reduce the log time by many hours. Using FLI provides low cost Distributed Acoustic Sensing (DAS) and Distributed Temperature Sensing (DTS) logs for the entire zone of investigation and therefore provides a much higher degree of certainty of locating the leak, however small or intermittent it may be.

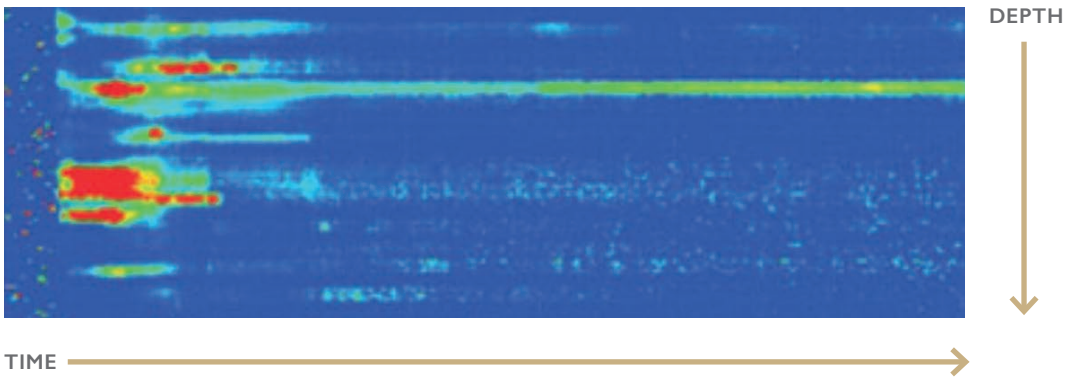


CONVENTIONAL METHODS VS FLI

FLI dramatically reduces cost, logistics and risk to personnel, equipment, wellbore and drilling location.

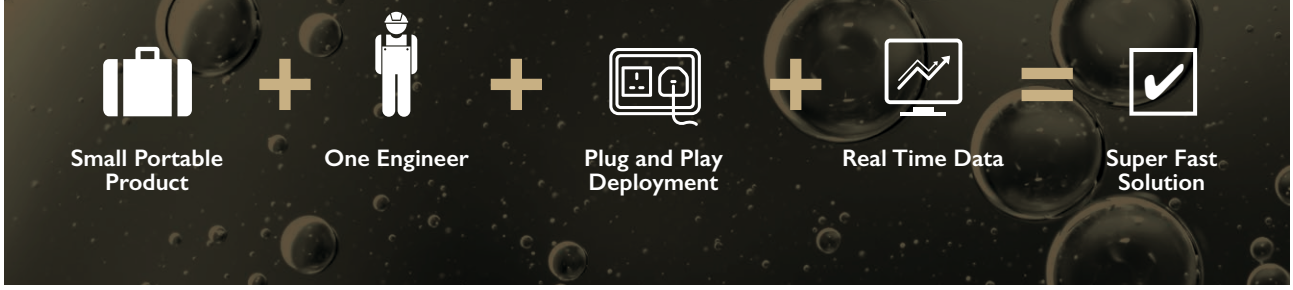
	TRADITIONAL LEAK DETECTION METHODS	FLI LEAK DETECTION
Logistics	Large footprint of wireline/slickline intervention equipment.	Lightweight self-contained system <55 lbs (25 kg), easy to transport and handle.
Risks	Multiple personnel onsite, overhead loads, rotating equipment, dynamic pressure control at wellhead, wireline/slickline under tension, fuel/chemical spillage, tool failure/repair & replace, stuck tool/fishing operation, potential lost tool in hole.	1-2 person operation, no rotating equipment, no overhead equipment, static pressure seal at wellhead, disposable fibre and tool.
Time	Several hours rig up/rig down, continuous operation and supervision of logging unit, NPT for non-measurement tool positioning. Flow determination and leak characteristics are captured over multiple passes to define the depth of the leak. Passes are slow at a maximum of 30 ft/min. Once leak depth is identified with stationary logs carried out at the defined leak depth, then multiple stationary logs are captured at 1-2 ft increments above and below the point to increase information collection whilst well characteristics are being altered at surface to maximise leak profile.	Simultaneous DAS and DTS capturing spectral acoustic noise (to measure flow information) and distributed temperature to identify the leak depth and characteristics in one pass, reducing operational time by many hours.
Measurement	Single point fast response temperature and spectral acoustic logging tools.	Real-time distributed DAS (spectral acoustics) and DTS (distributed fast response temperature).
Project Execution	Various service providers involved, multiple rental items, high mobilisation and standby costs.	Integrated Well-SENSE service (job planning, delivery, logistics, onsite personnel, FLI intervention, interpretation, answer/solution). One provider, one point of contact, minimal pressure control equipment, rapid mobilisation, minimal personnel and equipment standby.

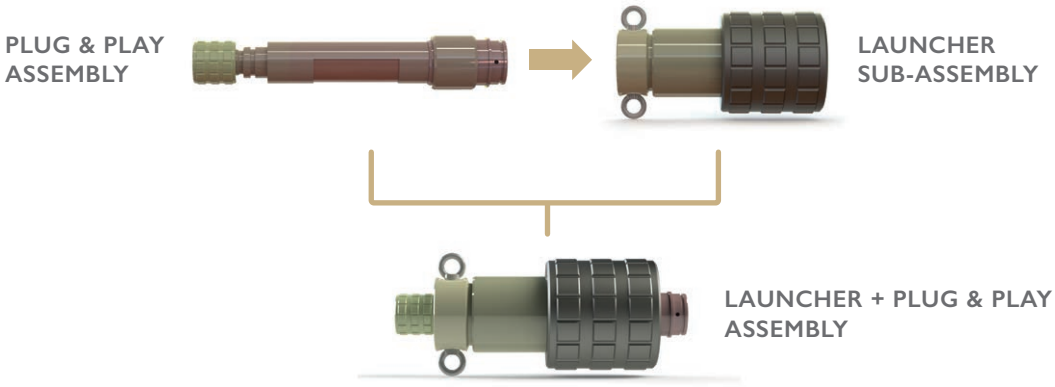
DISTRIBUTED ACOUSTIC SENSING (DAS) LEAK PROFILE



Leaks are quickly visible even to the untrained eye. This example shows distributed acoustic data recorded over time and depth to identify fluid movement whilst the well is shut in. Fluid movement, i.e. leaks, can be identified by the acoustic energy levels. Here blue = low energy or zero flow, yellow through to red = high energy flow equating to fluid movement. In this example we would expect to see no fluid movement whilst the well is shut in. However, in this case fluid movement (leaking into annulus) can be seen at multiple depths and speeds varying over time.

FLI IN ACTION





Our plug and play system is low risk and simple to operate

FEATURES AND BENEFITS

- Distributed acoustics and temperature captured in real-time
- Simple low risk 'plug and play' deployment system
- Simple to understand interpretation
- 60% faster results
- 60% reduction in cost
- Reduced NPT
- Less personnel and equipment needed on site
- Reduced operational cost
- Rich data without compromise
- No more lost in hole charges
- Lower cost, lower HS&E risk
- Environmental footprint is low

TECHNICAL SPECIFICATIONS

Plug and Play FLI:	Ultra-fast set up and deployment
Tool Diameter:	2.0 – 3.5 in (50.8 – 88.9 mm)
Tool Length:	OD Less than 5 ft (1.5 m)
Fibre Type:	Multi-mode, single mode, standard and harsh environment options
Well Depth/Fibre Length:	Up to 45,000 ft (13,716 m)*
Maximum Wellhead Pressure:	10,000 psi (690 bar)
Maximum Downhole Operating Pressure:	25,000 psi (1,724 bar)
Maximum Downhole Operating Temperature:	Up to 572°F (300°C)**

* Depends on tool diameter and fibre type ** Depends on fibre type

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FREQUENTLY ASKED QUESTIONS

1. **So the fibre itself is the sensor?**

   Yes, optical fibre is a well proven method of in-well sensing.

2. **How does it work?**

   FLI deploys fibre along the entire length of the wellbore.
   A fibre optic connector is available on the surface.
   A DTS unit is connected via a small diameter surface cable and DTS data recording begins immediately upon launching the tool into the well.

3. **What if it gets stuck in the well?**

   The tool can be allowed to degrade, or can be drilled or milled out. Alternatively, all tools come with a standard fishing neck.

4. **What about the fibre that's left in the hole?**

   10,000 ft of our standard fibre will produce the equivalent of 1 square inch of debris. The fibre will break down over time and presents no risk to the well or surface equipment.

5. **What happens if the fibre is damaged or broken during the logging operation?**

   In the unlikely event of this happening, a backup FLI tool can quickly be loaded onto the wellhead and launched into the well.

6. **Is it safe to leave in my well?**

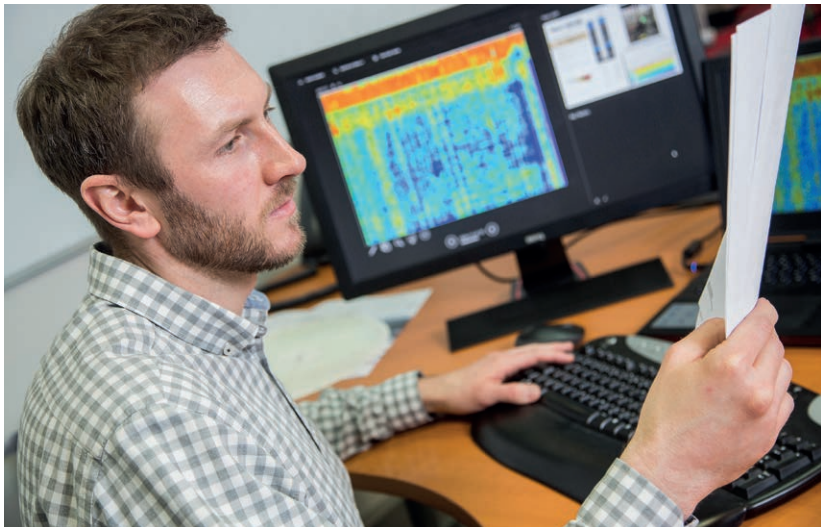
   Yes, the tool bodies and internal components are made from aluminium and plastic which degrade over a short period of time in normal well conditions, leaving no harmful substances or obstructions in the well.

7. **Have fibre optics been used for well profiling and production logging before and what's the difference?**

   Distributed fibre optic sensing technology has been fully commercialised and proven over the last few decades but FLI is different to other solutions because it uses bare fibre and is disposable. The main difference between fibre and conventional production logging methods is the ability to simultaneously measure key parameters along the entire length of the fibre

8. **Why is it so much cheaper?**

   FLI is a self-contained sensing tool requiring minimal personnel, well footprint and support equipment. It is a single use, disposable product which does not require protection to install in the well and does not need to be retrieved. This results in significantly lower direct costs for the FLI solution, reduced associated operational cost to the well operator and dramatically reduced health, safety and environmental risk to the well location and the wellbore.



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