

# Record Gravel-Pack Interval Saves USD 60 Million by Reducing Well Count, North Sea

Integrated approach enables successful packing of 4,347 ft of open hole in a challenging environment with low fracture pressure

## CHALLENGE

Gravel pack 4,347 ft of open hole in a shallow formation with unstable shale streaks.

## SOLUTION

Use OptiPac\* openhole Alternate Path† gravel-pack service together with diverter valves along the washpipe to reduce overall friction.

## RESULTS

Successfully packed the entire interval and saved the operator USD 60 million by connecting two reservoir sections with a single well.

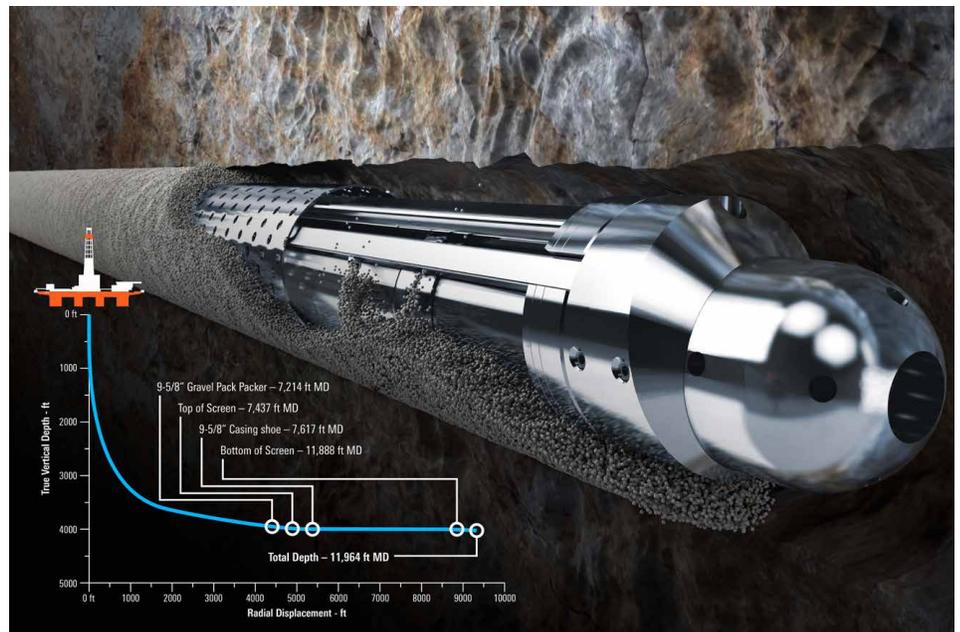


## Long openhole interval challenges successful gravel pack

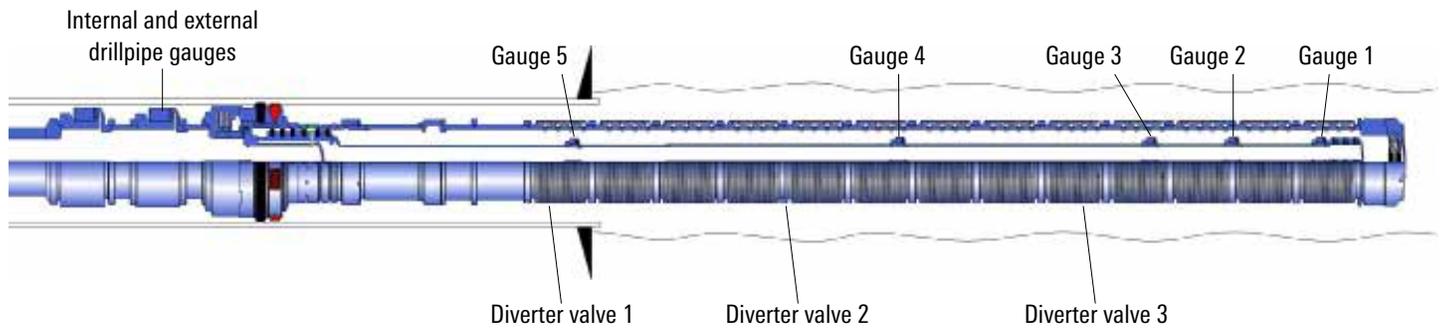
An operator wanted to produce two reservoir sections in a North Sea oil field with a single extended-reach well. Gravel packing was the completion technique of choice in the high-permeability sand, but the shallow TVD meant a low fracturing pressure. The friction pressure generated by pumping gravel over extended distances risked fracturing the formation, leading to fluid loss and an incomplete pack.

Screens with Alternate Path technology maximize the likelihood of a successful gravel pack over a long interval by using shunt tubes and nozzles to create an alternate flow path that allows slurry to bypass bridges and fill in voids. However, the burst pressure of the shunt tubes is 3,500 psi. Gravel-pack fluid friction is generally calculated at 1 psi/ft, limiting the maximum length of the screens to 3,500 ft compared with a requirement of 4,347 ft.

The challenge was compounded by the presence of shale streaks. Water-based fluids can cause shale to quickly swell, deteriorate, or both, resulting in an unstable wellbore that can collapse or cause incomplete gravel packing due to premature screenout. Water-induced spalling, or breaking up, of the shale can also impair pack porosity and permeability or plug the screen, blocking production.



The North Sea job established a new record for the world's longest openhole gravel pack—4,347 ft from TD to casing shoe—using Alternate Path technology.



*Diverter valves along the washpipe reduced the length of the fluid flow path, decreasing friction and addressing the challenge of a low formation fracture pressure.*

### Innovative creation of gravel bridges to divide the annulus provides a solution

To ensure full, uniform gravel packing across the entire interval, Schlumberger recommended a completion using the OptiPac service with

- ClearPAC XD\* polymer-free VES gravel-pack fluid
- nondamaging K240 shale stabilizer
- washpipe fitted with three diverter valves (containing one-way check valves)
- precisely controlled blending and pumping services
- state-of-the-art design and modeling software.

Low-friction-pressure ClearPAC XD fluid addressed the pressure limitation of the shunt tubes while the diverter valves ensured that the formation fracture pressure was not exceeded. Reverse circulation was used for cleanup, with fluids pumped down the washpipe and back up the annulus with the help of the 10K openhole antiswab service tool (ASST) to avoid activating the one-way diverter valves.

During gravel packing, the gravel-pack carrier fluid pumped down the openhole annulus flowed through the screen and along the screen-washpipe annulus. The higher annular fluid pressure opened the first diverter valve (located in the heel section), reducing the length of washpipe through which the returning fluid had to flow on its way back to surface and consequently reducing friction pressure on the formation.

The fluid diversion caused a bridge to form at the diverter valve; the bridge was bypassed with the help of the shunt tubes. As gravel packing progressed from heel to toe, two more bridges were intentionally formed at the remaining diverter valves. Using bridges to effectively divide the gravel-packed annulus into four shorter zones and divert slurry into the shunt tubes reduced the annular flow path of the slurry—and hence friction pressure—at any given time.

### Operator gains more than 4,000 ft of reservoir access with one well

The 4,347-ft openhole interval was successfully packed, providing access to both sections of the reservoir and saving the operator USD 60 million by eliminating the need for a second well. The job established a new record for the world's longest openhole gravel pack using Alternate Path technology.

The engineered fluid design minimized the amount of prepad that had to be pumped to remove viscous brine from the open hole at the start of the operation, saving time, reducing expense, and simplifying pit management.

The 10K ASST enabled constant hydrostatic pressure in the open hole, eliminating the swabbing effects of hardware movement and hence ensuring filtercake integrity before gravel placement. When gravel packing was complete, the service tool enabled spotting of filtercake removal treatments, eliminating a cleanup run and further reducing rig time and costs.

[slb.com/optipac](http://slb.com/optipac)

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