

PerforationVA

AN INDUSTRY-FIRST LEAP FORWARD IN THE EVOLUTION OF PERFORATION ANALYSIS

EV's Optis Infinity M125 provides a complete 360° image of the well while substantially reducing operating time and cost.

INCREASING THE EFFECTIVENESS OF HYDRAULICALLY FRACTURED WELLS

Maximising the efficiency of well completion and frac design is a major challenge for the global energy industry. Ineffective design may result in over or under-stimulation, leading to underperforming wells, rapid production decline and reduced ultimate recovery. Conventional diagnostic techniques such as micro-seismic, fiber optic, tracers or production logs are effective in evaluation at the stage or cluster-level, but as the individual perforations are the lifeblood of the well, effective evaluation requires information at the perforation-level.

IDENTIFYING OVER AND UNDER TREATED ZONES

PerforationVA provides complete understanding of proppant placement and the distribution of fracture networks. With this quantified information, it becomes possible to adjust design parameters that affect perforation erosion, thereby improving cluster efficiency and achieve an evenly distributed fracture network.

Having successfully completed a pilot to evaluate the performance of PerforationVA, a leading independent operator sought to apply the service to additional wells. However, careful consideration was given to manage the time and cost of the data acquisition operation. To enhance efficiency, EV suggested the introduction of Optis Infinity M125 technology, deployed in memory mode on standard coiled tubing, to eliminate the need for additional specialized equipment, such as E-coil or wireline tractors.

Previous technology relied on a single side view camera, rotated by an electric motor, requiring start and stop operations to locate and capture each individual perforation at their specific phasing. Optis Infinity, however, is equipped with 4 cameras in the same plane offset by 90 degrees, allowing for full 360° coverage of the well in a single continuous pass, without having to stop to locate perforations. The images in **fig.1** demonstrate the high-quality imaging acquired with the Optis Infinity M125, allowing for the accurate dimensioning utilized in PerforationVA services, **fig.2**.

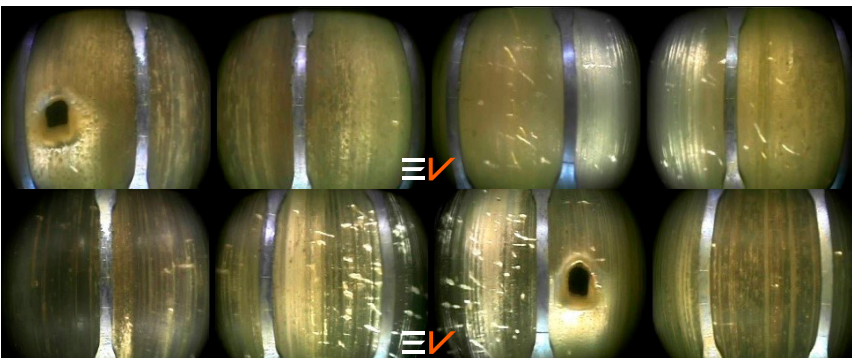


Figure 1: Optis Infinity Raw Images

THE CHALLENGE

After a successful pilot scheme, a leading independent operator wished to employ PerforationVA to additional wells and needed a step change improvement in operational efficiency, to ensure the long-term benefits of optimized completion and frac designs significantly outweighed the short-term cost and time penalties associated with performing the diagnostic service.

THE SOLUTION

EV's Optis Infinity M125 tool was deployed using standard coiled tubing, immediately after well clean-out procedures were complete. Data was acquired with a single, continuous logging pass at a speed of 15ft/min and with a total operating time of <14 hours. Once the data was acquired, PerforationVA services were performed to accurately dimension the surveyed perforations (**fig.2**), create composite mosaics images (**fig.3**), and provide a full analysis of the results (**fig 4**).

THE RESULTS

All perforations and stages were analyzed successfully with PerforationVA, completing the objective in full. Thanks to its 360° field of view and memory recording capability, Optis Infinity M125 eliminated the need for specialized conveyance equipment and significantly reduced data acquisition time, resulting in >80% reduction in operating time and >60% reduction in conveyance cost compared with previous operations using conventional camera technologies and conveyance methods.

QUANTIFYING CLUSTER EFFICIENCY

With a single run in hole, conveyed on standard coiled tubing, Optis Infinity M125 captured high quality images of 240 perforations distributed within 16 stimulated hydraulically fractured stages. With data acquisition complete the video data was analyzed by EV-Epidote's team of log analysts to deliver a PerforationVA service.

The individual in-situ post-frac perforation dimensions were determined such as the diameter and area, along with perimeter, circularity, and other related measurements. All perforations with visual evidence of erosion were identified and the erosional area calculated by comparing the area of the post-frac perforations with pre-frac perforation area references. A statistical analysis was provided to help identify correlations with stimulation parameters that had been varied between stages, including stage length, the number of clusters per stage, the number of perforations per cluster, cluster spacing, and perforation phase variations.

A STEP CHANGE IN WELL COMPLETION EFFICIENCY

Thanks to its 360° field of view and memory recording capability, Optis Infinity M125 eliminated the need for specialized conveyance equipment and significantly reduced data acquisition time, resulting in >80% reduction in operating time and >60% reduction in conveyance cost compared with previous operations. Furthermore, with all perforations successfully captured and analyzed by PerforationVA, the information objectives were completed in full, and in a significantly reduced timeframe.

These benefits combine to provide a step change in operational efficiency, delivering high-value information to help optimize the effectiveness of hydraulic fracturing of unconventional wells, with reduced operational cost and minimal delay to commencing production. With an anticipated annual addition of >20,000 unconventional wells in the United States alone, and with 40% of completion costs coming from frac operations, Optis Infinity and PerforationVA provide a cost-effective solution to help achieve increased economic return on one of the industry's largest investments.

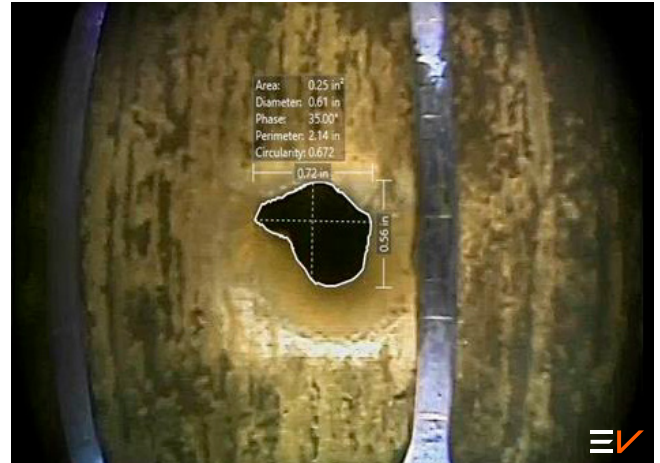


Figure 2: Dimensioned Perforation Image



Figure 3: Processed 'Mosaic' Image

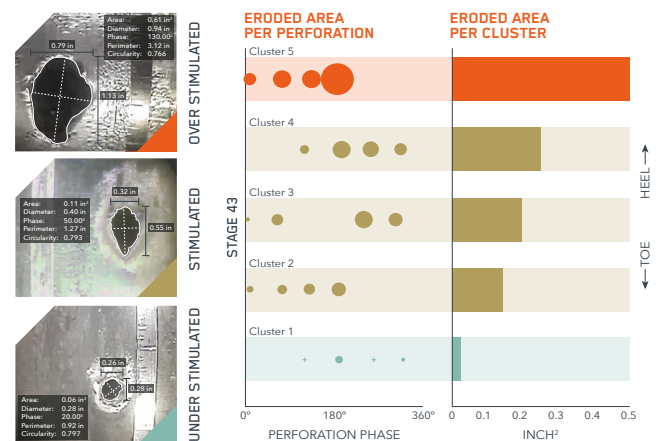


Figure 4: Cluster Efficiency Diagram