Advanced Perforating Flow Laboratory

OPTIMIZING PRODUCTION





Breakthrough Technologies Help Better Understand Downhole Performance



Reservoir cores are prepared and analyzed before testing.





State-of-the-Art Facility Provides Unparalleled Insight

The Advanced Perforating Flow Laboratory at Jet Research Center (JRC) is an industry leader in perforating system research, development and test programs. Since 2000, we have conducted tests tailored specifically for our clients' needs to help them better understand actual downhole conditions and perforating system performance.

To meet our customers' developing challenges, Jet Research Center expanded the Advanced Perforating Flow Lab with leading-edge vessels and technologies. These vessels provide our customers with the most accurate information possible regarding the effects of perforations in different formations and in different environments. This facility gets you as close to the real world as you can get in a laboratory setting.

Advanced Flow Vessels Raise the Bar

Our facilities include four unique testing vessels that do more than any other facility in the industry.

They include:

- 50,000-psi vessel Allows JRC to conduct tests at pressures higher than any other testing facility in the industry.
- 25,000-psi high-temperature vessels these vessels can flow at temperatures reaching 400°F (204°C), enabling us to test perforating capabilities in high temperatures and at high pressures.
- 10,000-psi vessel Can rotate to 180 degrees, enabling JRC to perform gravity-related sanding studies to better understand the effects of perforating and fracturing in horizontal wells.

Optimizing Production

With insights gained from the tests we perform here at the Advanced Perforating Flow Lab, we can find better ways to:

- Clean up perforations more effectively
- Maximize production
- Evaluate alternative perforation methods
- Assess new explosive compounds and their performance
- Use better-performing metals

JRC is leading the industry in research and development. Our expanded research and testing facilities lab provides insight into actual perforating system performance under the harshest reservoir conditions. And, with the most advanced evaluation techniques in the industry, we understand reservoir inflow from a perforation tunnel and how it can be optimized for specific well conditions.



As Close as You Can Get to Real-World Conditions The Advanced Perforating Flow Lab helps us understand how a perforator actually performs under extreme downhole conditions. It can provide real-world answers that account for overburden stress, reservoir pore pressure, wellbore pressure, and reservoir and wellbore response. The Advanced Perforating Flow Lab can also help identify the optimum solution to connect the wellbore and reservoir.



Consequences of the Wrong Assumptions

In the oil and gas industry, the wrong assumptions can lead to billion-dollar mistakes. In some cases, pipelines are developed, roads are built, and even towns are created, all on the assumption that millions of barrels of oil or gas equivalent will flow from just a few wells. Therefore, an operator must know precisely how each well is going to intercept the reservoir, and how efficiently and effectively that reservoir will flow into the wellbore.

The tests we do at the Advanced Perforating Flow Lab give our customers precise answers on the exact depth of penetration into the formation in different types of rock, and also what the crush zone and skin value of that perforation is expected to be. These insights help identify or develop the best perforating system for any given well condition.



Only Perforated Core CT Scanner in the Industry

Our expanded facility also includes an integrated command and control center, a core preparation laboratory, and an extensive core analysis laboratory for post-test evaluation. This laboratory enables us to conduct the most advanced perforated core analysis in the industry. We perform these tests with the latest imaging systems adapted from the medical industry for use in oil and gas environments. Our lab is the only one in the world with such dedicated equipment, allowing us to evaluate reservoir inflow at the structural level.



As Close as You Can Get

Perforations in Cement Do Not Correlate to Rock Performance

Wide Range of Applications Tailored for Specific Reservoir Conditions



CASE STUDY

Dominator[®] Charge Gives 21% Greater Penetration in Challenging North Sea Field

A major operator asked Jet Research Center to optimize its gun system for use in a marginal gas condensate field in the North Sea. Tests at the Advanced Perforating Flow Lab helped tailor charges to specific rock characteristics and reservoir conditions, providing deeper penetration and efficient tunnel cleanup for the operator's specific underbalance condition. These combined effects led to a 21% increase in rock penetration and a 12% productivity increase over benchmark conventional charges.

to Real-World Conditions

Testing and research at the Advanced Perforating Flow Lab have found that penetration and inflow performance of a perforating system in formation and under extreme conditions are much different than performance in cement. In fact, many times the results from these tests can mislead, because the best system in cement may not be the best system in real-world conditions. The tests we conduct at the Advanced Perforating Flow Lab are performed with actual cores provided by our clients, allowing better inflow evaluations for project appraisal and the ability to identify and refine the latest equipment for an optimized well completion.



CASE STUDY

Increased Production in Mature Well – Operator's Largest Producing Field in the World

In the Caspian Sea, perforation and completion techniques damaged productivity in an operator's largest field. In response, Jet Research Center developed a specialized shaped charge that could maximize downhole penetration specific to the reservoir and wellbore environment. After testing at the Advanced Perforating Flow Lab, the charge resulted in a 41% increase in clean perforation tunnels and a 34% increase in total core penetration depth.



CASE STUDY

Perforating Technique Optimization, Identifies Best Reservoir Inflow at HP/HT Conditions

After identifying the operational constraints of one client, a thorough testing program was developed to identify the optimum perforating technique to achieve maximum reservoir contact and inflow of a HP/HT reservoir. The APFL capabilities allowed accurate replication of in-situ reservoir conditions, enabling precise measurement of flow efficiencies with varying drawdown and fluid dynamics. Ultimately, a solution was developed and tested, which significantly improved tunnel geometry through increased perforation tunnel cleanup, providing increased production in the client's HP/HT reservoir.



CASE STUDY

Perforating Testing Shows Optimizing DUB Effects Results in More Productive Perforation

The strategy of improving gas production by removing perforation debris from perforation tunnels with dynamic underbalance (DUB), even in an overbalanced (OB) wellbore setting, was advanced by conducting a series of perforation tests. Based on API RP 19B (2014) Section 4, perforation tests were simulated matching well configurations and conditions in a high-pressure gas field to help improve production.

These tests and early field indicators show that despite perforating at a high-static OB, optimizing DUB effects with engineered volumetrics in the gun string improves perforation cleanup, which results in productive perforations.





Advanced Perforating Flow Laboratory

Unlocking the full potential of any well completion starts with optimizing reservoir contact and maximizing perforation inflow. This occurs through understanding perforator performance in rock at in-situ conditions, not large cement blocks at surface.



In-house core preparation provides accurate and rapid testing capabilities.



Cores meticulously prepared to simulate downhole environment. Rock is analogous to reservoir.



Cores are placed into the HP/HT vessel under simulated downhole conditions with stresses, pressures, and temperatures. Pictured here is the HP/HT vessel with thermo elements.



Perforated cores are analyzed using advanced technologies and analytical capabilities.

Capabilities to Simulate Nearly Any Hydrocarbon Environment

Parameter	HP/HT	Rotating	ХНР
Confining Pressure	25,000 psi	10,000 psi	50,000 psi
Pore and Wellbore Pressure	20,000 psi	5,000 psi	40,000 psi
Differential Pressure	10,000 psi	5,000 psi	10,000 psi
Temperature	400°F	Ambient	Ambient
Reservoir Type	Oil or Gas	Oil or Gas	Oil or Gas
Core Diameter	7, 9, and 12 in.	4, 7, and 9 in.	7 and 9 in.
Perforation Orientation	Down	0° - 180°	Down

HP/HT Tiers:

Tier I - 10-20 ksi and/or 300-400°F (HP/HT)

Tier II - 20-30 ksi and/or 400-500°F (Ultra HP/HT)

Tier III - 30-40 ksi and/or 500-600°F (Extreme HP/HT)



Take Charge of Your Reservoir Use the Advanced Perforating Flow Laboratory at Jet Research Center

PRODUCT SALES, RESEARCH, TESTING, AND MANUFACTURING FACILITY



JRC

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