PRODUCTION

Jet-Pump Lifting Systems

Achieving high-volume production when most lift methods fail

Weatherford®

You’re producing from greater depths, navigating extreme deviations, encountering high levels of gas and sand, and handling heavier, more corrosive fluids. In these conditions, many artificial-lift techniques can stick, lock, or wear down. Where the potential for high-volume production exists but conditions are tough, jet-pump lifting systems bring more of your valuable hydrocarbon assets to the surface—when nothing else will.

Low-maintenance lift. High-volume production.

With no moving parts and a compact, durable design, jet pumps can significantly decrease your risk of equipment failure in the most challenging wellbores. Deployed rig free, the pump is set downhole and moved up the wellbore for retrieval simply using pressurized fluid. Once installed, jet pumps require little to no maintenance but achieve big results.

At Weatherford, we pride ourselves on a long-standing history of innovation and expertise with jet-pump lifting systems. We own the brands that pioneered hydraulic-lift technology: Kobe®, which ran the first jet pump in 1972, as well as Guiberson and Oilmaster. Over the years, we have updated these trusted brands with in-house engineering and manufacturing innovations to help you put the most advanced pumps to work in your wells.

Today, only Weatherford delivers such robust and comprehensive jet-lift solutions, which include multiple pump configurations, versatile surface equipment, and powerful production software to suit diverse well conditions.

When other lift methods fail, Weatherford jet pumps deliver.

Jet pumps offer reliable performance across diverse applications and in the most difficult well conditions.

Early production
Quick, rig-free installation and retrieval—combined with the ability to handle high-volume, high-gas, and high-solids production—make Weatherford jet pumps well suited for your early-production applications.

Horizontal, highly deviated wells
Because jet pumps are compact, rig free, and powered using pressurized fluid, they can adapt to tight turns up to 24°/100 ft in severity and are as reliable in deviated holes as in straight holes.

High-volume production
Weatherford jet pumps produce at higher rates than many other lift methods. The production rate is adjustable by changing the power fluid rate to the pump, and it is limited only by well inflow and the horsepower of the surface pump.

Viscous, heavy oil
Able to produce oils with API values as low as 6, jet pumps can use heated power fluid to dilute heavy, viscous crudes and enable consistent flow. Weatherford was the first oilfield services company to use hot water as power fluid.

Dewatering gas, coalbed methane, and shale wells
Water buildup in gas and coalbed methane wells can create pressures that hinder hydrocarbon recovery. Jet pumps effectively pump out liquids and produce down to 13 B/D (2.07 m^3/d).

Frac fluid recovery
When it is difficult to initiate flow during frac operations, jet pumps are an asset. Frac sand has no effect on pump operation, which enables easy recovery of frac fluid and sand at rates of 2,000 B/D (317.97 m^3/d) or more.

Remote locations
The compact, simple, and rig-free design of jet pumps enables easy transportation to remote wellsites. You can also repair jet pumps at your site, which minimizes downtime and costs.

Highly corrosive fluids
Most of our standard pumps are manufactured using corrosion-resistant alloy, and the remaining parts can be easily upgraded at minimal cost. Chemicals to control corrosion, paraffin, and scaling can be added to the power fluid to ensure direct circulation through the pump. Fresh water can be added to dissolve salt deposits.

High-solids production
With tungsten carbide in high-velocity areas and no moving parts, Weatherford jet pumps tolerate solids well. If sand is fluidized enough to enter the pump, it will flow through without plugging.

Recovery from deep wells
Operated via circulated power fluid, jet pumps achieve near-balanced pressure to recover more liquids from depths reaching 20,000 ft (6,096 m).

High-temperature production
Using O-rings and seal rings made of high-temperature elastometers, our jet pumps can operate in temperatures up to 500°F (260°C).

Gassy production
Jet pumps do not experience gas lock. As a result, they can handle gas in the production fluid without interrupting production or damaging the pump.

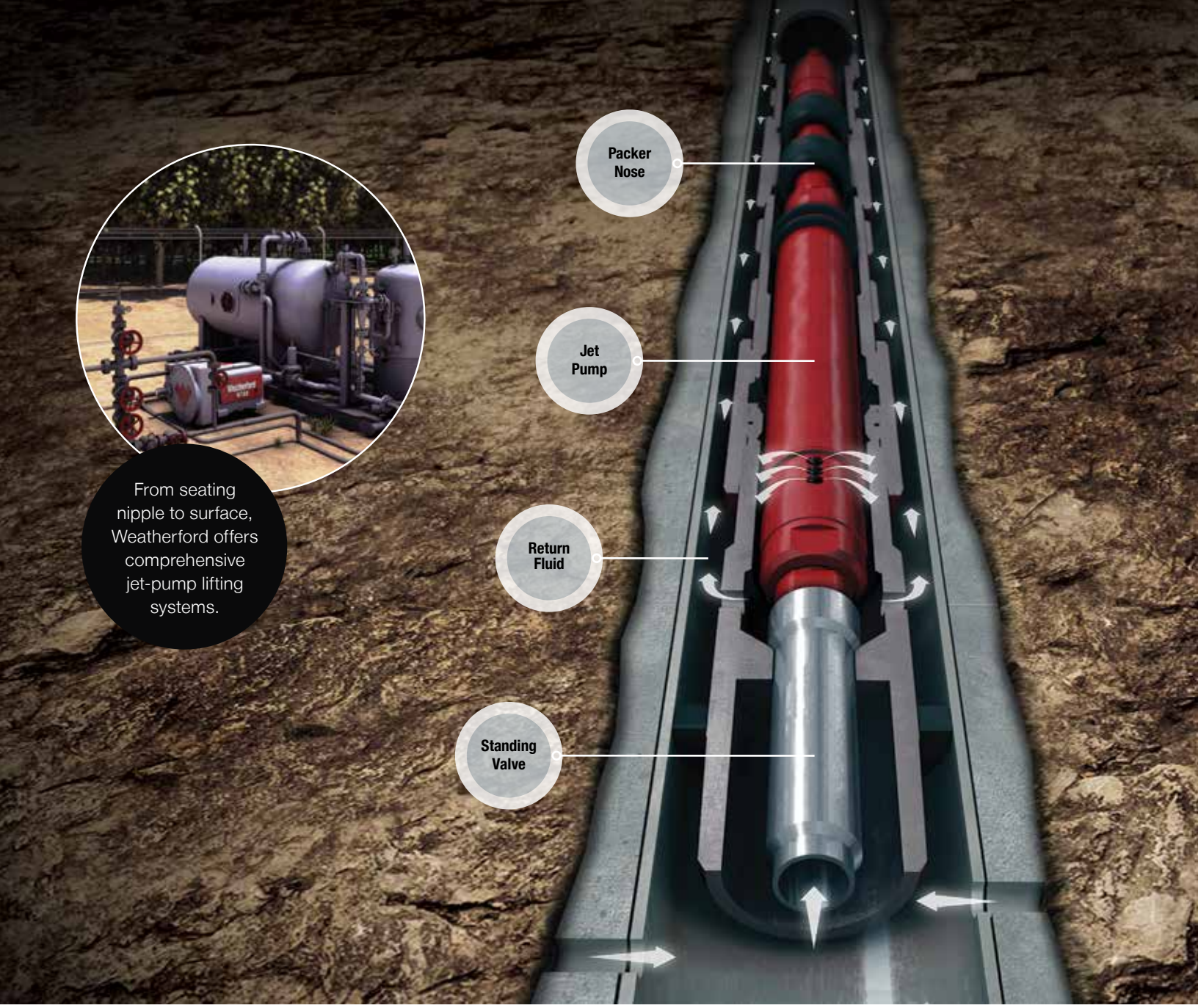
Subsea production
The power-fluid tubing can incorporate a flow loop with a radius of up to 5 ft (1.52 m), which is installed at the wellhead on the sea floor. The jet pump can then be circulated repeatedly—on demand—from the surface platform to the wellbore.

MAKING SHALE PLAYS PAY
Increased production between 7,700 bbl and 17,000 bbl during early production stages in 14 Bakken oil wells and

SAVED $850K PER WELL

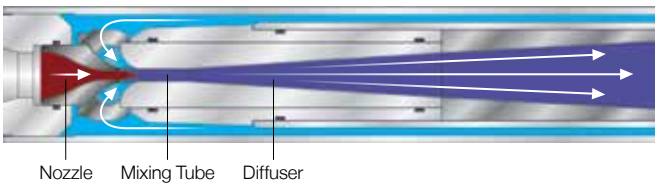
BETTER PERFORMANCE
During a 5-day test run in Kurdistan, Iraq, achieved the target production rate of

5,000 BOPD



How Jet Pumps Work

In a jet-pump lifting system, the pump is run downhole with no need for a rig. At the surface, the power-fluid system uses a multiplex pump to pressurize and inject power fluid into the wellbore. The fluid travels downhole through the jet pump to the nozzle, which reduces the fluid pressure using the Venturi effect. This draws reservoir fluid into the pump throat, where the fluids combine. The mixture then transfers to the pump diffuser, where pressure is increased to raise the fluids to the surface.



- Pressurized power fluid
- Reservoir hydrocarbons
- Comingled fluids (power fluid and reservoir hydrocarbons)

To suit changing production requirements and downhole conditions, the nozzle, mixing tube, and diffuser can be assembled using a variety of materials in multiple configurations:

- Standard single-seal jet pump
- High-volume jet pump
- Sliding-sleeve jet pump
- Tubing/packer jet pump
- Fixed-insert jet pump
- Fixed-casing jet pump

The Jet-Pump Advantage

- Reliability in horizontal, deviated, deep, and high-temperature wells
- High-volume production
- High tolerance for gas and solids in production fluid
- Solution suited for viscous, corrosive, and heavy crude oils
- Short, compact body that can navigate challenging wellbore angles
- Freestyle installation for easy downhole insertion and retrieval
- Installation options: in sliding sleeves, wireline nipples, and across gas-lift mandrels
- Compatibility with all bottomhole assemblies (BHAs)
- Low installation and workover costs
- No moving parts for minimized wear, maintenance, and risk of failure
- Long operational life (average of 4 years)

Providing Reliable Backup for Electrical Submersible Pumps

Electrical submersible pumps (ESPs) can fail when pumped off or exposed to solids or gas. If a crossover assembly (“Y” tool) is preemptively installed on the ESP, you can deploy a jet pump to continue production on a temporary or permanent basis. The crossover assembly bypasses the ESP—without the need to pull it—and diverts production fluid to the jet pump.

Design, Monitoring, and Analysis Software

Jet Pump Evaluation and Modeling Software (JEMS™)
JEMS software can customize your jet pumps to optimize performance and maximize your returns for specific applications. Weatherford engineers can simulate anticipated downhole conditions and performance ranges for every possible scenario. The software also determines the precise nozzle and throat sizes to deliver the most efficient, cost-effective jet-lift system for your well.

CygNet® Production Software
Leveraging existing supervisory control and data acquisition (SCADA) programs, CygNet software collects and manages large volumes of wellbore and reservoir data to give you a complete view of your jet-pump lift operations in real time. With this software, you can mitigate risks and determine the best way to get the most life from your wells.

WellFlo® Well Design and Analysis Software
This powerful software package incorporates the latest advancements in pressure, volume, temperature, multiphase flow, and reservoir inflow calculations. With its comprehensive library of industry-recognized algorithms for well modeling—combined with an array of design-and-sizing programs for jet pumps and other forms of lift—WellFlo software delivers robust modeling, troubleshooting, and diagnostic capabilities to optimize the productive life of the well.

Versatile, High-Power Surface Equipment

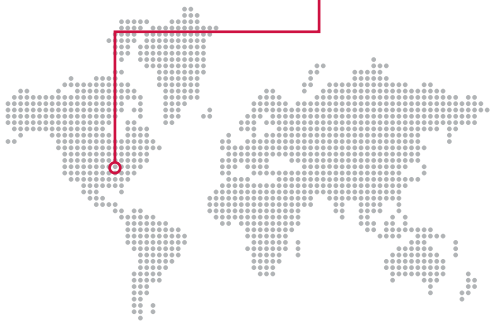
Weatherford jet pumps and hydraulic piston pumps share a common power-fluid system at the surface. This system can serve several wells from one package to lower overall costs, or it can serve wells on an individual basis. This equipment also enables you to change between jet pumps and hydraulic piston pumps in your well without incurring downtime or equipment replacement costs.

This two-skid system cleans, conditions, and pressurizes reservoir fluid to operate the jet pump. One skid contains the multiplex pump, which ranges from 60 to 625 HP, and an electric motor or multicylinder drive. The other skid contains a vessel in which production fluid and exhaust power fluid are conditioned and the oil is separated from gas and water. The pump and vessel are both corrosion resistant.

MORE COST EFFECTIVE

Recovered frac fluid 5x faster in Oklahoma play and

SAVED $200K PER WELL



Specifications

Corrosion handling	Excellent
Gas handling	Good
Solids handling	Good
Fluid gravity	>6° API
Servicing	Hydraulic or wireline
Prime mover type	Multicylinder or electric
Offshore application	Excellent

Parameter	Typical Range	Maximum
Operating depth	5,000 to 10,000 ft (1,524 to 3,048 m)	20,000 ft (6,096 m)
Operating temperature	100° to 250°F (38° to 121°C)	500°F (260°C)
Wellbore deviation	0° to 20° (<24°/100-ft build angle)	0° to 90° (<24°/100-ft build angle)
Operating volume	300 to 1,000 B/D (47.70 to 159 m^3/d)	≤35,000 B/D (≤5,565 m^3/d)

Tubing Size (in.)	Pump Type	Maximum Production Rate
1 1/2	Standard	400 B/D (63.59 m^3/d)
1 1/2	High volume	600 B/D (95.39 m^3/d)
2	Standard	2,000 B/D (317.97 m^3/d)
2	High volume	2,500 B/D (397.47 m^3/d)
2 1/2	Standard	3,000 B/D (476.96 m^3/d)
2 1/2	High volume	3,500 B/D (556.46 m^3/d)
3	Standard	4,000 B/D (635.95 m^3/d)
3	High volume	5,000 B/D (794.94 m^3/d)

Note: These values are based on standard circulation with a power-fluid to produced-fluid ratio of 2:0 and without the presence of gas.

Get more life from your wells.™

Jet-pump systems represent only a fraction of our production solutions. With unparalleled experience and an unmatched breadth and depth of solutions for all forms of artificial lift, we can optimize production in any well. Our customer service centers are conveniently located in every major oil-producing area of the world to address your needs efficiently wherever you operate. We also offer comprehensive artificial-lift training programs that enhance your team's expertise and productivity.

Jet-pump lifting systems are among the most versatile and effective forms of artificial lift and deliver high performance in the most challenging conditions. To learn more about our comprehensive portfolio of artificial-lift technologies and whether jet pumps are the best solution for your well, contact your authorized Weatherford representative or email **PO-Info@weatherford.com**.

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