

WELL TESTING

# REZCONNECT™

WELL TESTING SYSTEM

Solving challenges.™

**HALLIBURTON**



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## REZCONNECT™ WELL TESTING SYSTEM

The RezConnect™ Well Testing System is the industry's FIRST fully acoustically actuated Drill Stem Test (DST) system powered by Halliburton's proven DynaLink® Telemetry System.

It offers a complete well testing solution for acoustic control of DST tools, with measurement and analysis of well-test data in real-time. It also provides real-time surface verification of DST tools operational status and acoustic activation of bottom hole fluid samplers.

You can make informed decisions faster with the RezConnect system that can result in DST modifications to decrease rig time costs and increase reservoir returns!

### AWARDS:

The RezConnect™ Well Testing System received the Offshore Technology Conference (OTC) 2015 Spotlight on New Technology Award.

Each year, the Offshore Technology Conference (OTC) recognizes innovative technologies with the Spotlight on New Technology<sup>SM</sup> Award, showcasing the latest and most advanced technologies that are leading the industry into the future.

This award highlights leading hardware and software technologies based on five criteria: broad industry appeal, proven application, impact beyond existing technologies, less than two years since introduction and innovation capable of revolutionizing exploration and production.



# REZCONNECT™ WELL TESTING SYSTEM

## UNIQUE FEATURES

The system uses acoustic repeaters placed along the workstring to form a fully bi-directional communication system, allowing a live look at the formation response during the well test.

Typically, DST tools are operated by applying and/or releasing annulus pressure. Instead, RezConnect enables the downhole DST tools to be controlled by transmitting acoustic commands, reducing the maximum amount of required annulus pressure. RezConnect also provides real-time surface verification of the ProPhase™ Well Test Valve.

RezConnect is capable of initiating multiple bottomhole PVT sampling events, working with the Armada® Sampling System. Bottomhole samplers can now be acoustically actuated from the surface with the bottomhole samplers not only providing feedback that the sampler actuated has been successful but also providing the PVT sampler capture pressure. This provides critical PVT sampler quality assurance data while the samplers are still in the ground, allowing the operator to make instant PVT sampling decisions.

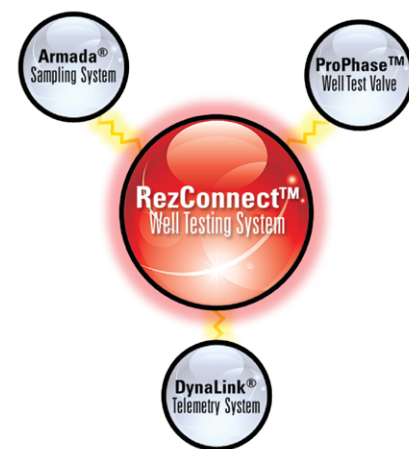
Furthermore, RezConnect has the ability in deepwater operations to acoustically transmit data and commands across the subsea test tree (SSTT). In deepwater emergency situations this allows the SSTT to safely disconnect and reconnect and resume full acoustic wireless communication and functionality.

## BENEFITS

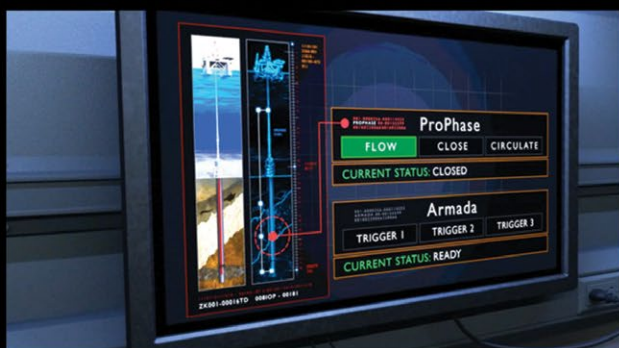
- Potential to reduce operating expenses
- Real-time reservoir analysis
- Assurance of data
- Effective bottomhole pressure, volume, and temperature fluid sampling
- Safety in operations
- Downhole tools status and diagnostics

## APPLICATIONS

- Drillstem testing
- Pressure and temperature monitoring
- Sand control
- Sampling
- Stimulation
- Interference
- Hydrate monitoring
- Long-term production test
- Downhole tool activation
  - Armada® samplers
  - ProPhase™ valve
  - Downhole shut-in tool
  - TCP



# Make informed decisions faster.

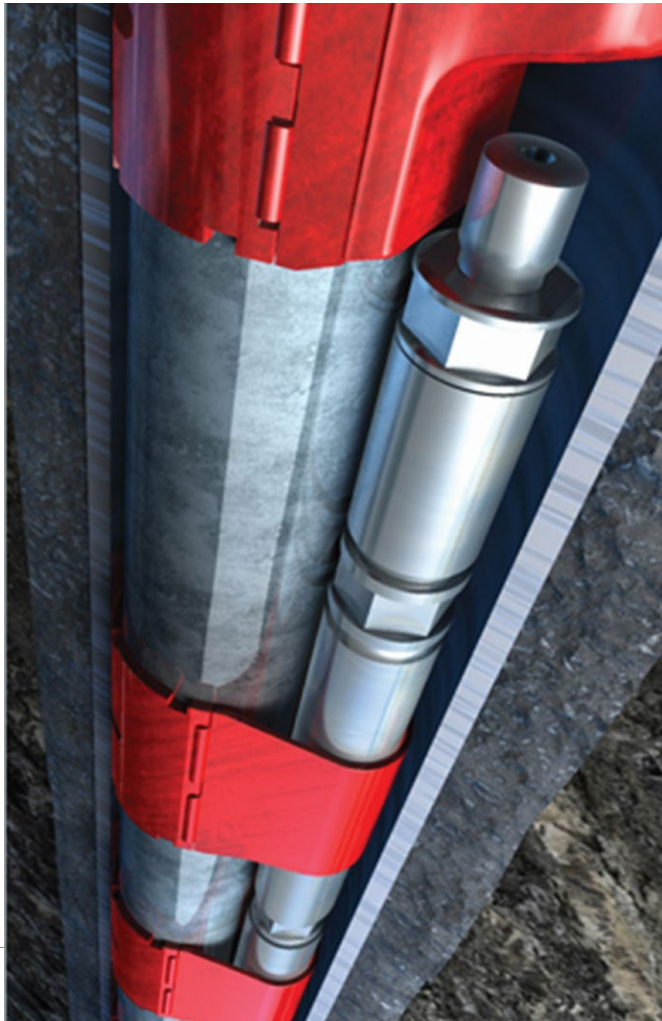


## RELIABLE WIRELESS DOWNHOLE TELEMETRY TECHNOLOGY

The DynaLink® Telemetry System provides the backbone for the RezConnect™ Well Testing System, the complete Halliburton wireless well-testing solution offering the industry's first system for fully acoustically controlled drill-stem testing tools.

### FEATURES

- **Cost Effective.** The DynaLink system helps reduce the cost of operations and enhances the economic value of the reservoir through flexible access to critical and accurate real-time data pertinent to the reservoir evaluation. This flexibility enables well-timed decisions regarding drillstem testing and future sand control or stimulation applications.
- **Reliable.** Simple modular design reduces operational complexity, enabling versatility to perform the job with wireline if necessary. For pressure and temperature monitoring, a dual memory gauge enables redundancy capability.
- **Compact Size.** The DynaLink system enables ease of transportation and application flexibility.
- **Simple.** The DynaLink system operates very similar to memory gauges, and the system's software interface is extremely user friendly.



- **Attachment System.** The DynaLink system provides standard pipe body clamps.
- **Modular downhole modem design.** The DynaLink system interfaces with pressure/temperature gauges, samplers, production logging sensors, tubing-conveyed perforating (TCP) firing heads, and downhole tool actuators.

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### REAL-TIME DYNALINK® APPLICATIONS

- DynaLink® real-time data availability enables tool diagnosis and operational monitoring during the development of the test.
- The DynaLink system enables the simultaneous acquisition of real-time data from gauges located at different positions in the tool string, enabling applications such as data assurance, testing interference between different formations, and monitoring hydrate formation conditions along riser.
- Availability of downhole pressure and temperature data during the test enables assessment on sampling conditions. The Armada trigger sampling system enables sample actuation by DynaLink acoustic telemetry when the required sampling conditions are met and then confirmation of sampling.
- Halliburton provides real-time data at any remote user designated by the customer. The Real Time Operation Center routes the DynaLink data through InSite Anywhere® remote monitoring, and the data is received in the user computer with the InSite® Direct interface.

# PROPHASE™ WELL TEST VALVE

The ProPhase™ well test valve is Halliburton's premier telemetry controlled electrohydraulic tester/circulation valve. This tool combines the functionality of the Halliburton's Select Tester® valve and OMNI™ circulating valve. It is designed to operate via the RezConnect™ Well Testing system and/or with low-pressure annulus telemetry commands.

## BENEFITS

- Simple to operate and maintain. Both mechanical assembly and electronics controller assembly can be completely serviced and function tested independent of each other. (Mechanical assembly can be function tested without electronics.)
- Industry-leading circulating rates, enabling for up to 30 bbl/min (4.8 m<sup>3</sup>/min) of clear fluid to minimize rig time.
- If required, both mechanical and electrical controller assembly can be maintained at rig site.
- Potential to simplify job planning.

### When using the RezConnect system:

- Acoustic telemetry control method minimizes need for applied annulus pressure.
- Real-time verification to the surface of operational status and valve position after acoustic command is sent.
- Minimal annulus pressure is required when flowing the well for Quick Close functionality.

## FEATURES

Pressure telemetry control method operates tool based on annulus pressure changes.

- Pressure telemetry is independent of hydrostatic pressure, so multizone or underbalanced testing can be accomplished in a single trip.
- The RezConnect system adds the capability of operating with an acoustic telemetry system.
- Ability to switch from acoustic telemetry to pressure telemetry without pulling the string or making any changes to the ProPhase valve.
- Modular plug-and-play electronic assembly provides the ability to completely isolate electronics from large-scale mechanical assembly quickly to help ensure optimization of rig time.
- Mechanical design helps reduce the effect of debris fallout on top of closed ball, increasing debris tolerance.
- Low-pressure profile operation enables tool to be operated in deeper (high hydrostatic) environments.
- Secondary slot within carrier body enables a gauge to be run with a pressure tap below the tester ball valve.
- Tool can be completely disabled downhole to a “pipe” condition via a rupture disc override.
- Mechanical design helps prevent the circulating ports and ball valve from being open at the same time.

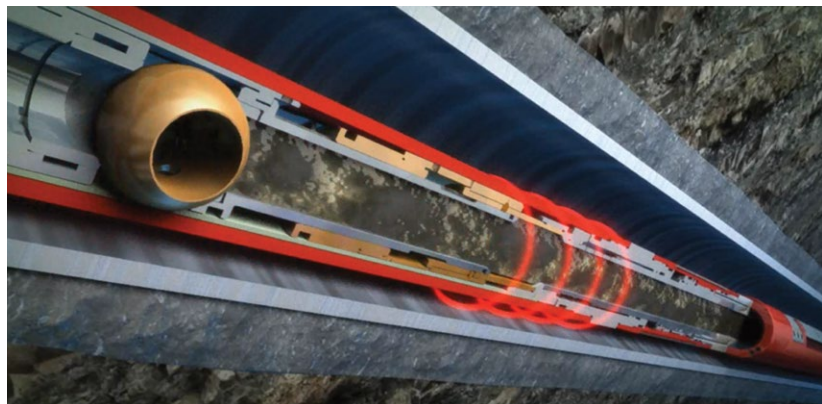
## OPERATIONS

The ProPhase valve has two methods of activation. It can be activated with the RezConnect system by the push of a button, or it can be activated with pressure telemetry by sending a unique annulus pressure “address,” which ends at a “base” pressure.

When the base pressure is reached, multiple tool functions can be executed. With pressure telemetry, most tool operations require a minimum amount of applied annulus pressure, while with the RezConnect system applied annulus pressure is only required for one particular operation. All operational modes are available with both activation methods.

Operational modes include:

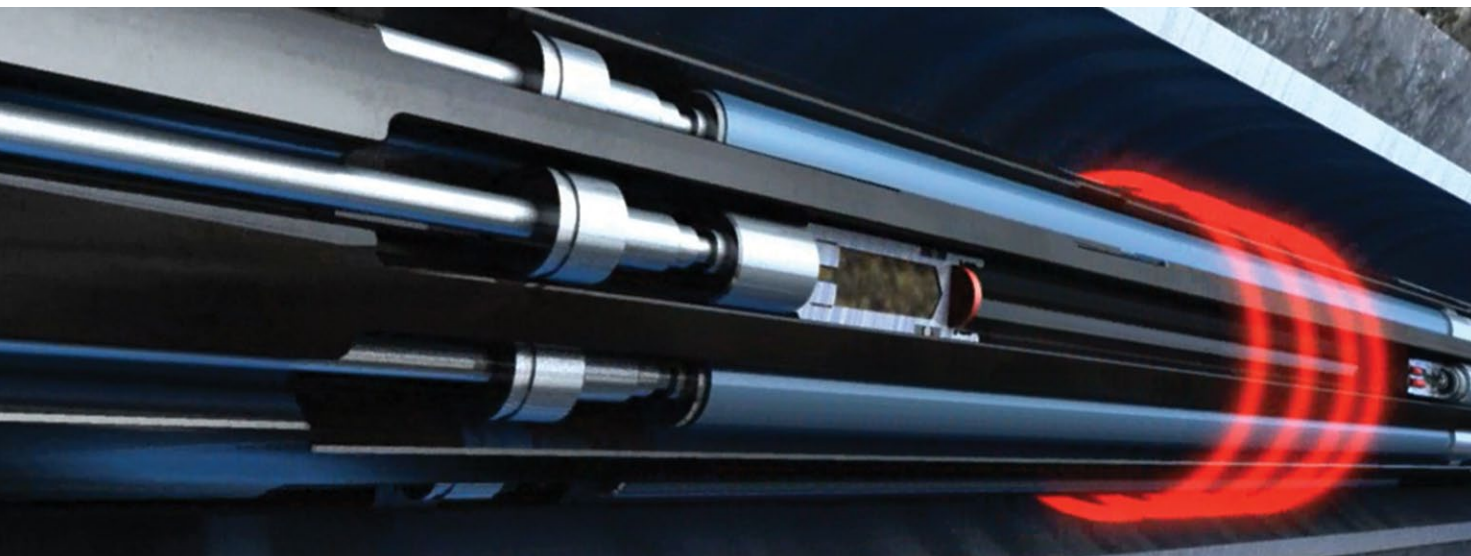
- Flow with Quick Close Function Enabled
  - Circulating ports are closed, and ball valve is open.
  - If applied annulus pressure is released, the ball valve will automatically close.
  - With the RezConnect system applied, annulus pressure is required to provide this safety functionality.
  - This mode is designed for unplanned job events.



- Shut-In
  - Circulating ports are closed, and ball valve is closed.
- Circulate
  - Circulating ports are open, and ball valve is closed.
- Cushion Circulate
  - There is no need to re-address after cushion fluid is pumped into place.
  - This mode is specifically designed for nitrogen cushion operations.
- Underbalanced Circulate
  - Circulating ports are opened only after applied annulus pressure is reduced to a preset level.
  - Ball valve is closed.
- Flow with Quick Close Function Disabled
  - After sending the flow command, the Quick Close feature can be disabled if annulus pressure is increased above base pressure.
  - This mode enables pulling out of hole with ball valve in the open position.



## ARMADA® SAMPLING SYSTEM



The Armada® sampling system is specifically designed to operate in normal or hostile cased-hole environments for extended periods of time. The state-of-the-art smooth bore design with ceramic coated nickle alloy samplers enables the tool to be run with up to nine samplers plus one or more pressure/temperature gauges to monitor bottomhole conditions. The samplers utilize a positive displacement sample chamber and a nitrogen pressure-compensation system to help ensure that the collected sample maintains pressure during recovery. The Armada sampling system is available in 5-in. and 7-in. models.

### TRIGGER METHODS

These carriers are equipped with three rupture disc (RD) ports. Each RD activates three samplers. Consequently, three samplers can be taken during each of three separate flow periods in the course of a multi-flow well test.

By attaching acoustic triggers to the carrier, the Armada sampling system now becomes an integral part of the RezConnect™ Well Testing System. Without the need to pressurize through the annulus, the acoustic triggers are the perfect solution when a well has a narrow pressure window for annulus pressure operated tools.

### SAMPLE VERIFICATION

The revolutionary TRACE DynaGauge™ system, as part of the RezConnect Well Testing System, can be used to provide real-time knowledge that representative reservoir fluid samples have been collected. No other tubing conveying sampling system in the industry provides this capability.

### VERSATILE CONFIGURATION

The versatile configuration enables the system to be run with up to nine samplers, dictated by the desired recovery pressure. Because a

common nitrogen section is used to service all the samplers, running fewer samplers enables a higher recovery pressure. The carrier can also accommodate a gauge set for monitoring annulus, tubular, and common nitrogen pressure.

Even though both sizes utilize the concept of a common nitrogen source for pressure maintenance, the configuration of the source is different. The 5-in. model uses a single nitrogen case, whereas the 7-in. model uses between four to seven high-pressure tubular sections. Both sources deliver extremely capable recovery pressures to support the highest probability for single-phase sampling.

### APPLICATIONS

Bottomhole sampling by carrier is the preferred sampling method for high-pressure/high-temperature environments or any applications where wireline intervention is considered inappropriate or too expensive in terms of lost rig time.

### BENEFITS

The Armada sampling system has been designed with extreme sour gas wells in mind. The inert nature of the ceramic coated sampler limits not only hazards related to stress corrosion cracking of conventional 17-4 PH sample tools but also facilitates measurement of trace elements such as  $H_2S$ . The tools have a smooth bore inside diameter (ID) to permit unobstructed passage of wireline or tubing conveyed intervention tools without damaging the samplers. Because of its unique features, the Armada carrier can be fully assembled and pressure tested at the base before being shipped to location. At location, only the nitrogen sections need to be charged and the Armada system is ready to run. This can result in significant reduction in time and personnel costs and improved safety.

# TRACE DYNAGAUGE™ SYSTEM

## DESCRIPTION

The revolutionary TRACE DynaGauge™ system is the industry's first gauge that provides real-time knowledge that representative reservoir fluid samples that have been collected while the samplers are still downhole. This innovative system is an addon that is used in the tubing-conveyed 5-in. and 7-in. Armada® sampler carriers. The TRACE DynaGauge system is used in conjunction with the DynaLink® telemetry system, enhancing real-time sampling and reservoir assessment. It integrates into the RezConnect™ Well Testing System for a complete wireless welltesting solution.

## FEATURES

- The gauge has an estimated battery life of 20 days at 329°F (165°C).

- The DynaLink telemetry system can interface with Armada carriers to gather real-time data for the customer.
- The gauge can monitor the nitrogen pressure as samples are taken and communicate that information to the surface by using the DynaLink telemetry system. This data can confirm whether a sample has been taken and how many samples have been taken before the tool is returned to the surface.

## BENEFITS

- Connects into the Armada carrier the same way as the samplers and is able to interface with all nine samplers
- Confirms real-time sample collection and retention
- Due to its smaller size, has a greater opportunity to be used in a variety of applications



# REZCONNECT™ WELL TESTING SYSTEM

## CASE STUDY

A powerful demonstration of the RezConnect™ Well Testing System was performed for a Halliburton customer in a South American deepwater environment. The job was conducted from a semisubmersible rig, at a water depth of 7,053 feet. The 17,600 feet deep well was in a pre-salt region. During this well test, Halliburton wirelessly transmitted data from the seabed to the downhole tools using repeaters sequenced along the workstring, resulting in a completely wireless transmission system across the seabed equipment to the downhole tools.

Despite the challenging conditions, the RezConnect system successfully communicated at 100% throughout the well test, demonstrating the reliability of downhole wireless technology.

The well test valve was acoustically operated multiple times. Every command issued provided a response seen on surface, both by the response of the reservoir and the acoustic feedback response. During the sampling period of the well test, the customer chose to activate all three sets at once collecting 3600 cc of fluid samples. A confirmation was received on the surface that the sampling process had taken place, which was verified upon the removal of the tool from the well. This Halliburton technology elevated the testing operations to a higher performance level and improved quality standards.

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