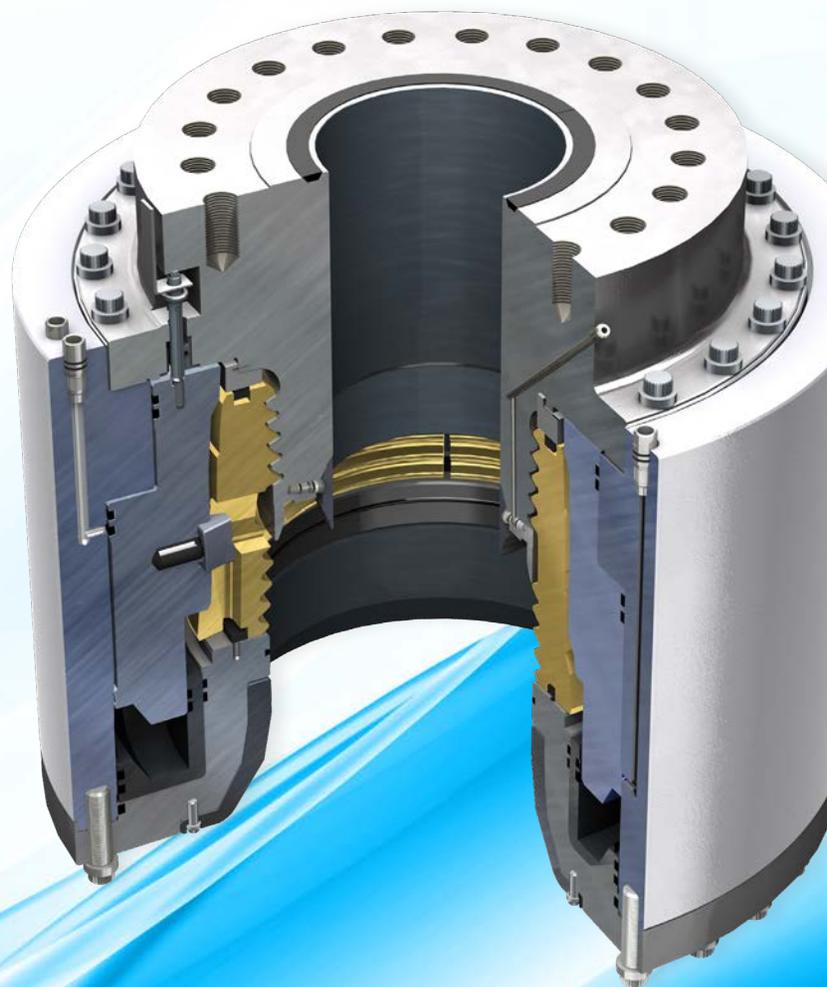




# **DXe<sup>®</sup>** Subsea Wellhead Connectors

Superior, versatile  
solution in  
high-fatigue shallow  
water conditions  
and ultra-deep  
critical service



# Eliminates significant environmental and operational risks

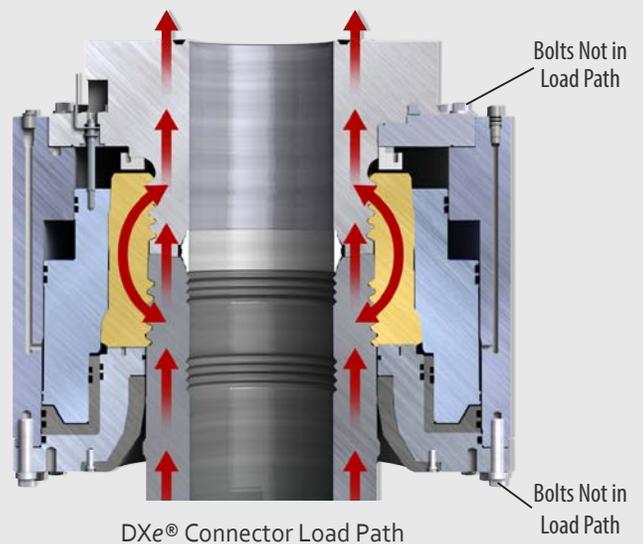
## Extends service life in *all* water depths

Dril-Quip's DXe® Wellhead Connector is a proven solution that's ideal for high-pressure, high-temperature (HPHT), severe bending and high-fatigue conditions. It is an evolution in connector technology that encompasses years of experience and lessons learned from our earlier, highly successful DX® and SDX® Connector designs, which have been used for more than 20 years throughout the world — from shallow water Gulf of Mexico with its adverse ocean currents to the critical service environment of ultra-deepwater Brazil. And now, this latest product in our Connector portfolio has the added benefit of being Green by Design™.

Since the wellhead is the single barrier to the ocean, this is critically important. The DXe Connector is the only connector in the world that solves the well-known problem of stress-cracking bolts or bolt failures caused by drilling-riser and tension loads. That's because we've eliminated bolts from the load path.

## Eliminates failure with unique no-bolt design

Some wellhead connectors have a load path that drives applied preload through the bolts required for assembly. In addition to corrosive seawater exposure, these bolts are subjected to cyclic loads from the drilling riser, and from tension loads generated by internal pressure. Fatigue cycles and material imperfections work together to form cracks that can propagate through the bolt's threads, causing failure.



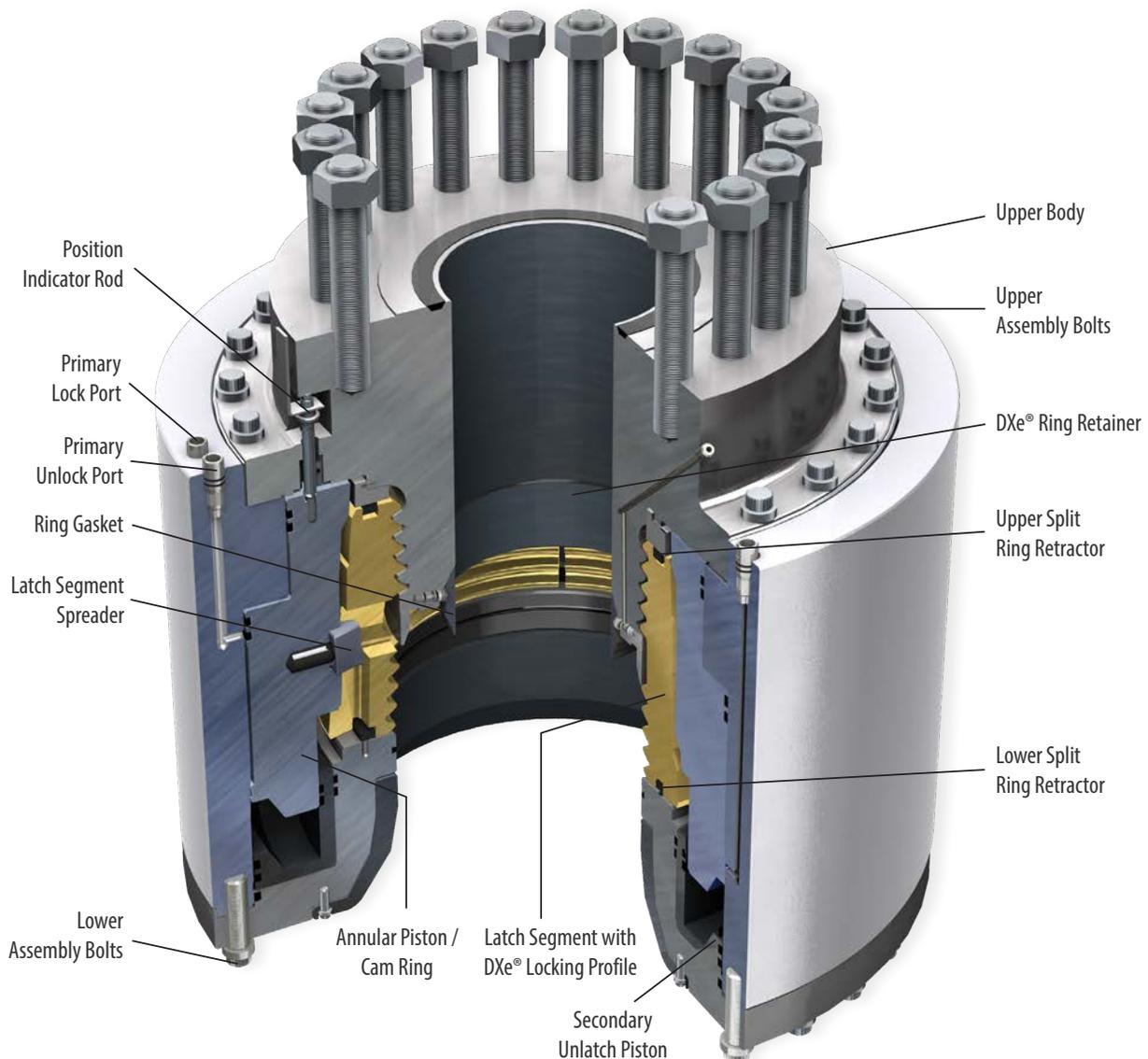
# Exceptionally versatile — easily configures for H4 profile

## Innovative locking profile ensures long fatigue life

Dril-Quip's DXe® Connector design is simple and extremely versatile. It can be easily configured to latch onto any manufacturer's wellhead simply by swapping the latch segments (or dogs). It is equally reliable for either DXe or H4 profiles.

When the connector is locked and in operation, the load path travels through the connector, the wellhead main body and the latch segments via an innovative, patented locking profile. As the segment latches to the wellhead, it clamps to the connector's upper body simultaneously and creates a closed loop with a nearly straight load path.

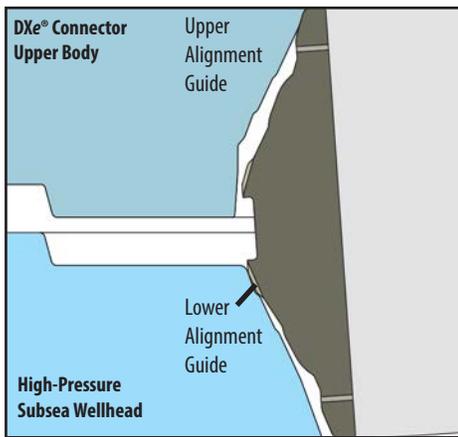
Loads applied to the connector travel only through segments made from ductile alloy steel and do not pass through the DXe® Connector bolts, which are not subject to cyclic stresses at operating loads.



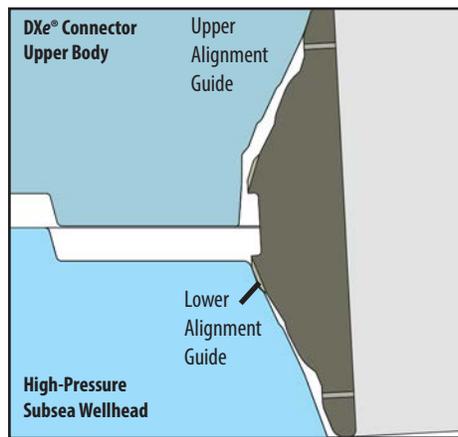
## Self-aligning gaskets engineered for critical service

Removing bolts from the load path is a major advance in connector performance, but a lot more goes into making Dril-Quip's DXe® the ideal connector for the most challenging conditions. The DXe® Connector is the only connector in the industry that has a gasket rated to 20,000 psi, 400°F and 4,500 m (15,000 ft) water depths.

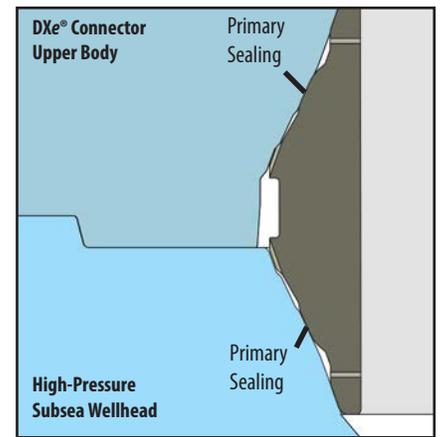
The self-aligning DXe® ring gasket simplifies installation, which is particularly important when using an ROV. Its increased hub contact area means higher bending capacity.



The DXe® ring gasket alignment guides engage the ring gasket surface in the upper body of the connector. These alignment guides assist alignment, while protecting the metal sealing surfaces.



Downward movement of the connector and alignment guides automatically adjusts the ring gasket into the proper sealing position. Both alignment guides ensure that the sealing surfaces are not touched during this movement.



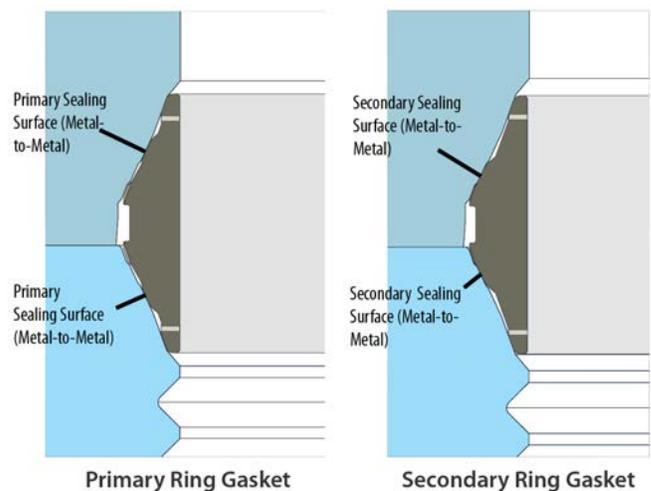
As the connector lands, the ring gasket settles into the sealing position. It is preloaded when the connector is locked and the latch segments are energized.

## Effective primary and secondary metal-to-metal seals

The Dril-Quip DXe® Connector was designed with environmental safety and risk reduction as top criteria. It features a pair of independent, primary and secondary, metal-to-metal sealing surfaces.

The primary DXe® gasket is used during normal operations and protects the secondary metal-to-metal sealing surface. In the event of damage or leak, a secondary DXe® ring gasket can be installed. The secondary ring gasket uses the secondary sealing surface for a reliable metal-to-metal seal.

- **Internal Pressure Rating: 20,000 psi**
- **Water Depth Rating: Up to 4,500 m (15,000 ft)**
- **Temperature Range: 35°F to 400°F**



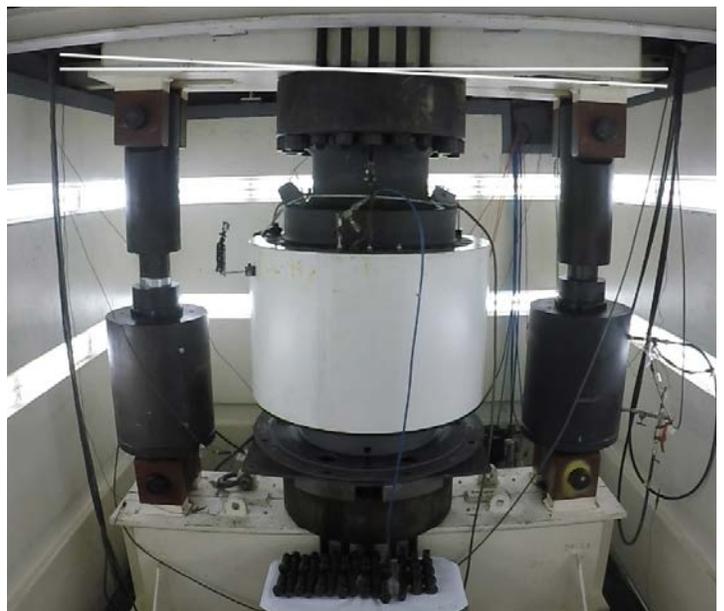
# Uniquely qualified to *both* API 16A and API 17TR7 Requirements

**Dril-Quip has gone to extraordinary measures to ensure that our DXe® Connector will exceed performance requirements for even the most challenging wells. It has been tested more than any other competitive product — to 90 million cycles — and passed the latest API 16A and API 17TR7 editions, which no other connector in the industry has done to date.**

## Superior load characteristics — exceed API 16A requirements

Dril-Quip's extraordinary DXe® design was proven by performing API 16A load tests with the bolts removed. Using standard locking pressure, the DXe® Connector was first locked to a test stump with a 30" DXe® wellhead locking profile. Locking pressure was then bled off, and the locking circuit was vented. All external attachment bolts were removed, including bolts in the upper and lower bodies.

Structural load tests were performed, including tension and compression testing to 1 million pounds combined with bending, and pure bending up to 8.2 million ft-lb. Load tests were performed with and without bore pressure, which was applied in increments of 5,000 psi up to 20,000 psi. The "no-bolts" connector successfully passed each test. This remarkable performance — impossible with ordinary connectors — was identical to the standard DXe® Connector tested with all its bolts in place.



DXe® Connector Load Test with No Bolts

# Qualified more than any other connector in the industry

## Verification testing

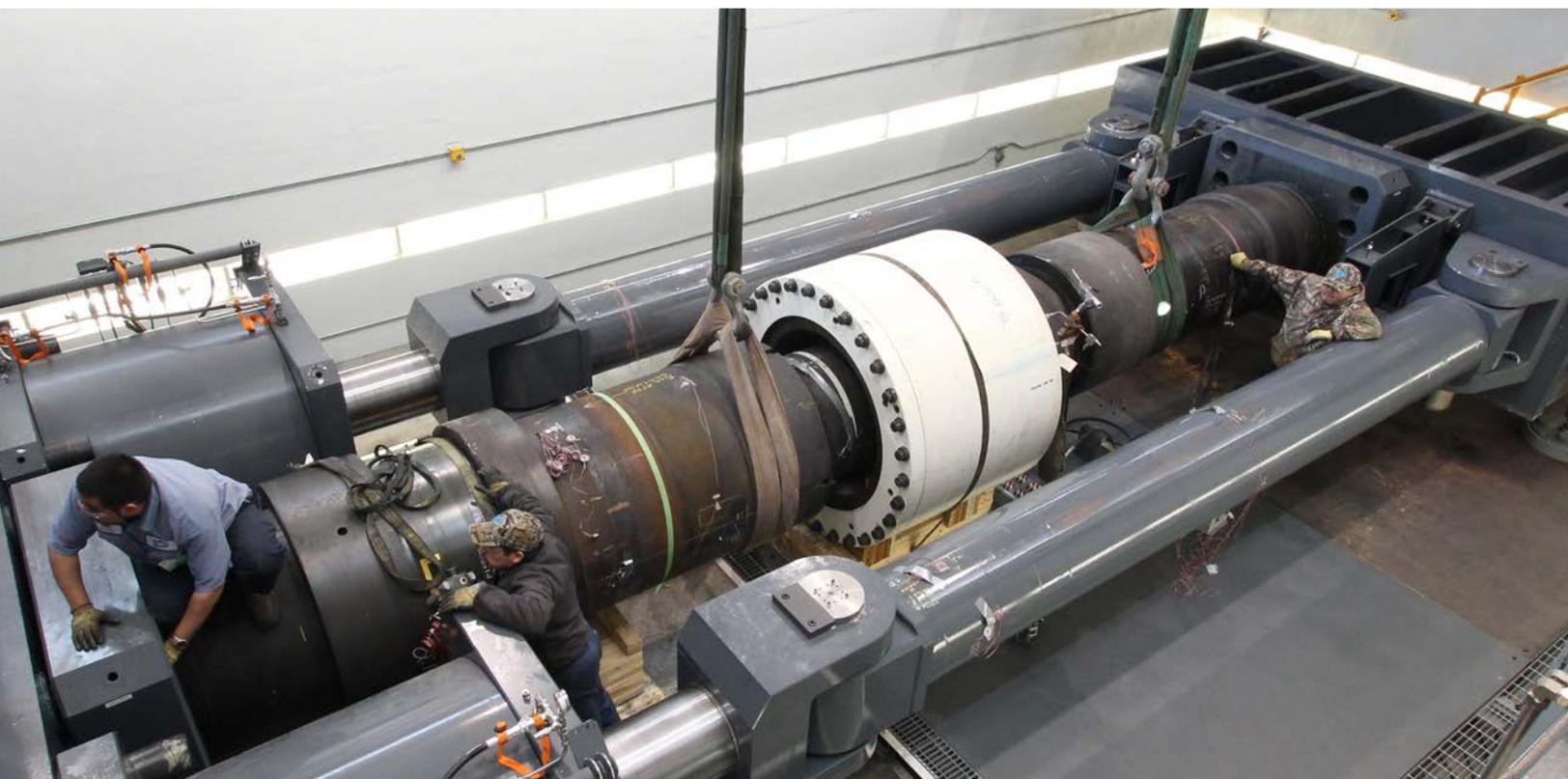
Highly sophisticated design and finite element analysis (FEA) tools were used to optimize details of Dril-Quip's DXe® Connector locking profile. The primary objectives were uniform load distribution and minimizing peak surface stresses directly related to connector fatigue performance. This resulted in a subsea wellhead connector with high load capacity and high fatigue resistance, all within the smallest possible dimensional envelope.

## Structural validation testing

Wellhead connector physical validation testing was conducted with Dril-Quip's proprietary test machines. The test specimen consisted of a wellhead connector and 18-3/4-in. wellhead locked into a 36-in. conductor housing.

Tests were conducted using Normal, Extreme and Survival load conditions, per API 17TR7. Strain gauges at critical locations collected data for comparison to strains from FEA at the same locations. Bending moments were applied, with a variety of combined loads. Comparison of 3-D FEA and validation test results indicated close correlation between analysis and test data.

The 3-D FEA was performed to generate capacity charts when Normal (66.7% of yield), Extreme (80% of yield) and Survival (100% of yield) load conditions were applied to the wellhead system. These three load conditions were applied in both the verification analysis and physical validation testing of the wellhead system. The DXe® Connector had zero defamation even at the Survival load.



## Exceptionally low SAF during fatigue testing

To properly evaluate fatigue characteristics of the wellhead system and connector, met-ocean data (wave and current profiles), drilling vessel motions and soil conditions were collected on specific well sites from several severe drilling cases around the world. A global riser analysis was performed to identify a representative fatigue spectrum and a predicted failure point.

The data was used to develop and conduct a full-scale fatigue test program on a complete system. A fatigue test machine, designed and built by Dril-Quip, was used to accelerate the fatigue phenomena.

Strain gauges were applied, and pressure was introduced into the bore. The machine was operated with an eccentric load that introduced an alternating stress level to the specimen. Continuous cyclic stress was applied to the specimen until the predicted failure point was reached in the fifth week of testing. There was no change in vibration spectrum (which would have indicated the onset of failure) or leakage, so the test was continued to 90 million cycles. This far exceeded maximum fatigue conditions evaluated. The test specimen was disassembled, and close inspection revealed no fatigue damage, proving that the DXe Connector is superior to ordinary connectors.



## Effective. Versatile. Extraordinary.

**The oil and gas industry has seen how bolts in the load path can result in catastrophic consequences. From the bending stresses that occur from ocean currents in shallow water to the extreme pressures and temperatures of ultra-deep wells, Dril-Quip's evolutionary DXe® Connector eliminates this concern. It is uniquely designed and qualified to deliver the reliable performance, superior fatigue life and high capacities that no other connector offers for either DXe® or H4 connections, and it's field-proven in countless installations worldwide.**

## Experience The Power of e™

**That's Dril-Quip's DXe® Connector, and that's the Power of e™. Make the DXe® the connector you specify for all your projects. Contact your Dril-Quip representative today.**



*the power of* ™

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