XL Systems
Large-bore Casing and Conductor Connectors

NOV Completion & Production Solutions

Worldwide Sales

Aberdeen, United Kingdom
Dubai, United Arab Emirates
Houston, Texas, USA
Perth, Australia
Rio de Janeiro, Brazil
Singapore
Trinidad and Tobago

Worldwide Manufacturing

Batam, Indonesia
Beaumont, Texas, USA

XL Systems is a worldwide organization with sales and manufacturing locations strategically positioned to support all major offshore producing basins. Manufacturing operations are streamlined into two large-capacity plants to service the Eastern and Western Hemispheres.

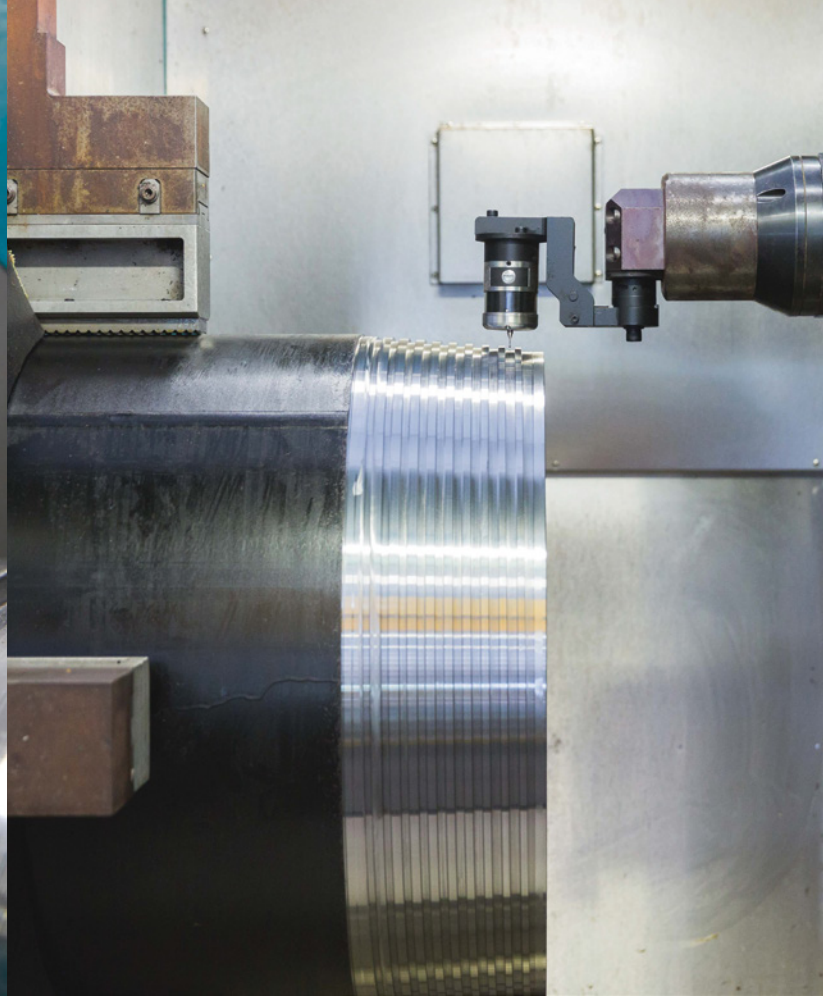
The foundation for world-class wells

XL Systems supplies the onshore and offshore oil and gas drilling industry with robust and reliable connector products for conductor and surface casing strings. We've continuously served the industry since 1985, while launching several industry first innovations:

- Integrally threaded connectors for large diameter casing sizes
- Metal-to-metal primary pressure seals for large diameter connectors
- Wedge thread technology for drive pipe applications
- Full-scale fatigue testing for conductor connectors
- PDLs for lifting and handling large diameter joints with flush connectors
- Viper™ connectors developed specifically for deepwater projects
- The easily reversible ViperLock™ anti-rotation device
- StingRay™ automated pipe-to-connector welding

XL Systems has a strong commitment to designing and manufacturing high performance, large-bore connector products. We pride ourselves on being a technology leader in connector development. Our product development process includes advanced digital simulations followed by full-scale physical testing to benchmark product performance. Proven products allow our customers to understand, evaluate, and quantify risks for harsh environment well construction projects.

XL Systems also has a strong commitment to developing and maintaining low-cost, high-quality manufacturing processes that our customers demand. We've streamlined our connector threading and welding operations into two high-volume plants serving worldwide operations. Each operation includes purpose built threading and welding machines ideally suited to manufacturing our connector products.



Threading Capabilites

XL Systems was founded on the belief that integral-threaded connectors are a cost-effective solution for large-bore surface casing and conductor strings. This has proven true for our XLF and XLC-S connectors, with more than 35 years of field service history. These connectors eliminate the need for connector forgings, pipe-to-connector welding, and weld inspection.

Proprietary wedge thread technology is the key to unlocking superior performance for XL Systems integral connectors. In the made-up position, the connector threads wedge together, forming a dovetail fit that effectively locks the pin and box together. Wedge threads “shoulder in the threads,” streamlining the connector profile by eliminating the need for a bulky torque shoulder.

Since integral-threaded XLF and XLC-S connectors are machined directly on pipe joint ends, they have the ideal connector geometry of a true flush inside diameter (ID) and true flush outside diameter (OD) profile.

XL Systems uses horizontal boring machines for pipe threading. The pipe is held stationary and the machine tool rotates around the pipe to cut threads and seal profiles. Coupled with automated touch-probe inspection, this machining platform has proven robust and reliable for large-bore connector threading. Our machines are configured for threading pipe from 20- to 48 inch sizes, and we have the capability to machine threads in 72-inch and larger sizes.

XL Systems plants in Beaumont, Texas, and Batam, Indonesia, each have multiple production threading lines for servicing high-volume orders.

Welding Capabilites

XL Systems welding engineers have developed automated processes for pipe-to-connector welding that deliver consistent high-quality welds at production volumes. Our pipe-to-connector welding is based around the proprietary StingRay welding platform, which is a highly automated submerged-arc welding machine built specifically for double-sided connector welds.

Forged rings for XL Systems weld-on connectors are produced to XL Systems material specifications. Our metallurgists and welding engineers work in concert to develop connector forging alloys and associated welding procedures that are cost- and performance-optimized.

Many of our customers drilling in harsh environment locations need connectors and connector welds with improved toughness and excellent fatigue life. XL Systems has developed and tested high-toughness and high-fatigue welding procedures suitable for the most severe drilling environments.

Each major XL Systems manufacturing plant is fitted with multiple StingRay welding lines for high-volume welding. We also maintain accessory welding stations at each plant for pipe jointer welding, for assembling accessory joints with float shoes and float collars, and for attaching lifting devices like padeyes and lifteyes.

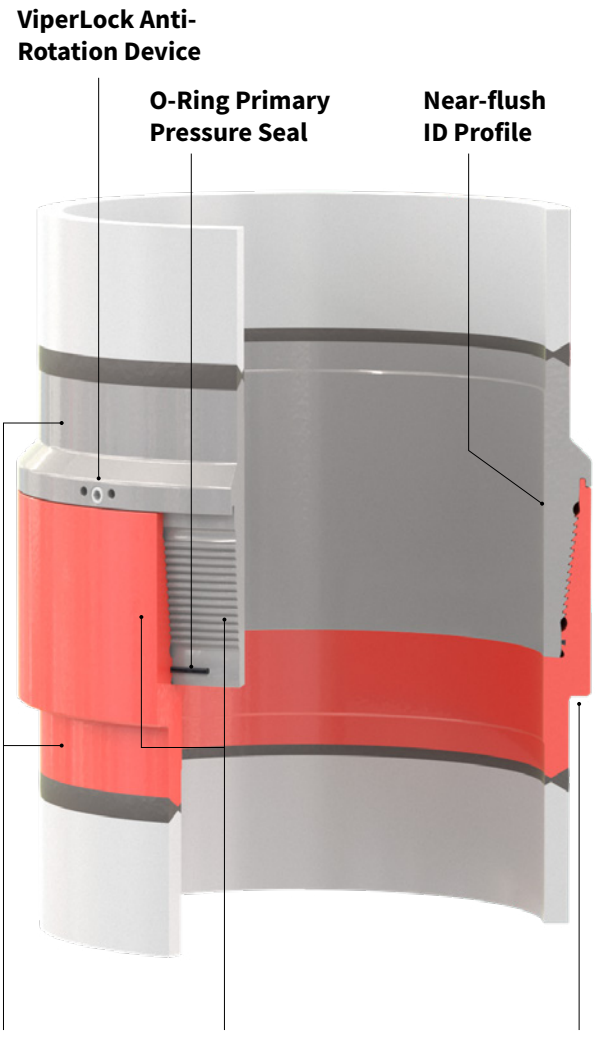
16- to 34-inch Sizes

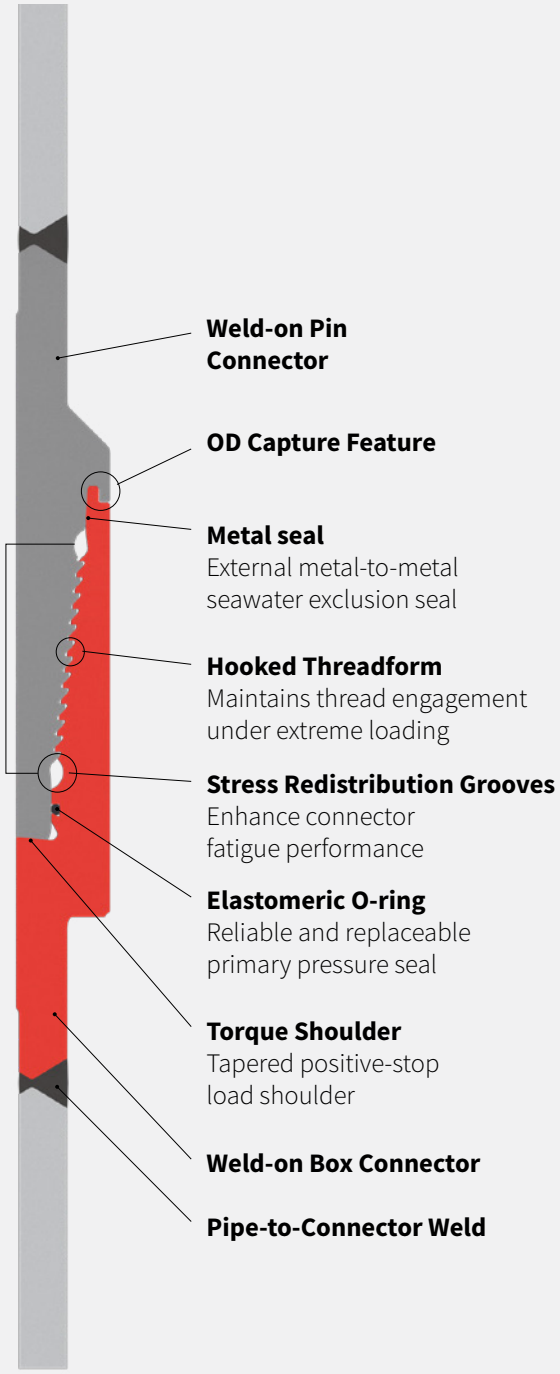
Viper connectors in the 16- to 34-inch size range feature a near-flush ID profile and an integral lift shoulder on the box connector suitable for handling with standard casing running tools, including side door and horseshoe elevators.

Viper connectors in all sizes share several common features, including threadform, deep-stabbing and self-aligning profiles, stress redistribution grooves, dual seals, redundant capture features, and engineered weldnecks.

The primary pressure seal for this connector is the elastomeric O-ring located inboard from the threads. The external metal seawater exclusion seal provides a backup pressure seal.

All Viper connectors feature the ViperLock anti-rotation device to prevent unintended connector backoff.



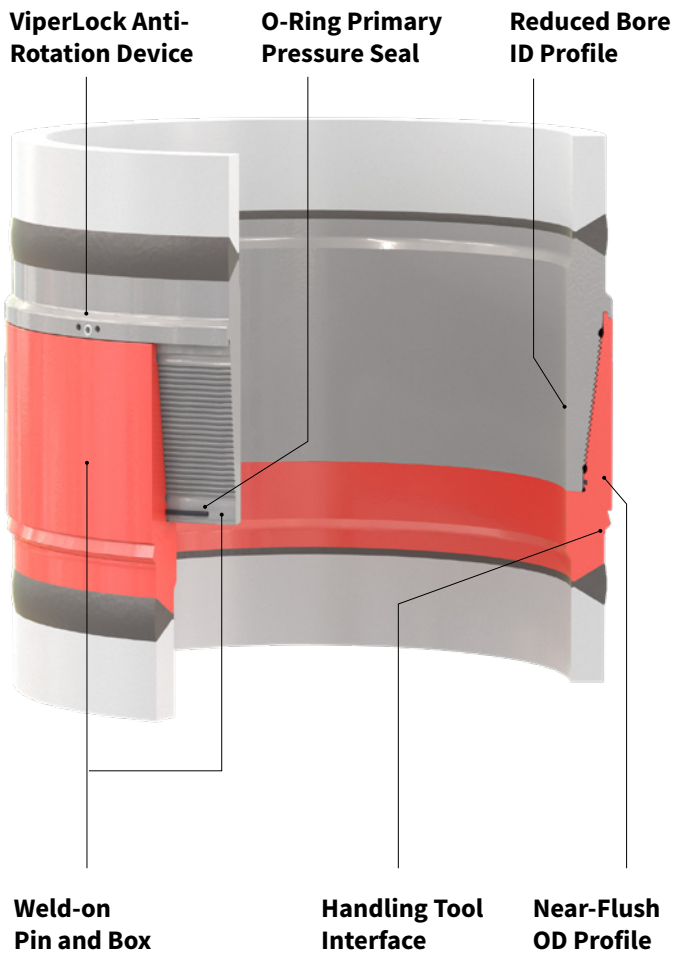


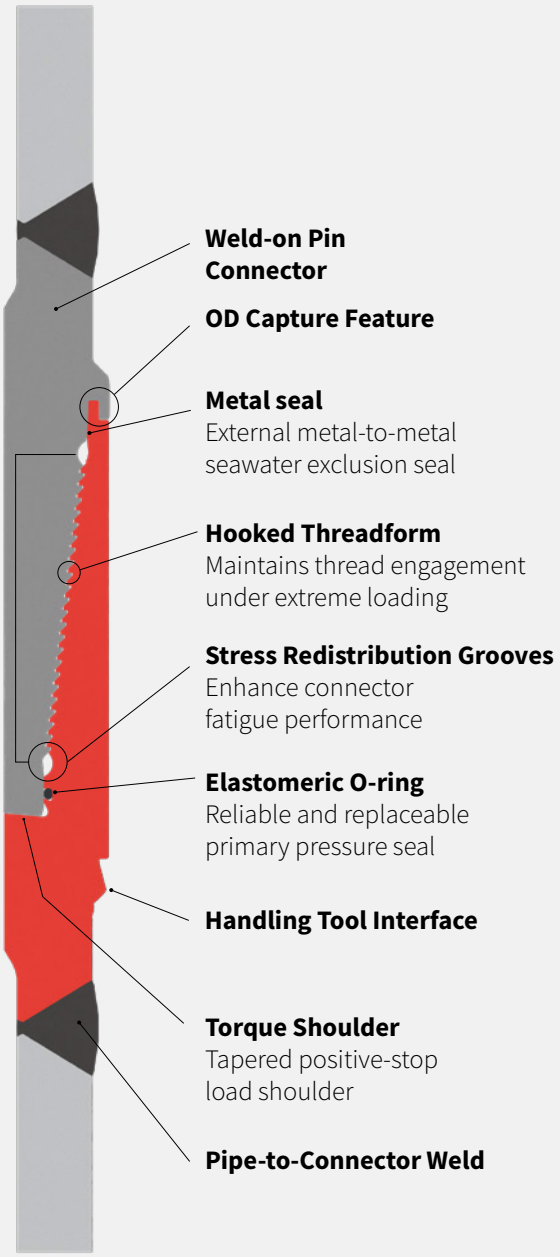
36- to 38-inch Sizes

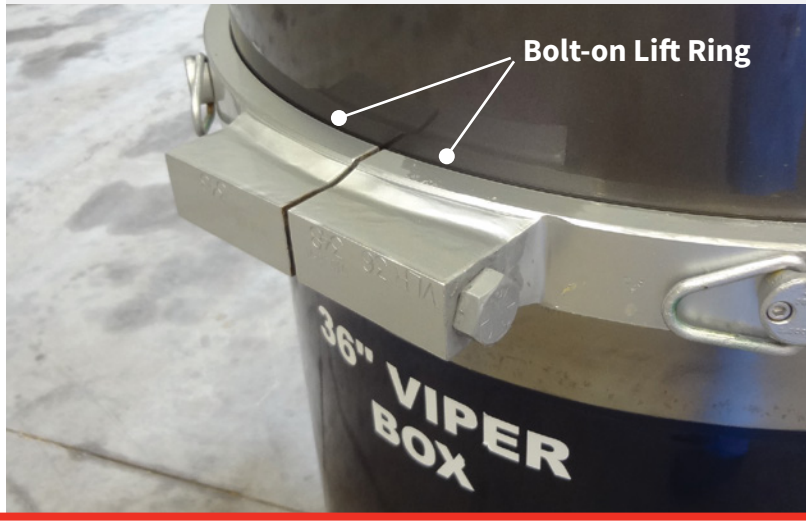
Viper connectors in 36-inch and 38-inch sizes feature a near-flush OD connector body profile that provides specific benefits:

- The 36-inch connector will pass through a 37½-inch rotary bushing and standard subsea accessories
- The near-flush OD profile minimizes soil disturbance during jetting installation, improving the load carrying capacity of the conductor

The 36-inch and 38-inch Viper connectors include a handling tool interface profile that fits a removeable, bolt-on lift shoulder for easy running and handling.







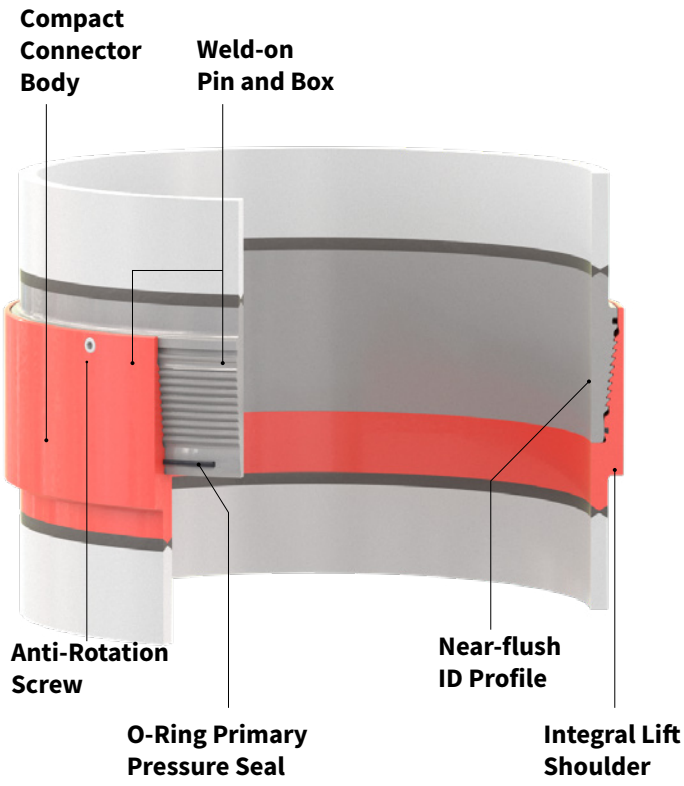
16- to 30-inch Sizes

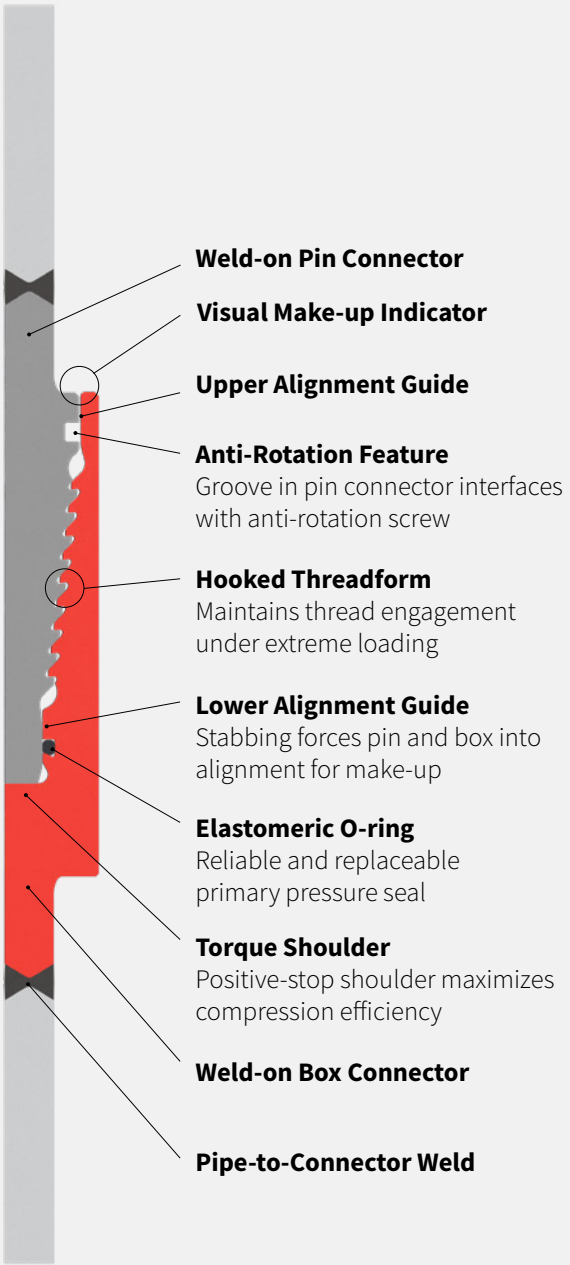
Scorpion connectors were developed to be a robust yet economical full pipe-body-strength solution for projects in moderately severe environments. Scorpion connectors are well-suited for onshore and shallow-water offshore surface casing and conductor applications.

Scorpion connectors are designed for quick and easy running and handling on the rig. The integral box lift shoulder is compatible with standard casing elevators and is sized to support full string weights. Integral alignment guides force the pin and box into perfect alignment as the connector is stabbed together. The tapered threads allow for a deep stab and fewer turns for full connector makeup.

The Scorpion connector design incorporates proven performance features found in our large-bore premium connectors, including the hooked threadform, a replaceable elastomeric O-ring pressure seal, and stress redistribution grooves to manage peak stresses in the load path.

All Scorpion connectors feature a mechanical anti-rotation device to prevent unintended connector back-off.





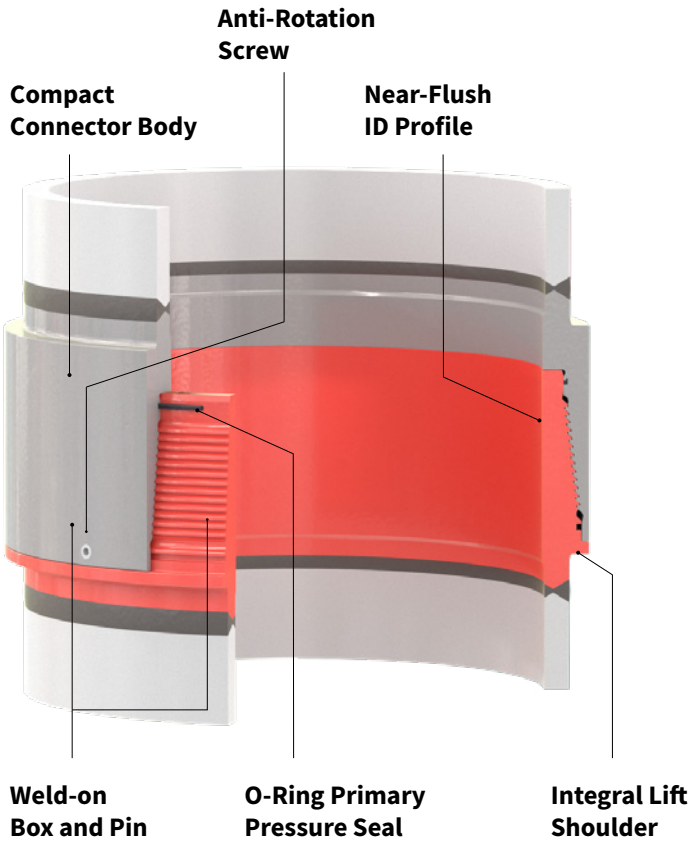
16- to 30-inch Sizes

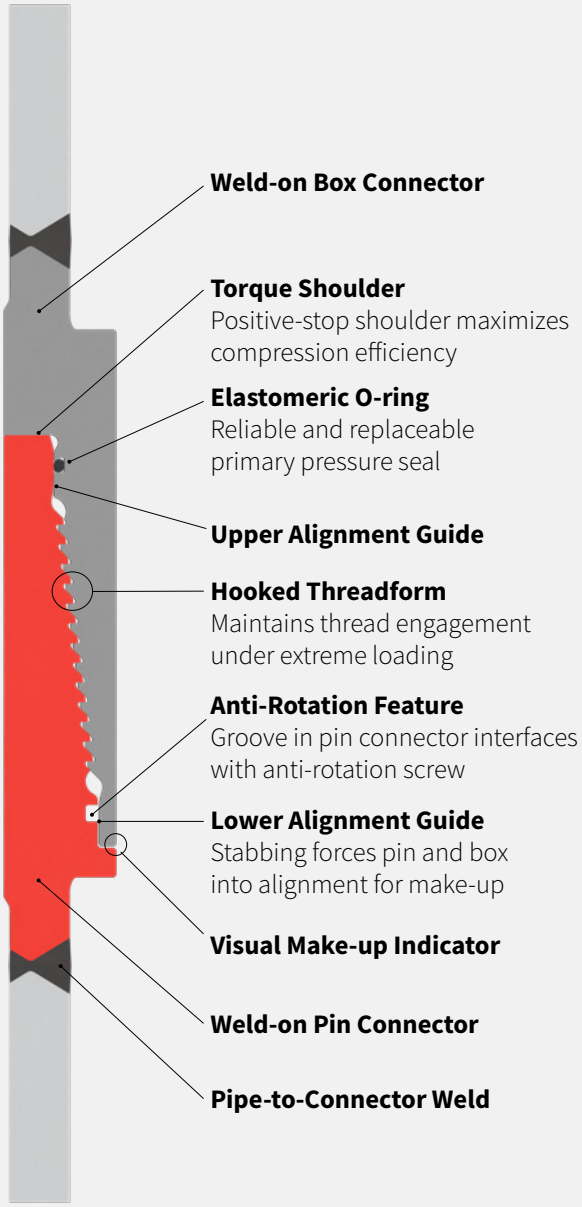
For conductors installed by pile driving, a heavy-duty connector configuration called ScorpionDrive is used. This connector has improved compression strength compared to standard Scorpion connectors.

ScorpionDrive connectors are run in the pin-up, box-down orientation for easier interface with the pile driving hammer. A simple stab-in drive adapter transmits pile driving forces across the generous pin end face surface facing upward.

ScorpionDrive connectors feature the same robust design features as standard Scorpion connectors: deep-stabbing tapered threads, a self-aligning profile, hooked threadform, a reliable and replaceable elastomeric O-ring primary pressure seal, and stress redistribution grooves to manage peak stresses in the load path.

All ScorpionDrive connectors include a mechanical anti-rotation device to prevent unintended connector back-off during pile driving and in-service.





20- to 30-inch Sizes

XLW-GT connectors are designed for robust and reliable performance in the most demanding onshore and offshore surface casing, liner string, and conductor applications.

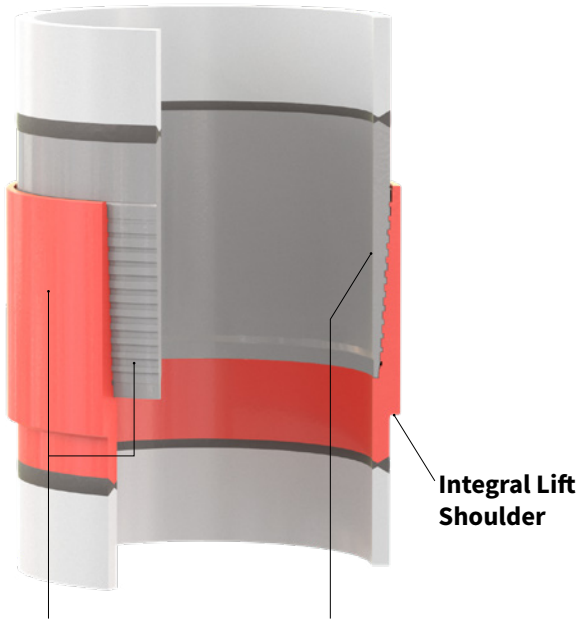
The primary pressure seal for XLW-GT connectors is a metal-to-metal seal on the ID side of the threads. This seal maintains robust gas-tight sealability at full pipe body pressure ratings. The wedge thread design provides a secondary thread-fit seal.

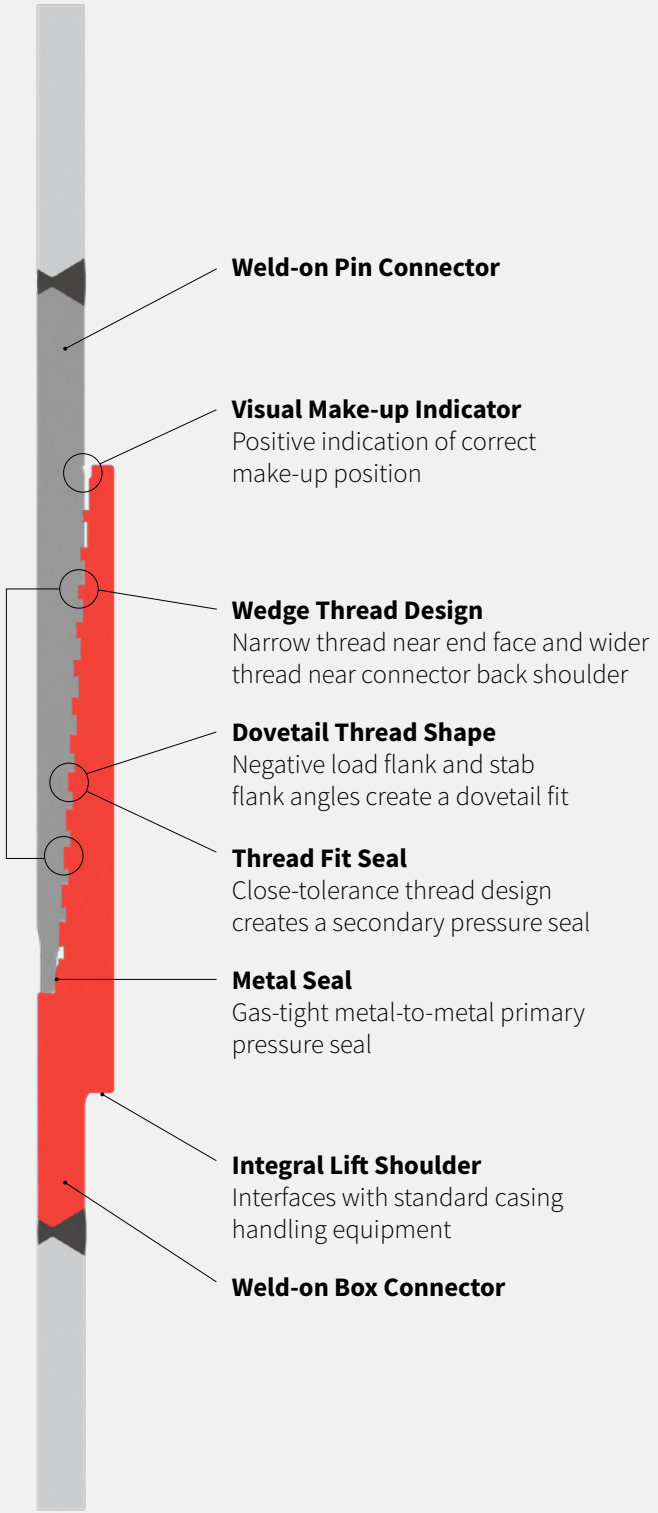
XLW-GT connectors match full pipe body structural strength in a compact connector profile. Wedge thread technology eliminates the need for a thick torque shoulder, simultaneously providing robust connector strength and generous ID and OD clearances.

An integral lift shoulder is incorporated on XLW-GT box connectors for easy running and handling on the rig using standard casing elevators.

XLW-GT connectors share favorable field make-up characteristics with all XL Systems wedge connectors: fast make-up, deep stabbing, low-torque spin-up, high torque capacity, and built-in resistance to unintended back-off.

XLW-GT connectors make-up in approximately 3 turns from stab to full make-up and do not require a mechanical anti-rotation device to prevent unintended connector back-off.





20- to 48-inch Sizes

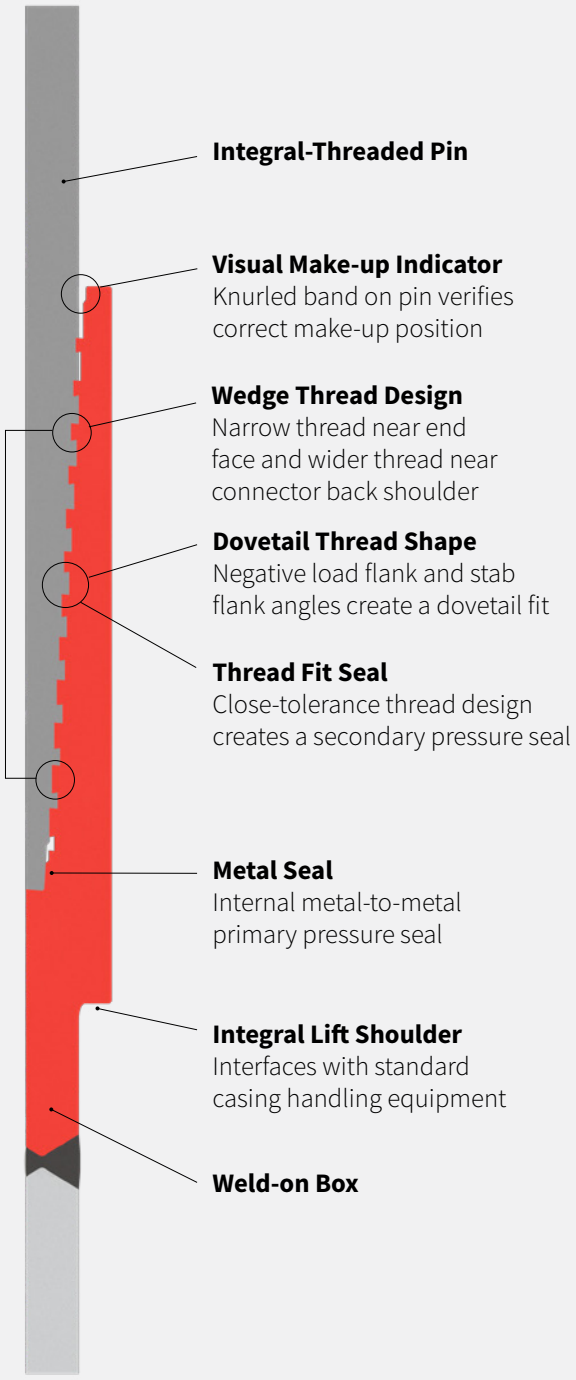
XLW connectors are designed for robust and reliable performance in demanding onshore and offshore surface casing, liner string, and conductor applications. The connector wedge thread design provides for easy handling and fast connector make-up on the rig.

The primary pressure seal for XLW connectors is a metal-to-metal seal on the ID side of the threads. This seal is rated at full pipe body pressure for liquid service. A separate product, the XLW-GT connector, is designed and tested for sealing gas pressure. XLW connectors have a secondary thread-fit pressure seal.

XLW connectors match full pipe body structural strength in a compact connector profile. Wedge thread technology eliminates the need for a thick torque shoulder, simultaneously providing robust connector strength and generous ID and OD clearances. XLW connectors feature a true flush ID profile in all sizes and an integral lift shoulder on the OD of the box connector.

The XLW thread design features a dovetail thread shape with negative load flank and stab flank angles. This geometry provides for smooth load transfer across the thread interface and prevents thread jump-out failures under extreme overload conditions.

XLW connectors make-up in approximately 3 turns from stab to full make-up and do not require a mechanical anti-rotation device to prevent unintended connector back-off.



20- to 48-inch Sizes

XLC-S connectors utilize XL Systems second-generation wedge threadform, designed for robust and reliable performance as conductors or structural strings in offshore and onshore well construction projects. The wedge thread design provides for easy handling and fast connector make-up on the rig.

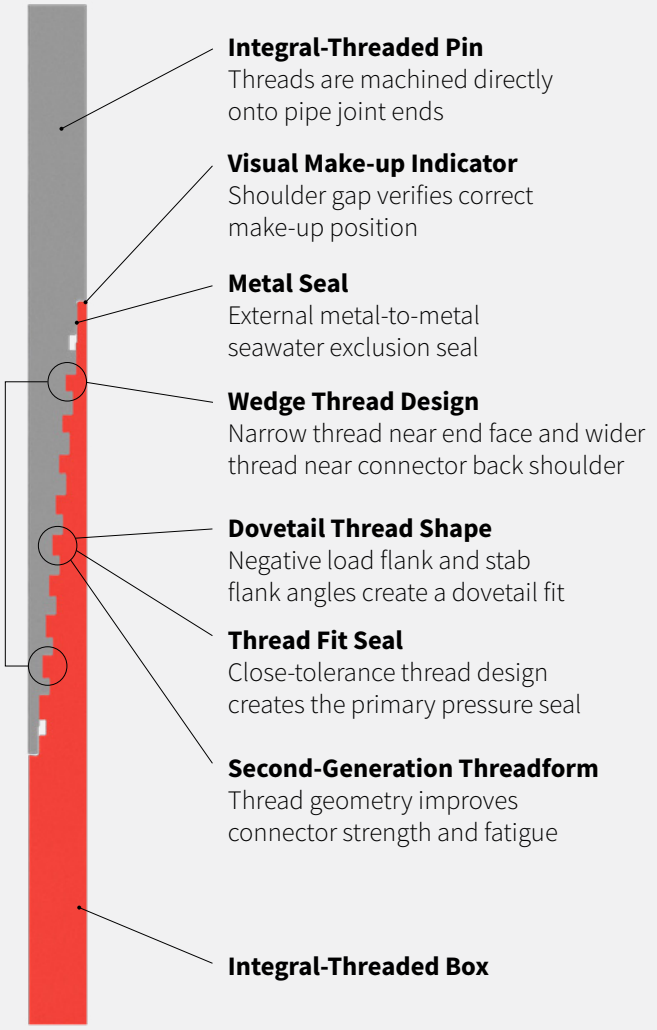
Figures on this page show the integral-threaded XLC-S connector configuration with pin and box threads machined directly onto the pipe joint ends. This produces the ideal connector geometry of a true flush OD and flush ID profile. Integral-threaded XLC-S connectors typically have connector strength efficiency ranging from 60% to 85% of pipe body structural strength.

Handling large-bore, flush OD connectors can be a challenge. XLC-S connectors can be supplied with multi-function lifting devices called 'PDLs' which act as a thread protector, drive adapter, and include a lift shoulder for handling joints with standard casing running tools like elevators.

XLC-S connectors share favorable field make-up characteristics with all XL Systems wedge connectors: fast make-up, deep stabbing, low-torque spin-up, high torque capacity, and built-in resistance to unintended back-off.

The XLC-S connector is a dual-seal design. The primary pressure seal is the thread fit seal. A secondary external metal seal is included and works primarily as a seawater exclusion seal.

XLC-S connectors make-up in approximately 3 turns from stab to full make-up and do not require a mechanical anti-rotation device to prevent unintended connector back-off.

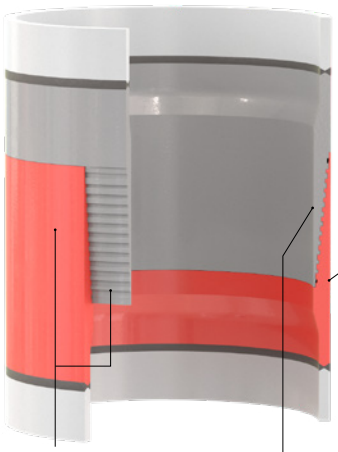


20- to 48-inch Sizes

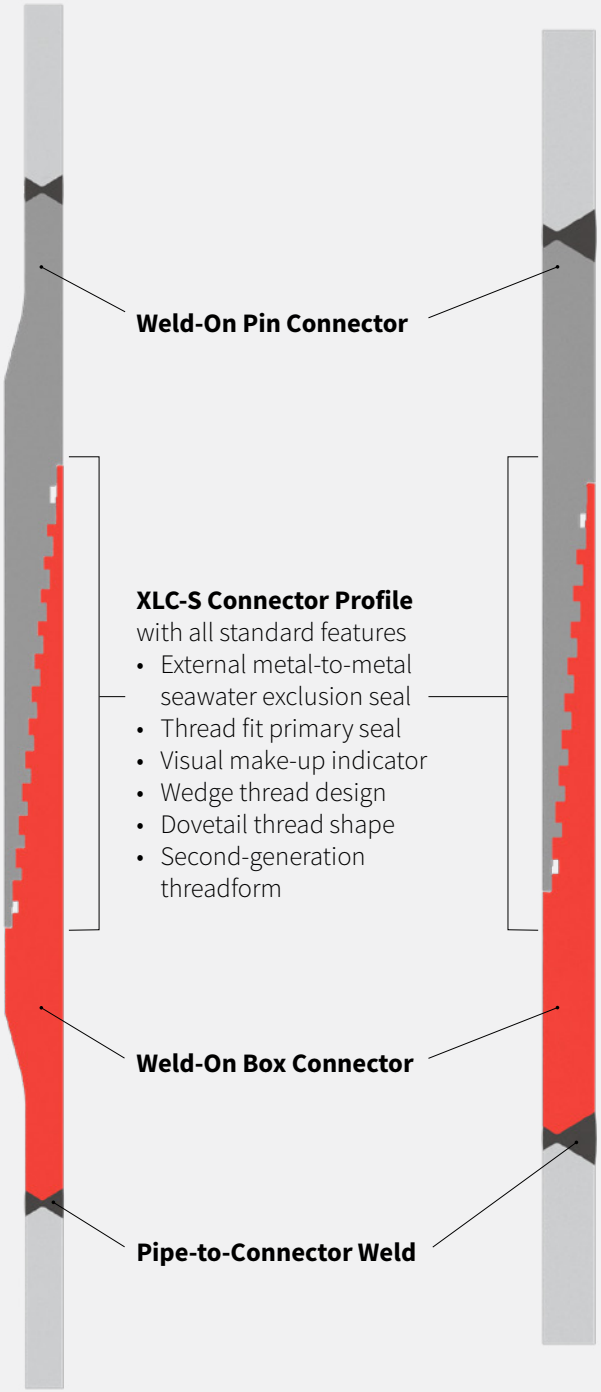
Weld-on connectors using the XLC-S threadform are available for applications where higher connector strength or improved fatigue performance is desired or required. XLC-S-RB (reduced-bore) connectors use thicker-wall weld-on rings that match or overmatch the pipe grade. XLC-S-HS (high-strength) connector weld-on rings match pipe body dimensions but are a higher-strength material grade.

XLC-S-RB and XLC-S-HS connectors use the same wedge thread design as standard XLC-S connectors, so handling and makeup characteristics are identical to XLC-S connectors. The difference is improved connector static strength and improved connector fatigue life.

XLC-S-RB Connector



XLC-S-HS Connector



20- to 48-inch Sizes

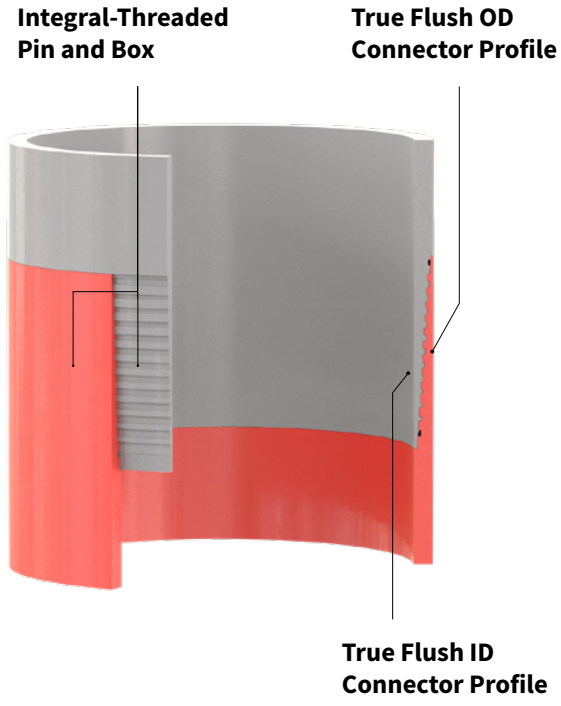
Figures on this page show the integral-threaded XLF connector configuration with pin and box threads machined directly onto the pipe joint ends. This produces the ideal connector geometry of a true flush OD and flush ID profile. Integral-threaded XLF connectors have internal and external pressure ratings that match full pipe body ratings. Connector tension, compression, and bending capacities typically range from 50% to 70% of pipe body capacity.

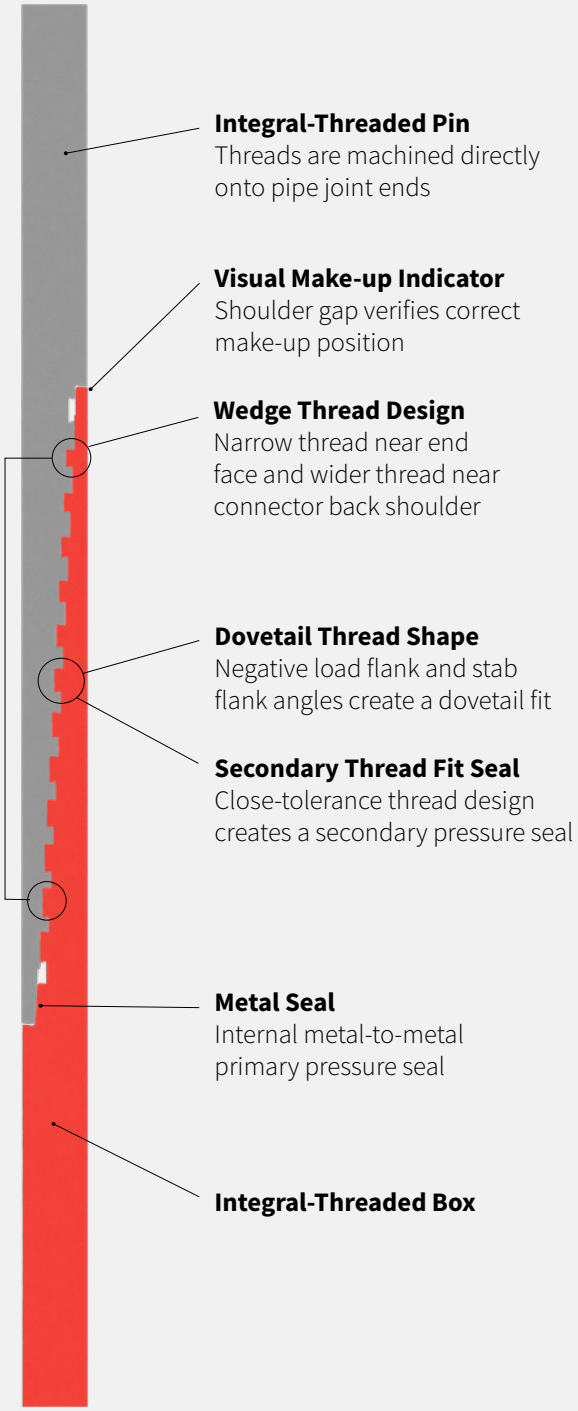
The XLF connector is a dual-seal design with an internal metal-to-metal primary pressure seal. The tight-fitting tapered wedge thread provides a secondary thread-fit seal. XLF connectors are intended for use on casing strings where liquid pressure containment is a primary design driver.

Handling large-bore, flush OD connectors can be a challenge. XLF connectors can be supplied with multi-function lifting devices called 'PDLs' which act as a thread protector, drive adapter, and include a lift shoulder for handling joints with standard casing running tools like elevators.

XLF connectors share favorable field make-up characteristics with all XL Systems wedge connectors: fast make-up, deep stabbing, low-torque spin-up, high torque capacity, and built-in resistance to unintended back-off.

XLF connectors make-up in approximately 3 turns from stab to full make-up and do not require a mechanical anti-rotation device to prevent unintended connector back-off.



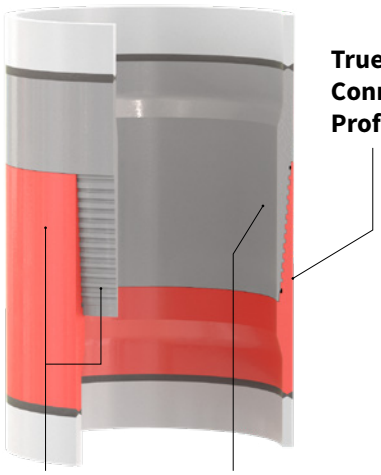


20- to 48-inch Sizes

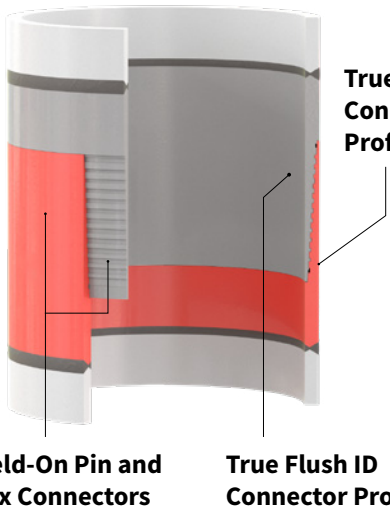
Weld-on connectors using the XLF threadform are available for applications where higher connector strength is desired or required. XLF-RB (reduced-bore) connectors use thicker-wall weld-on rings that match or overmatch the pipe grade. XLF-HS (high-strength) connector weld-on rings match pipe body dimensions but use a higher-strength material grade.

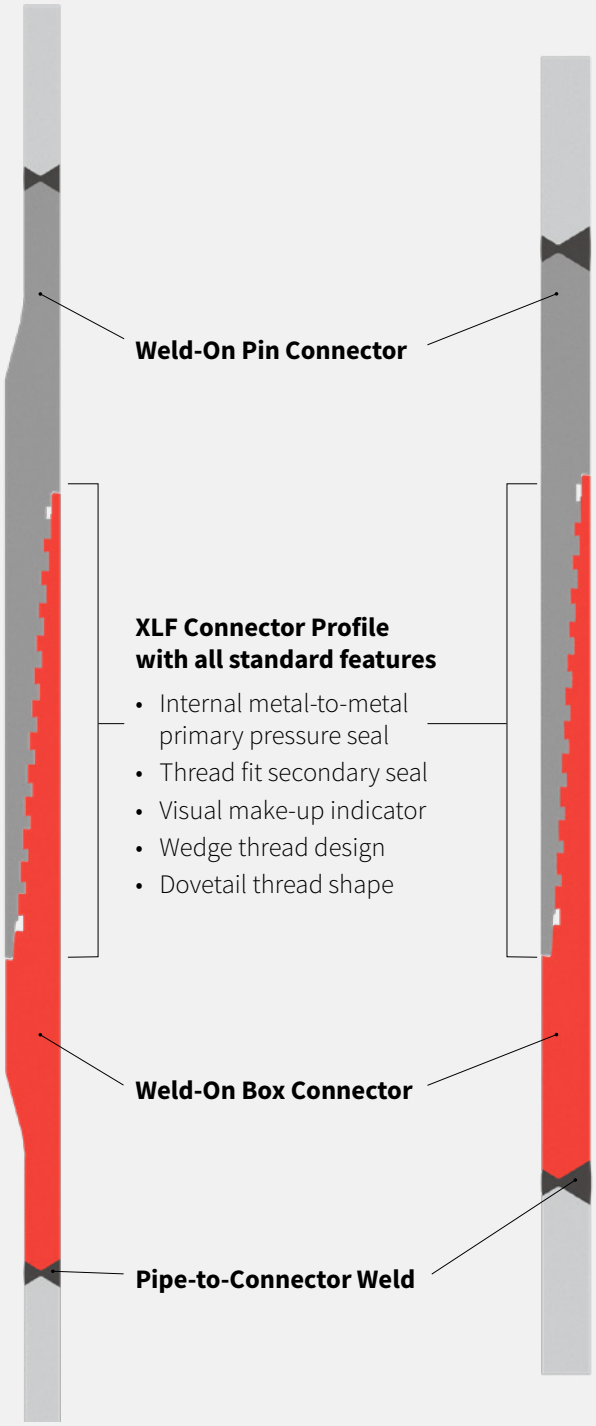
Handling and makeup characteristics for XLF-RB and XLF-HS connectors are the same as standard XLF connectors since they feature the same wedge thread design. The weld-on versions of the XLF connector provide improved connector strength compared to integral-threaded XLF connectors.

XLF-RB Connector



XLF-HS Connector





XLF-RB Connector **XLF-HS Connector**

A Unique Partnership

Full-scale physical testing plays an important role in the XL Systems product development process, so much so that we invested in a dedicated connector testing facility. Our Engineering Test Lab is a unique partnership with Stress Engineering Services located in Waller, Texas, which is a short distance from Houston. The purpose-built 15,000 sq. ft. (1400 sq. m.) facility is owned and operated by Stress Engineering and houses XL Systems-owned testing equipment. Tests are conducted by Stress Engineering personnel to XL Systems specifications, providing built-in independent verification of testing activities. The dedicated staff of Stress Engineering and NOV engineers and technicians allows for quick-turnaround testing.

The Role of Physical Testing

Full-scale physical testing primarily serves to benchmark and calibrate digital simulations of connector performance. For example, to establish a connector bending strength rating, first a series of finite element analysis (FEA) simulations are completed to predict failure modes and limit states. From the FEA results, critical locations on the connector body are selected for measuring surface strains during a physical test. A full-scale bending test sample is built, and strain gages are placed at the pre-determined critical locations. The test sample is loaded, or typically over-loaded, with bending force, and surface strain measurements are collected during the test. Post-test, these measured strains are compared with FEA predictions, and the FEA model is “tuned” to match the actual connector behavior. This “tuned” or “calibrated” digital simulation model is then used to establish connector ratings for the tested connector size and for other connector sizes in the same product family. Essentially, full-scale tests are used to improve accuracy and reduce uncertainty in our connector performance simulation models.

For some connector performance ratings, including fatigue and pressure sealability, digital simulation tools are simply not trusted in the industry as prediction tools. Full-scale physical testing is the only suitable solution for assessing connector performance in these cases. The Engineering Test Lab’s dedicated resources are available and are extensively used for fatigue tests and combined loading pressure sealability tests.

Vertical Make-and-Break Machine

The test lab was designed around the capability for vertical makeup of test samples to simulate rig conditions. The vertical make-and-break (VMB) machine is purpose-built and features 150,000 ft-lb torque capacity in both directions, continuous rotation, hydraulic gripping of sizes 16- to 36-inches diameter, automated controls, and electronic torque-turn data acquisition. The VMB machine is situated over a 40 ft caisson and under an 80-ft tower for handling full-length joints.

Load Frame

XL Systems purchased and fully refurbished a load frame with 5 million lb capacity so that we can complete connector combined loading pressure sealability tests in-house. The load frame is a unique design with a large, adjustable-size load bed and bending trunnions integrated into the end fixtures. Load frame capacities are 5 million lb tension, 3 million lb compression, and 1 million ft-lb bending.

Bending Test Frame

Our bending test fixture was purpose-built for static bending overload tests on connectors up to 36-inches diameter. The design uses four-point loading, which creates a desirable 13-ft long constant moment region about the connector. Bending forces up to 7.8 million ft-lb can be achieved.

Harmonic Fatigue Machine

XL Systems purchased a harmonic fatigue machine from Stress Engineering Services for dedicated use in our test lab. This test type has become the de-facto standard for pipe weld and pipe connector fatigue testing in the offshore industry. The entire circumference of the test connector is exposed to cyclic loading, which is a severe and rigorous test. A high load frequency is possible with harmonic testing, accumulating around two million stress cycles per day.

Supply Chain

Delivering top-quality casing and conductor joints requires two things: we start with top-quality materials, and these materials are available when we need them.

XL Systems has frame agreements with key pipe mill partners for dedicated production tonnage each month. This ensures that even when pipe joints are in tight supply, XL Systems customers have access to materials in the sizes and grades required for a project. Our pipe is supplied to an internal specification with requirements more stringent than API 5L standards for properties including straightness, roundness, material strength, and frequency of material testing.

Our connector forgings are similarly sourced through partnerships with key suppliers who primarily work for NOV, ensuring a reliable supply of connectors as needed by our customers. All connectors are supplied to XL Systems material specifications in proprietary grades.

Connector Material Grades

Unlike pipe for which industry standards like API are widely accepted, there are no standard material specifications or material grades for weld-on connectors. XL Systems has developed our own material specifications and proprietary material grades, as do other suppliers of weld-on connectors.

There are distinct advantages in using proprietary alloys for connectors. Most notably, the alloys can be optimized for compatibility with XL Systems welding procedures—cost-optimized products are the end result.

Ring forgings for XL Systems weld-on connectors are produced to XL Systems material specifications in three primary grades: M70, M80, and M95. Other grades with special alloying are available.

Quality, Health, Safety, and Environment

XL Systems is committed to achieving and maintaining the highest quality standards, as well as meeting the most stringent customer requirements. To ensure continuous quality improvement, each of our manufacturing facilities maintain ISO 9001:2015 Quality Management System certification, thus are routinely scrutinized though persistent internal and third-party audits.

We are committed to conducting our business in a manner to safeguard people and the environment in which we operate. Each manufacturing facility is ISO 14001 and ISO 45001 certified.

Field Service

XL Systems maintains a staff of experienced, offshore-certified field service engineers and technicians based in the US, Europe, and Far East. Our field service personnel are available for supervising the inspection, running, and handling of our connectors in all onshore and offshore producing regions.

Field service engineers are, by far, the most cost-effective way to ensure that a casing or conductor string will be assembled correctly and will function as designed. Some advantages for using XL Systems field service engineers include:

- Our field service engineers know how to run our connectors quickly. Our data shows that our engineers' per-joint running times can be half the time required by a typical casing crew. Not all casing running operations are on the well construction critical path, but when they are, the time savings delivered by our field service engineers easily pays their ticket.
- Since large-bore casing and conductor joints are heavy items and are always lifted and handled several times between our plant and the drilling rig, impact damage to connectors is common. Our field service engineers can assess connector damage and perform field repairs, often salvaging joints with minor damage and bypassing the cost and hassle of returning joints onshore for inspection and repair.
- Passing a casing string leakoff test requires the pressure seals on every connector in the string to function properly. Our trained personnel are company representatives with a vested interest in each casing string passing this test the first time. The leakoff test is an immediate evaluation of their work, so each connector seal is inspected, and each connector makeup is scrutinized with this in mind.
- When there are issues in the field with a connector makeup or a casing string not passing a leak test, XL Systems can assume more of a single point of responsibility when our field service personnel are involved. We can quickly make things right for the end user when we are involved end to end.

Engineering

XL Systems maintains a staff of experienced and highly trained engineers supporting all aspects of our business: product development design, testing and analysis; product specification for manufacturing; manufacturing process engineering; and materials and welding engineering.

Many of our connector products have similar functional characteristics and similar performance envelopes. Our engineers are experts at working with customers to match our products to wide-ranging customer applications, delivering the right connector performance envelope at the right cost.

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