XL Systems

Viper Connectors

Our Viper™ large-bore casing and conductor connectors are designed, tested, and field-proven for successful use in deepwater and harsh environment applications.

Viper connector strength ratings meet or exceed full pipe body strength in nearly all connector sizes for pipe grades up to API 5L Grade X80.

The Viper connector design features a dual-sealing mechanism with an elastomeric O-ring primary pressure seal and a secondary metal-to-metal seawater exclusion seal. Robust connector sealability has been demonstrated with ISO 13679 CAL I-E or API 5C5 CAL I liquid and gas sealability testing in several connector sizes.

Viper connectors are designed for exceptional fatigue performance under cyclic loading, and extensive full-scale fatigue testing has been completed for the product line.

Viper connectors are available in two thread configurations. Viper-1ST connectors have a single start thread and make up in approximately 1.68 turns. Viper-3ST connectors have a triple-start thread and make up in approximately 0.56 turns. All Viper connectors feature a deep-stabbing, self-aligning profile and the robust ViperLock™ anti-rotation device.

More than 2 million feet of pipe with Viper connectors have been successfully run in offshore and onshore projects worldwide since 2005.

Viper connectors are available in

16- to 38-inch

sizes

for onshore and offshore conductor and casing applications

Typical Applications

- A true multi-purpose connector suitable for most large-bore casing and conductor applications
- Deepwater subsea well conductors or ‘jet strings’
- Platform conductors or ‘drive pipe’
- Jackup exploratory well conductors
- Surface casing strings, including deviated strings
- Deepwater casing strings run in open water

Unique Features and Benefits

Modern design

Advanced design and analysis tools were used to develop a connector well-suited for use in today's extreme deepwater environments where full pipe body strength, robust sealability, and excellent connector fatigue performance are critical.

Proven performance

Extensive full-scale physical testing was completed to verify connector strength ratings, define gas and liquid sealability envelopes, and to demonstrate connector fatigue performance.

Dual-seal design

The elastomeric O-ring primary pressure seal is reliable and replaceable and a secondary metal-to-metal seawater exclusion seal is provided.

Gas-tight sealability

Gas sealability testing to full pipe body envelope pressures in 20- and 22-inch connector sizes, including API RP 5C5 worst-case dimensional tolerances for connector sealability.

ViperLock anti-rotation

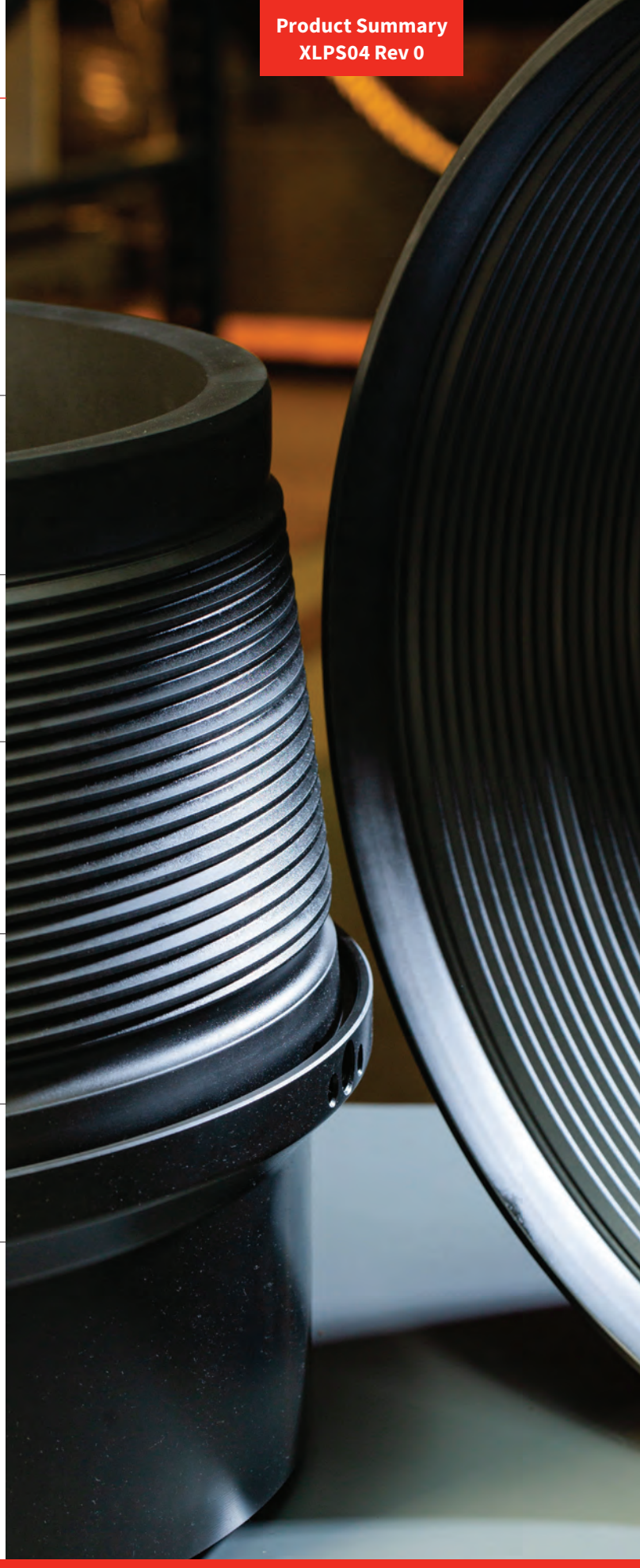
The patented ViperLock mechanical anti-rotation device provides robust resistance to connector back-off, truly reducing the risk of dropped strings.

Engineered weldneck

Extended length and engineered thickness transitions enhance the fatigue life of the pipe-to-connector welds.

Family-of-parts design

Consistent geometric design rules applied across all connector sizes mean consistent and predictable connector performance for the full Viper connector product line.



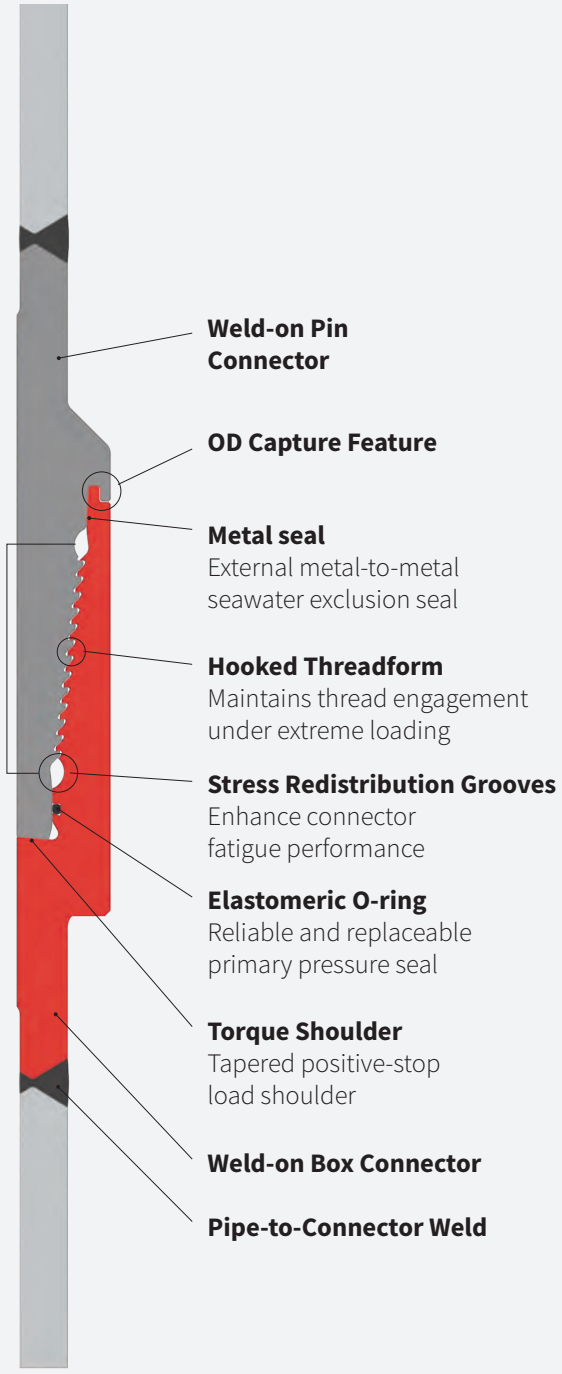
16- to 34-inch Sizes

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.

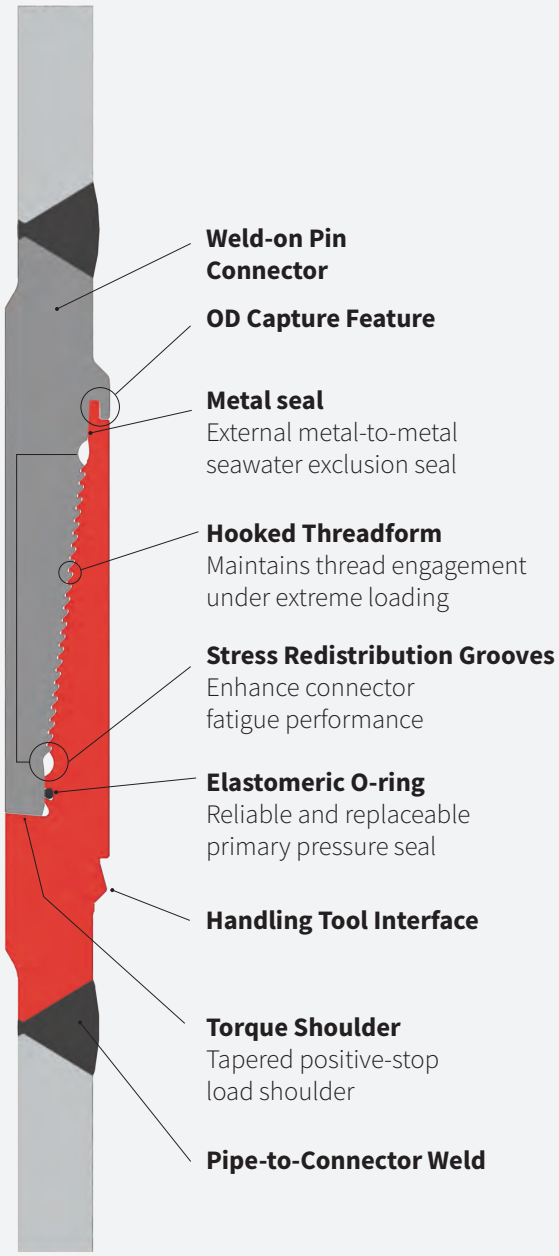


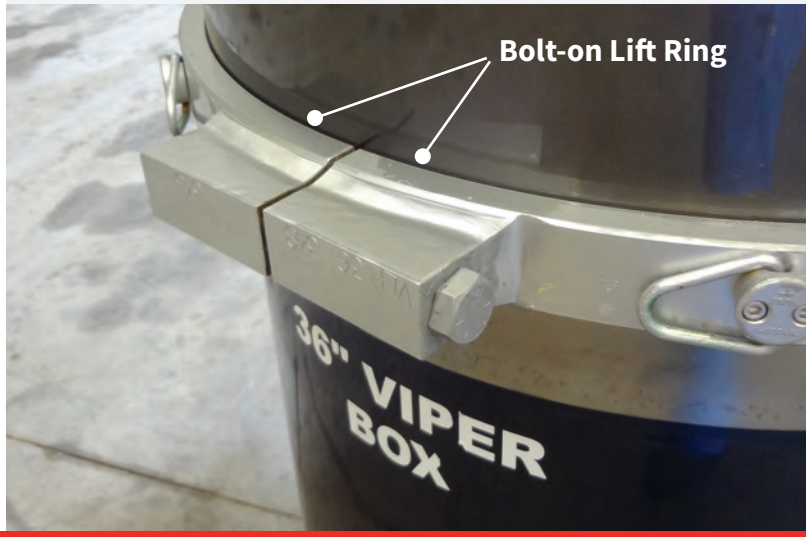
36- to 38-inch Sizes

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.





ViperLock Anti-Rotation

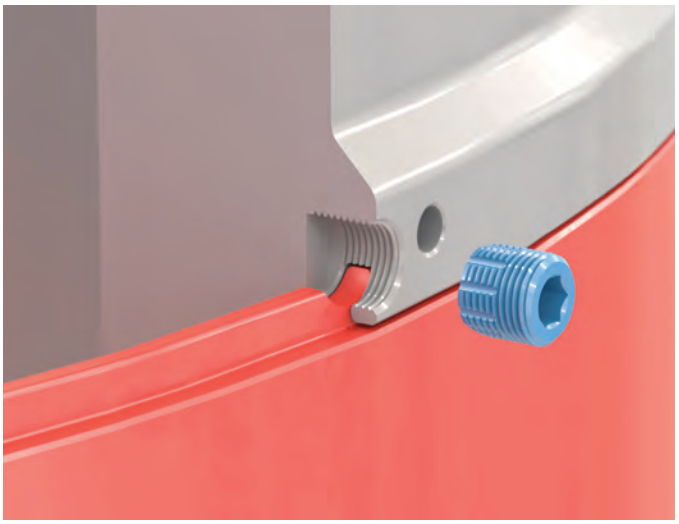
The patented ViperLock anti-rotation feature has distinct advantages:

- ViperLock is quick and safe to install on the rig floor
- ViperLock is fully reversible if tripping a string is required
- The unique design absorbs a tremendous amount of back-off torque energy, providing robust resistance to unplanned connector rotation
- Full-scale testing confirms ViperLock ratings and performance

The ViperLock feature is incorporated into the OD capture region of the Viper connector. In this area, the end face of the box fits inside a capture groove on the OD of the pin. A ViperLock screw is inserted into a pre-drilled hole in the connector pin, creating a shear pin effect between the screw and the end face of the box.

All standard Viper connectors include four sets of ViperLock holes. Typical field deployment uses two screws and leaves two spare holes. Anti-rotation resistance can be increased by installing three or four anti-rotation screws in each connector. See Viper connector performance data sheets for ViperLock anti-rotation torque ratings.

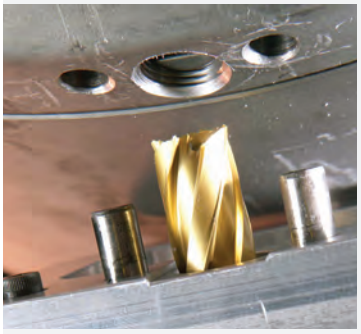
Viper connectors can be special ordered with more than four ViperLock features for special applications where additional anti-rotation resistance is required.



ViperLock Anti-Rotation Feature Cutaway View

Step 1

A typical ViperLock feature has three shallow holes drilled into the pin connector. The center hole is threaded to accept the ViperLock screw. After make-up, the end face of the box encroaches in the center hole as shown.



Step 2

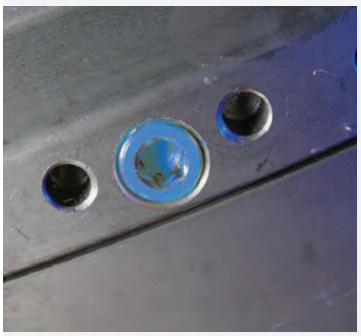
Guide pins position the bit of the ViperLock reaming tool in the center hole. A hand-held, air-powered drill provides power. This operation is completed on the rig floor after connector make-up.

Step 3

After reaming, the end face of the box has been 'scalloped' in the center hole. This creates the opening for installation of the ViperLock screw.

Step 4

The self-tapping ViperLock screw is inserted with an air impact wrench. Up to four screws, spaced 90 degrees around the circumference of the connector, can be installed for maximum resistance to anti-rotation.



Step 5

Once the ViperLock screw is installed, the OD profile is flush with the connector OD. The standard installation of two ViperLock screws can be completed in about 40 seconds.

Physical Testing Summary

Connectors planned for use in critical, harsh-environment projects require proven, reliable, and predictable performance. XL Systems recognized this need with the Viper connector development project and planned and executed an unprecedented physical testing program. Viper connectors are, quite possibly, the most extensively tested large OD connector product available.

The array of proven performance data from Viper connector full-scale physical tests allows customers to understand and assess risks for unplanned connector overload events which are always possible in harsh environment projects.

- Combined loading sealability tests demonstrate the robust performance of the Viper connector seals over the full pipe body performance envelope
- Gas sealability tests to ISO 13679 CAL I-E (gas) or API 5C5 CAL I (gas) protocols demonstrate best-in-class connector pressure integrity to full pipe body envelopes
- Bending tests demonstrate that connector strength exceeds pipe body strength and that Viper connector bending overload is a desirable ductile process. Catastrophic jump-out bending failure modes have not been observed for Viper connectors
- The large number of full-scale fatigue tests allows for statistically-based characterization of Viper connector fatigue life and direct calculation of the connector's probability of failure for risk-based project designs
- Tests of the ViperLock anti-rotation feature demonstrate robust connector resistance to unintended back-off

See XL Systems Engineering Technical Briefs for detailed information on each of the Viper connector physical tests.

Physical test type and number of Viper samples tested

OD (inch)	Wall (inch)	Combined Load	Fatigue	Bending	Pile Driving	Anti-Rotation	Make-and-Break	TOTAL
18⅝	0.500	2	–	1	–	–	2	5
20	0.625	6	–	2	2	3	6	19
20	0.812	2	13	1	–	2	2	20
22	1.000	2	–	–	–	–	2	4
22	1.250	2	–	–	–	–	2	4
22	1.500	2	–	–	–	2	2	6
30	1.000	2	12	1	2	8	2	27
36	1.500	–	15	1	–	–	–	16
36	2.000	–	11	–	–	–	–	11
TOTAL SAMPLES		18	51	6	4	15	18	**112**

Connector Performance Data Sheets

XL Systems maintains a library of connector performance data sheets or 'spec sheets' for all of our connector products on the nov.com website. Select the **SpecsDirect** link from the XL Systems homepage at **nov.com/xlsystems**. Pipe and connector performance data change from time to time and users are encouraged to obtain up-to-date product data for each project.

Connector Material Grades

Viper connectors are produced to NOV XL Systems material specifications in three primary grades: M70, M80, and M95. The table below shows recommended connectors grades matched to API 5L pipe grades. Other standard connector grades with higher strength or special alloying are available.

Connector Grade	Connector Yield Strength	API 5L Pipe Grade					
		X52	X56	X60	X65	X70	X80
M70	70.0 ksi = 483 MPa	R	R	R	R	NR	NR
M80	80.5 ksi = 555 MPa	O	O	O	O	R	R
M95	95.0 ksi = 655 MPa	O	O	O	O	R	R

R — Recommended pipe and connector grade combination

O — Optional grade combination for higher connector strength

NR — Not recommended

Connector Thread Configurations

Viper connectors in all sizes are available in two thread configurations as described below. Connector strength ratings and dimensions are identical for Viper-1ST and Viper-3ST connectors. Viper-1ST and Viper-3ST connectors are not interchangeable and will not thread together.

Product name	Number of thread starts	Number of turns from stab to full makeup
Viper-1ST	1	1.68 turns
Viper-3ST	3	0.56 turns

Field Service Procedures

See the following XL Systems field service procedures for additional information on running and handling pipe with Viper connectors:

FSPXL0003 Connector O-Ring Installation Procedure
FSPXL0004 Viper Connector Field Service Procedure
FSPXL0005 Viper Connector Storage, Inspection, and Repair
FSPXL0006 Viper Bolt-on Lift Ring Service Procedure
FSPXL0008 ViperLock Tool Kit Operation and Maintenance
FSPXL0009 Drive Subs for Viper Connectors
FSPXL0019 Approved Thread Compounds

Connector Groups

Viper connectors are weld-on designs and the same connector body can be used with multiple pipe wall thicknesses. Connector design groups are summarized in the table below. Each color block within a given diameter column identifies a unique connector design. Connectors within a color block group will thread together without specially fabricated crossover joints.

	Diameter (inch)											
Wall (inch)	16	18-5/8	20	22	24	26	28	30	32	34	36	38
0.438												
0.468												
0.500												
0.625												
0.635												
0.688												
0.750												
0.812												
0.875												
1.000												
1.125												
1.250												
1.500												
1.750												
2.000												
2.250												
2.500												

Viper Design Group 1 Viper Design Group 2 Viper Design Group 3 Viper Design Group 4