



3" DC15 Connection vs. 3" 1502 Connection

TECH-SEAL INTERNATIONAL

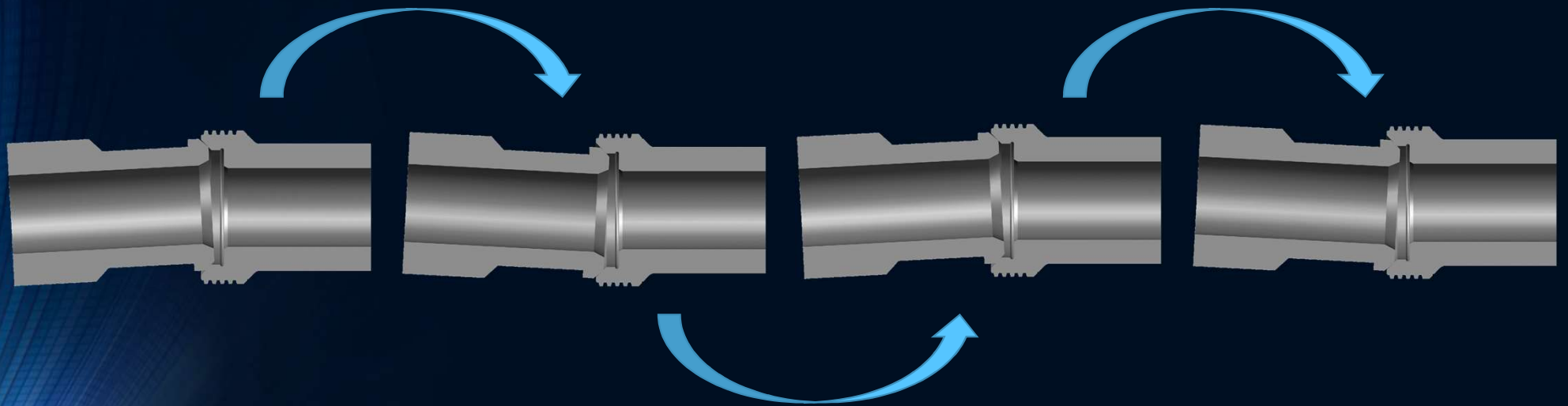




Conventional 3" 1502 Connection



3" 1502 Connection: (Male-to-Female Contact)

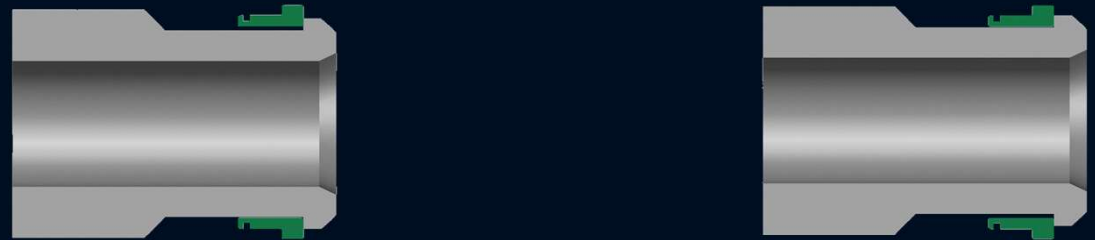


- Contact between a radius (male connection) and the 45 degree angle (female connection) results in a rotation connection with high stress concentrations in several areas.

3" 1502 Connection: (Split Ring Contact)

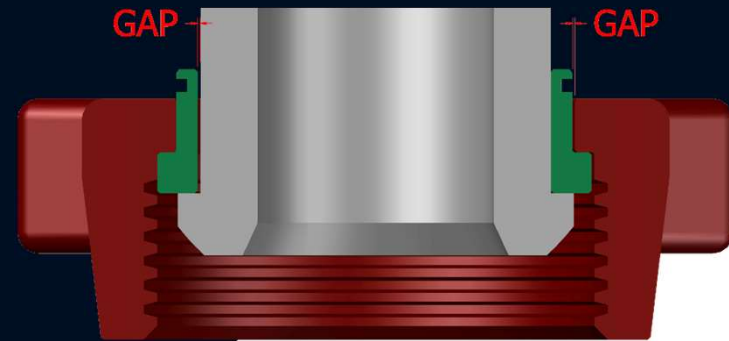
Male Connection:

- The split ring makes contact with the male connection at a 90 degree angle which causes the split ring to shift around. This causes the split ring to make contact on different points of the male connection resulting in the development of stress concentration.



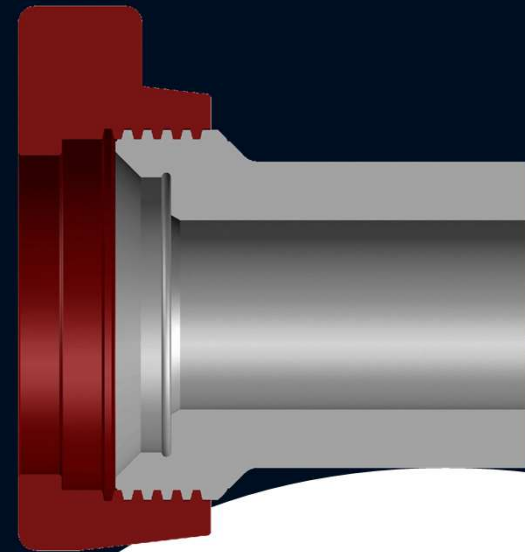
Wing Nut:

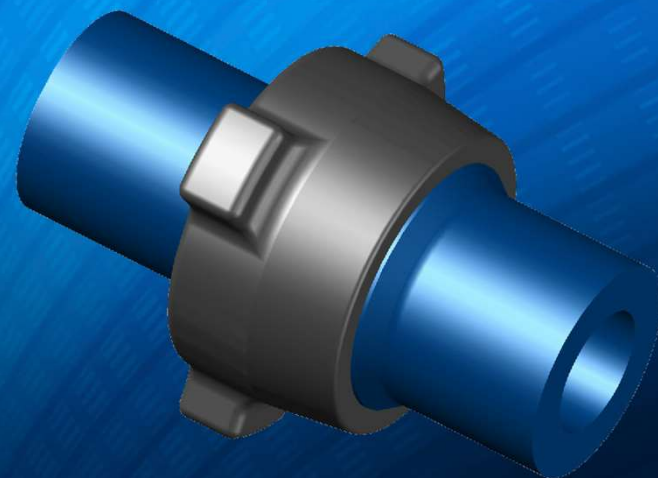
- 90 degree contact between the male connection, split ring, and wingnut allows the split ring to shift. The result is an uneven contact among the 3 components and high stress concentrations.



3" 1502 Connection: (Female Connection)

- Short thread engagement along with a thin wall under the thread while under bending load results in stress concentration.





Connection Breakthrough

3"DC15 CONNECTION

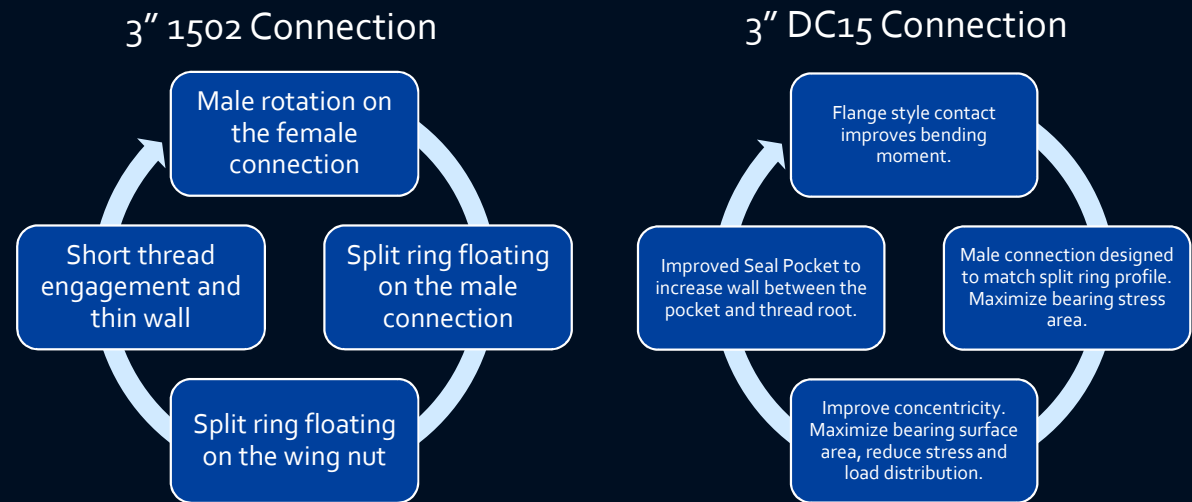
PATENT PENDING



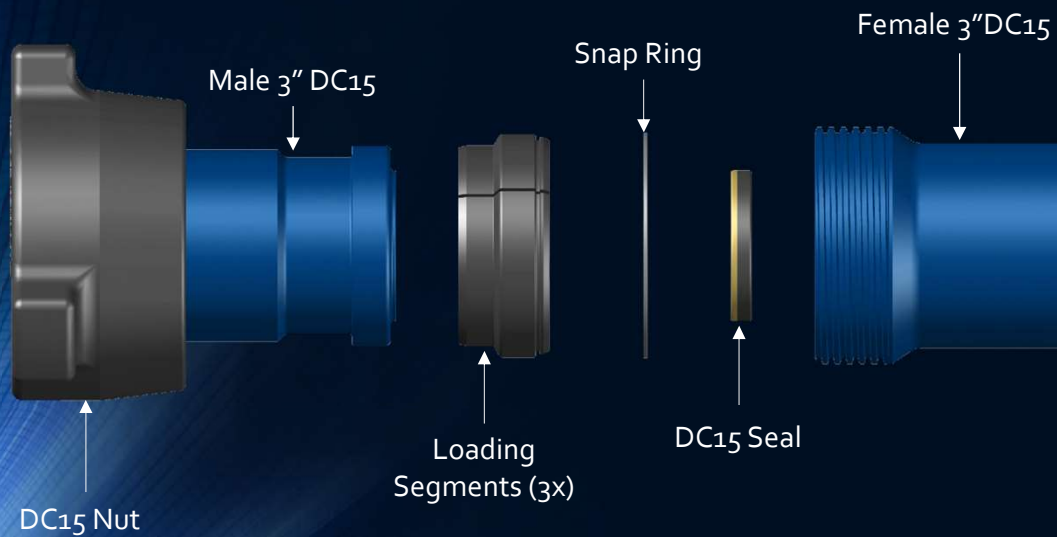
3" DC15 vs 3" 1502 Hammer Union: Design Overview

Introduction:

Hammer Unions have been the standard in the oil and gas industry for over 50 years. However, the hammer union has weaknesses and limitations for current critical applications. In response to this, Tech-Seal International has designed and manufactured the 3"DC15 Connection. We have critically analyzed every flaw within the hammer union connection. After doing so, we visited each flaw one by one and made significant improvements in every aspect. This resulted in the 3"DC15 Connection having improved performance over the hammer union connection in both fatigue and bending loads.



3" DC15 Connection Design: Assembly Breakdown



Design Features:

- Improved contact geometry between components.
- Minimized stress concentration at external thread roots of the female connection.
- Minimized stress concentration at the male shoulder corner.
- Minimized stress concentration at the last full thread engagement of the nut.
- Improved DC15 union seal design offers longer lasting performance than the 1502 hammer union seal.
- 3 piece load segments with special geometry to reduce stress concentration.

Benefits:

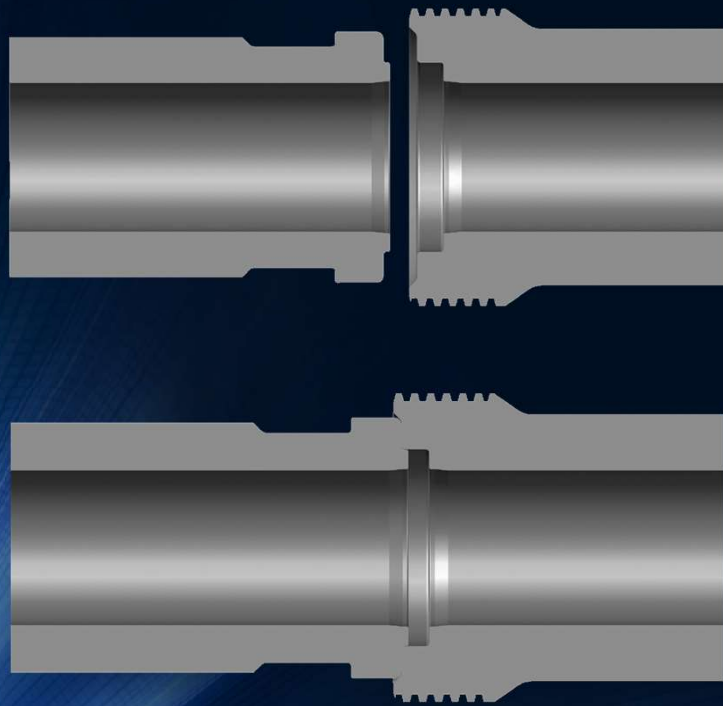
- Uniform bore between male, female and union seal.
- Reduce erosional damages at connection.
- Improve fatigue life of the equipment.
- Improvement in bending load.

3" 1502 Union Seal vs. 3" DC15 Seal



	3" 1502	3" DC15
Anti-Extrusion Ring Material	Brass	Stainless Steel
Metal Volume (Cubic Inches)	0.094	0.158
Elastomer Seal Volume	2.418	1.185
V-metal/V-total %	3.74	11.76
Seal Material	HNBR	Viton
Working Temperature Range	-20 to 350°F	-10 to 400°F
3" DC15 Packing has 1.7 times more metal than the 3" 1502 union seal.		
3" 1502 union seal has 2.04 times more rubber than the 3" DC15 seal.		

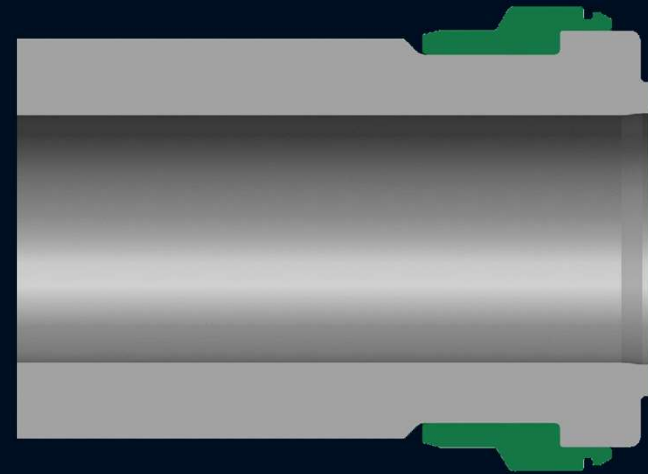
3" DC15 Connection: (Male-to-Female Contact)



- The male and female connection make flat face-to-face contact. This improves the connection under bending loads.

3" DC15 Connection: (6X More Contact Area)

- The DC15 Split Ring makes full contact with the male connection at multiple surfaces, not 1 like the 1502 hammer union.
- Maximize bearing stress area helps to reduce stress at the connection.
- Improved concentricity helps load distribution to improve fatigue life of the connection.



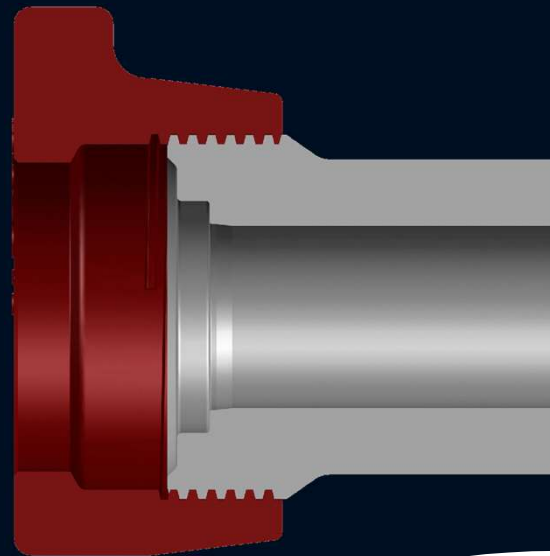
3" DC15 Connection: (Load Distribution)



- The DC15 Wing Nut makes full contact with the split ring at the angle which prevents the split ring from shifting under load.
- The cone-like shape results in a concentric force distributed between the split ring and the wing nut.

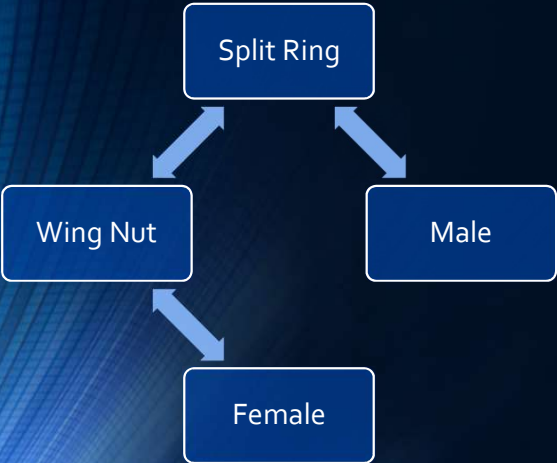
3" DC15 Connection: (Improved Female Connection)

- Increased thread engagement.
- Removing the o2 groove at the seal pocket, under the thread results in an increased wall thickness and reduces stress at the cross section.
- Reduced stress concentration at external thread root.

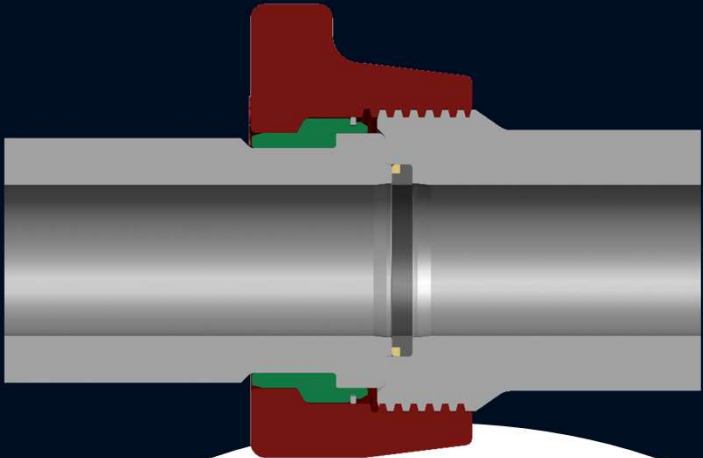
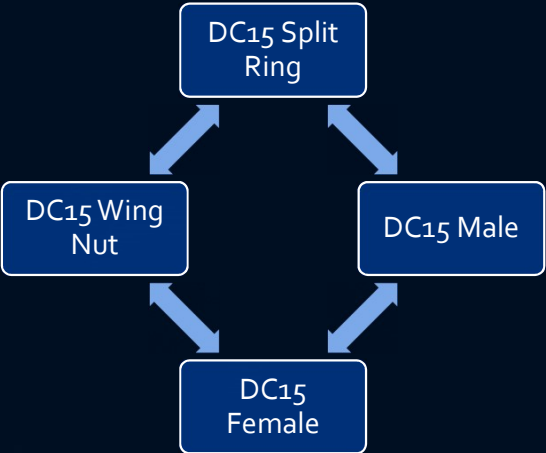


DC15 vs 1502 Connection Design: Completing the Square

1502
Contact Pairs



DC15
Contact Loop



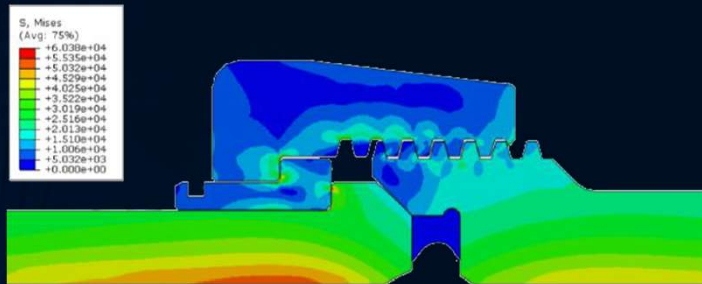
Test Results and Comparisons

3" 1502 CONNECTION VS 3" DC15 CONNECTION

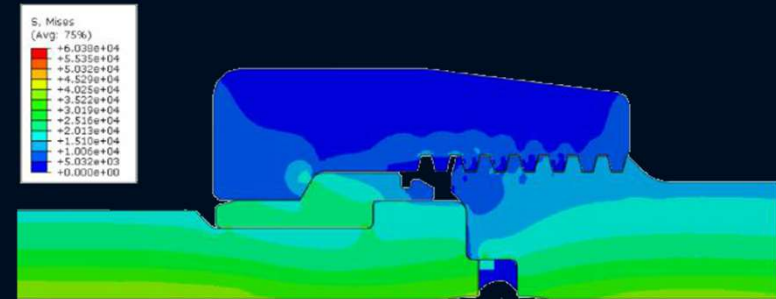


FEA Evaluation

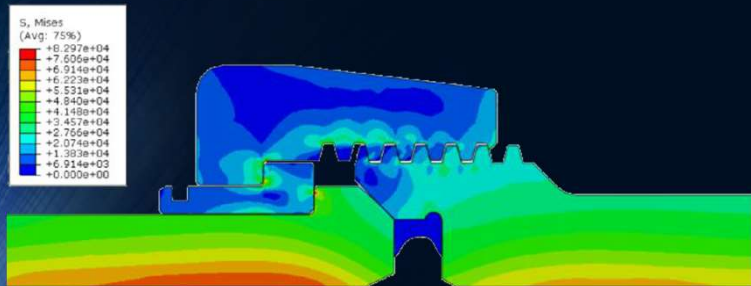
1502 under 15,000 PSI Internal Pressure



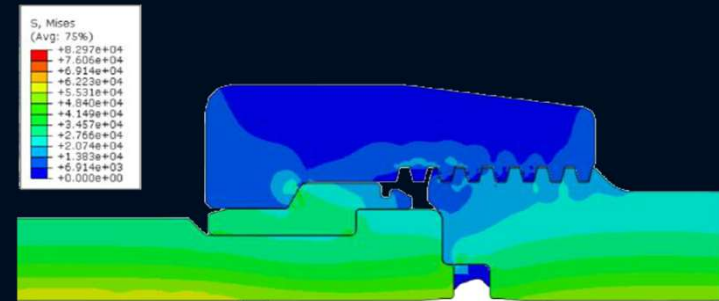
DC15 under 15,000 PSI Internal Pressure



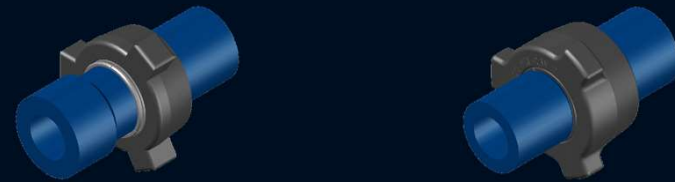
1502 under 22,500 PSI Internal Pressure



DC15 under 22,500 PSI Internal Pressure



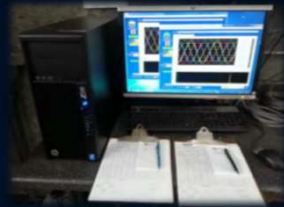
FEA Evaluation Results



Test	Condition	3" 1502	3" DC15
1	Stress Level at 15,000 PSIG Internal Pressure	Stress: 60,380 PSI	Stress 40,320 PSI
2	Stress Level at 30,000 PSIG Internal Pressure (Failure)	Stress: 97,870 PSI	Stress 78,210 PSI
3	Tension load to failure with 15,000 PSIG Internal Pressure	60,000 lbf.	212,500 lbf.
4	Bending moment to failure with 15,000 PSIG Internal Pressure	16,300 ft*lbf	42,500 ft*lbf



Fatigue Test and Results



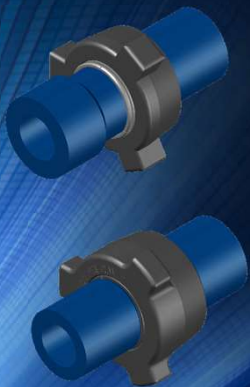
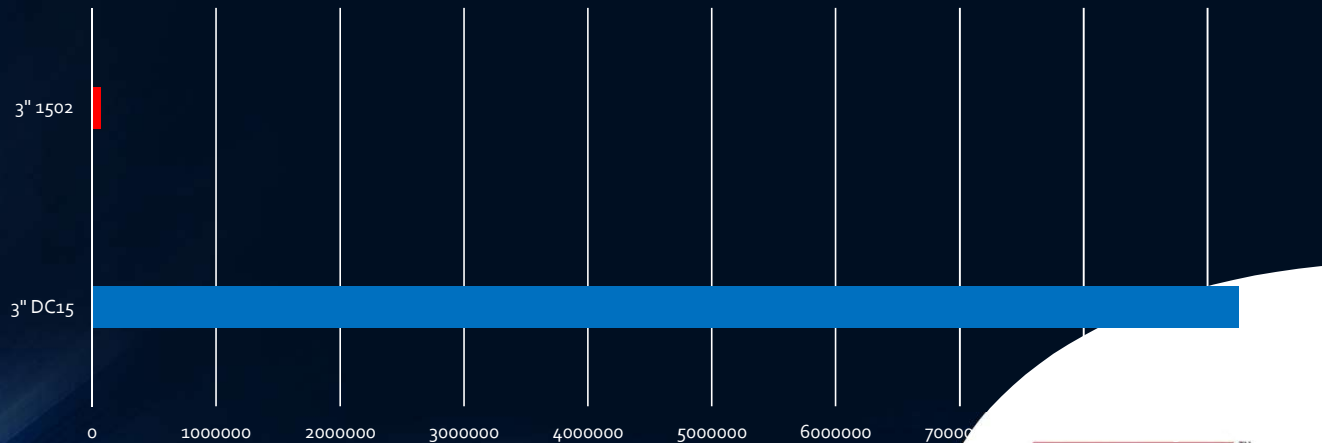
- Aside from running an FEA Evaluation, the DC15 connection was also put under a full scale physical fatigue test alongside the 1502 hammer union connection.

Average of Three Tests:

- 3" 1502: 70,143 Cycles
- 3"DC15: 9,265,093 Cycles

■ 3" 1502 ■ 3" DC15

Fatigue Test Results
3" 1502 vs 3" DC15



Executive Summary



Stress Engineering Services, Inc. (SES) was requested by Tech-Seal International (TSI) to perform full scale fatigue tests on 3" Hammer Unions. TSI requested to test both existing 1502 connections and their DC15 connection. Three samples of both types of connections were tested. The objective of the fatigue tests was to determine the fatigue performance of the DC15 connection compared to the existing 1502 connection.

Fatigue testing was performed by SES per resonant fatigue proposal 1203695-TS-PO-01_Rev2. All samples were tested at a stress range of 15,000 PSI. A static internal pressure of 7,500 PSI was applied throughout the entire duration of the fatigue test. The test results were compared to the 2014 BS7608 B and D mean fatigue curves, and the 2016 DNVGL B1 mean fatigue curve.

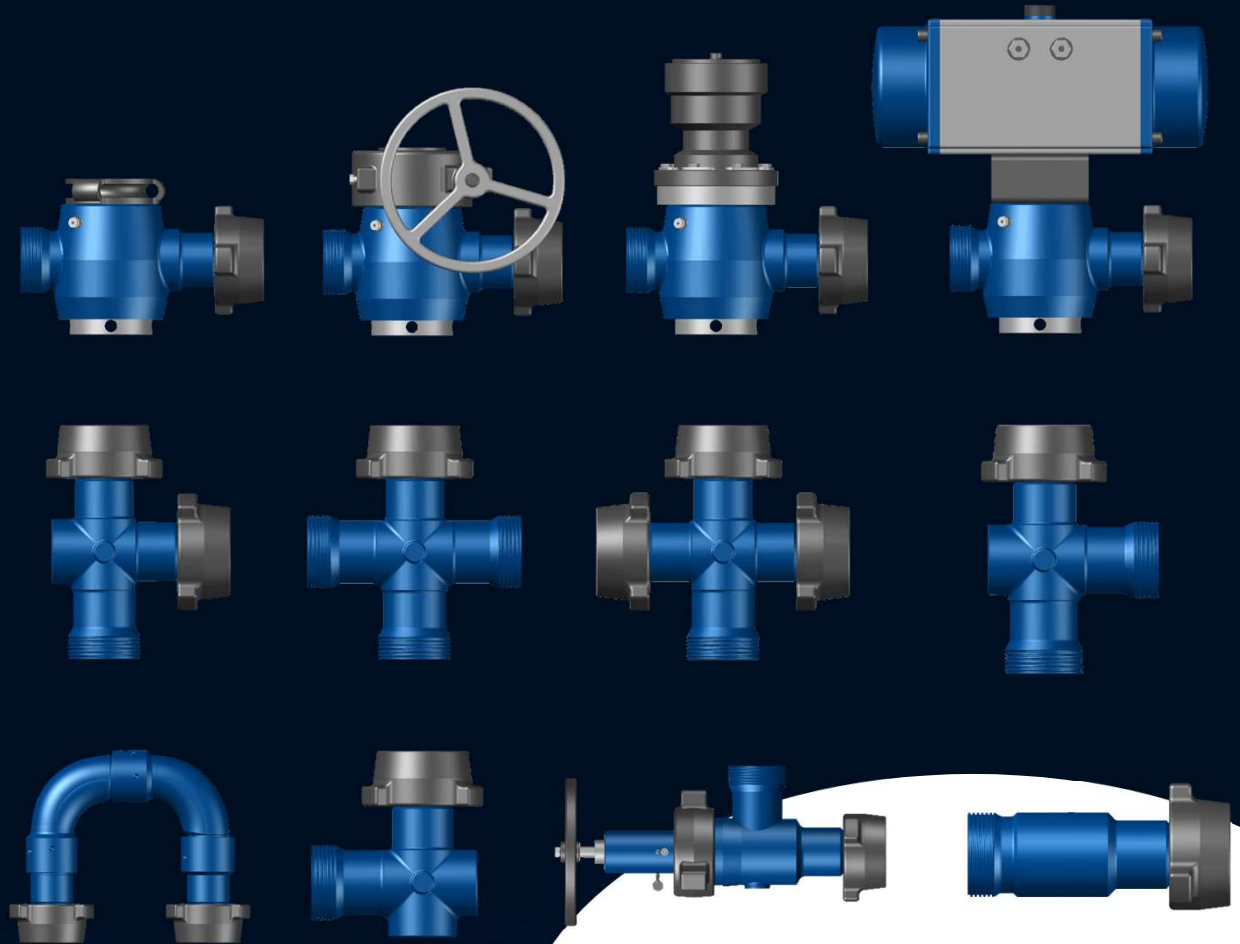
Testing was performed in June and July, 2017. Testing progressed on each sample until failure occurred or runout was declared. Failure was defined as a through-wall crack in the pipe or leak from the connection. **Based on the data and calculations, the mean DC15 connection performance is 48 times better than the 1502 connection performance.**



DC15 Availability

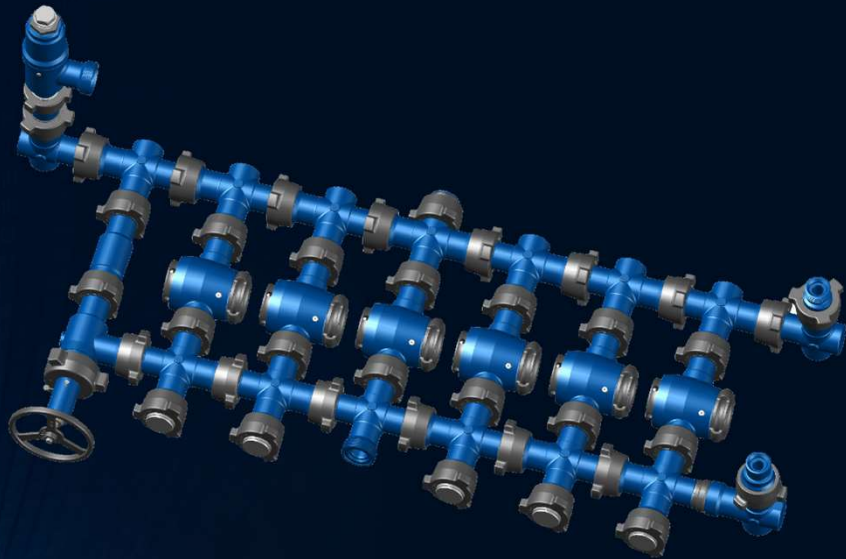
Tech-Seal International has incorporated the DC15 connection into many of our current products. Custom configurations are available.

- Plug Valves
- Flapper Check Valve
- Integral Fittings
- Swivels
- Laterals
- Chokes
- NPST Pipes



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DC15 Applications

- The DC15 connection can be incorporated into many applications whether it be single line or complex manifolds.
- With crossovers TSI is capable of changing your entire fracking system or just high stress areas.

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