

Ameriforge

An AFG Holdings Company



Taper-Lok[®] Connectors

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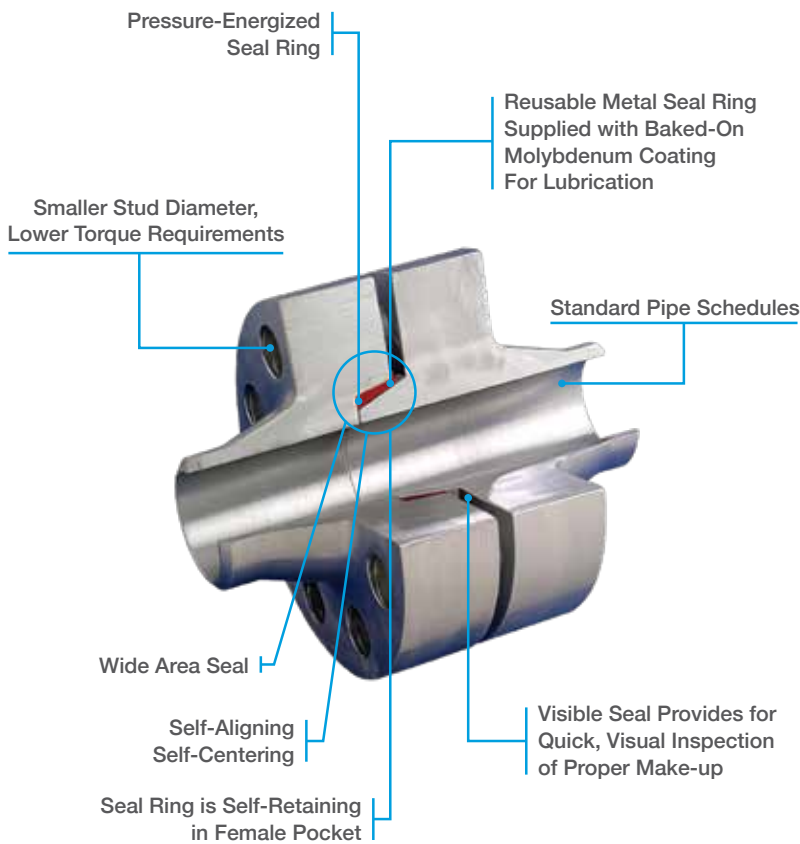
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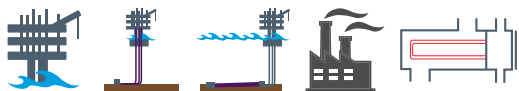
Taper-Lok® Products Engineered to Outperform

Taper-Lok® pressure energized and enhanced connectors from Ameriforge are engineered to provide the safest, most reliable seal of any bolted connection while offering unequaled design flexibility and engineered advantages. Sizes start at 3/4" to 85".



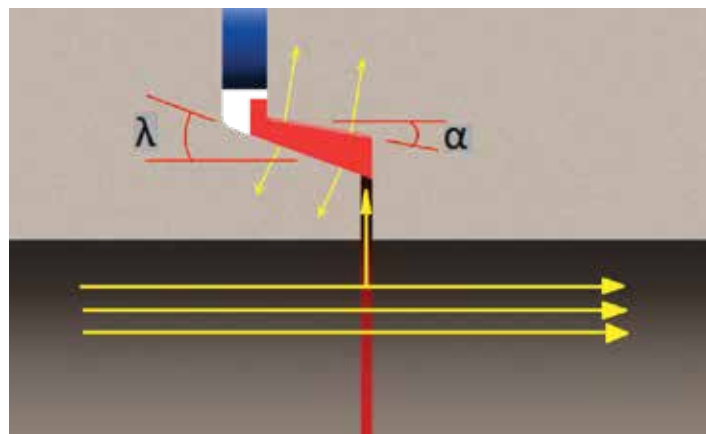
Our Service Commitment

Our clients deserve a service commitment that does not end with installation. Taper-Lok not only provides complete product training, installation and field repair instructions, but also project management support, product design and design calculations. All while providing leak-free service for the life of your connector. Our oldest connectors have been in operation more that 40 years with combined leak-free service of over 1 billion hours without failure.



Taper-Lok® Connectors

- Over 40 years and thousands of connections with leak-free service
- Consists of a male and female flange that aids with misalignment
- Reusable metal-to-metal wide area seal with converging angles
- Sizes ¾-in. – 85-in.*
- Pressures from vacuum to 20,000 psi*
- Services of -350°F to 1500°F*
- Field repairable
- Designed to withstand high external loads
- Visual seal aids with make-up
- Available in all material grades
- Taper-Lok connectors are subsea diver-friendly with additional features that provide ease of assembly and diver safety during the installation process



These benefits significantly decrease installation time and cost.

**Special designs available.*

Swivel

Blind

Misalignment



Applications

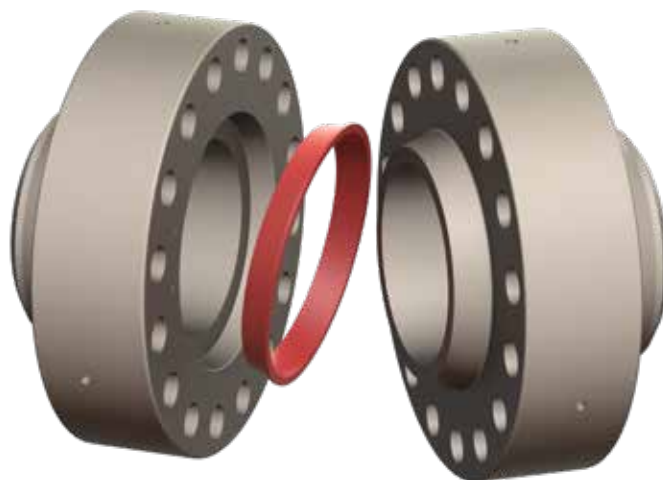
- Topsides, risers and subsea
- Petrochemical and refinery
- Spool tie-ins, production risers, manifolds and flow lines
- Pipeline transmission and distribution
- Heat exchanger body and channel flanges

8-in. – 2500# ANSI Class Comparison



Taper-Lok Connector
246 kg

ANSI B16.5
628 kg



Female
Weld Neck

Seal Ring

Male
Weld Neck

Taper-Lok® and CoffeLok™ Connection Systems

Our process piping, pipeline, riser and exchanger connection systems provide the solutions to chronic problems associated with standard ANSI and API flange connections.



Leak-Free Reliability

Ameriforge's metal-to-metal seal ring technology offers leak-free reliability over traditional ANSI and API gaskets. Our seal rings offer the equivalency of welded joint integrity and can be used in critical and chronic leak areas.



Weight Savings

With weight savings of up to 80% in comparison to ANSI flanges, our connection systems can typically save up to 1 million lbs. of weight on an offshore floating platform.



Space Savings

Space savings of up to 82% with smaller O.D. and length dimensions compared to ANSI/API flanges. Pipe runs are closer together to create more room for process equipment and future tie-backs. Ideal for small O.D. pull-in-head requirements.



External Loads

Ameriforge connectors are able to handle high fatigue and high bending moments. We can optimize the design of the connector as needed to meet project requirements.



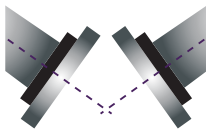
Quick Assembly

Our connection systems typically use fewer and smaller bolts in comparison to ANSI or API flanges. Our catalog of connectors include clamps that only require four bolts and connectors that are self aligning.



Cost Savings

In many cases, our connector assemblies are less expensive to purchase than the corresponding ANSI or API flange assembly. Our leak-free seal rings save operational costs.



Misalignment Capability

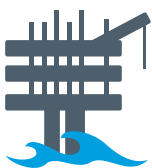
Ameriforge offers connection systems that are self-aligning and offer up to 20° of misalignment capability.



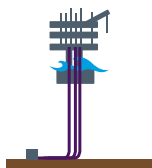
High Pressure/Temperature

Our connector systems have applications in high pressure and/or high temperature where they out perform ANSI and API flanges in terms of reliability and leak free service.

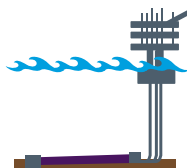
Connector Applications



TOPSIDES



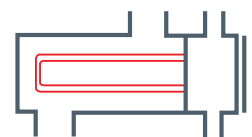
RISERS



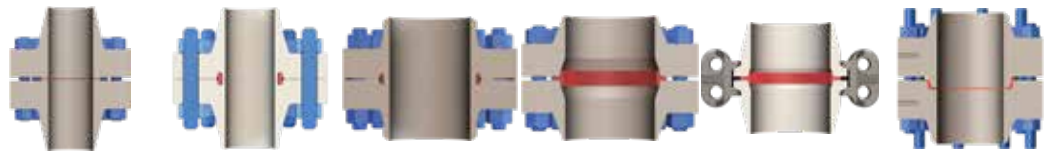
SUBSEA



REFINERY &
PETROCHEMICAL



HEAT EXCHANGER
RETROFITS

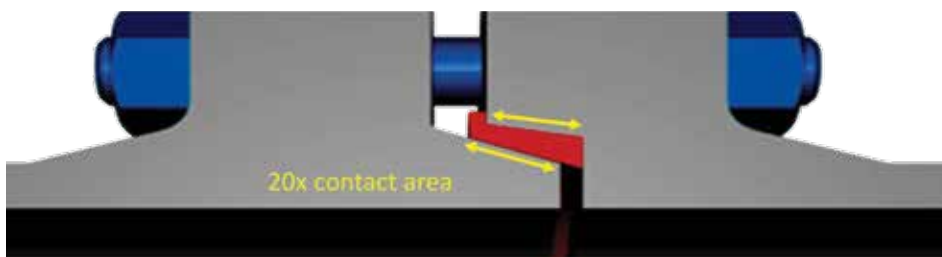
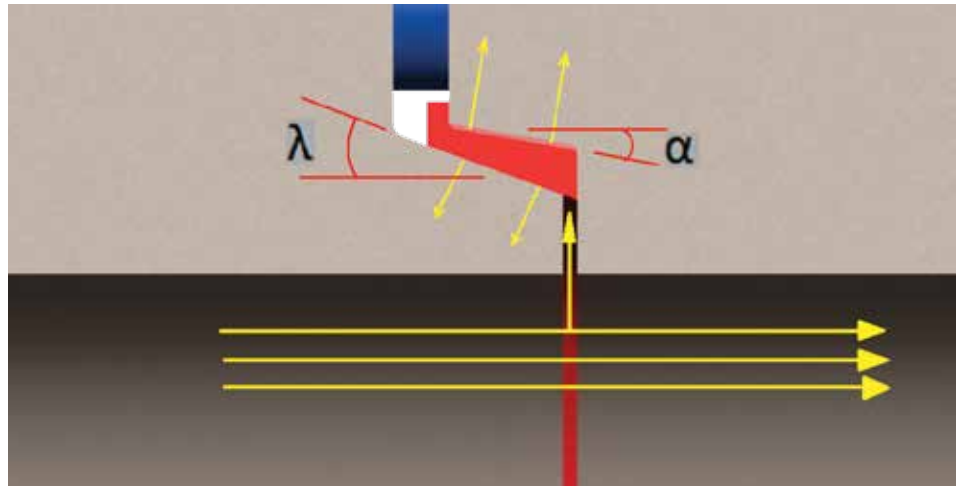


		ANSI / API Flanges	CoffeLok Compact Flange (Economy)	CoffeLok Compact Flange (NORSOK L-005) ISO 27509	CoffeLok Compact Flange (Standard)	CoffeLok Clamp Connector	Taper-Lok Connector
Leak-Free Reliability							
Weight Savings							
Space Savings							
External Loads							
Quick Assembly							
Cost Savings							
Misalignment Capability							
High Pressure/ Temperature							

ICON
RANK = 1 6
 OK Superior

Taper-Lok® Seal Rings - How They Work

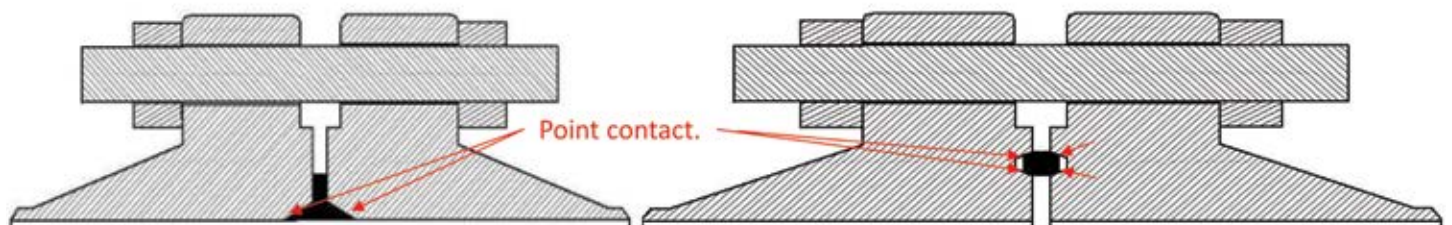
The Taper-Lok connection uses the MECHANICAL ADVANTAGE of the inclined plane and generates up to THREE TIMES the gasket force on the seal ring. It also requires less bolt load and less bolting. As this pressure increases it enhances sealing capability.



Taper-Lok connectors incorporate a wide area seal that has up to 20 times the contact area of other metal-to-metal seals. This ensures a robust connection that can easily withstand the rigors of repeated job site connections in tough conditions.

In Comparison to Other Connectors

Many metal-to-metal ring type connections rely on a narrow band of contact. In principle, this will be sufficient, but in practice, in field conditions they are easily damaged. Due to the wide area sealing surface, the Taper-Lok Seal Ring design is more forgiving when dealing with harsh field conditions and potential installation damage.



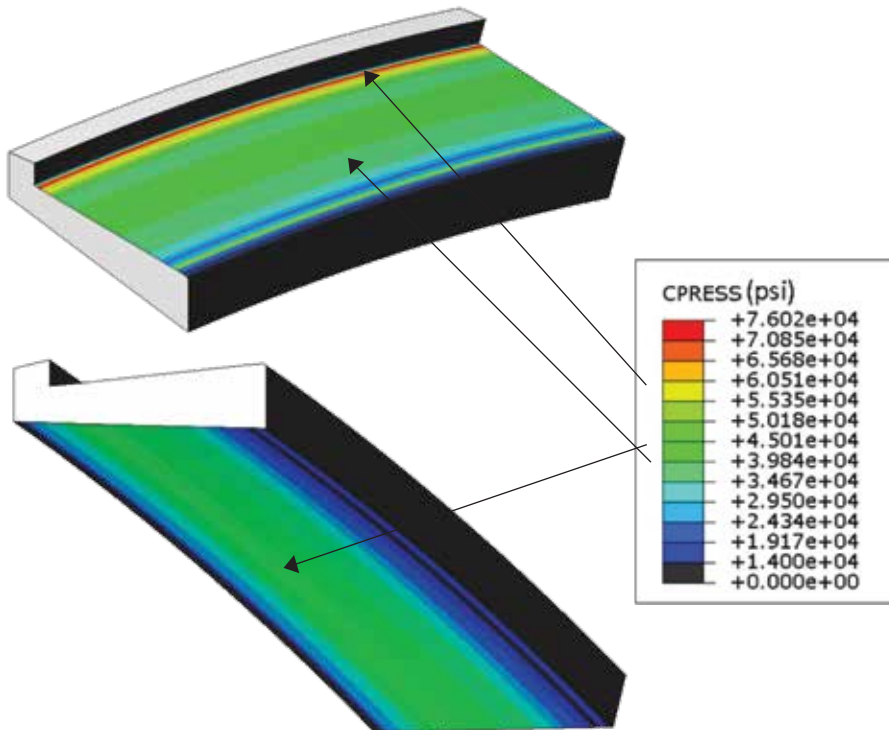
Lip type metal seal found on hub/clamp and compact flange connectors

RTJ type seal found in ANSI / API flanges

Taper-Lok® FEA Contact Pressure

Contact Pressure Example - 2,545 psi (per ASME BPVC Section VIII)

Taper-Lok connectors have very high contact pressure and the largest surface area of any metal-seated connector in the industry. Our FEA example below proves that we have more than enough contact pressure required by the ASME Code to maintain a leak free seal.



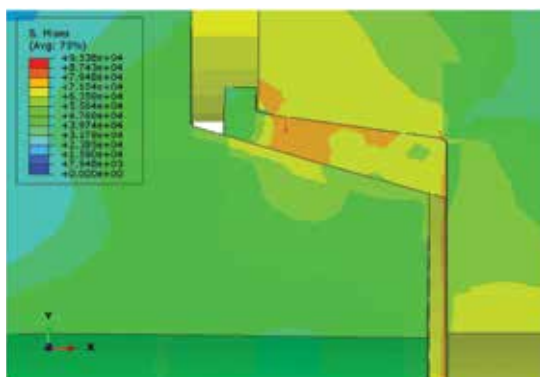
35,000 to 55,000 psi contact pressure is more than enough required (14,000 psi) to maintain a leak free seal. (Green, Blue and Yellow colors)

Internal Pressure, $P = 2,545$ psi

Maintenance Factor, $m = 5.5$

Min Contact Pressure = $m \cdot P = 14,000$ psi

Contact Pressure Example - 20,000 psi

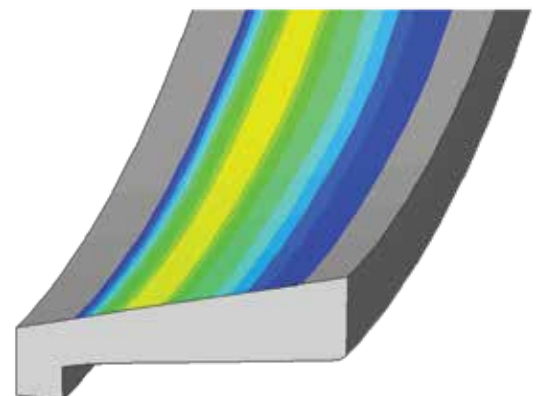
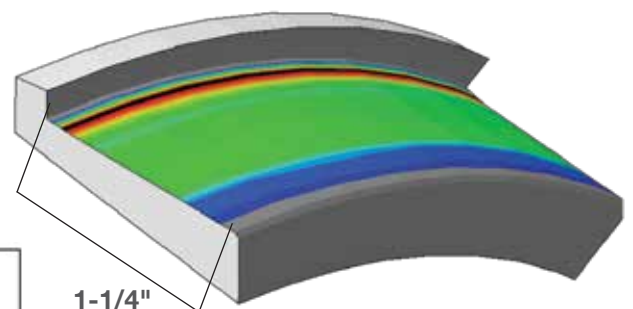
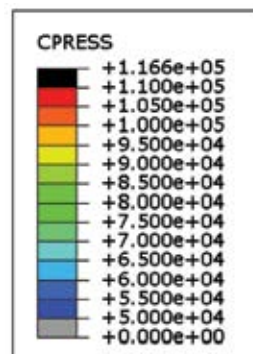


In this example at 20,000 psi any contact pressure that is not gray color is sufficient to maintain a leak free seal.

Contact pressure:

$$m \cdot P (\text{min}) = 2.5 \cdot 20,000 = 50,000 \text{ psi}$$

$$m \cdot P (\text{min}) = 5.5 \cdot 20,000 = 110,000 \text{ psi}$$

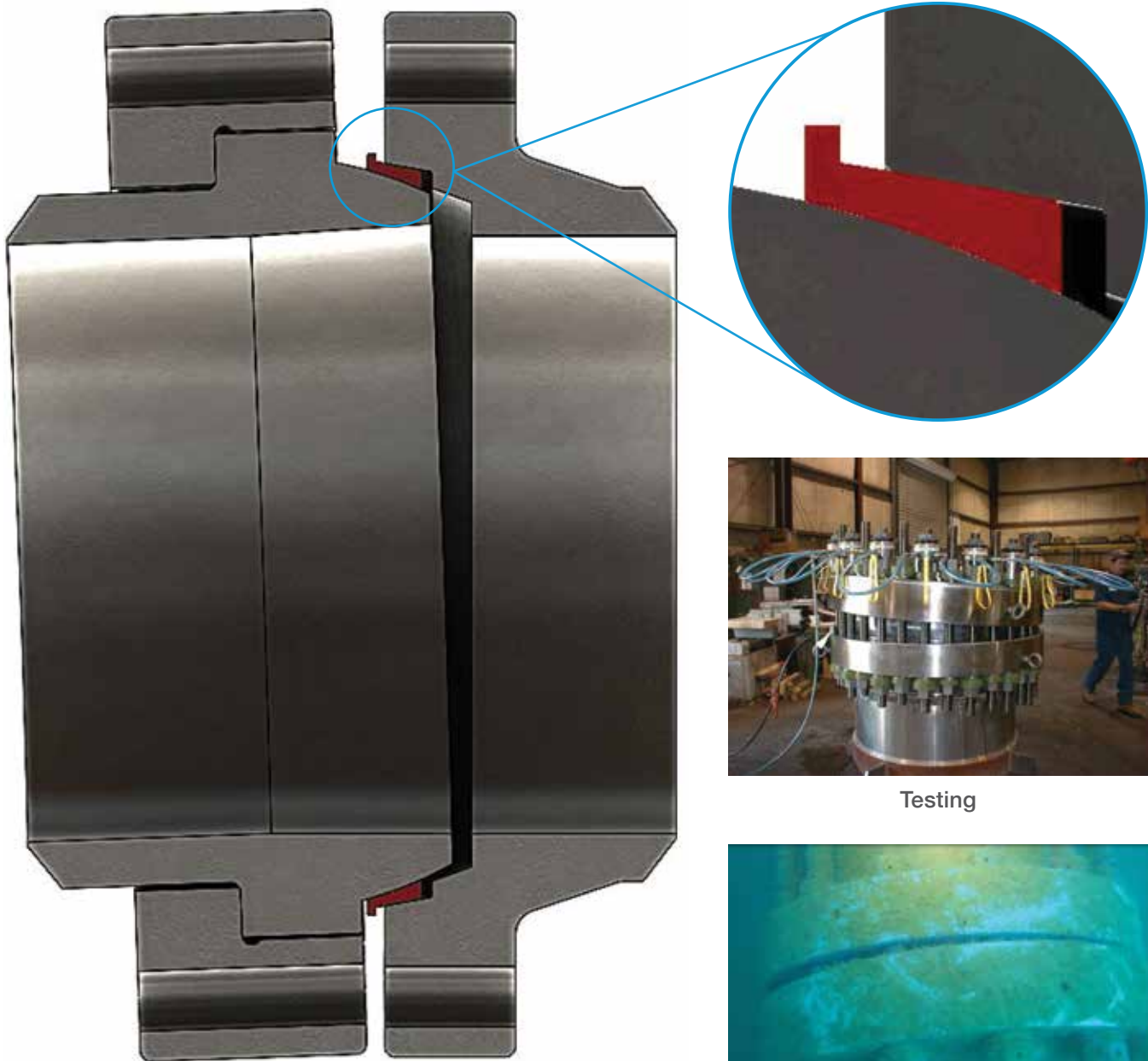


Taper-Lok® Seal Rings - Misalignment Capability

Our *Taper-Lok* technology can make connectors with a **spherical nose and seal ring** on the male end, which allows for 2 to 3 degrees of misalignment as standard.

- Perfect installation solution for misalignment of heavy wall pipe during fabrication
- Great for diver installed pipelines, flow lines and risers.
- **If the bolting can be inserted through the bolt-holes the joint can come together**

Taper-Lok® Swivel Assembly with Spherical Nose



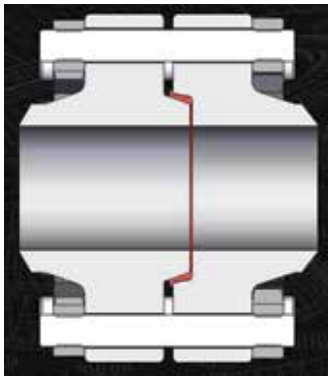
Testing



After 10 years of subsea service, this spherical nose and sealring are still doing the job of keeping this pipeline leak free.

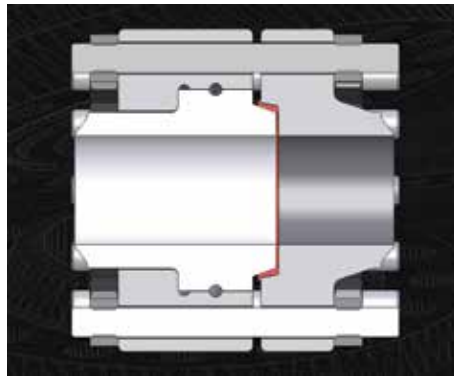
Taper-Lok® Flange Configurations

Weld Neck Assembly



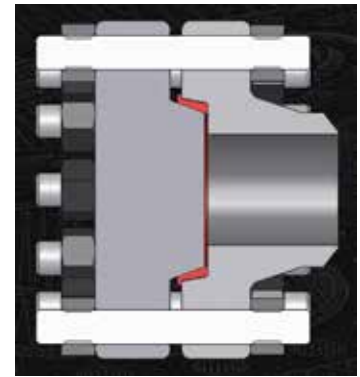
The Weld Neck Assembly is a compact flange comprised of a male flange, a female flange, a seal ring, and a complete set of studs and nuts. Weld neck assemblies are typically used for both new piping construction and replacement of existing flanges.

Swivel Flange Assembly



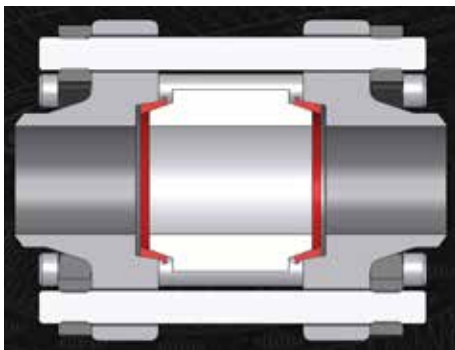
The Swivel Assembly is comprised of a female weld neck flange, a seal ring, a male fitting, a swivel ring flange, and a complete set of studs and nuts. In swivel flanges greater than 12", ball bearing races are included to greatly ease the rotation of the swivel ring during installation. This connection encompasses all of the features of a weld neck assembly but gives the ability to align bolt holes with a simple rotation of the swivel ring.

Blind Closure Assembly



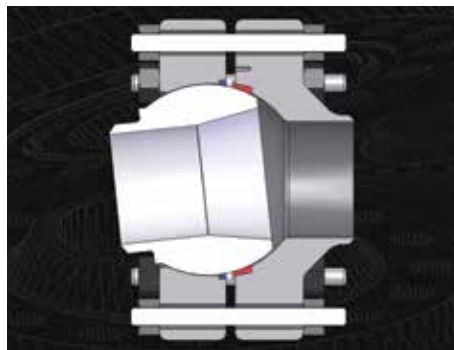
The Blind Assembly is comprised of a male or female weld neck flange, a male or female blind flange, a seal ring, and a full set of studs and nuts. Blind assemblies are frequently used for both manways and containment connections on pressure vessels, heat exchangers, pipelines, and skid packages.

Double Male Adapter



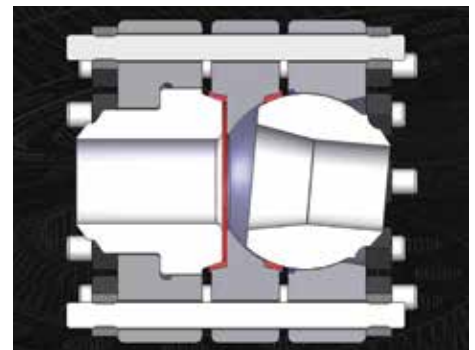
The Double Male Adapter is an individual component that has two opposing male noses and is inserted in between two female flanges. The double male adapter can serve many purposes based on the desired configuration. It can be designed to accommodate instrumentation, serve as a double block and bleed and even work as a strainer. However, it is most commonly used when converting an existing flange set up to the Taper-Lok sealing technology.

Ball Misalignment Flange



The Misalignment Assembly is comprised of a weld neck flange with a spherical recess in the face, a ball joint, a spherical seal ring, a swivel ring flange, and a complete set of studs and nuts. The standard misalignment assembly (shown) allows up to 10-degrees of both axial and angular misalignment of piping. When 10-degrees of misalignment is not enough, then this assembly can be modified to include a second ball joint that would allow for up to 20-degrees of misalignment of piping.

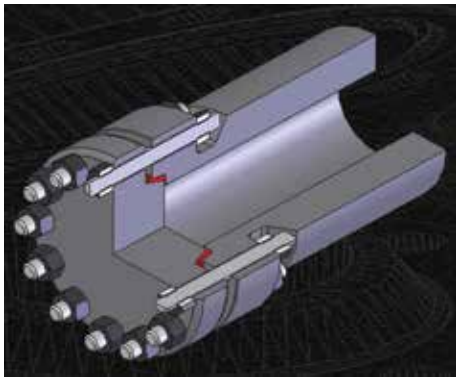
Swivel and Ball Misalignment



The MVL Assembly (Misalignment/ Swivel Assembly) is a combination of a Swivel assembly and a Misalignment assembly. The two assemblies are connected together by an intermediate adapter flange that holds both the seal ring for the misalignment and the swivel flanges. This assembly allows for up to a 10-degree misalignment of piping while also allowing for ease of bolt hole alignment during installation. This product is typically used in subsea application between the flow line and riser piping.

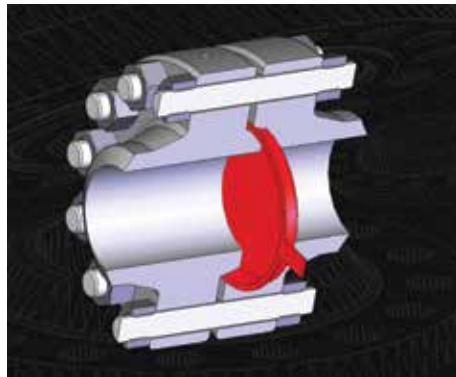
Taper-Lok® Flange Configurations

Long Weld Neck Assembly



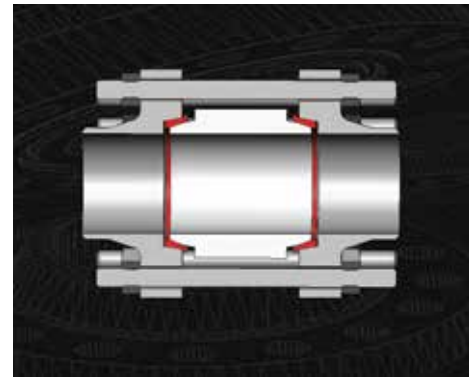
The Long Weld Neck Assembly is comprised of a male or female flange with an extra long reinforced neck, a seal ring, a male or female blind flange, and a complete set of studs and nuts. The long weld neck is typically used in pressure vessel applications where the reinforced neck thickness is required to match or replace the material that was removed from the shell of the pressure vessel. The blind flange can also be replaced with a weld neck flange if continuous piping is required.

Skillet Blind



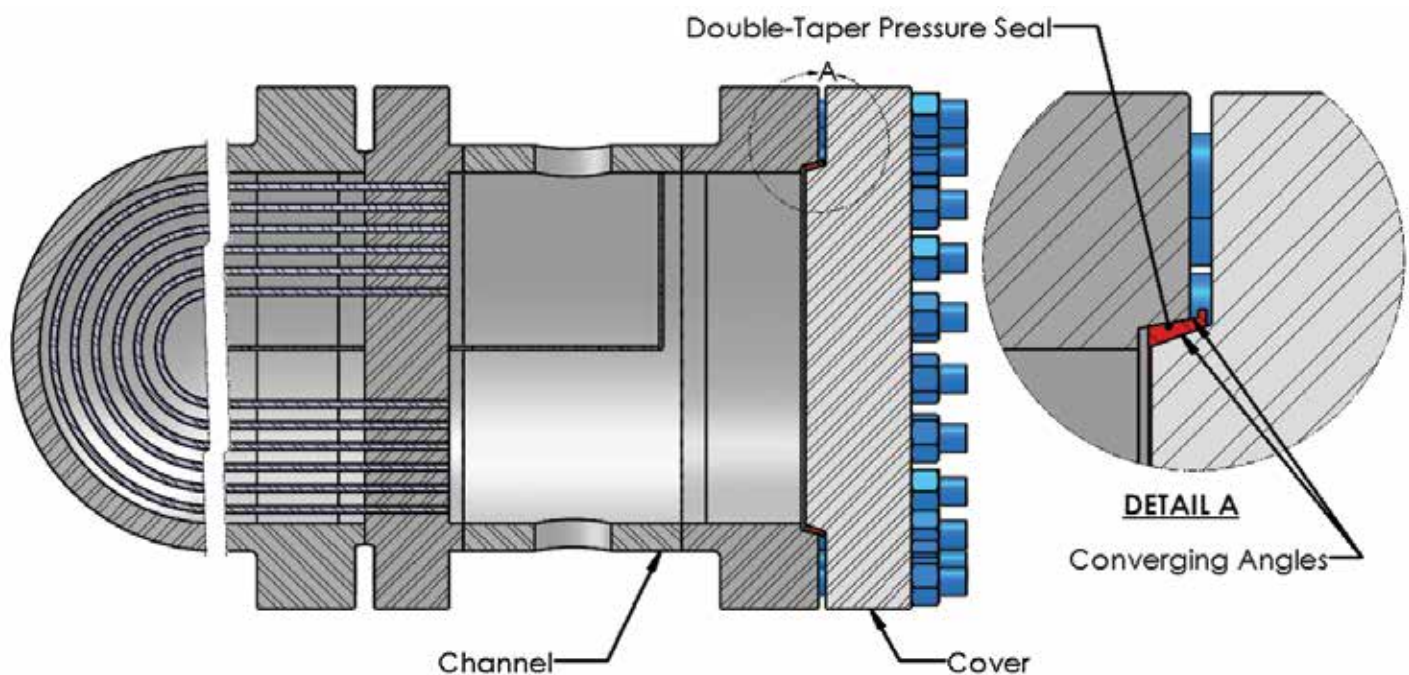
The Taper-Lok Skillet Blind is an individual component that is comparable to a pancake blind for an ANSI flange. The skillet blind is a pancake blind with a Taper-Lok seal ring integrated into the design. Skillet blinds are rated for hydro-test pressure and can be inserted into any Taper-Lok connection when blinding is required.

Spherical Double Male Assembly



The Spherical Misalignment Assembly is comprised of two misalignment-female weld neck flanges, two spherical seal rings, a spherical male adapter, and a complete set of studs and nuts. Because of the allowable misalignment, spherical washers are installed to reduce stress on the studs. This technology is based on the "double ball joint" shape of the spherical male adapter, which allows for both axial and angular misalignment of piping.

Heat Exchangers and Vessels



Channel or big body flanges on heat exchangers and vessels. New build construction or retrofits

Taper-Lok® Connectors for Offshore Topsides Applications

- Weight and space savings of up to 80% in comparison to ANSI / API of flanges
- Misalignment for heavy wall pipe and connecting modular skid packages
- Facilities / process piping runs can be closer together saving valuable deck space
- Valves
- Vessels
- Heat Exchangers
- Manifolds
- Membrane Systems
- Compressors
- Injection Systems
- Separation Systems
- Numerous Other Applications



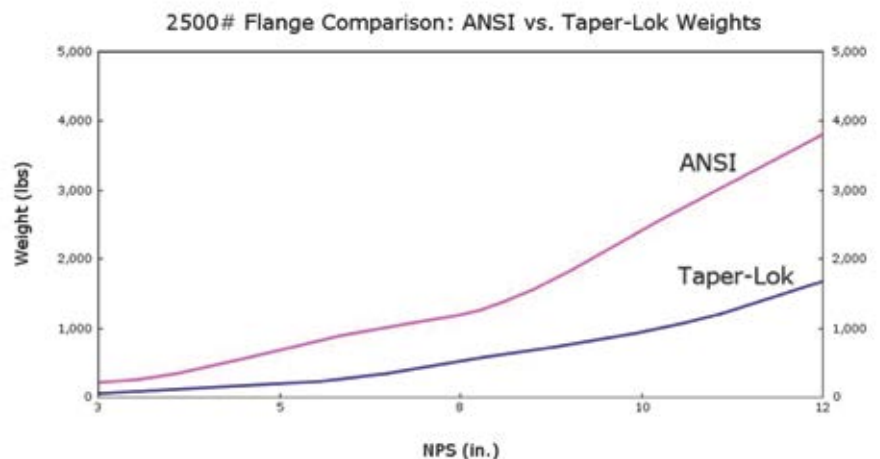
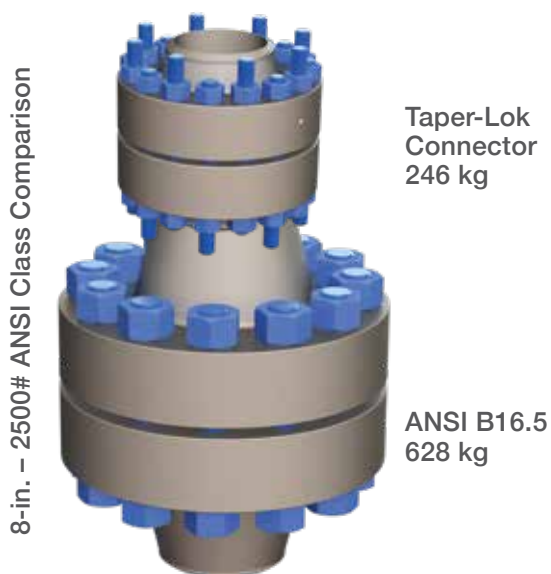
Manifold Skids



Valves



Membrane Systems



Taper-Lok® Connectors for Offshore Riser Applications

- Small outside diameters for pull-ins
- High fatigue and external load capacity
- Misalignment capability
- Self aligning
- Test port options
- Production risers
- Flexible riser end-fittings
- Stress joints
- Flex joints
- Riser hang-off
- Platform hull piping
- Numerous Other Applications



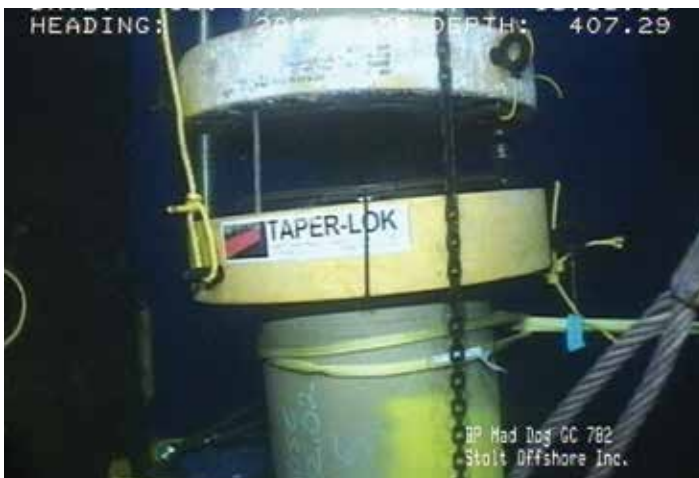
Stress Joint



Offshore Riser



S-Lay Installation



Diver Installed Riser



Diver Installed Riser

Taper-Lok® Connectors for Subsea Applications

- "Diver Friendly" installation
- Misalignment capability
- Self aligning
- Test port options
- Subsea manifolds, PLEM, PLET
- Subsea pipeline transmission/ Distribution
- Flow lines
- Subsea Valves
- Flexible riser end-fittings
- Well heads
- Numerous Other Applications



26 inch Swivel Flange



26 inch Swivel Flange



44 inch Swivel Flange



Taper-Lok connector on 26 inch Subsea Ball Valve



Taper-Lok connector on 48 inch Subsea Check Valve

Taper-Lok® Technology Additional Features

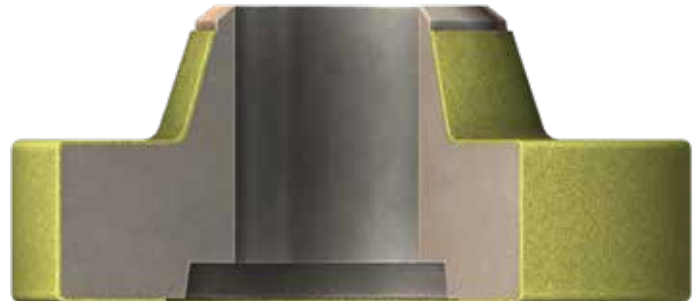
Swivel Flange with Ball Bearing Races

- 12" and above
- Allows easy rotation by hand on large diameter flanges
- Saves several/many installation hours per connection



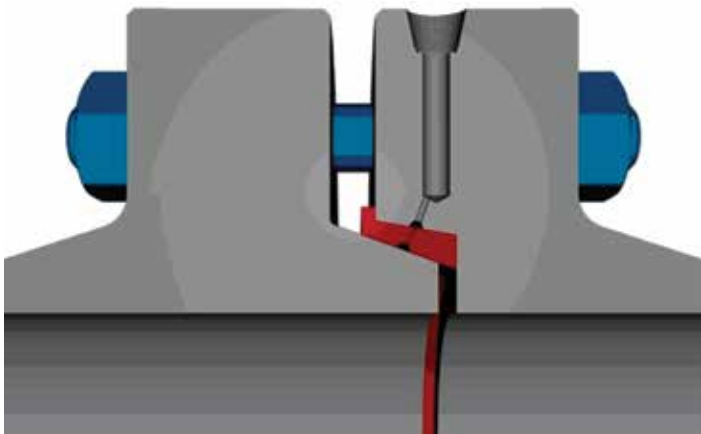
External Coating

- Flanges, studs and nuts may be coated if required
- Corner radii for better adhesion and less chipping
- Radius means safer handling for heavy items



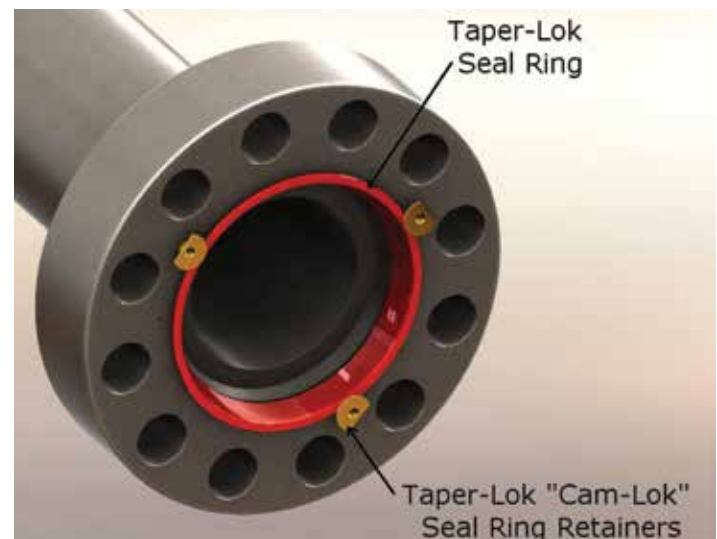
Annulus Test Port

- No need for secondary test seal due to wide area of Taper-Lok Seal Ring
- Can hold full working pressure on back seal test



Cam-Lok Seal Ring Retainers

- Holds the seal ring in the correct position
- Keeps hands and fingers away from "Pinch Points"
- Designed to remain in place after make-up



Taper-Lok® Additional Features

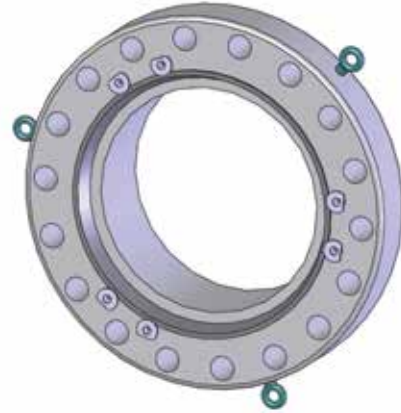
Subsea Studs and Nuts with Tensioner Allowance

- Tommy holes on nuts and extra length on studs for subsea tensioning



Lifting Eyes

- Connections are offered with three tapped holes allows lifting eyes for easier fabrication and installation



Ball Misalignment Flange

- 10-20 degrees of misalignment capability
- Pipeline Repair
- Jumper Spools
- Tie-ins
- Hull Piping



3-Bolt Quick Assembly Swivel with 3 Degrees Misalignment Offers Reduction in:

- Package weight
- Assembly time
- Labor cost
- Maintenance cost
- Inventory cost

Applications Include:

- Truck and skid mounted systems
- Well stimulation systems
- Frac trucks
- Meter runs
- Piping systems
- And many more



Taper-Lok® Heat Exchanger Reliability

Increase reliability, decrease maintenance costs

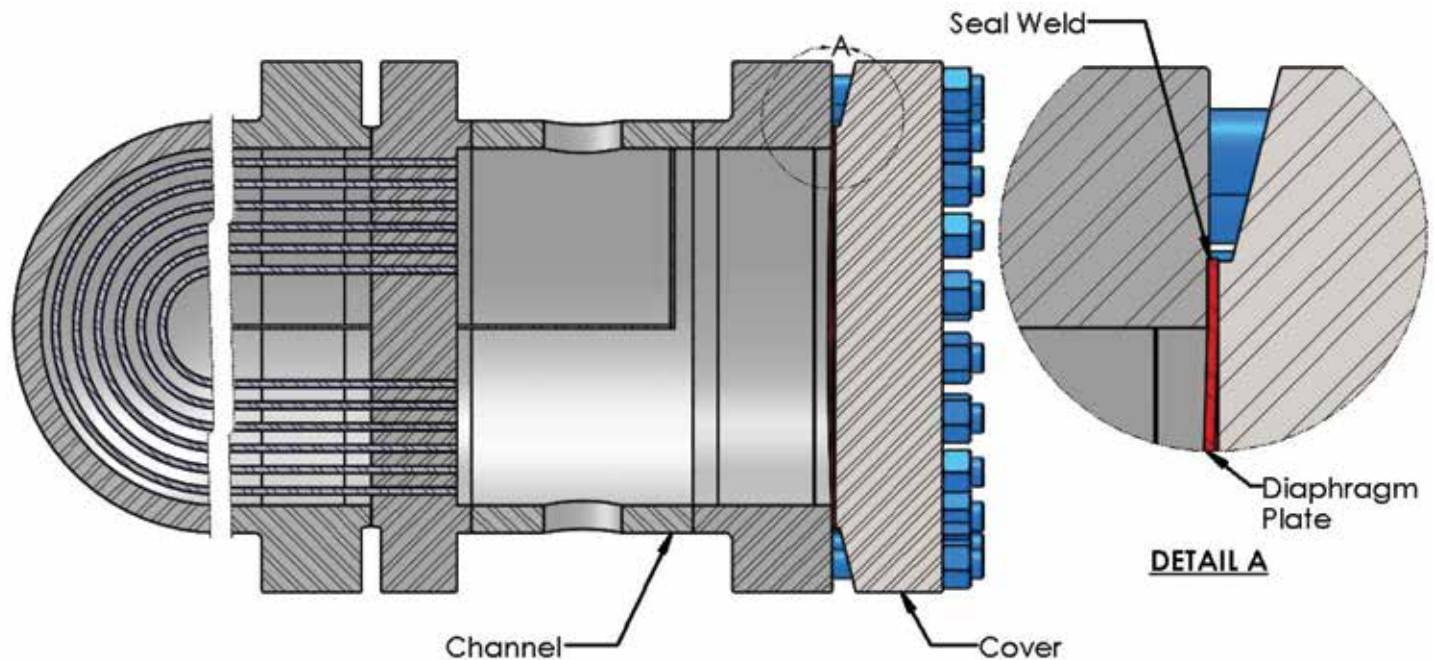
The Problem: Cracks at seal weld cause leaks

Problem

Cracking at the diaphragm plate seal weld is a common problem that causes extended down time and high repair costs.

Leaking welded diaphragms of high pressure heat exchangers in hydrotreating and hydroprocessing service units are a serious problem for the petrochemical industry. The welded diaphragm is located just in front of the tube side cover plate and is highly stressed due to the combination of high pressure hoop stress and large compressive forces from the cover plate bolting. The strenuous environment and thermal cycles stimulate corrosion cracking at the weld of the diaphragm, therefore causing a path for leaks.

Reoccurring equipment failures demand that the units be taken out of service for weld repairs, temporary clamp installation, or welding of new metal diaphragms. Heat exchanger repairs are very costly due to the decommissioning of the entire drive train, as well as the lost opportunity from extended downtime.



Taper-Lok® Heat Exchanger Reliability

Increase reliability, decrease maintenance costs

The Solution:

Eliminate the cause of leaks with the Taper-Lok retrofit

Solution

Eliminate all problematic welding and simplify the design by using the Taper-Lok seal. The basic converging angle seal geometry wedges itself between the cover plate and channel wall to create a pressure tight seal. The seal is self-energizing, and is also pressure enhanced, therefore creating an even tighter seal and achieving leak-free service.

Pressure Seal Advantage

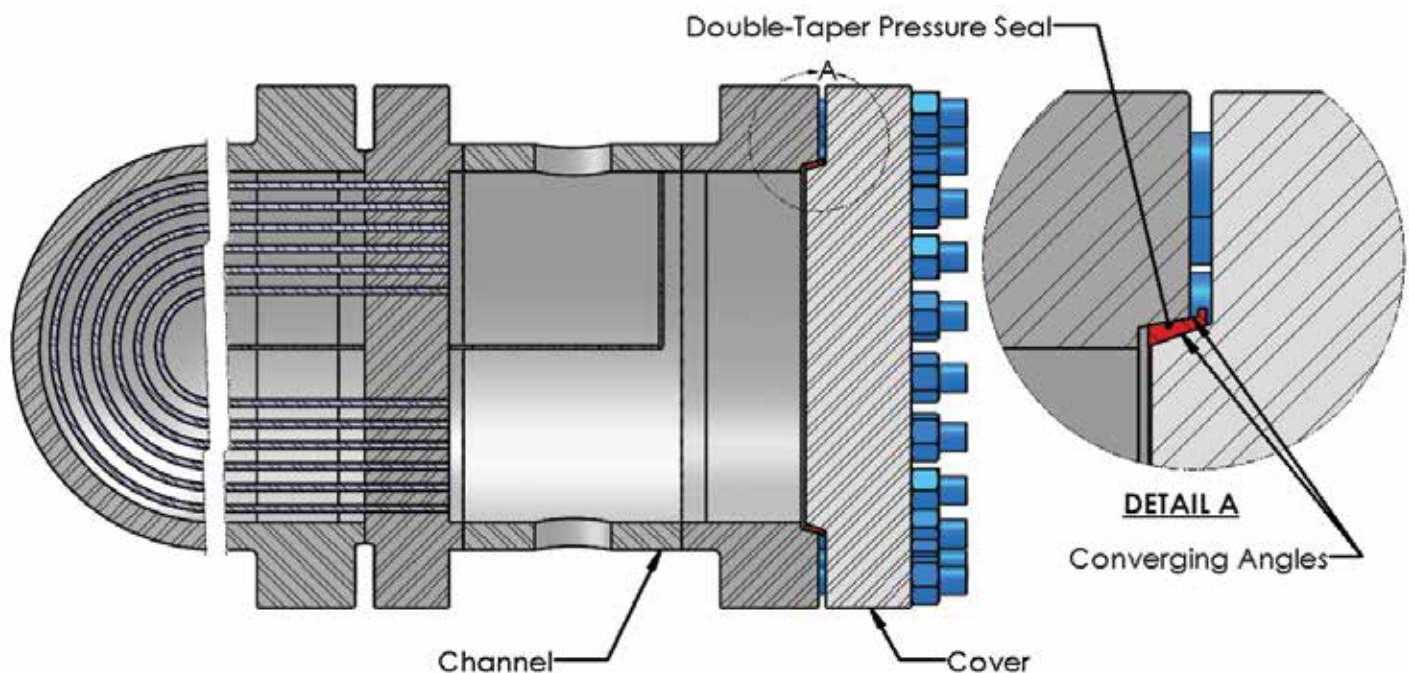
The Taper-Lok seal is a metal-to-metal seal ring with dual converging tapered contact surfaces. The converging angle geometry wedges itself between the male cover plate and the female channel wall to create a pressure tight seal. When internal pressure is applied to the seal it becomes self energizing, therefore creating a tighter seal. The materials used in the seal area of the pressure vessel and cover are the same as the seal ring, thus eliminating thermal expansion and galvanic corrosion problems. In addition, the seal ring is coated with a baked on Molybdenum coating to eliminate galling.

Solution Benefits:

- 5 to 1 cost reductions over equipment life
- Proven 3 step retrofit process
- Maintenance time reduced from 11 to 3 shifts
- Plant uptime increased

Elimination of:

- Seal weld and gauging of diaphragm
- Machining and stress relief of weld build up
- Nitrogen purge - hydrogen bake out
- Non-destructive weld testing to search for cracking
- Repeat of process when leaks detected



Taper-Lok® Heat Exchanger Reliability

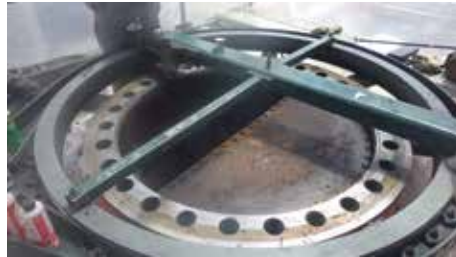
Increase reliability, decrease maintenance costs

Onsite retrofit procedure completed during normal shutdown time frame

New Design with Taper-Lok
Pressure Seal (No Diaphragm)



Machine Taper-Lok female seal groove
into existing exchanger channel using
OD or ID mounted machine



Install Taper-Lok Seal Ring



Install Taper-Lok
male blind cover flange



Tensioning the connection



Taper-Lok Retrofit Complete

Taper-Lok Design

- 1- Replace Taper-Lok seal ring
- 2- Install Taper-Lok closure/cover plate
- 3- Install nuts and tension studs (studs can be left in-place during shutdown)

Total time = (3x) 12 hour shifts

Welded Diaphragm Design

- 1- Gauge off diaphragm plate
- 2- Nitrogen purge
- 3- Seam weld new diaphragm
- 4- Stress relief welded diaphragm
- 5- Non-destructive weld testing
- 6- Reinstall studs, original closure and nuts
- 7- Leak test - repeat entire operation of leak is detected (costly time wasted!)

Total time = (11x) 12 hour shifts

Design Simplicity

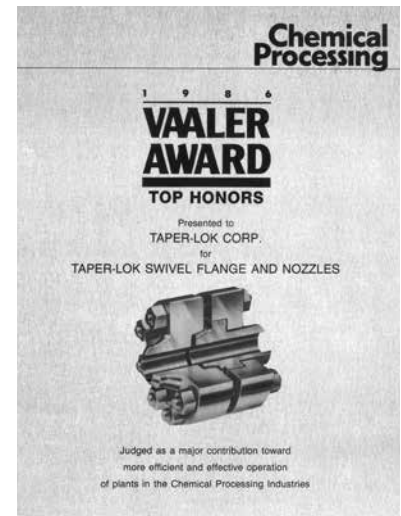
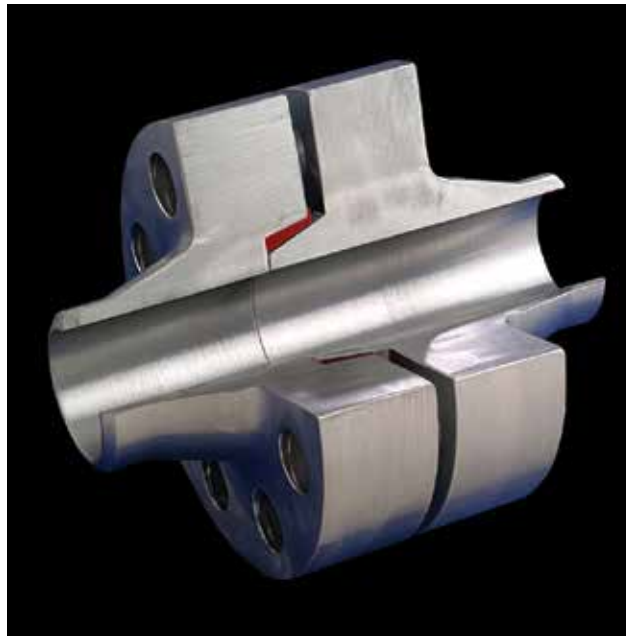
With the Taper-Lok seal, there is:

- No welding
- No complicated closure assembly
- Increased reliability
- Cost savings in maintenance, turn-around time and lost production / opportunity cost
- Designed in accordance with ASME Boiler and Pressure Vessel Code Section VIII

Taper-Lok® Connectors for Downstream Applications

Petrochemical and Refinery

- Leak-free reliability since 1965
- High pressure/temperature
- Misalignment capability
- Self aligning
- Gas/Oil Hydrotreaters
- Hydrocrackers
- Desulphurization
- Polymer lines
- Alkylation unit
- Sulfuric acid
- Hydrochloric acid
- Highly corrosive services
- Numerous Other Applications
- Up to 40,000 psi



Chemical Processing Award
for Innovation: Taper-Lok
Swivel Flange and Nozzles

Taper-Lok Zero Gap Flange configuration available for
smooth internal bore in corrosive and erosive applications



Lethal Fluid



Compressors



Hydrogen Plant Flanges



Separation

Taper-Lok® Relationship to Codes and Standards

ASME B31.3			
Unlisted Products			Listed Products
ASME VIII Div 1		ASME VIII Div 2	
Taper-Lok and CofferLok Products		Taper-Lok and CofferLok Products	
			ASME B16.5
			ASME B16.47
			MSS SP-44

DNV RULES
Submarine Pipeline Systems DNV OSF 101
ASME VIII Div 2
Taper-Lok and CofferLok Products

ASME/BOILER AND PRESSURE VESSEL			
ASME VIII Div 1		ASME VIII Div 2	
Calculations and Acceptance Criteria		Part 4 Design by Rules	Part 5 Design by Analysis
Taper-Lok and CofferLok Products		Calculations and Acceptance Criteria	Numerical Analysis and Code Validation
		Taper-Lok and CofferLok Products	Taper-Lok and CofferLok Products

API/BOILER AND PRESSURE VESSEL			
ASME VIII Div 2			
Part 4 Design by Rules		Part 5 Design by Analysis	
Calculations and Acceptance Criteria		Numerical Analysis and Code Validation	
Taper-Lok and CofferLok Products		Taper-Lok and CofferLok Products	

Customer references and test reports available upon request

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