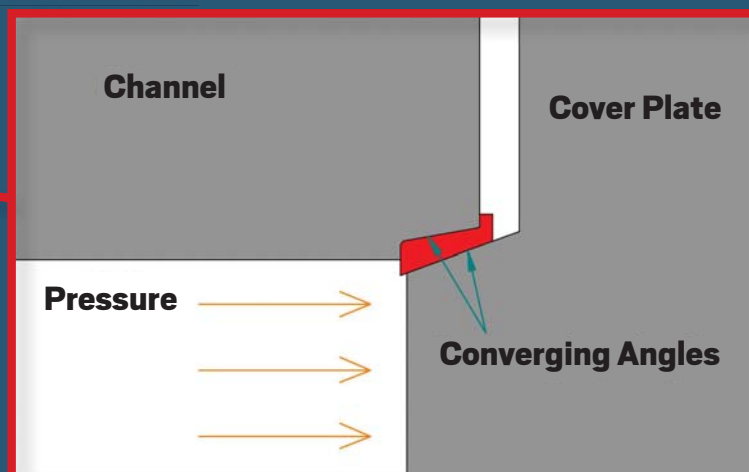
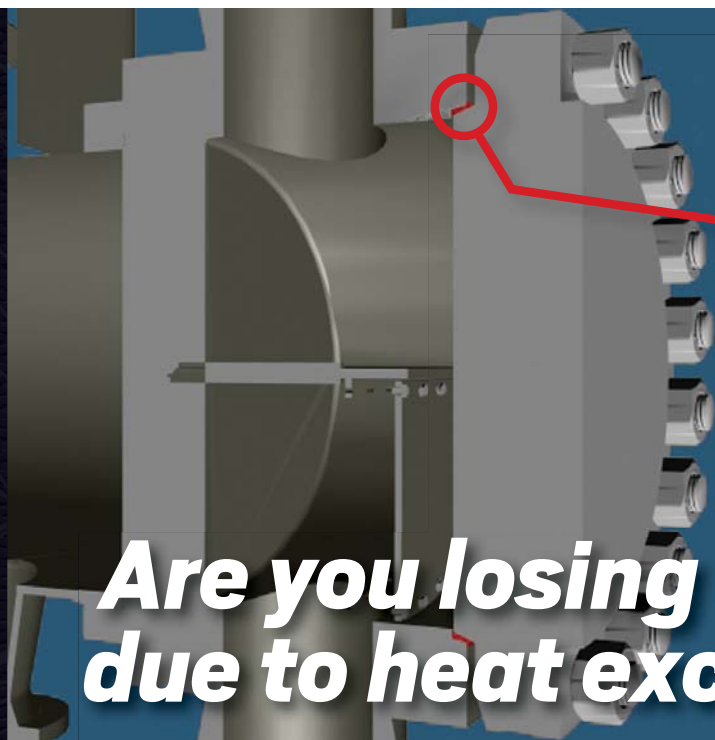


Taper-Lok[®]

Leak-Free Service



Are you losing time and money due to heat exchanger repairs?

The Taper-Lok[®] Solution

Problem:

If your repair costs are high, and you are dealing with severe lost opportunity from extended downtime, it may be caused by the common problem of corrosion cracking at the diaphragm welds on your heat exchanger.

Solution:

You can eliminate all problematic welding and simplify your 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. When internal pressure is applied, the seal becomes self energizing, therefore creating a tighter seal.

Designed in accordance with ASME Boiler & Pressure Vessel Code Section VIII. ^[1]

Benefits:

- ✓ 5:1 cost reductions over equipment life
- ✓ Proven retrofit process
- ✓ Maintenance down time reduced by a factor of 3:1
- ✓ Plant uptime increased due to improved reliability
- ✓ Elimination of:
 - Seal weld and gouging of diaphragm plate
 - Machining and stress relief of weld build up (Nickel butter coat)
 - Nitrogen purge
 - Hydrogen bake out
 - Non-destructive weld testing to search for cracking
 - Operation repetition when leaks detected
- ✓ Easy access to Tube Bundles and other internal equipment.

Heat Exchanger Reliability

Increase reliability, decrease maintenance cost

Weld Elimination & Design Simplicity

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.

Design Simplicity

With the Taper-Lok® seal, there is:

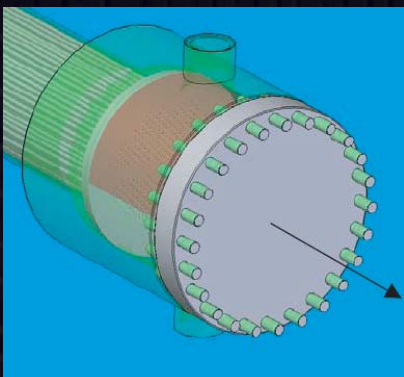
- No welding
- No complicated closure assembly
- Increased reliability
- Cost savings in maintenance, turn-around time and lost production / opportunity cost
- Designed in accordance with ASME Boiler & Pressure Vessel Code Section VIII. ^[1]



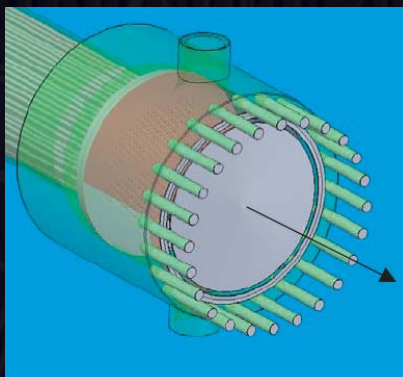
Onsite Retrofit Procedure

For Existing Equipment

1. Remove dollar plate



2. Remove diaphragm seal



3. Field Machine Taper-Lok® seal pocket into vessel



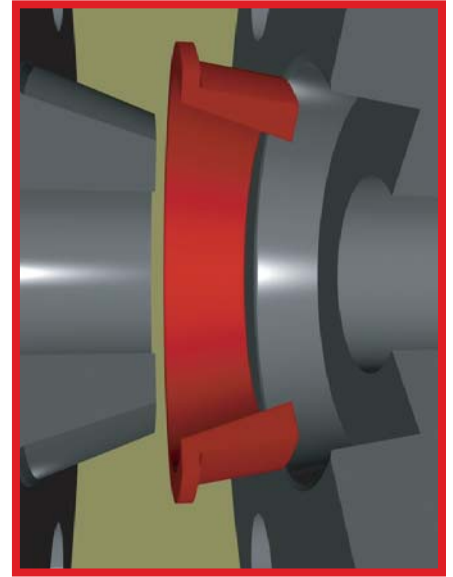
4. Insert Taper-Lok ring



The Taper-Lok® Advantage

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 & 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.



The Taper-Lok® Pressure Seal Advantage

“ The maintenance associated with using a Taper-Lok® seal ring in a high pressure heat exchanger is the equivalent and comparable to any other heat exchanger that is designed for low pressure.”

David R Smith

Operations Manager
JV Industrial Companies

ok® seal

5. Install new closure over existing bolt pattern



6. Tension studs



New Exchanger Builds

Taper-Lok® will work directly with your Heat Exchanger OEM to introduce and design this sealing technology into your new equipment, or perform an onsite retrofit to existing heat exchangers.





| No. of Shifts (12 Hour Shifts) | Maintenance with Existing Welded Diaphragm | Retrofit from Welded Diaphragm to Taper-Lok® 2:1 SAVING | Maintenance with Taper-Lok® 3:1 SAVING | No. of Shifts (12 Hour Shifts) |
|--------------------------------|---|---|--|--------------------------------|
| | | Key Points | Additional Benefits | |
| 10 | Tighten Studs & Nuts | Elimination of Cracking Diaphragm. (Root Cause) | Increased Thermal & Heat Transfer Efficiency (Multi Pass Partition Exchangers) | 10 |
| | Reinstall Cover Plate | | | |
| 9 | Stress Relieve | Improved Future Reliability (Less Unplanned Shut Downs due to leakage) | Half the bolt Pre-Stress required | 9 |
| 8 | NDE | Ease of Access for Future Maintenance Operations. | Less Sensitive to Thermal Cycling | 8 |
| 7 | Weld New Diaphragm in Place | Retrofit design in accordance with ASME Boiler & Pressure Vessel Code Section VIII ^[1] | No Purging Gases Required | 7 |
| 6 | Weld and Re-machine "Butter- Coat" Layer onto Channel Face | | Elimination of Hydrogen Bake Out from Welded Areas | 6 |
| 5 | Nitrogen Purge | Tighten Studs & Nuts | Less Equipment Required | 5 |
| 4 | NDE | Install Seal Ring and Reinstall Cover Plate | No - Gouging, Welding, Machining, NDE, Stress Relieving etc. | 4 |
| 3 | Machine Channel Face | Machine Seal Ring Pocket | Reduced Bolt Relaxation & Gasket Creep | 3 |
| 2 | Gouge out Diaphragm | NDE | Tighten Studs & Nuts | 2 |
| 1 | Remove Cover Plate | Machine Channel Face | Reinstall Cover Plate | 1 |
| | Welded Diaphragm | Gouge out Diaphragm | Inspect Sealing Area & Replace Seal Ring | |
| | | Remove Cover Plate | Remove Cover Plate | |
| | | Taper-Lok® | Taper-Lok® | |

ROOT CAUSES OF WELDED DIAPHRAGM FAILURE THAT ARE ADDRESSED BY THE TAPER-LOK SEALING METHOD

- ☒ Tensile Overload caused by difference in thermal expansion between Low Alloy Channel & Stainless Steel Diaphragm.
- ☒ Chloride Stress Corrosion Cracking (SCC) - Aggravated by concentration of Chlorides in the crevice between Channel & Diaphragm.
- ☒ Polythionic Acid Stress Corrosion Cracking due to Stainless Steel becoming sensitized by welding operations.
- ☒ Galvanic Corrosion between dissimilar metals.

[1] Independent 3rd Party analysis of methodology & interpretation of the ASME code has been undertaken by a PE and is available upon request.

Taper-Lok® 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. Taper-Lok's® oldest connectors have been in operation more that 35 years with combined leak-free service of over 200 million hours without failure.