

Dual Seal Upgrades

For legacy API pumps



AESSEAL® the upgrade specialist

- Proven reliable solution
- Simple to manage
- Minimal change and service interruption
- Lowest implementation cost
- Reducing fugitive VOC emissions and risk of fire



Dual Mechanical Seal Upgrades for the Oil and Gas Industry

Many of the developed world's refinery and petrochemical processing facilities were built over 30 years ago.

The dependability of existing pumps, coupled with their high cost, has restricted the wholesale replacement of these mature assets. Single mechanical seals fitted on these old generation machines will, in many instances, no longer meet current safety requirements.

In view of aging machinery fleets, responsible companies now reference the recommended best practice API 691 Risk Based Machinery Management. This defines the minimum requirement of Health, Safety and Environmental (HSE) risk across the machinery lifecycle. Process Hazard Analysis (PHA) teams at many companies have identified equipment requiring 'multiple layers of protection' which is achieved by the use of dual mechanical seals for these pumps.

Upgrading these machines to modern sealing devices that incorporate an API 682 compliant dual mechanical seal can be achieved providing high levels of safety and reliability.

Typical Pumping Applications Requiring Dual Seals



Process streams containing:

- Acute toxicity – e.g. H₂S, caustic amines, HF



- Aspiration hazards – e.g. fluids with benzene or butadiene >0.1%, carcinogenicity / organ toxicity



- Flammable – e.g. pumping temperature > auto ignition temperature or 260°C (500°F), NFPA Class 1 liquid, hydrocarbons expected to fully or largely flash to vapour on release (e.g. LPG)



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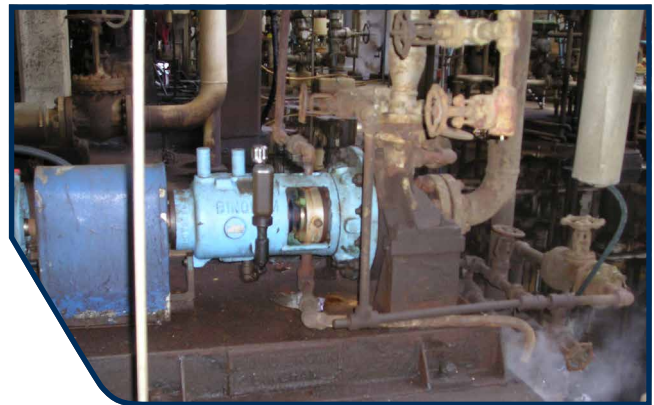


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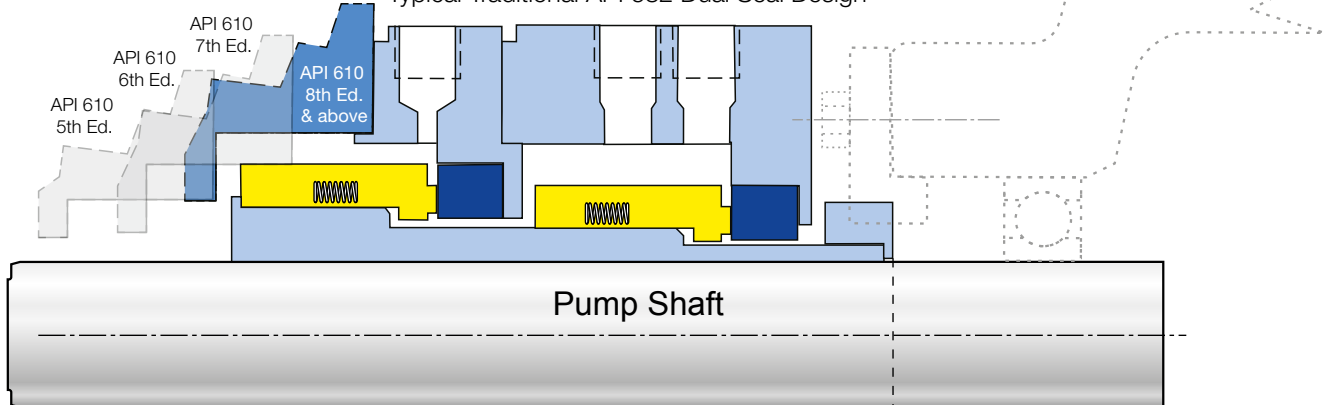
The physical space required for many of today's API compliant dual mechanical seals does not lend itself to installation on old pumps with small seal chambers (stuffing boxes).

In addition, the cost and inconvenience of pump modification, or replacement in order to accommodate traditional API 682 dual cartridge seal designs can be considerable.



Legacy API pump with single seal installed

Pump Seal Chamber Evolution



Pump Seal Chamber Evolution from API 610 5th Edition

Traditional seals are often too long to fit legacy pumps

However, there is an alternative...

Unique Solutions - CAPI-TXS™

The CAPI-TXS™ has been designed by AESSEAL® specifically for the legacy pumps found in abundance in the oil and gas industry.

Using API 682 qualified componentry in a compact modern design means it will fit almost all pumps without modification to the seal chamber.

The CAPI-TXS™ reduces lifecycle cost, upgrade cost and lead times.

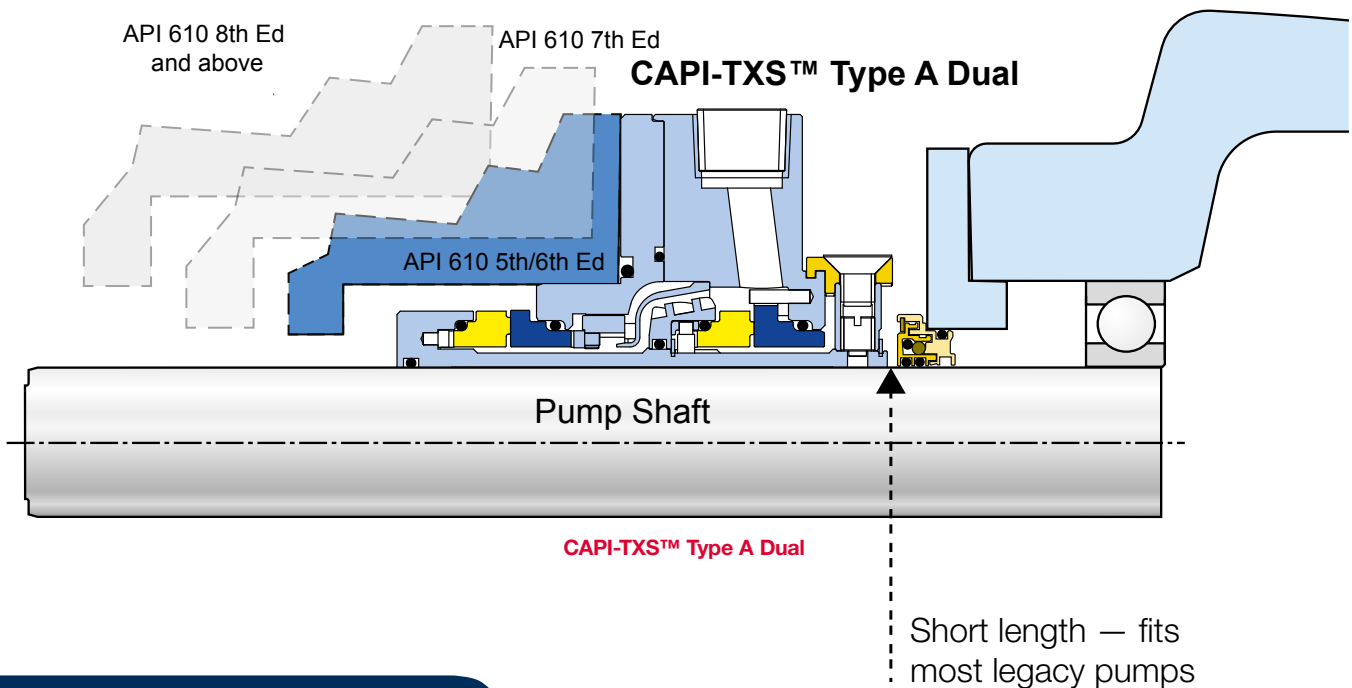
The CAPI-TXS™ enables users to extend the useful life of their older process pumps while simultaneously meeting 21st century safety and emissions requirements.

The CAPI-TXS™ fits to most legacy process pumps without the need to modify the pump casing, and, therefore, significantly reduces the cost of an upgrade. An upgrade using the CAPI-TXS™ also means the large capital costs associated with replacing the pump or fitting a 'back pull-out' unit are avoided completely.

Project execution can be both swift and efficient as the CAPI-TXS™ allows upgrades to be easily performed during the regular maintenance cycle.



Pump Seal Chamber



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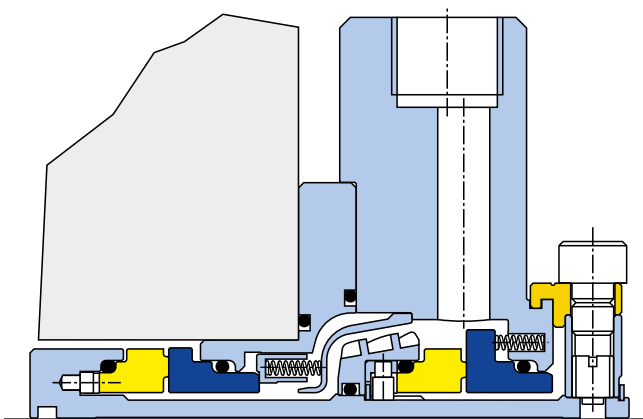
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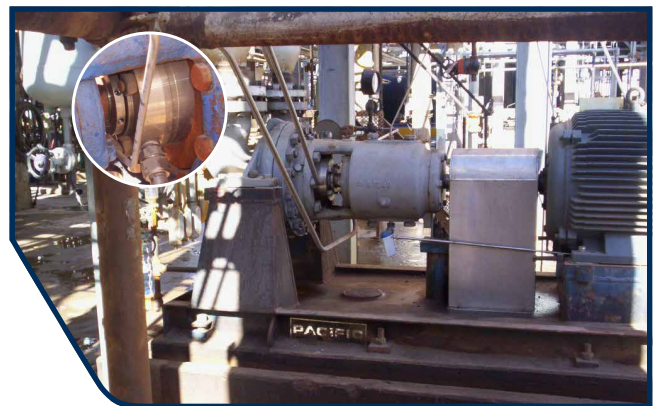


Features and Benefits

- **Compact** – CAPI-TXS™ can be fitted to most API 610 pumps, 5th, 6th, 7th edition and non API 610 pumps, regardless of OEM
- **Increased reliability** - Cartridge design uses API 682 qualified components. Integral bi-directional internal pumping ring circulates barrier/buffer fluid, reducing seal face temperatures and improving reliability
- **Stationary seal design** - Seal is designed with stationary flexible elements (springs) for improved tolerance to pump casing or gland plate distortion and misalignment due to pipe loads, thermal distortion, pressure distortion, etc



Typical CAPI-TXS™ Cross section



CAPI-TXS™ Dual installed on a legacy pump

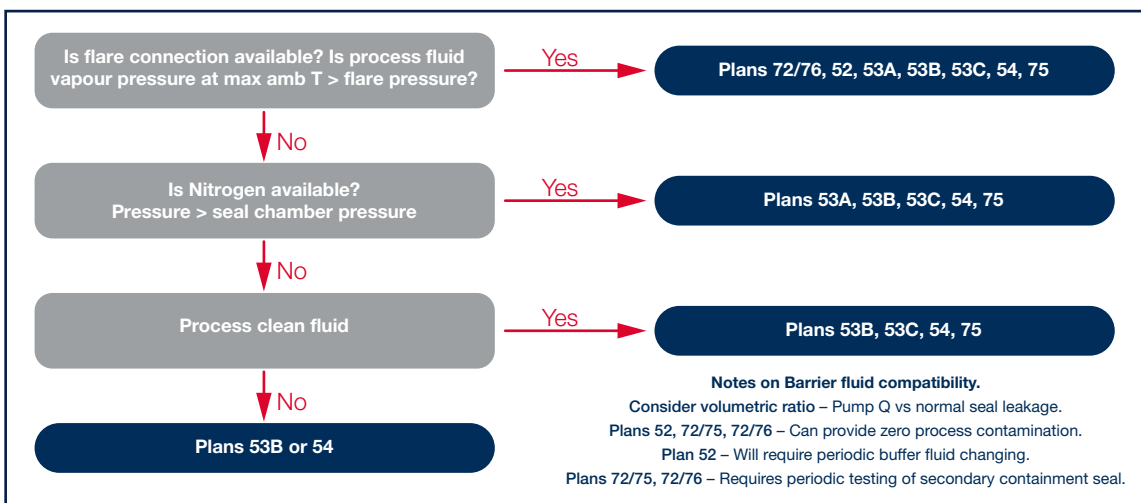
Dual Seal Auxiliary Systems (Piping Plans)

Along with our range of seals, AESSEAL® offers a comprehensive range of auxiliary systems and, most importantly, our applications support engineers will review your application and recommend the most suitable solution to help improve reliability.



Seal Support Systems

There are 10 dual seal piping plans available published in the API 682 standard. These can be subdivided into Unpressurised (Arrangement 2) and Pressurised (Arrangement 3). The principal difference between Arrangement 2 and Arrangement 3 configurations is the concept of containment of leakage versus the elimination of process fluid leakage. Available outer seal plans: 52, 55, 72 / 75, 72 / 76 Unpressurised, 53 A B C, 54, 74 Pressurised



AESSEAL® offers a range of auxiliary systems to support dual seals, including:

Plan 53B

53B has many benefits for retrofit application

- Simple, stand alone solution – ease of installation
- Requires no external / auxiliary connections
- Low installation costs
- Provides high level of safety
- Fault tolerant – containment solution
- Simultaneous condition monitoring of both the inner and outer seal via trending pressure decay on plan DCS
- Available in both welded pipe option and tube compression fit - tube compression fit is now accepted for pressurised dual seal by most best-in-class users
- Loss of process fluid will not occur in the event of failure of either the inner or outer seal faces
- Standards: ASME VIII Div.1, PED 2014/68/EU



20L 53B



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Plan 54

- Stand alone Plan 54 system with integral tank
- Internal cooler or air cooler options
- Can be used to support more than one seal



Plan 53A and 52 Seal Reservoirs

- The AES-28™ 316SS
- 316 stainless steel, 28 litre / 7.39 US gallons
- Weld pad level gauge
- Integral cooling coil
- Rating of 45bar @ 100°C / 652.7psi @ 212°F
- Standards: ASME VIII Div.1, PED 2014/68/EU
- Connections: screwed, socket welded, butt welded



Plan 75

- For use with containment seals where leakage is condensing
- Used in conjunction with Plan 72
- Standards: ASME VIII Div.1, PED 2014/68/EU



Plan 72 & 76

- For use with containment seals where leakage is vaporizing



Project Engineering Support

The AESSEAL® aftermarket support team provides expert advice to ensure that the correct piping plan and system is selected.

No one piping plan selection is correct for every application; in selecting an auxiliary system, the team will consider: process conditions, reliability, total cost of installation and ease of installation.

Each seal/system is provided with a full documentation pack, typically comprising of: parts list, seal assembly drawing, seal flush schematic, auxiliary system drawing and IOM manual.

Typical Upgrade Project

Typically, a project to upgrade multiple pump seals would be to have a list of seals and then plan to carry out the upgrades to a pre-determined program.

Such a program means that the pump is removed from site, given a full overhaul and then recommissioned. The process of removing a pump for upgrade is costly and causes emissions in itself from purging activities.

AESSEAL® has engaged in upgrade projects that have been undertaken as part of the pump maintenance program. Seal auxiliary systems are pre-selected and site pre-surveyed in readiness for upgrade.

The pump is only removed when existing seals fail and the dual upgrade seal is designed and supplied along with auxiliary system on a 'just in time' basis.

Upgrade Project Example 1

European petrochemical business benzene and butadiene emission reduction program.

A total of 38 pumps from various pump manufacturers and bearing frames were converted to dual seals between 2007–2010. The upgrade was to bring the plant into compliance with emissions regulations. The upgrade was completed in the normal maintenance period with a 'just in time' supply philosophy. Pumps were only removed as the original single seals failed and the upgrade took place in the normal maintenance cycle without modification to pumps. The cost saving by adopting this approach was estimated at \$1m.

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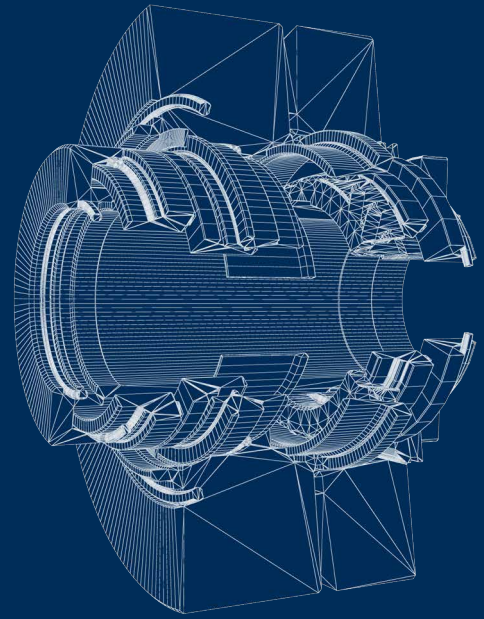




Total Cost of Installation

Dual seal and auxiliary system hardware are often only a minor cost in the dual seal upgrade.

Connections and tie-ins to utilities (particularly flare systems) can exceed the cost of the seals and systems. The table below illustrates the additional services and equipment involved, depending on the piping plan configuration selected.



Seal Vendor	Seal Arrangement	User - Contractor Scope					
		Other Parts	Number of Instruments	Hook Up / Tie In			
Aux System					N2	Water Cooled	Flare
52	2	No	2	No	Normally	Required	52 Hardware Flare Connection
53A	3	Regulator	2	Yes	Normally	No	53A Hardware N2 Connection
53B	3	No	1*	No	Air / Water	No	53B Hardware
53C	3	No	2	No	Air / Water	No	53C Hardware
54	3	No	2	No	Air / Water	No	54 Hardware
72 / 75	2	No	3	Yes	No	Required	72/75 Hardware Flare Connection & Drain
72 / 76	2	No	3	Yes	No	Required	72/76 Hardware Flare Connection
74	3	No	2	Yes	No	No	74 Hardware N2 Connection

\$ Costs

Arrangement 2 & 3 Dual Seal Systems

Upgrade Project Example 2

At an olefins plant in Europe, 15 pumps were modified from single seals to CAPI-TXS™ with 53B auxiliary systems.

The pumps had historically been unreliable due to light hydrocarbon service with limited vapour suppression margin and process upset conditions. Since implementing the upgrade in 2010, pump reliability has climbed from less than 3.5 years MTBF to approaching 7 Years MTBF.

Legacy Pump Brands Upgraded by AESSEAL® Technology

- Afton®
- Begemann®
- Bingham
- BW/IP
- Byron Jackson®
- David Brown
- Dresser

- Ebara
- Ensival
- Flowserve®
- Gabbioneta™
- Goulds
- Guinard
- Hayward Tyler

- IDP
- Ingersoll Rand®
- Ingersoll Dresser
- ITT Goulds
- KBL
- KSB
- Marelli
- Niigata Worthington™
- Nuovo Pignone
- Pacific®
- Ruhrpumpen

- Shin Nippon
- Stork
- Sulzer
- Sulzer Bingham
- Thyssenkrupp
- Union
- United
- Weir
- Wilson-Snyder®
- Worthington®
- Worthington Simpson™

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The Legacy API Pump Upgrade Expert

AESSEAL® is a leading global specialist in the design and manufacture of mechanical seals, bearing protectors and seal auxiliary support systems.

With operations on six continents, our growth has been fuelled by the delivery of exceptional customer service and market leading innovation that benefits our customers with improved plant reliability and peace of mind in a supplier they trust.

Utilizing finite element analysis (FEA), computational fluid dynamics (CFD) and our own in-house-developed predictive software tools, all of our seals are designed for manufacture on the latest 9 and 11 axis machine tools.

Over several decades, 7% of annual sales have been reinvested in R&D, leading to probably the most advanced range of sealing technology available globally.

AESSEAL® has a long and established expertise in supplying the oil and gas industry with leading sealing solutions. AESSEAL® has several thousand designs installed as retrofits to legacy pumps. These upgrade solutions are cost effective, simple to fit, do not generally require modification to the pump and, in many cases, can be performed during the routine maintenance planning cycle.

Our CAPI™ range of API seals have been qualification tested to API 682 so you can be confident that you are buying the very best.

Upgrade Project Example 3

USA owned refinery H₂S upgrade

At a refinery in the USA, 12 pumps were upgraded from single seals to dual seals. The dual seal upgrade program was driven by a need for compliance with the company's policy on pumps with H₂S. Pumps were upgraded without any modification to the pumps and use of Plan 53B auxiliary system. Conversion was across six bearing frames sizes from three legacy pump manufacturers. The pumps were originally installed in 1975.

High reliability - pumps and seals have now run for over eight years – only one pump has failed during this time and this was for a non-seal related incident.

Savings achieved - savings achieved in the conversion program were more than \$0.4m over the cost of purchasing new pump back pull-out bearing frames.





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AESSEAL plc is certified to:

ISO 9001, ISO 14001, ISO/IEC 20000, ISO/IEC 27001,
ISO/TS 29001, ISO 37001, ISO 45001 & ISO 50001



Net Zero champions globally



Use double mechanical seals with hazardous products.



Always take safety precautions:

- Guard your equipment
- Wear protective clothing

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