

Self-sealing fastening without chemistry

By John Arnold, sales and marketing director, APM Hexseal

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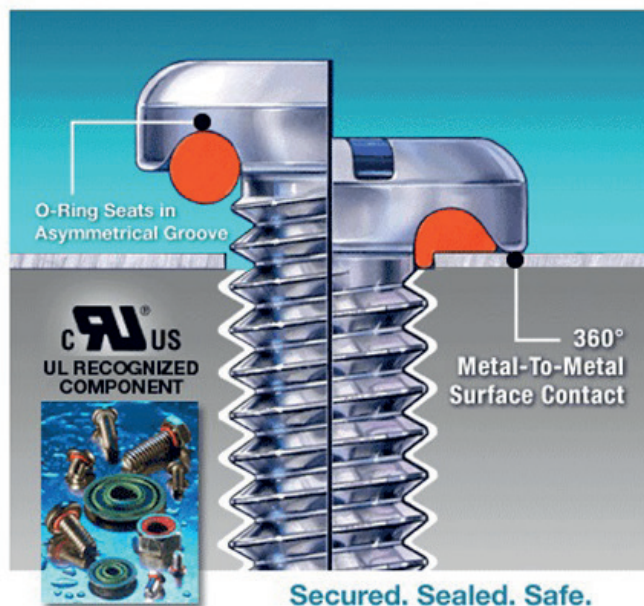
'Dry' embedded O-ring sealing fastener technology (with optional thread locking) and 'wet' liquid adhesive thread locking, have been the choices for pump manufacturers and users for more than half a century – wherever secure sealing under pressure as well as fastening has been required. Fluid/gas fastener leakage originating from within as well as preventing seepage from external contaminants, requires a reliable, adjustable sealing barrier – especially when field servicing and employee health are considered.

Every fastening assessment should include a review of the options against the following criteria:

- What psi/vacuum rating (internal/external) is considered operational, and what are the temperature conditions?
- What chemicals – including cleaning agents and lubricants – gas or other liquids will the fastener be exposed to?
- Will there be concern about field servicing, especially spare parts availability?
- Will there be any preference for either a liquid or dry mechanical sealing method during production?
- Will excessive vibration be a consideration – therefore requiring additional thread locking? If so, which method (liquid or dry) best addresses installation time, future maintenance and economic considerations?
- Will the fastening be done as part of a high-speed automated assembly operation, or will manual fastening be the rule?
- Will the main sealing concern be limited to installation, with little or no concern about warranty, or are there longer range potential maintenance considerations?

The 'wet' liquid method – best suited for large automated production applications – is typically an anaerobic adhesive/sealant used with other applied chemical(s). That's because most are designed as two-step processes involving prep and curing. These can be difficult to remove during field servicing, and can create possible environmental disposal issues of the chemical residues. This type of fastener replacement generally requires a new fastener and sealant re-application. Because these sealants are harsh chemicals, physical contact and inhalation of vapours can present a health hazard causing eye, skin and respiratory tract irritation, as well as environmental disposal problems. According to the NSF International (formerly the National Sanitation Foundation), which develops standards and criteria for health related equipment, products and services worldwide, these types of sealants should not be used where it might come in contact with food which could also be a problem with other materials and liquids. Applying the correct number of anaerobic drops and thread location is essential for sealing integrity.

The APM self-sealing screw/bolt 'dry' embedded O-ring method presents none of these problems and provides complete 360° metal-to-metal, full-clamping contact. That's because the O-ring, generally silicone rubber (A-A-59588, Class 3B, Grade 50), nests in an asymmetrical



'protective' groove located under the head of the screw and or bolt (see materials chart for other compatibility choices). This simple, safe technique results in maximum sealing to 20,000psig/vacuum which is able to sustain harsh environmental operating temperatures from -160°F to +500°F (-106°C to +260°C).

These stainless steel Series 300 fasteners can easily be reused multiple times without appreciable O-ring degradation, making it an ideal candidate for field serviceability. No chemicals are required as part of the installation process, therefore, no health issues. No assembly is required as fasteners are delivered pre-assembled. No special training required – just insert and torque. They also work well for bleeding applications. There's a wide choice of drive styles. The standard pan head, for example, is available from a #2-56UNC-2A to a 1/4-28UNF-2A, in lengths from 5/16 to 1 1/4 inches, metric pan head screws are available from M2 to M6 thread. When an APM SEELNUT® is used, a silicone insert is incorporated where the top 2 or 3 threads would normally be located. However, the insert already has its own threads on the I.D surface thus allowing maximum torque and sealing.

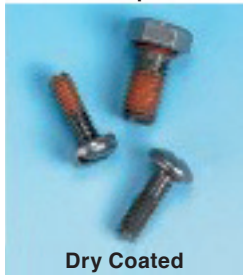




Pellet



Strip



Dry Coated

For extreme screw, bolt or nut vibration applications, there are several thread locking options offered; adjustable polymer (normally Nylon) embedded pellets; an adjustable polymer vertical strip, (both located in the lower half of the thread area). Alternatively, APM offers a pre-applied dry coating process which is fused to the thread surface. All options are adjustable while maintaining their full sealing capability. These vibration resistant fasteners are delivered pre-assembled so installation is a simple, one-step mounting procedure; either for initial or field servicing and no special prep or curing time is required. A wide choice of imperial and metric sizes and tamper-proof heads are offered.

For electrical enclosure applications and for liquid transmission system component sealing requirements, APM also offers various size self-sealing liquid-tight SEELOC® washers with

normal outside diameters of ½, 1 and 1½ inches, imperial 6 to ½ inch and metric M3 to M6 threads. They seal to 100 psi, and are constructed with a special profile silicone seal

moulded under high pressure to a 300 series stainless steel contoured disc that compresses to form a 360° seal including the inside diameter surface which further prevents thread leakage. SEELOC® washers mount easily with standard screws and bolts. All APM self-sealing fasteners and washers are a UL Recognised Component (UL Type 4X/6 enclosures) and are IP66/68 ingress rated, and RoHS Compliant.

APM self-sealing fasteners and washers can be found throughout many industries including gas and oil, marine and offshore, food and chemical processing plants and laboratories of all kinds, plus construction and mining; anywhere, indoors or outdoors, that require high pressure wash down and where exposure to the elements and extreme temperatures are present.



Various dry sealing fastening techniques

Embedded O-ring self-sealing fastener system vs O-ring, washer and liquid sealing technique

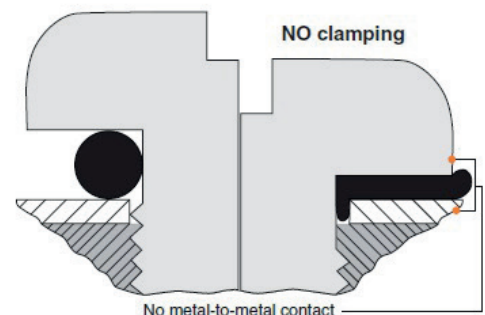
Two step O-ring technique

Action: Crush & fill

Results:

- NOT able to meet full torquing requirements without compromising seal.
- Contact surface has NO metal-to-metal contact.
- Inconsistent/low pressure sealing capacity and possible seal rupture.
- NO elastomeric flow-control.
- NOT reusable – high probability of O-ring damage.
- Two step technique requires stocking two separate parts and two SKUs.

POOR



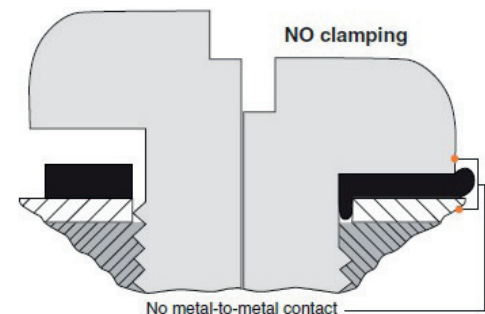
Two step washer technique

Action: Crush & fill

Results:

- NOT able to meet full torquing requirements without compromising seal.
- Contact surface has NO metal-to-metal contact.
- Inconsistent/low pressure sealing capacity and possible seal rupture.
- NO elastomeric flow-control.
- NOT reusable – high probability of washer damage.
- Two step technique requires stocking two separate parts and two SKUs.

POOR

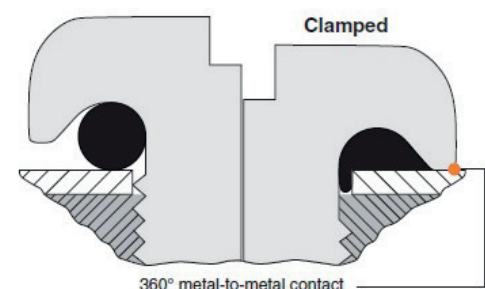


One step embedded O-ring in a groove technique **EXCELLENT**

Action: Predetermined size O-ring embedded in an asymmetrical groove. Partially compressed (20%) into countersunk threaded area.

Results:

- System allows full torquing with sealing integrity.
- 360° metal-to-metal head panel contact.
- Seals to 20,000 psig/vacuum against internal/external gas/liquid leakage.
- Multiple reusability due to minimum O-ring friction.
- Temperature range -160°F to +500°F (-106°C to +260°C)
- UL recognised, RoHS certified.



Elastomeric materials chart

Material	Relevant specifications	Service temp	RESISTANT TO				TYPICAL PROPERTIES			
			Ozone	Chemicals	Oil	Solvents	Tensile psi	Elongation %	Abrasion resistance	Compression set
Silicone rubber	A-A-59588 CLASS I&II GR 30-70	-94°F to 400°F -70°C to 204°C	Excellent	Good	Good	Fair	500-1800	100-800	Fair	Excellent
Silicone rubber	ASTM D1418 GR 30-70	-80°F to 400°F -62°C to 204°C	Excellent	Good	Good	Fair	500-1800	100-800	Fair	Excellent
Fluoro silicone rubber	MIL-R-25988 AMS 3326 GR 60	-78°F to 150°F -61°C to 66°C	Excellent	Excellent	Excellent	Excellent	2000-2200	300-400	Good	Excellent
Buna N (NBR)	ASTM D2000-90 M2BG714 GR 60	-65°F to 250°F -54°C to 121°C	Fair	Good	Excellent	Good	1500-3000	400-600	Good	Excellent
Neoprene (EPR)	MIL-R-3065 GR 60	-65°F to 300°F -54°C to 149°C	Good	Good	Good	Fair	1500-4000	100-700	Excellent	Good
Ethylene propylene (EPDM)	ASTM D2000-90 M3BA708 GR 60	-65°F to 300°F -54°C to 149°C	Excellent	Excellent	Poor	Good	1400-1600	500-600	Excellent	Excellent

Wet vs dry issues and benefits

	WET LIQUID METHOD	APM DRY METHOD
Prep and curing	Yes	No
Ease of field service	Hard	Easy
Environmental issues	Yes	No
Human health issues	Yes	No
Correct formula issues	Yes	No
Re-usability	No	Yes