
evolution

2021 Award Nomination

Title of Innovation:
EVOLUTION® - Isolation Gasket

Nominee(s)
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Category:
(select one below)
Materials Design

Dates of Innovation Development:
January 2013 to January 2020

Web site: www.gptindustries.com/EVOLUTION

Summary Description: Pipelines continue to change. Higher pressures, higher temperatures, more steam and more chemical additives are being used to extract deeper and more difficult-to-capture oil and gas. In addition, higher concentrations of sour gas are becoming more prevalent around the world and carbon capture/greenhouse gas emissions reduction efforts are an increasingly higher priorityTraditional glass reinforced epoxy (GRE) based isolation gaskets

have been used for over 30 years to control CP current and protect against galvanic corrosion of dissimilar metals. GRE, however, has had severe ill-effects from these processing changes resulting in failures that range from a loss of isolation to significant leaks and fires. EVOLUTION® has eliminated the most pressing issues oil and gas operators face when working with isolation gaskets by completely redesigning the gasket. EVOLUTION comprises a fully encapsulated 316 stainless steel core with a proprietary coating that exhibits the highest dielectric strength of any isolation gasket product. EVOLUTION provides oil and gas operators a fire-safe gasket that delivers the highest-pressure resistance, highest temperature resistance, greatest chemical resistance, and tightest sealing capabilities in the market, all while reducing the thickness of isolation gaskets to 1/8" to aid in installation and design. In addition to a longer service life, EVOLUTION can allow operators to consolidate inventories, reduce installation errors, and extend the life of mating equipment due to the superior design and construction of the gasket.

Full Description:

(Please provide complete answers to the questions below. Graphs, charts, and photos can be inserted to support the answers.)

1. What is the innovation?

EVOLUTION® is the first fully encapsulated isolation gasket with:

- The highest dielectric strength ever developed for an isolation product
- The highest-pressure capability of any isolating product ever developed
- The most chemical resistance of any isolation gasket ever developed
- The tightest seal of any isolation product ever developed

This product isolates flanges to prevent galvanic corrosion and to optimize cathodic protection systems. All previous technology is attacked by chemical additives, by sour gas, steam and high-pressure. This new design eliminates these past problems and specifically addresses several other significant issues that pipeline operators have expressed in recent years such as fire safety, simple installation and inventory consolidation.

2. How does the innovation work?

Isolation is critical to proper corrosion prevention regarding dissimilar metals and for the isolation of cathodic protection current. Traditional GRE (glass reinforced epoxy) gaskets are porous and allow water to enter the body of the gasket during hydrotest reducing the gasket's ability to isolate. GRE gaskets also have issues with chemical attack by steam, sour gas and some hydrocarbons and chemical additives. GRE is also attacked by higher temperatures (over 265°F for G10 and over 360°F for G11) and blows out at between 12,000psi to 20,000psi. EVOLUTION is chemically compatible with virtually all chemicals, is non-porous, and has been tested in high pressures up to 32,000psi. EVOLUTION is rated to 500°F and has more than 50% greater electrical isolating capabilities versus GRE products. EVOLUTION is also only 1/8" (.125") thick. Most high-pressure GRE isolation gaskets are .260" thick or greater making installation difficult and many are damaged during the installation process. Pipelines are typically designed using software that defaults to 1/8" thick gasket use, so stress/strain on the pipes are minimized with EVOLUTION and installation is much easier.

3. Describe the corrosion problem or technological gap that sparked the development of the innovation. How does the innovation improve upon existing methods/technologies to address this corrosion problem or provide a new solution to bridge the technology gap? -

Cathodic protection systems and dissimilar metal connections require the use of isolation gaskets and joints to properly control the electrical current within an appropriate section of piping. Isolation gaskets have been used for over 30 years and have been predominately comprised of either a phenolic material or a glass reinforced epoxy (GRE). Because GRE and/or phenolics cannot handle the high-pressure requirements involved in most pipeline applications, these materials are often laminated over a metallic retainer that must be properly selected for chemical compatibility with the media. In addition, GRE and phenolics are porous which allows leakage of the pipeline media over time, occasionally with substantial consequences including fires and explosions. Furthermore, these materials are often chemically attacked by the media and chemical additives, hastening the gasket's degradation.

In addition to structural and chemical deficiencies, current isolation gaskets are ¼" thick, whereas most pipelines are designed for gaskets that are 1/8" thick. This leads to difficulties during installation and quite often, improper installation of isolation gaskets which causes failures prior to ever experiencing actual pipeline operation. In fact, 80% of all gasket failures are due to improper installation. Many of these cases are because of gaskets that are thicker than the design calls out.

EVOLUTION addresses many technological gaps that are present within the flange isolation market:

- EVOLUTION utilizes a coating that completely encapsulates a base layer of 316 stainless steel. This proprietary coating has a greater than 50% increase in dielectric strength over existing isolation kits and it is compatible with all media that may be present within oil and gas pipelines. Because of this, proper material selection is obsoleted; A single material configuration can be utilized for every application. In prior technology, operators had to carefully select a range of materials to ensure chemical, temperature, and pressure compatibility. EVOLUTION's single material configuration allows for much simpler product selection and removes the inherent risk of selecting and installing an improper material combination for an application.

- Because it uses a metal core with no GRE or phenolic, and a metallic seal, EVOLUTION can handle higher pressures than any other isolating gasket and is naturally firesafe. Should a fire develop outside the flange where EVOLUTION in installed, the gasket will maintain its sealing capabilities until the fire can be extinguished, thus not allowing the often-flammable media to provide additional fuel.

- For installation ease, EVOLUTION is 1/8” thick so that is matches the designs of pipelines and facilitates a much simpler installation, making it less prone to failure due to installer error. Eliminating the use of pry-bars and flange-spreaders also increases safety for the installers as so heavy equipment should be necessary.

- Conventional gaskets place the sealing component up to 1” outside the inner diameter of the gasket/pipe meaning that media will sit between the gasket and the pipe flange. This media can cause electrical isolation failure and can lead to rapid flange-face corrosion. EVOLUTION utilizes a PTFE ID-seal that is designed to seal tight to the inner diameter of the pipe/flange. This prevents any potential buildup of media or solids.

- EVOLUTION seals more than 1,000 times tighter than existing isolation gaskets making it a perfect choice for companies wishing to reduce their carbon gas emissions. Through extensive testing, it has been determined that EVOLUTION demonstrates a leak rate of 1cc of helium every 3,000 years.

4. Has the innovation been tested in the laboratory or in the field? If so, please describe any tests or field demonstrations and the results that support the capability and feasibility of the innovation.

Put simply, the EVOLUTION isolation gasket is the most extensively tested product of its type ever. EVOLUTION has undergone 24 separate tests conducted by independent testing houses and through GPT’s internal testing facility. There are 7 additional long-term tests currently in process with industry-leading interim results. Testing has been broken down into five areas; Electrical, Environmental, Performance, Coating and the Shell type-acceptance Test (TAT) aimed to meet every potential scenario out in the field and in order to satisfy all applicable industry standards.

The tests performed include:

PERFORMANCE TESTING

- API 6FB Fire
- API PR2
- Bend
- Blowout - (Hydro)

- Chevron fugitive emissions
- Coating compression*
- Explosive decompression*
- Sealability
- Sour gas aging*
- VDI 2200*
- VDI 2440 - (TA Luft)*
- SHELL TAT TESTING
- ISO 15848-1
- DIN EN 13555
- HOTT
- HOBT
- 10 EN 13555
- ASTM F37-06
- ASTM F 607
- Electrical Isolation*

COATING

- Abrasion
- Adhesion
- Cross-cut adhesion
- Scratch
- Taber abrasion

ELECTRICAL

- ASTM D149
- Electrical VAC breakdown
- Electrical VDC resistance

ENVIRONMENTAL

- Salt fog spray
- Steam immersion*
- Sweet & sour gas
- UV*

*NOTE: Tests are in progress

The results of testing have been, quite frankly, outstanding. Here are some highlights;

COMMON EVOLUTION™ MATERIAL PHYSICAL PROPERTIES

ASTM	Test Method	Typical Values
D149	Dielectric Strength Volts/Mil (Short Time)	1,400
D229/D570	Water Absorption (%)	0.03%
ASTM D4060	Taber Abrasion	>1 GΩ @ 1000 VDC
Abrasive Wheel: CS-17 Load: 1000 g	Mass Loss [mg]	56
Number of Cycles: 5000 Platform Rotation: 72 RPM	Taber Wear Index	11.3
	Tensile Strength gasket (psi)	70,000
	Tensile Strength Dielectric Material (psi)	24,000
	*Temperature Range °F/°C	
	Minimum	-60°F/-51°C

B117	Salt Spray Resistance @ 5% salt solution with no red rust (hrs)	Maximum	500°F/260°C 2,000

EVOLUTION™ TEST RESULTS

Test	Value
Compression Test - EN 13555 @ 260°C	180 MPa (E_G)
Creep Relaxation Factor $P_{QR}(T_P)$ - EN 13555 @ 260°C	1.00
Hot Blowout Test - HOBT @ 260°C @ 62.3 bar	No Blowout
Shell Leakage Test - MESC SPE 85/300-3.3.2 @ ambient @ 81.9 MPa (gasket stress) @ 51 bar (test pressure)	6.48x10^-12 PA-m^3/s/mm Tightness Class A
Shell Leakage Test - MESC SPE 85/300-3.3.2 @ 260°C @ 81.9 MPa (gasket stress) @ 42 bar (test pressure)	3.08x10^-8 PA-m^3/s/mm Tightness Class B
Shell Cycle Test - MESC SPE 85/300-3.3.2 @ 260°C @ 81.9 MPa (gasket stress) @ <0.1 bar (pressure drop)	<0.1 bar (pressure drop)

To put these results and tests into context, EVOLUTION is the tightest sealing Isolating gasket ever tested achieving a Shell class A tightness, which equates to the release of ~1 cc of Helium every 3,000 years. EVOLUTION has the highest dielectric strength recorded in testing of any Isolation Gasket. EVOLUTION has been tested to the highest temperature and pressure rating of any isolation gasket previously constructed. Furthermore, the unique coating which encapsulates the gaskets has gone through similar rigorous testing. One such test was the ISO1518 Scratch Test. The test involves a tungsten carbide hemispherical stylus, which weighs 2000g, being placed on the product and scratching the surface until isolation is lost. GPT conducted the same test on two other industry coatings, a Fusion Bonded Epoxy and a Xylan™ coating. The Xylan coating failed after 2 passes. The fusion Bonded Epoxy failed after 90 passes. EVOLUTION successfully reached 1,400 passes, at which point the test was stopped.

A dedicated testing portal, which houses the testing reports and certifications is available on the GPT website. Access can be granted on request.

In addition to laboratory testing, EVOLUTION has been thoroughly vetted through in-field beta testing. 18 successful beta tests have taken placed globally, in a multitude of different sizes, pressures and applications, by the leading oil and gas operators including; Shell, Dominion, PG&E, Petronas, Marathon, Saudi Aramco, Williams and many more. Results of these tests are available on request.

5. How can the innovation be incorporated into existing corrosion prevention and control activities and how does it benefit the industry/industries it serves (i.e., does it provide a

cost and/or time savings; improve an inspection, testing, or data collection process; help to extend the service life of assets or corrosion-control systems, etc.)?

The use of EVOLUTION is very easily implemented into existing corrosion prevention and control practices. It has been common practice to use a gasket specifically designed for fire-safety in flammable services, a gasket specifically designed for high-pressures in more extreme pressure applications, a gasket specifically designed for high temperature applications, and a gasket specifically designed for chemical resistance in aggressive medias. This leads to an increase in risk of selecting and installing the wrong gasket and requires operators to hold substantial inventory levels to cover all possible applications. EVOLUTION can be installed in all these applications, so inventory costs are reduced and errors by installing the wrong gasket are eliminated. Perhaps more importantly, EVOLUTION provides a significantly longer service life than any other gasket and due to its design, it promotes longer service lives of its mating flanges and equipment. This longer life results in various operator cost savings including reducing unplanned shutdowns, reducing blowdowns, reducing product loss and reducing maintenance spend as well as reduced record-keeping, among others.

Is the innovation commercially available? If yes, how long has it been utilized? If not, what is the next step in making the innovation commercially available? What are the challenges, if any, that may affect further development or use of this innovation and how could they be overcome?

EVOLUTION was made commercially available on January 7th, 2020 and has been utilized since that time commercially by numerous oil and gas companies around the world. In addition, EVOLUTION was tested through beta-testing for six months prior to commercial launch at numerous oil and gas operators. The challenges related to further development for this product include:

- Size development: The product is currently available from ½" nominal pipe size (NPS) to 24" NPS. GPT Engineering is currently working on offering commercially available sizes up to 36" NPS.

- Pressure rating development: The product is currently available up to API 5K pressure rating and ASME 2,500# class. Engineering is currently working on offering commercially available pressure up to API 10K and then API 15K and ASME 2,500# class.

- Cryogenic testing development: The product is currently rated to -60F, however customers have expressed a desire to use this product in cryogenic applications in LNG. Engineering is currently working to have tests performed at cryogenic temperatures to extend the lower temperature rating of the product.
- Evolution has received American Bureau of Shipping (ABS) certification for shipboard use in corrosive applications.

6. Are there any patents related to this work? If yes, please provide the patent title, number, and inventor.

Yes.

Patent Number: D886253

Type: Grant

Filed: Mar 15, 2018

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Assignee: Garlock Pipeline Technologies (Wheat Ridge, CO)

Inventors: Christopher Remley (Wheat Ridge, CO), Aaron Alfano(Wheat Ridge, CO)

Primary Examiner: Amy C Wierenga

Application: 29/640, 610