INNOVATIVE ENGINEERING FOR CORROSION PROTECTION

For Zero Fugitive Emissions & Extreme Critical Sealing Applications
The VCS/VCFS systems use proprietary materials to address the regulations associated with fugitive emissions requirements that are closely monitored and highly sensitive to regulatory agencies today.
FEATURES
» Extreme, high-reliability sealing and electrical isolation solution for critical service applications
» Seals and isolates all pressure ratings through ANSI 2500 class and API 10,000 psi service
» Withstands severe service conditions including vibration, temperature and pressure fluctuations
» Designed to withstand corrosive environments, including high concentrations of CO₂, H₂S, produced water and aggressive inhibitors
» Good electrical isolation properties for cathodic protection
» Pressure-activated seals provide high confidence sealing, eliminates costly leaks and provides a solution for fugitive emissions
» Gasket is sized to the bore to protect flange faces from media-induced corrosion and flow-induced erosion
» Prevents turbulent flow at flanged connections
» Mitigates galvanic corrosion in dissimilar metal flanges
» High-strength laminate material resists failure due to excessive compression
» Available to match any flange specification (ANSI, ASME, API, MSS, BS, DIN, AS, others)
» Can mate mismatched RTJ with raised-face flanges
» Easy installation, make up and removal
» Sealing system is not sensitive to low bolt loads - providing reliable sealing through a range of bolt stress
» Gasket is self-aligning and centering - quick to install and no special tools are required
» Maintenance-free corrosion-resistant design is resistant to deforming under load
» Works in Ring Joint Flanges, reducing fluid entrainment, flow induced erosion and media induced corrosion between flanges
» Reusable by simply replacing sealing ring

APPLICATIONS
» H₂S Service
» High pressure flanges
» Critical service applications
» High pH Service
» Locations where one prefers an integral seal element
» A more convenient spiral-wound type gasket replacement

Before Tightening
The flange faces come into contact with the sealing elements, which extend slightly above the surface of the retainer. As the flange is tightened the sealing elements are compressed into the machine groove, developing an initial high unit pressure against the flange faces.

NOTE: Can work for ring joint flanges reducing fluid entrainment.

After Tightening
The flange faces come into firm contact with the retainer, thus compacting the sealing elements within grooves. At the same time, the unique VCS spring energized seal provides elastic memory for a polymer not normally associated with this characteristic - resulting in a simple flat gasket with extremely high loading and self energizing characteristics without adverse cold flow problems.

Sealing element may be positioned anywhere between the I.D. of the gasket and I.D. of the bolt circle depending on flange design.

NOTE: Can be custom made to order

High Integrity 316 Stainless Steel Metal Core
Stainless Steel Spring
Spring Energized PTFE Seal (Others Available on Request: FKM, ...etc.)
G-10 Reinforced Laminate (G-11 Available)

VCS Sealing & Isolation
VCFS Firesafe Isolation

VCFS FIRESAFE
» Based upon proven GPT VCS platform
» Provides complete flange electrical isolation
» Tandem seal technology
» PTFE sealing system has 20+ years successful track record
» E-Ring sealing systems is dual purpose fire safe and backup
» Passed API 6FB, 3rd Edition Fire Test
» Use in conjunction with cathodic protection systems
» Mitigates potential flange rotation
» Provides a tighter seal under low bolt loads

INTRODUCTION
The creation of the VCFS was driven by the demands of our customers who needed to electrically isolate their flanges but worried about the performance of non-metallic components in the event of a fire. This was especially a concern in the offshore market where the consequences of a fire on platforms are very hazardous and costly.

Additionally, the needs of users in piping and LNG applications, where the risk of a fire would greatly threaten life and property, drove the need for an electrical isolation seal that is fire safe per API 6FB.

DEVELOPMENT
Development of the patented VCFS took over three years in overcoming the many challenges involved. One major challenge was how to maintain bolt load during the event of a fire. This involved addressing the sealing mechanism itself as well as the isolating washers.

Extensive testing led to the use of a hardened Inconel E-ring to perform the secondary sealing after the PTFE seal had been melted by the fire. However, the E-ring compression was quite critical, and had to be mitigated to prevent excessive compression during the burn. This led to use of the back-up ring to precisely manage E-ring compression.

Another problem was that as metallic elements, neither the E-ring nor the back-up ring provided the required isolation properties. The solution was to employ a dielectric coating that would isolate and withstand compression of the flanges.

The result was the formulation of the proprietary X37 coating which performed admirably during testing and provided isolation even after three bolt-up operations to full torque levels.

The next challenge came due to the fact that standard G-10 Glass Reinforced Epoxy (GRE) washers degraded in a fire and lost bolt load, which resulted in the release of media in a fire. This led to the development of tandem Hardened Coated Steel washers that electrically isolate, yet retain bolt load in a fire.

The combination of these elements created a system that would both electrically isolate the flanges and pass the API 6FB Fire Test.

Before Fire

After Fire
API 6FB FIRE TEST

The API 6FB test requires that any sealing end connection hold for 30 minutes in a flame condition and then for a 60 minute cool down period. After the assembly is cooled to room temperature the line is de-pressurized and then re-pressurized. During all facets of the test the gasket must not exceed an API prescribed leakage rate.

The testing assembly included 6” Class 300 VCFS kits complete with sleeves and HCS washers, 6” carbon steel flanged blinds with a 2” bore and 1” pipe welded to the outside of the flanges at the bore complete with 1” end caps. Studs and nuts for the flanges, Grade A193-B7 and 2H respectively and two high capacity propane burners, six thermocouples and six calorimeter blocks.

After the 1” pipe was welded to each of the steel flange blinds, end caps were threaded onto each pipe end. Ports were created in one of the end caps to accommodate the necessary pressure equipment. The GPT VCFS gasket was installed between the flanges and the flanged assembly was made up with a torque value of 200ft-lbs using the appropriate star pattern.

After the flange assembly was completed a Megger® isolation testing device (model MIT 481) was used to validate the gasket’s isolation properties. The ISO isolation tester was set to the highest setting of 1000V DC and the isolation between the flange-to-flange connections was measured. The isolation between the flanges and threaded stud connection was then measured using the same setting; four different isolation measurements were taken for this test at the 3, 6, 9, and 12 o’clock bolt positions.

The two large propane burners were then put into place according to API fire test protocol. These burners were ignited manually and were used to provide the flame for the thirty minute burn cycle. The flame was controlled by a valve at the central computer location; this valve was used to regulate the propane flow into the burners. Chart 1 contains the temperature logging for the calorimeter blocks and thermocouples during the full 60 minutes burn and cool down cycle.

The leakage that occurred during the 120 minute burn and cool down cycle was calculated using readings that were taken by a differential pressure transducer. Water that was used for the testing media was stored in an 8 inch pipe with an inside diameter of 8.071 (20.5cm). Using basic volume calculations, volume loss per every inch (2.54cm) of water height was determined.

System pressure was another variable that was tracked during the API 6FB test. The protocol required that pressure be held constant during the 120 minute burn and cool down cycle. Since any water leakage in the system would result in an overall pressure loss, the pressure must be increased appropriately to maintain the average pressure specified by API 6FB testing protocol. Chart 2 shows the pressure versus time curve for this test.

For sizes below 6” on RTJ flanges and 2” on raised face flanges GPT has designed the single seal Firesafe isolating kit. The single seal utilizes the technology of the E ring to provide the seal and the 3X7 coating and the GRE laminate continues to give full isolation properties that are prevalent in the traditional GPT VCFS design.

The VCFS is also offered in a High Temperature design that utilizes G-11 Instead of G-10. This allows the seal to service higher operating temperatures up to 392°F.

65,000psi Compressive Strength gives the seal the ability to withstand the bolting and flange stresses

750-800 VPM Dielectric Strength shows that the kit has the capacity to meet the isolation demands

0.05% Water Absorption assures that the product will not suffer from the effects of ingress from media

50,000psi Tensile Strength gives the user the confidence that the seal has the ability to withstand the internal pressures

Most of the standard bolting lubricants are conductive so GPT developed a non conductive metal free grease called PikoLube in order to minimize the potential of resistance loss. GPT would recommend this lubricant for use on isolating systems and it has a friction factor of 0.15.

Unlike some suppliers GPT will not offer a product that does not conform to the highest technical standards. We are proud of our achievements in design and technology and will give the support and back up necessary to provide the most suitable products. In this regard GPT is unique in the industry.

*NOTE: The “FS” or “Fire Safe” designation denotes only that this gasket has successfully passed the API 6FB fire test. Due to the fact that every fire is unique and many uncontrolled variables are present, no other claims regarding suitability or performance in a fire are made. Each designer, user and/or operator will need to assess their individual situation when deciding to install FS style gaskets. Patent Pending.
**COMMON VCS MATERIAL PHYSICAL PROPERTIES**

<table>
<thead>
<tr>
<th>ASTM</th>
<th>Test Method</th>
<th>G-10 Epoxy/ Glass</th>
<th>G-11 Exopy/ Glass</th>
</tr>
</thead>
<tbody>
<tr>
<td>D149</td>
<td>Dielectric Strength Volts/ Mil (Short Time)</td>
<td>800</td>
<td>550</td>
</tr>
<tr>
<td>D695</td>
<td>Compressive Strength (psi)</td>
<td>65,000</td>
<td>58,000</td>
</tr>
<tr>
<td>D229</td>
<td>Water Absorption (%)</td>
<td>0.04</td>
<td>0.08</td>
</tr>
<tr>
<td>D257</td>
<td>Insulation Resistance Meg Ohms</td>
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<td>225,000</td>
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<td>Flexural Strength (psi)</td>
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<td>D638</td>
<td>Tensile Strength (psi)</td>
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<td>D732</td>
<td>Shear Strength (psi)</td>
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<td>Temperature Range (°F)</td>
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<tr>
<td></td>
<td>Temperature Range (°C)</td>
<td>-129 to 150</td>
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**VCS TEST RESULTS - TYPICAL**

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<tr>
<th>Test</th>
<th>VCS Value</th>
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<tr>
<td>Compression Test EN 13555 @ 150°C C</td>
<td>140 Mpa Gasket Stress</td>
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<tr>
<td>Creep Relaxation EN 13555 @ 150°C C</td>
<td>0.99 Relaxation Factor</td>
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<tr>
<td>Leakage Test EN 13555 @ 40 bar Helium @ 5 Mpa to 80 Mpa gasket stress</td>
<td>1.0 x 10⁻³ mg/m/s Leakage rate</td>
</tr>
<tr>
<td>Hot Blowout Test HOBT @ 151°C @ 165 bar</td>
<td>No Blowout</td>
</tr>
<tr>
<td>Shell Leakage Test T-2.232686 @ ambient @ 52 Mpa</td>
<td>4.2 x 10⁻³ pa-m²/s/mm Leakage Rate</td>
</tr>
<tr>
<td>Shell Cycle Test T-2.232686 @ 150°C @ 45.6 Mpa</td>
<td>&lt; 0.10 bar pressure loss</td>
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**ELEMENT TEMPERATURE LIMITS**

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<tr>
<th>NPS</th>
<th>150#</th>
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<td>625</td>
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<td>2263</td>
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<td>2263</td>
<td>5553</td>
<td>15686</td>
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**NOTE:** This torque chart is for B16.5 flanges only. The recommended max value is 30,000psi. Please verify that your preferred % of yield is not exceeded with these values. The values above are for temperatures at or below the gasket rated temperature.
VCS Flange Isolation Kits

DOUBLE WASHER SET
Double washer set flange isolation kits include the following components for each bolt:
Two - 1/8” thick steel washers
Two - Isolating washers
One - Full length isolating sleeve

SINGLE WASHER SET
Single washer set flange isolation kits include the following items for each bolt:
One - 1/8” thick steel washer
One - Isolating washer
One - Isolating sleeve

G-10 ONE-PIECE SLEEVE AND WASHER SET
One-piece sleeve and washer set flange isolation kits include the following items for each bolt:
One - 1/8” thick steel washer
One - 1/8” thick G-10 Washer
One - G-10 Isolating Sleeve

STEEL WASHERS
Steel washers are designed to fit over the isolating sleeve or the retainer ring on the one-piece sleeves and washers. The outside diameter is sized to fit within the bolt facing on ANSI standard flanges. They are made of 1/8” (3.2mm) thick plated hot-rolled steel. (Stainless steel available)

APPLICATION CONSIDERATIONS
Double washer configurations may be used for added protection against the possibility of “shorting out” the nuts and bolts. In addition, double washer sets electrically isolate the nuts and bolts from both flanges.

APPLICATION CONSIDERATIONS
In buried applications, single washer configurations may be used to allow the Cathodic Protection (CP) current to reach the nuts and bolts. If desired, nuts on the opposite side of the cathodically protected flange may be included as part of the CP system.

APPLICATION CONSIDERATIONS
Easier to install, one-piece sleeves also allow the inspector a visual indication of sleeve usage.

1/8” WASHER MATERIAL PHYSICAL PROPERTIES

<table>
<thead>
<tr>
<th>ASTM Test Method</th>
<th>G-10 Epoxy/Glass</th>
<th>G-3 Epoxy/Glass</th>
</tr>
</thead>
<tbody>
<tr>
<td>D149 Dielectric Strength Volts/Mil (Short Time)</td>
<td>800</td>
<td>550</td>
</tr>
<tr>
<td>D695 Compressive Strength psi</td>
<td>45,000</td>
<td>58,000</td>
</tr>
<tr>
<td>D229 Water Absorption %</td>
<td>0.04</td>
<td>0.08</td>
</tr>
<tr>
<td>Operating Temp °F</td>
<td>Cryogenic to +302</td>
<td>Cryogenic to +392</td>
</tr>
<tr>
<td>Operating Temp °C</td>
<td>Cryogenic to +150</td>
<td>Cryogenic to +200</td>
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SLEEVE MATERIAL PHYSICAL PROPERTIES

<table>
<thead>
<tr>
<th>ASTM Test Method</th>
<th>Mylar Epoxy/Glass</th>
<th>G-10 Epoxy/Glass</th>
<th>Nomex® Epoxy/Glass</th>
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<tr>
<td>D149 Dielectric Strength Volts/Mil (Short Time)</td>
<td>4000</td>
<td>800</td>
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<tr>
<td>D695 Compressive Strength psi</td>
<td>N/A</td>
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<td>D229 Water Absorption %</td>
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<td>Operating Temp °F</td>
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<td>Operating Temp °C</td>
<td>Cryogenic to +149</td>
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<tr>
<td>D790 Flexural Strength psi</td>
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<tr>
<td>Cut Through Resistance ft-lbs</td>
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Nomex is a registered trademark of DuPont
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<thead>
<tr>
<th>Quantity</th>
<th>Nominal Pipe Size</th>
<th>ANSI Class</th>
<th>Gasket Type</th>
<th>Gasket Style</th>
<th>For VCS</th>
<th>Washers</th>
<th>Washer Material</th>
<th>Sleeve</th>
<th>Gasket I.D.</th>
<th>Schedule Pipe Flange</th>
<th>Type</th>
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</thead>
<tbody>
<tr>
<td>Specify Below</td>
<td>Specify Below</td>
<td>150#</td>
<td>E = With Bolt Holes</td>
<td>VCS</td>
<td>Retainer</td>
<td>G-10</td>
<td>G-11</td>
<td>Double Washer</td>
<td>G-10</td>
<td>G-10</td>
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<td>300#</td>
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<td>600#</td>
<td>F = Ring Holes</td>
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</tbody>
</table>

**FOR FLANGE ISOLATION KITS OVER 24" IN ADDITION TO THE ABOVE PLEASE SPECIFY:**

- Flange Facing (Raised, RTJ, etc.)
- Flange I.D.
- Flange O.D.
- Flange Thickness
- Number of Studs/Bolts
- Stud/Bolt Diameter
- Stud/Bolt Hole Diameter
- Stud/Bolt Circle Diameter
- Nominal Bolt Diameter (Threads/Inch)
- Sleeve Length
- Pipe I.D.
- Steel Sleeve I.D. (For Concrete Pipe)
- Product in Line
- AWWA Class & Table (Or other similar std.)
- Internal Lining
- Warranty

**WARRANTY**

All products are warranted against failure caused by manufacturing defects for a period of one year. Any product found to be so defective and returned within one year from date of shipment will be replaced without charge.

The above warranty is made in lieu of, and we disclaim, any and all other warranties, expressed or implied, including the warranties of merchantability and fitness for a particular purpose, and buyer agrees to accept the products without any such warranties. We hereby disclaim any obligation or liability for consequential damages, labor costs or any other claims or liabilities of any kind whatsoever.

**Note:** Caution! Bolts with smooth shank portions may not fit within sleeves. Verify prior to ordering.

Flange Faces >250 Micro Inches:
For flange face surfacing greater than 250 micro inches, consult factory.
GPT WATER JET AND CNC MACHINES

GPT’s water jet machinery cut intricate parts with no heat-affected zone, distortion, or mechanical stresses caused by other cutting methods. In addition, they cut with a narrow kerf, to provide better usage of raw material. As a result GPT has the ability to provide more accurate gaskets, with more intricate shapes and possibilities without wasting raw materials. CNC machines cut precise dimensions to accommodate specific seal elements and gasket tolerances.

Typical Specifications

ALL CRITICAL SERVICE APPLICATIONS
Materials for sealing gaskets on pipes containing water, aqueous fluids, oil, sour or natural gas (up to 302°F, 150°C) consist of the following components:

ISOLATION AND SEALING GASKET
One isolating and sealing gasket, VCS Type “F”, 0.260” thick, 316 stainless steel core retainer laminated on both sides with a G-10 fiber glass reinforced laminate containing a precision tapered groove to accommodate the controlled compression of a PTFE spring energized seal. Sealing element placement shall accommodate either flat, raised or RTJ face flanges. The PTFE seal shall be spring and pressure energized. The G-10 retainer shall have a 800 volts/mil dielectric strength and a minimum 69,000 psi compressive strength. The I.D. of the flange isolating gasket shall matches the bore of the flange in which it is installed.

QUALITY
Isolation Kits are manufactured at a GPT facility that has a registered ISO 9001:2008 Quality Management System. Submittals shall include copy of valid registration. Performance suitability and material compatibility shall be determined by the user.

AVAILABILITY
Isolation Kits manufactured by:
GPT, Denver, CO, U.S.A.,
Telephone: 303-988-1242, Facsimile: 303-988-1922,
www.gptindustries.com e-mail: info@gpt.com

Extreme Critical Sealing for Industries

PRODUCTION FIELDS AND OFFSHORE
In gathering and injection piping, tank farms, oil and gas processing systems, and sour gas and water handling systems. Christmas trees, pumps, valves, and wherever it is important to guard against the loss of product.

PETROLEUM MARKETING FACILITIES
In terminal and tank farm piping, marine and airport fueling systems and other product handling facilities where it is essential to prevent loss of product or damage due to a flange leak or blowout.

LNG AND SNG SYSTEMS
For loading, unloading, liquefaction, regasification and processing of LNG, the production and processing of SNG, and wherever it is essential to provide a leak-proof flange for use from cryogenic to very high temperatures.

PIPELINE AND DISTRIBUTION PIPING
In compressor and pumping station piping, metering and measurement facilities, valves and other control equipment and elsewhere on a mainline piping system where a long-lasting, leak-proof flange is essential. In gas distribution piping - underground storage facilities, town border stations, industrial meter, regulator sets, and district regulators.

REFINERIES
In piping systems for heavy gasoline, caustic and acid based materials, carbon slurry, and wherever it is essential to protect plant and personnel from damage due to flange leaks or blowouts.