SIMPLIFICATION OF ISOLATION PRODUCT SELECTION THROUGH ADVANCED DESIGN

The standard for selection of a gasketing material has long been the "STAMP" acronymwhich stands for Size, Temperature, Application, Media and Pressure. By gathering this information around the installation point of the gasket, a gasket that should be suitable for the service would be obtained. Add to that for isolating kits the need to block electrical flow, most would simply select a gasket that is termed "isolating" and the selection process would theoretically be complete.

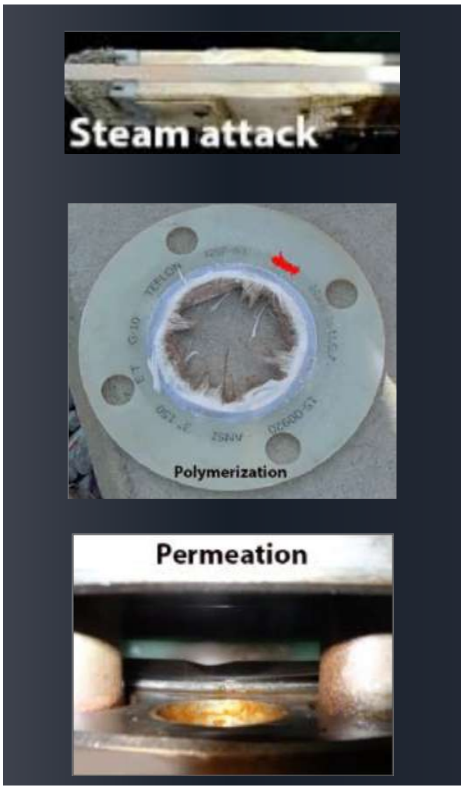
However, theory and practice often do not parallel each other and this is definitely one of those cases.

For "Size" the common practice would be to select the standard ANSI, API, DIN, AU, etc. nominal pipe size. For isolating purposes, more information would be required. The pipe schedule would be necessary as it is very important to match the exact pipe inside diameter, not the nominal size. The reason this is important is to eliminate any voids where conductive particles could collect. The system must be evaluated for the potential for conductive particles whether they might be from hot tapping the line to the formation of iron sulfide between the reaction of sour gas, water and the carbon steel in the pipe (see image). This also helps minimize the potential for cavitation and flange face erosion. For "Temperature" all materials that the isolation gasket is constructed of must be rated to the maximum temperature the application will experience. If one of the components is rated to a lesser temperature, the entire system is at risk. Similar to temperature, but not exactly the same conversation is "fire safety". If the pipeline is transporting a flammable material, the isolation kit should be rated for the temperatures and duration that would be typically experienced in a fire. The rationale is that an isolation gasket that is not fire safe in the event of a fire can leak and feed the fire with flammable product.

For "Application", the flange type and bolt types must be assessed. Is the gasket going into a raised face to raised face flange with B7 bolts and 2H nuts that are all in good condition? If so, the application is very straightforward and is relatively simple to select the proper isolation kit. If, the flanges are a raised face to RTJ (Ring Type Joint), then this information must be supplied to the gasket manufacturer as the sealing element may not land in a contact area of the mis-matched flanges and may not seal. The sealing elements must land on the raised surface of the raised face flange and also on the "non-groove" portion of the RTJ. This can be challenging especially in small diameter flanges, so it is necessary to work with the technical group of the manufacturer of the isolation gaskets to confirm the gasket type is compatible with the mis-matched flanges.

IRON SULFIDE

Not only must the gasket be compatible with mis-matched flanges, but it also must be galvanically compatible with exotic pipe/flange metallurgy. A GRE gasket with a standard 316SS core for example would need an Inconel 825 core if the pipe/flange metallurgy was Inconel 825. Another consideration for application is the amount of available space to install an isolation gasket. Many critical service isolation gaskets are somewhere between .260” (6.4mm) and .308” (7.8mm)thick. Gaskets of this thickness can be difficult to install when the available flange gap is let’s say .200” (5mm) wide. This can lead to damaged gaskets and flange faces during the attempt to install.



For “Media”, there are multiple nuances to contemplate. The general practitioner would simply look up the chemical or chemicals that would be in the pipe and look up the chemical compatibility with the isolating gasket product. If the resulting value was an “A” or “B” rating, then the gasket would likely be selected. The actual selection process is more involved as it is necessary to include any cleaning or biocide agents and to determine the chemical compatibility with the isolation gasket. It is also necessary to look up the temperature of the chemical and determine not only the chemical compatibility at that temperature, but to determine if the chemical is aqueous based and if so, does that temperature cause the chemical to revert to steam? If it does cause the chemical to generate steam, then the compatibility of the isolation gasket must also be compared to steam or even hot water. The typical isolation gasket comprised of GRE (glass reinforced epoxy) is not chemically compatible with hot water or steam due to a process called “hydrolysis” or the breaking of chemical bonds by water molecules (see image). If the media is a monomer (low molecular weight molecule that has a propensity to combine with other low molecular weight molecules (in this case ester links) to create repeating chain molecules (the process of polymerization)), then care must be taken in the selection of isolating gasket materials to prevent polymerization (see image). Another consideration for media is determining if the media is a liquid or gas and if it is a gas, what is the acceptability of permeation? The typical GRE gasket has poor permeation attributes. GRE is constructed of glass fibers and epoxy. The glass fibers are perfectly straight and give media (gas or liquid) the ability to move along the glass fibers and permeate from the gasket internal diameter (ID) to the gasket outside diameter (see image). GRE manufacturers have attempted to improve the permeation resistance of GRE products, but have been unsuccessful due to the nature of glass fibers.

The "Pressure" aspect appears fairly straightforward. If an isolating product is rated for up to 2500# class use, then it is often that simple. Where it can become more delicate is when the temperature rating of the application is near the upper range of the GRE material and/or the pressure range is near the top of the rating. Glass reinforced epoxy products often have a glass transition temperature (Tg) that can be approximately 50 degrees Fahrenheit or 10 degrees Celsius lower than the rated operating temperature. At high pressures, this combination can blow a GRE isolating product out due to the fact that the GRE is in a semi-solid state. When operating conditions for either temperature or pressure are nearing maximum values, it is advisable to contact the manufacture prior to using the GRE based gasket. When pressure AND temperature are nearing the maximum ratings, do not install the product until contacting the manufacturer.

Pressure does start to get complex when other factors start to be considered. For example, an isolating gasket may be rated to a certain pressure when the proper torque, proper flange conditions and application variables exist, but when these items start to decay through improper installation or torque values, rotated flanges or corroded flanges or thermal cycling, the pressure rating can also begin to decay. Pressure can also disqualify a gasket selection if the user has tight sealing considerations due to the increase in permeation with increased pressure. A tighter sealing product may be required in these instances.

The above STAMP process is what is normally undertaken when selecting any type of gasket. When selecting an isolation gasket, the electrical isolation properties must also be taken into account of course. Again, this is not as simple as it sounds. Many corrosion engineers use a 500 volts per mil (VPM) rating as a "go/no go" assessment for isolation products. This 500 VPM rating can be acceptable or it could be an issue. Most GRE products have at least a 500 VPM rating and in a dry condition are acceptable as an isolating product. Most GRE products also have a good water absorption value (typically between .01% and .02%). However, this is an ASTM D570 test and is simply an immersion in water with no pressurization. Many isolation gaskets will be isolation tested prior to hydrotesting a pipeline and will pass the test. However, after pressurizing the pipeline with water, the operator will find that an isolation test after hydrotest can show very low resistivity for the isolating gasket (see graph of Pre/Post Hydro). Additionally, there are isolation gaskets that have excellent dielectric properties in a dry state, but are constructed of hygroscopic meaning they absorb moisture. This is common for phenolic and fiber based isolation gaskets.

As you can see, selecting the proper isolation gasket can be much more complex than one would typically expect. This selection process has been simplified by a new, patent pending design for an isolating gasket. The design does not include GRE, but is constructed of a .125" (3.2mm) thick 316L stainless steel core coated with a very high dielectric coating (1,800 VPM typical). The coating is extremely chemically and abrasion resistant.

THE DESIGN HAS A REDUNDANT SEALING SYSTEM AND HAS SUCCESSFULLY PASSED API 6FB FIRE STANDARDS IN MULTIPLE SIZES/CLASSES.

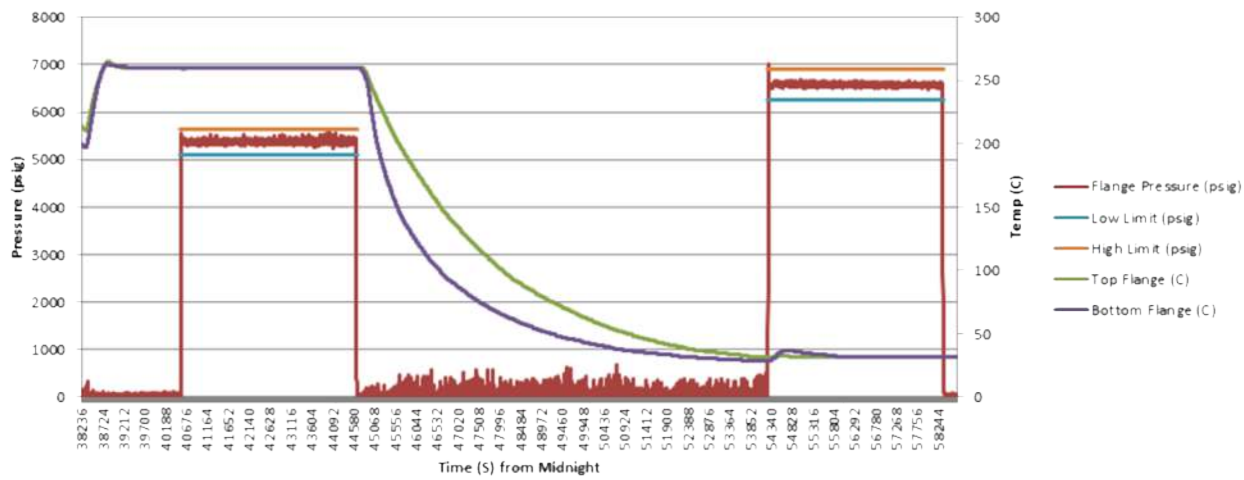
How does this new product simplify the STAMP gasket selection process?

For "Size" - The isolation gasket has been designed so that the retainer is the same regardless of class. The only change necessary is the primary PTFE sealing element width. The sealing element is machined to properly fit the pipe bore dimension after compression. This reduces manufacturing time and shortens lead-time.

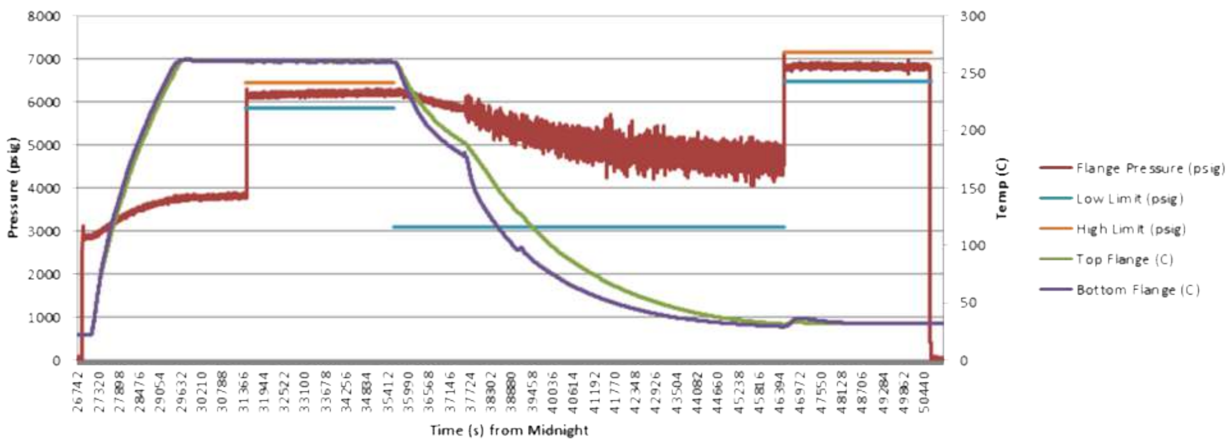
For "Temperature" – The materials of construction are all rated to at least 500°F(260°C) and the Tg is higher than this value. The only consideration beyond the gasket for temperature selection would be the sleeves and washers. The sleeves and washers should be selected based on their temperature rating.

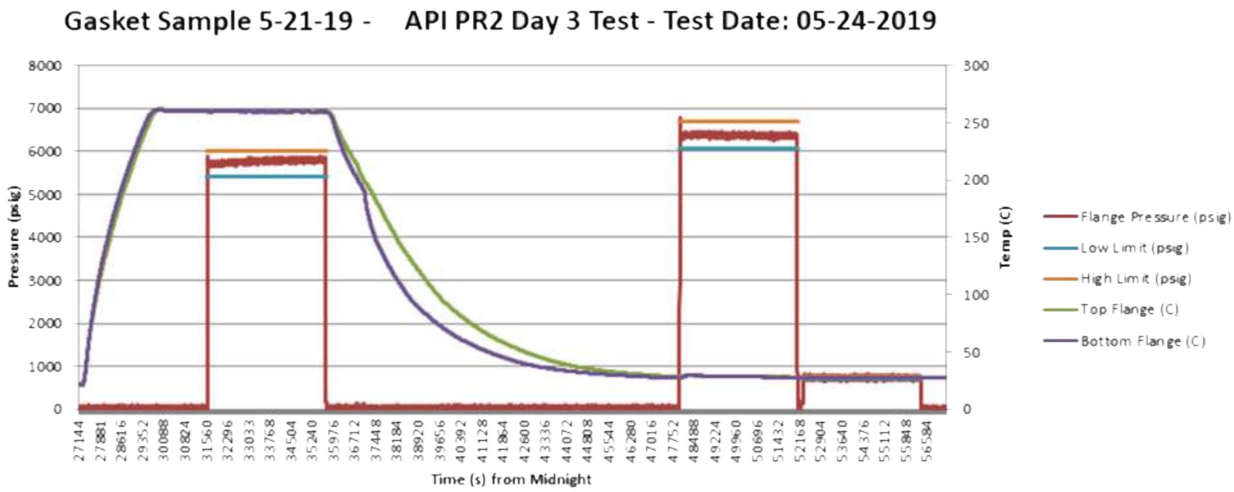
For "Application" – This design has successfully passed API 6FB in multiple sizes and classes. The coated metal core, restructured PTFE and metallic C-ring yield virtually no leakage and is excellent for pipelines that experience cycling applications as noted in the API PR2 results below.

Gasket Sample 5-21-19 - API PR2 Day 1 Test - Test Date: 05-22-2019

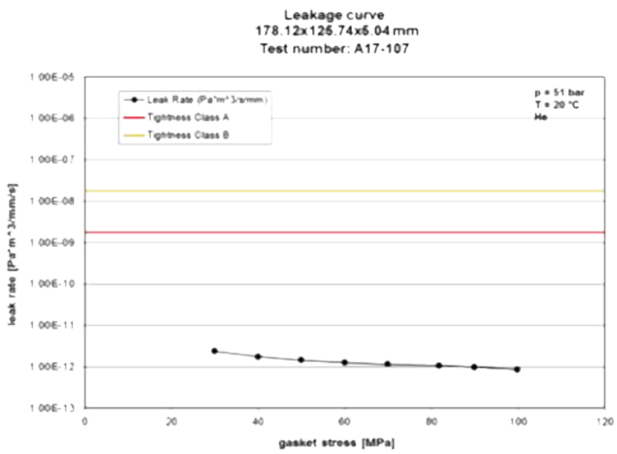


Gasket Sample 5-21-19 - API PR2 Day 2 Test - Test Date: 05-23-2019





Emission results from Shell TAT (Type Approval Testing) are extremely favorable due to the redundant seal design (see below results) the design passes the Type A Shell approval value by approximately 1,000X:



For “Media” – The material combination of this design is rated for use in sour gas, steam, hot water and many other chemicals that GRE based isolation gaskets are not rated for. It is not prone to hydrolysis.

For “Pressure” – The product has been tested at high pressures and the lowest pressure leakage was 28,000psi (1,930 bar) versus less than 15,000psi (1,034 bar) for metal cored GRE isolation products. The seal design is a pressure activated seal, so as the pressure is increased, the sealability is not significantly compromised and in some cases can improve.

Electrically, the new design has a typical dielectric value of 1,800 volts per mil and is hydrophobic in nature (repels moisture).

As can be seen, this new design dramatically reduces the selection process complexities and simplifies not only the selection process, but eliminates the need for various isolation products in oil and gas pipelines.