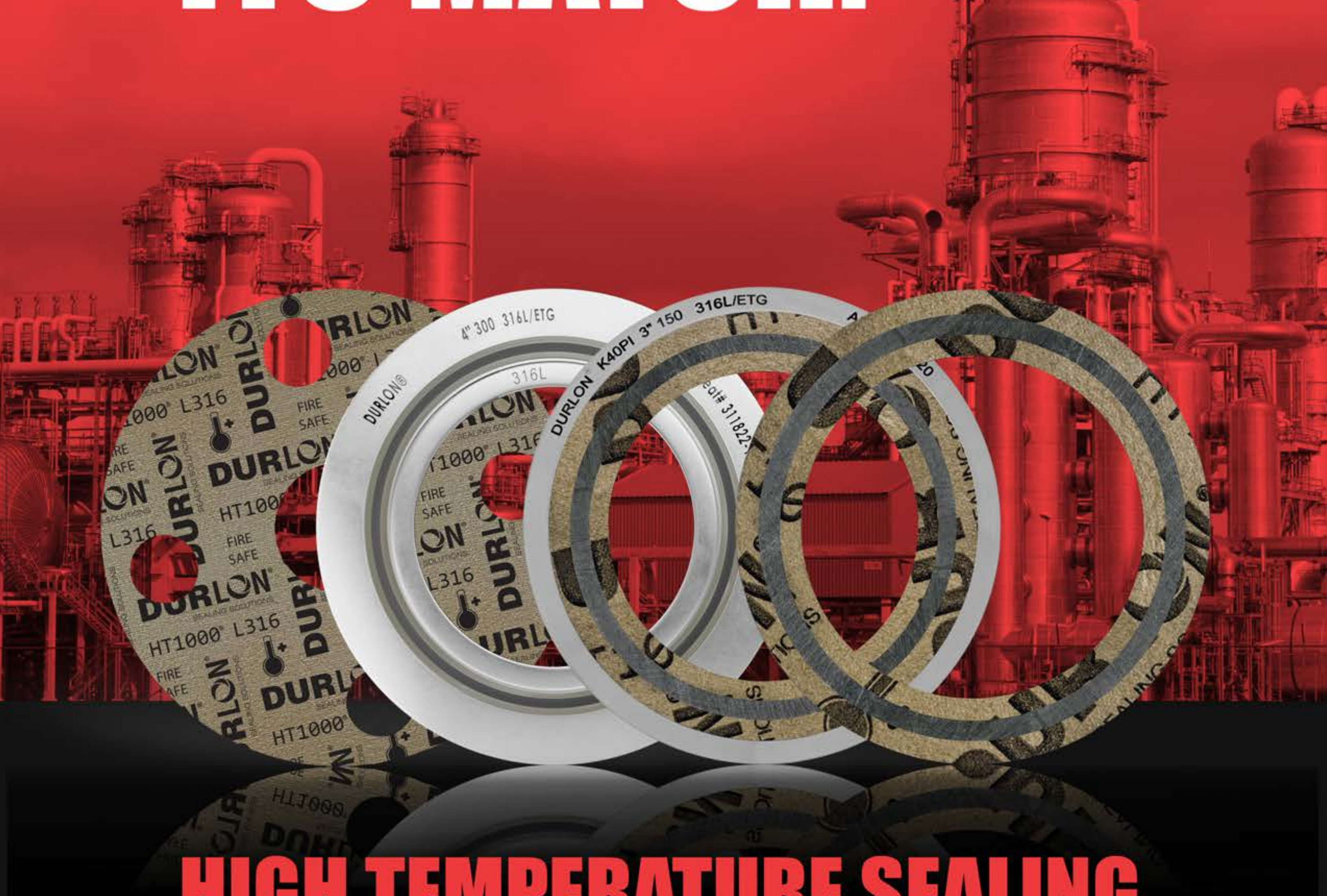
FIRE HAS MET ITS MATCH.



HIGH TEMPERATURE SEALING

Providing Solutions For Extreme Applications

DURLON®

PERFORMANCE IS KEY

When exposing industrial bolted joints to extreme temperatures and pressures, selecting the right gasket is crucial for ensuring effective sealing and longevity. Gasket temperature limits vary, with Phyllosilicate handling up to 1000ºC (1832ºF), Flexible Graphite up to 450ºC (850ºF), and Compressed Fiber up to 400ºC (750ºF). In high-temperature applications such as gas turbines, heat exchangers, and exhaust manifolds, Phyllosilicate gaskets are ideal due to their high tensile strength, low weight loss under extreme conditions, chemical resistance, fire safety, non-combustibility, and sustainability.

Phlogopite mica, a temperature-resistant phyllosilicate, offers superior weight retention and sealing performance at extreme temperatures. When impregnated with an inorganic binder, Phlogopite mica paper exhibits less than 4% weight loss at 800°C (1,472°F), making it suitable for applications requiring temperature resistance up to 1,000°C (1,832°F).

TABLE OF CONTENTS

Durlon® gaskets provide exceptional performance in extreme temperatures, maintaining stability, reducing leakage rates, and minimizing maintenance time, making them an excellent choice for industrial applications in refineries, power generation, and chemical industries.

DURLON®
SEALING SOLUTIONS

Durlon® DRI-ETG SWG

Durlon® Extreme Temperature Gaskets (ETG) have been engineered to provide the preeminent solution to sealing gasketed joints having exposure to high temperatures, typically greater than 650°C (1,200°F) and up to 1,000°C (1,832°F). At extreme temperatures, flange assembly torque retention is the key component to maintaining a tight seal. Durlon® ETG combines a oxidation boundary material with the excellent stability and sealing characteristics of flexible graphite in order to preserve seal integrity and to retain the initial assembly torque.

Durlon® ETG adds an inner and outer protection boundary in the form of a mica-phyllosilicate based sealing material called Durlon® HT1000® which consists of phlogopite mica paper impregnated with an inorganic binder at less than half the binder amount found in a typical vermiculite-phyllosilicate filled product. This lower binder content allows for superior weight retention and results in ultimate extreme temperature sealing performance.

The Durlon® DRI-ETG SWG is the Sealing Industry's current BEST AVAILABLE TECHNOLOGY for effectively sealing EXTREME TEMPERATURE APPLICATIONS.

For detailed information on the testing procedure and results of the API 6FB (Onshore and Offshore) Fire Test, please refer to page 9 for the procedures and protocols. Additionally, the results on page 10 provides comprehensive data and analysis from the conducted tests, offering valuable insights into performance metrics and safety standards.

Certifications	
Fire Test	API 6FB, Fourth Edition 2019, Type 1 (Onshore Test)
Fire Test	API 6FB, Fourth Edition 2019, Type 2 (Offshore Test)
Fire Test	API 607, 4th Edition with Exxon Modifications

Gasket Factors	G_b psi (MPa)	a	G_s psi (MPa)
Type DRI ETG	90 (.620)	0.590	0.1 (0.0001)

m & Y Factors	m	Y psi
Type DRI ETG	2.8	5,800

Style DRI:

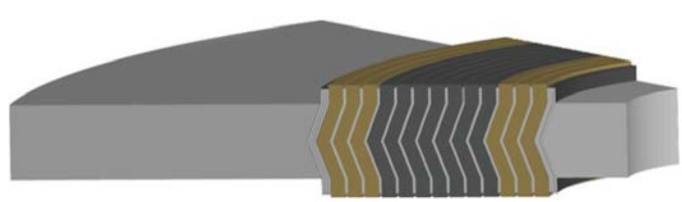
Sealing element (D) combined with a centering ring (R) and an inner ring (I) which improves radial strength and protects the sealing element from erosion and inward buckling

API 6FB Fire Test Type 2 (Offshore Test):

- Burn/Cool Down Duration: 60 min at an avg. pressure of 547psig
- Amount of Time of Avg. flame Temp. > 1093°C (2000°F): 30 min
- Allowable leak rate for 6" Class 300#: 24.0 ml/min
- Gasket Leak Rate during burn/cool down: 0 ml/min
- Gasket Leak Rate after Depressurization/Repressurization test: 0 ml/min

INDUSTRY APPLICATIONS:

- Exhaust Systems (Marine and Land-based, Automotive, Steel Industry)
- Turbochargers Equipment
- High Temperature Gas Boilers and Heat Exchangers
- Superheated Steam
- Oil and Gas Production and Burners
- Chemical and Petrochemical Processing
- Biomass Gasification Process
- Marine and Land-based Machinery
- Reactors and Power Generations
- Mineral and Fertilizer Processing



Durlon® Durtec® ETG

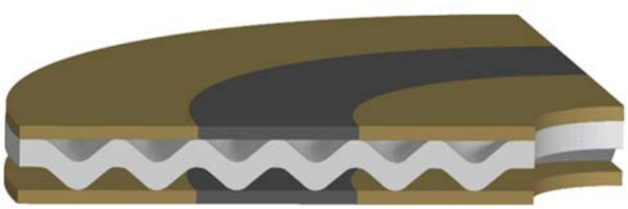
Durlon® Durtec® gaskets are made with a specially engineered machined metal core that is bonded on both sides with soft covering layers, typically flexible graphite. The core is produced by proprietary technology that allows the finished gasket to have the best possible mechanical support function. The Durtec® core is virtually uncrushable, unlike conventional corrugated metal core gaskets. The precision construction guarantees that Durlon® Durtec® gaskets will have excellent sealing characteristics even under low bolt loads.

The Durtec® ETG gasket is designed to withstand high temperatures and pressures, to be blowout resistant, to be fire safe, and to resist toxic and or corrosive chemicals for such applications as: pipeline flanges, valves, small & large pressure vessels, heat exchangers, towers, and tanks.

Durtec® is a registered trademark of Triangle Fluid Controls Ltd.

Physical Properties*	
Temp.: Min Max (material dependent)	-200°C (-328°F) 1,000°C (1,832°F)
pH range, Room Temp.	0-14
Pressure: Max, bar (psi)	430.9 (6,250)

**Depends on facing material and metallurgy of core.*
Note: Data shown is for Inconel 625 core with ETG covering layers.



CORE MATERIALS:

- Standard core material is 316 stainless steel with a nominal thickness of 0.125” (3mm)
- Other core materials including but not limited to: SS304, SS321, SS316Ti, Monel®, Titanium, Hastelloy® Incoloy 800, Incoloy 825, Inconel 625 & Alloy 20 can be manufactured to your specifications on request

INDUSTRY APPLICATIONS:

- Exhaust Systems (Automotive, Steel Industry)
- Industrial Boilers and Heat Exchangers
- Oil and Gas Production and Burners
- Turbochargers Equipment
- Superheated Steam
- Incineration Processes
- Chemical and Petrochemical Processing
- Marine and Land-based Machinery
- Process Drying Equipment
- Mineral and Fertilizer Processing

Certifications	
Fire Test**	API 607, 4th edition with Exxon modifications

***Durtec® gasket faced with flexible graphite passed modified API 607 fire test and meets the requirements of Shell Specification MESC SPE 85/203 & PVRC SCR Flexible Graphite Spec for FG 600 material.*

Durlon® K40-ETG Kammprofile

Durlon® Kammprofile gaskets have a solid metal core with concentrically serrated grooves machined into the top and bottom faces. The metal core is typically stainless steel, but it can be supplied in various metallurgies as per the customer's request.

The serrated core is covered with soft sealing material and is dependent on the service conditions of the system. Flexible graphite and expanded PTFE sealing layers are most common, but other products like HT1000® or (Extreme Temperature Gaskets) ETG's can be used as well. While providing the Durlon® Kammprofile gasket with excellent sealing properties, the soft sealing layers also fill in minor flange imperfections and protect the flange surfaces from damage.

Durlon® Kammprofile ETG gaskets are the preferred choice for high temperature applications requiring improved performance at low seating stresses. The serrated peaks provide reduced contact area and when combined with the soft conformable sealing layers, the Durlon® Kammprofile gasket provides a virtual metal-to-metal connection. They feature excellent resistance to blowout and provide superior stability for ease of handling and installation.

Durlon® ETG's engineered design principle is focused around providing oxidation protection zones around the central oxidation inhibited flexible graphite sealing component. Standard industrial grade flexible graphite typically begins to rapidly oxidize at around 650°C (1,200°F). By adding oxidation inhibitors to the graphite, the rate and amount of oxidation can be significantly reduced, thus extending the seal life of the material. However, oxidation can still occur and at extreme temperatures, it can be fatal to the integrity of the joint.

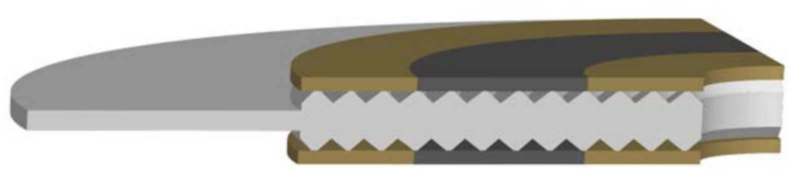
Physical Properties	
Temperature: Min Max (material dependent)	 -200°C (-328°F) 1,000°C (1,832°F)
Pressure, max, bar (psi)	414 (6,000)
pH range, Room Temp	0-14

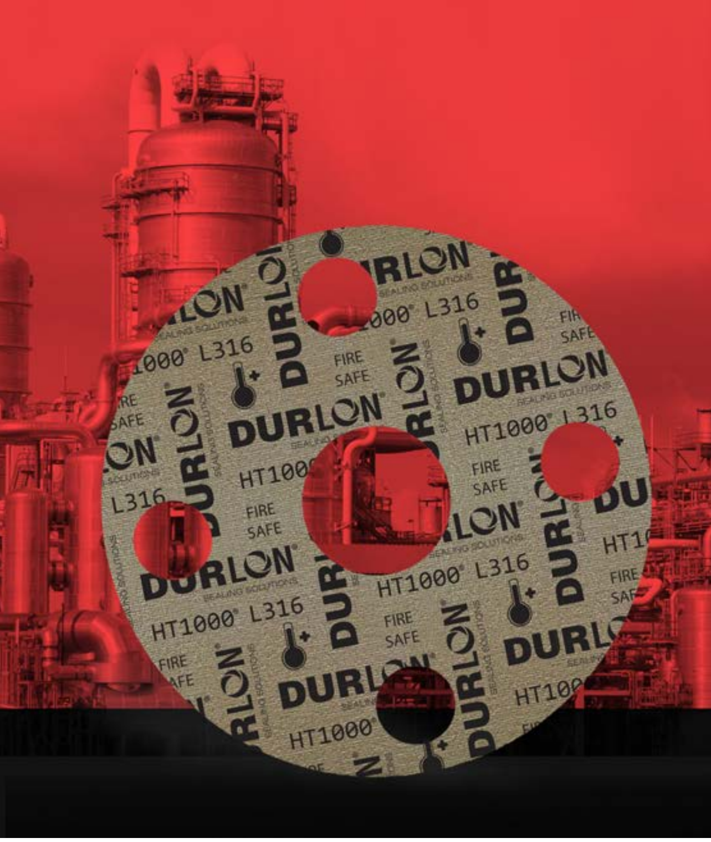
INDUSTRY APPLICATIONS:

- Exhaust Systems
- High Temperature Gas Boilers and Heat Exchangers
- Superheated Steam
- Oil and Gas Production and Burners
- Incineration Processes
- Chemical and Petrochemical Processing
- Biomass Gasification Process
- Reactors and Power Generation Plants
- Process Drying Equipment
- High Temperature and Strong Oxidizing Media

CORE MATERIALS:

- Standard core material is 316 stainless steel with a nominal thickness of 0.125" (3mm)
- Other core materials including but not limited to: SS304, SS321, SS316Ti, Monel®, Titanium, Hastelloy® Incoloy 800, Incoloy 825, Inconel 625 & Alloy 20 can be manufactured to your specifications on request
- Core material is generally selected in an identical material to the piping system in order to reduce corrosion problems





Durlon® HT1000®

Durlon® HT1000® consists of phlogopite mica paper impregnated with an inorganic binder at less than half the binder amount found in vermiculite-phyllosilicate filled products. This lower binder content allows for superior weight retention, less than 5% weight loss at 800°C (1,472°F), and results in ultimate extreme temperature sealing performance up to 1,000°C (1,832°F). Durlon® HT1000® characteristics allow for it to be used as a sealing material on its own or combined with various carrier media in heat exchangers, exhaust manifolds, and other equipment commonly found in the refinery, power generation, and chemical industries.

Phlogopite mica is a non-toxic naturally occurring hydrated silicate of potassium and magnesium with a lamellar and non-fibrous structure. It is flexible, has a high tensile strength, can withstand substantial mechanical pressure perpendicular to the lamellar plane, is chemically resistant, fireproof, infusible, incombustible, non-flammable, and is a known alternative to asbestos.

HT1000® is a registered trademark of Triangle Fluid Controls Ltd.

INDUSTRY APPLICATIONS:

- Exhaust Manifolds and Engines
- Boilers
- Reactors and Power Generations
- Chemical and Petrochemical Processing
- Process Drying Equipment
- Incineration Processes
- Power Generation
- Oil and Gas Production

Physical Properties - Style S90	
Color	Metallic Green-Gold
Material	Phlogopite Mica, 90% min.
Binder	Silicone
Temperature: Min Max	-55°C (-67°F) 1,000°C (1,832°F)
Pressure, Max, bar (psi) Style S90 Styles L316/T316	 5 (73) 40 (580)
Density, g/cc (lbs/ft^3)	1.9 (119)
Compressibility, % ASTM F36J	18-25
Recovery, % ASTM F36J	39-43
Volume Resistance, (Ω/cm) IEC 60093 @ 23ºC @ 500ºC	 ~10^{15} ~10^{10}
Weight Loss @ 800°C, % DIN 52911	 ≤5
Thermal Conductivity, W/(m.K) ASTM D5470-2017 @23ºC @600ºC	 ~0.20 ~0.30
Dielectric Strength, (kV/mm) IEC 60243	~14
Flamability rating UL94	V-0

The above table refers to Style S90 properties unless otherwise specified.

Certifications	
Fire Test	API 607, 4th edition with Exxon modifications
RoHS Reach Declaration	Compliant

Style: S90

Phlogopite mica paper impregnated with an inorganic binder and no carrier.

Style: L316

Phlogopite mica paper impregnated with an inorganic binder laminated with a 0.002” thick 316 stainless steel carrier.

Style: T316

Phlogopite mica paper impregnated with an inorganic binder laminated with a 0.004” thick 316 stainless steel perforated carrier.

HT1000® is a registered trademark of Triangle Fluid Controls Ltd.

Durlon® HT1000® Paste

High Temperature Sealing Compound

Physical Properties	
Temp.: Min Max	260°C (500°F) 1,000°C (1,832°F)
Curing Time Chart	
Temperature	Required Time
149°C (300°F)	4 Hrs
204°C (400°F)	3 Hrs
260°C (500°F)	2 Hrs
316°C (600°F)	1 Hr
371°C (700°F) or Higher	<1 Hr

Note: In high pressure gasket sealing applications or if ambient pressure testing is being performed, it is recommended that the HT1000® Paste be pre-cured with a heat source such as a heat gun or oven if available prior to putting the gasket into pressurized service.

STORAGE: Store in closed container in a cool, dry place (refrigerate for best shelf life). Keep away from open flames.

WARRANTY: The company assumes no liability for damage caused by this product other than purchase or replacement of this product. The responsibility for determining whether or not the product is suitable for use rest with the purchaser.

Durlon® HT1000® Paste is a sealing compound designed to be used in conjunction with our HT1000® sheet material specifically for large dovetail gaskets. The paste allows end users to create larger diameter gaskets using cost effective dovetail gasket segments. The HT1000® Paste allows end users to eliminate possible leak paths of traditional dovetail gaskets, while providing end users the one piece gasket construction and lower leakage rates similar to one-piece gasket.

AVAILABILITY: 170 g (6 oz) and 90 g (3.2 oz) containers.

PASTE USAGE GUIDE:

HT1000® Paste is designed for use with HT1000® dovetailed gaskets.

Recommended Amount:
5 grams (0.18 oz) per inch of gasket cross-section per segment.

Example Calculation:

- Gasket Size: 60” ID x 66” OD (Cross-section: 3”)
- Dovetails: 6 segments
- Paste Needed*: 5 g/in/segment × 3 in × 6 segments = 90 g (3.2 oz)

**Based on supplier input and internal experimentation.*

SHELF LIFE:

6 months in unopened container from the date it was packaged.

INSTRUCTIONS:

1. Make sure gasket segments are aligned and laying flat pre-assembled. Ensure that both the gasket and flange are free of debris, oils, and grease.
2. Open container of HT1000® Paste and apply a thin, even layer to the dovetail portion of the gasket, using a disposable brush or putty knife, smoothing out any uneven portions.
3. Assemble flange and tighten bolts according to gasket manufacturer’s recommendations (torque, bolt-up method, etc.).
4. HT1000® Paste will begin to cure in service (Please see applicable Curing Time Chart to the left).

API 6FB Fire Test Procedures

Fire Safety Tests and High-Temperature Gasket Performance Testing

In high-temperature applications, accurately assessing and comparing the performance of gasket materials presents a significant challenge due to the lack of standardized testing procedures. This gap underscores the crucial role of rigorous, application-specific gasket fire safety tests like API 6FB. These tests not only evaluate fire safety of the gaskets but also serve as a benchmark for measuring gasket performance under extreme conditions.

Understanding the API 6FB Fire Test

Type 1 (Onshore Test) vs. Type 2 (Offshore Test)

The American Petroleum Institute (API) has developed the API 6FB standard, a rigorous testing protocol that assesses the fire safety of flange gaskets used in upstream, midstream, and downstream applications. This standard is divided into two types of applications: Type 1 - Onshore, and Type 2 - Offshore.
In both tests, the gasket is installed in a bolted flange assembly. The flange is then pressurized to 550-570 psig and exposed to intense external flames for a total of 60 minutes. After cooling down and depressurizing, the gasket is repressurized to 550-570 psig. To pass the test, the allowable leak rate for both the burn/cool-down and depressurization/repressurization phases is 24.0 ml/min for 6" Class 300# gaskets. The primary distinction between them lies in the testing conditions and the intensity of fire exposure. Almost all fire safety tests are performed with 6-inch ANSI Class 300 gaskets.

As shown in Table 1, API 6FB Type 1 (Onshore) tests involve multiple burners with flame temperatures ranging from 1400 to 1800°F and a calorimeter block temperature of 1200°F. The test setup and the flame intensity are shown in Figure 1 (to the right).

API 6FB Type 2 (Offshore), recognized as the more stringent test, involves a single, more intense burner with flame temperatures between 2000 to 2500°F and a calorimeter block temperature reaching up to 1800°F. This test setup, and the flame intensity are shown in Figure 2 (page to the right).

The elevated requirements of the Type 2 (Offshore) test are designed to simulate the harsher, more unpredictable conditions typical of offshore environments, such as drilling rigs and platforms. This makes it a critical standard for equipment expected to withstand extreme scenarios.

TYPE 1 TEST SETUP PRIOR TO BURN

TYPE 1 TEST DURING BURN

Figure 1: API 6FB Type 1 (Onshore) Test Setup Prior to Burn (Top) and Test During Burn (Bottom).

Table 1. Temperature Differences in API 6FB test types.

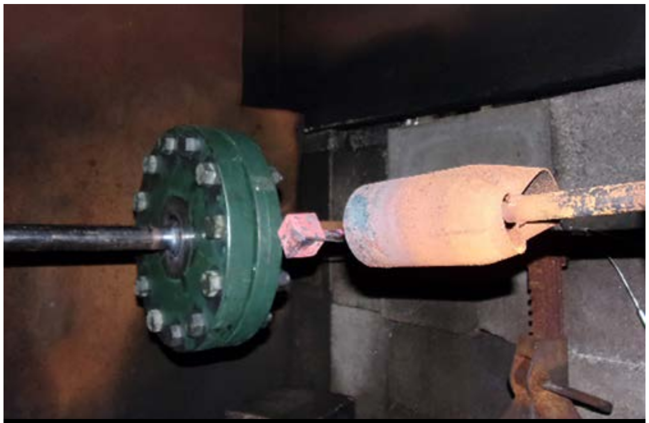
	Type 1 (Onshore)	Type 2 (Offshore)
Number of Burners	Multiple or widespread	1
Flame Temperature	760-982°C (1400-1800°F)	1093-1371°C (2000-2500°F)
Calorimeter Block Temperature	648°C (1200°F)	982°C (1800°F)

Unmatched Performance

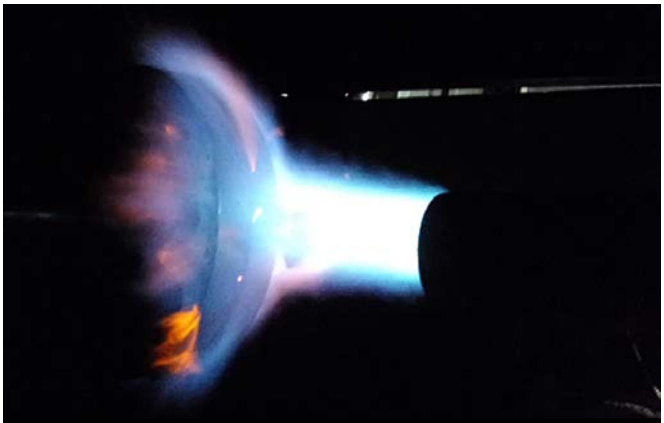
Distinguished Performance in API 6FB Testing - Type 2 (Offshore)

Durlon® SWG DRI-ETG sets a new industry precedent with its performance in fire safety tests. The API 6FB Type 2 (Offshore) test, recognized as the most stringent standard, challenges the gasket to perform under the harshest conditions, akin to those found in offshore oil drilling operations. **Durlon® SWG DRI-ETG not only passed this rigorous test but did so with zero leakage, an unmatched achievement among high-temperature gasket products on the market.** In fact, its performance in the API 6FB Type 2 (Offshore) test demonstrated zero leakage during both the Burn and Cool Down and the Depressurization – Repressurization Tests, a feat unprecedented in any competitor's Type 1 (Onshore) or Type 2 (Offshore) test report.

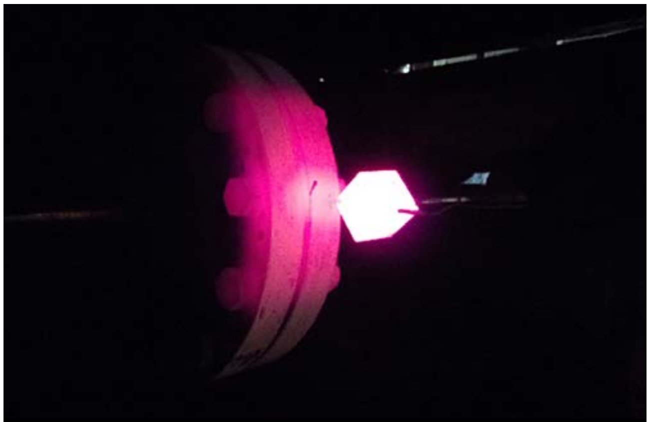
Notably, most gasket manufacturers focus almost exclusively on Type 1 tests, often avoiding the more demanding Type 2 tests due to their stringent requirements.



TYPE 2 TEST SETUP PRIOR TO BURN



TYPE 2 TEST DURING BURN



TYPE 2 TEST IMMEDIATELY AFTER BURN

These tests have been authenticated by Yarmouth Research and Technology (www.yarmouthresearch.com) and certified by a Professional Engineer, providing our customers the reliable information they need.

YRT Yarmouth Research and Technology

Figure 2 (refers to all 3 images above): API 6FB Type 2 (Offshore) Test Setup Prior to burn (Top Left), Test During Burn (Top Right) and Test Immediately after Burn (Bottom Left).

HT1000®
Superior Thermal Stability

Superior Material Quality - HT1000® Phlogopite Mica and APX2® Graphite

Poor thermal stability and excessive weight loss are common issues with gasket materials at elevated temperatures, which can compromise their structural integrity and sealing capabilities. A crucial factor in the success of Durlon® SWG DRI-ETG is its use of HT1000®, a high-performance phlogopite mica. This material has shown superior weight loss resistance at high temperatures compared to other fillers, such as those based on vermiculite and talc. The exceptional thermal stability of HT1000®, contrasted with vermiculite-based and talc-based fillers, is illustrated in Figure 3 (below). This characteristic ensures that the gasket maintains its integrity and sealing performance over time in high-temperature applications.

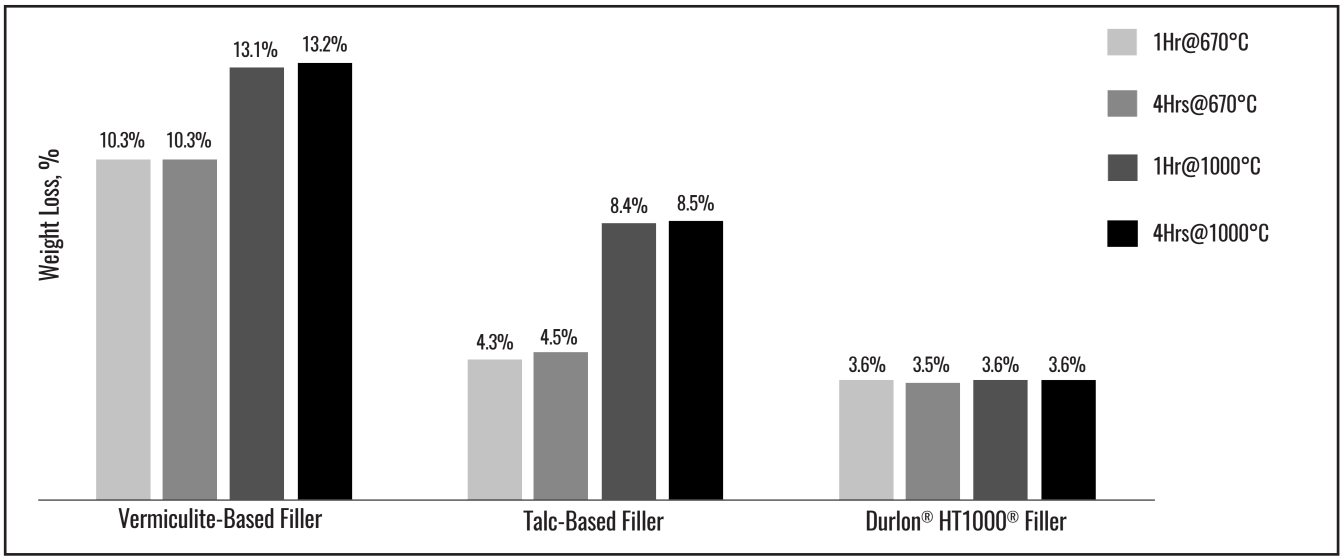
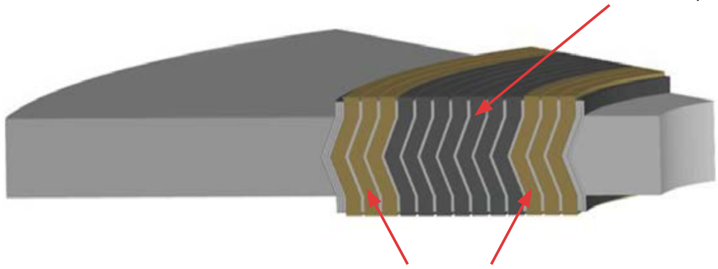


Figure. 3: Weight lost test results under various high temperature test conditions.

Another key component of Durlon® DRI-ETG SWG is SIGRAFLEX® APX2®, a homogeneous, highly oxidation-resistant flexible graphite gasket material produced by SGL Group. Made from high-quality expanded natural graphite, it is free from adhesives and binders, enhancing its purity and performance. Specifically developed for high-temperature applications, SIGRAFLEX® APX2® offers maximum protection against oxidation, ensuring greater reliability and an extended service life.

The combination of HT1000's thermal stability and superior insulation characteristics with the sealing performance of high-end APX2® flexible graphite enables successful and durable high-temperature sealing.

Of course, such achievements are only possible due to the precise engineering involved in the production of Durlon® High Temperature products. A schematic view of Durlon® DRI-ETG SWG is shown below.



Comprehensive Certification and Industry Recognition

Durlon® DRI-ETG SWG is the only high-temperature gasket to pass the API 6FB Type 2, API 607, and API 6FB Type 1 (Onshore) tests, demonstrating its superior fire safety and adaptability to various operational challenges.

Pioneering Heat Resistance

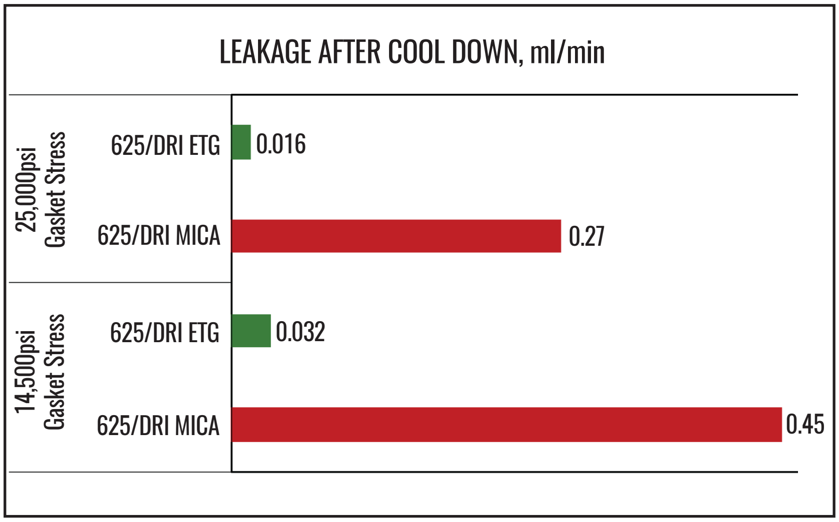
Custom High Temperature Testing

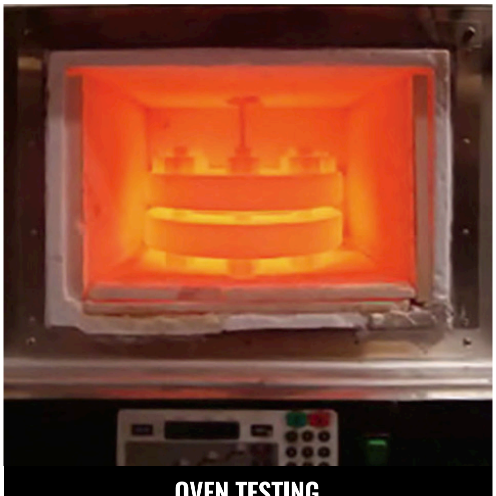
In this test, the nitrogen sealability of Durlon® DRI-ETG was evaluated under the most challenging conditions imaginable, where an entire pressurized gasketed flange was placed inside an oven and exposed to extremely high temperatures.
This method, unprecedented among gasket manufacturers, was designed to push the DRI-ETG gasket to its limits by subjecting the entire gasketed flange to severe heat and assessing its performance. Additionally, the test aimed to evaluate the ETG configuration and measure how well graphite improves sealability at elevated temperatures when thermally shielded by HT1000®.

Two types of 4-inch Class 600 Durlon® spiral wound gaskets were prepared for this testing procedure: one with the ETG configuration and one using only mica filler. The gaskets were tested at 14,500 psi and 25,000 psi gasket stresses according to the following procedure:

- The test assembly was calibrated for pressure drops versus volumetric leak rate.
- The assembly was pressurized with nitrogen to 150 psig, and leakage was measured.
- The entire assembly was heated in the oven to 1382°F and held for 24 hours.
- After stabilization, the leakage was recorded using the pressure decay method.
- The assembly was then cooled to ambient temperature and pressurized with nitrogen to 150 psig to measure the leakage one final time.

As shown in the chart below, the ETG configuration, consisting of high-temperature flexible graphite thermally protected by the high-performance HT1000® material, improved leakage performance by 14 to 17 times—a staggering enhancement.





OVEN TESTING

Conclusion: Leading Innovation in High-Temperature Sealing

Durlon's commitment to using high-quality materials such as APX2® high temperature flexible graphite and HT1000® phlogopite mica, combined with precise manufacturing processes, establishes Durlon® DRI-ETG SWG as a leader in sealing technology for high-temperature applications. Its unmatched performance in rigorous fire tests assures industry stakeholders of its reliability, making it the preferred choice for any high-temperature application. With the ever-growing requirements for safety and low fugitive emissions across the industry, Durlon® remains dedicated to providing innovative solutions that redefine safety and sustainability standards.

HIGH TEMPERATURE SEALING

Industrial sealing requires superior performing gaskets that can effectively retain their stability at high temperatures.

The importance of high-temperature sealing cannot be overstated, as failure in these seals can lead to catastrophic consequences, including equipment damage, safety hazards, and significant financial losses. Advances in material science and engineering have led to the development of seals capable of performing in increasingly harsh conditions, ensuring reliability and longevity. For instance, metal seals coated with special ceramics can endure temperatures well beyond 1000°C, while high-performance elastomers maintain their properties in environments ranging from cryogenic to extreme heat. Proper selection, design, and maintenance of high-temperature seals are crucial for ensuring the safety, efficiency, and longevity of high-temperature industrial systems.

For high-temperature applications, ensure your gasket is reliable and capable of delivering optimal results.
Trust Durlon® for high-performance gaskets that meet your needs.

DURLON®
SEALING SOLUTIONS