# Welcome to the Gore Fluid Sealing Specialist Training!

- Our program will begin shortly
- We are hosting this training remotely. We ask the following:
- All participants *will be on mute* until the end of the training session
  - Thank you!

# INTRODUCTION

GORE® Industrial Gaskets Fluid Sealing Specialist Training

2025

Together, improving life

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# Gore Industrial Gaskets Team



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## W. L. Gore & Associates — a Global Enterprise



Our promise

*Together, improving life* is the guiding light behind our Enterprise strategy



- Manufacturing in the U.S., Germany, U.K., Netherlands, Japan and China
- · Sales offices worldwide



Headquarters



unique inventions



Billion of annual revenues

### W. L. Gore & Associates — Globally recognized among 15+ Diverse Industries



Aerospace



Fire & Public Safety/Police



Oil & Gas



Apparel & Textiles



Industrial & Manufacturing



Power & Utilities



Automotive



Life Sciences



Semiconductor & Microelectronics



Chemicals



Military



Technology & Telecommunications



**Environmental Protection** 



Mobile Electronics



Test & Measurement

## Agenda

- **1.** Why is the right gasket selection important?
- 2. What is PTFE?
- **3.** What is ePTFE and how does it differ from PTFE?
- 4. Gore Gasket Overview
- 5. Standards/Dimensions
- 6. Application Help/Best Practices Training

# IMPORTANCE OF GASKET SELECTION & BEST PRACTICES

# Benefits of Designed Gasket Solutions:

Refinery study presented at 2019 ASME bolted Joint symposium



- Leaks waste time, money, and pose safety risks
- Magnitude of waste may be hidden as "business as usual"
- Solutions:
  - Engineered gasket materials
  - Best practices installation
  - More design margin

# Industry Study of Leak Incidents: What Happened?



# WHAT IS PTFE?

# Discovery of PTFE (polytetrafluoroethylene)

In 1938 Roy Plunkett discovered PTFE as an unintended consequence of a "failed" refrigeration gas experiment.

#### **Properties of PTFE**

#### Advantages for gasketing

- Chemically inert to nearly all media (pH 0-14)
- Wide range of thermal resistance:
   -269 °C to +315 °C (-452 °F to +600 °F)
- Non-aging, weather- and UV-resistant

Great for an industrial gasket!

#### Disadvantage for gasketing

Mechanically weak



Deforms excessively under heat and pressure



Roy Plunkett (on the right), reenacts discovery of PTFE powder with assistants Jack Rebok (left) and Bob McHaress

## Polymerization of Tetrafluoroethylene

- PTFE is produced by polymerization of a C<sub>2</sub>F<sub>4</sub> (tetrafluoroethylene) monomer to produce a very long chain macro molecule.
- The Carbon-Fluorine chemical bond is the strongest known producing superior protection against chemical attack.

But...

- mechanically weak and it creeps!

- Reason: No chemical cross-linking
  - Poor electrical attraction to itself

		ETFE	FEP/TFE/FPA	FLPE	FLPP	HDPE	LDPE	PC	PETG	РР	PVC	ТРЕ***
Acids, Dilute or Weak		E	Е	Е	E	E	E	E	G	Е	E	G
Acids, **Strong/Concentrated		E	E	G	G	G	G	G	N	G	G	F
Alcohols, Aliphatic		E	E	E	E	E	E	G	G	E	G	E
Aldehydes		E	E	G	G	G	G	G	G	G	G	G
Bases/Alkali		E	E	F	E	E	E	N	N	E	E	F
Esters		G	E	G	G	G	G	N	G	G	N	N
Hydrocarbons, Aliphatic		E	E	Е	G	G	F	G	G	G	G	E
Hydrocarbons, Aromatic		G	E	E	N	N	N	N	N	N	N	N
Hydrocarbons, Halogenated		G	E	G	F	N	N	N	N	N	N	F
Ketones, Aromatic		G	E	G	G	N	N	N	N	N	F	N
Oxidizing Agents, Strong		E	E	F	F	F	F	F	F	F	G	N
*Not for tubing chemical resistance (except PV <b>EXCELLENT</b> 30 days of constant exposure causes no damage. Plastic may tolerate for 30 years.	**Except for oxidizit     G     G     Little or no dam     30 days of const     to the reagent.	ood ood nage aft stant ex	See oxidizing er oosure	g agents, si So co rea str	me effec nstant ex agent. Th azing, cra rength or	FAIR t after 7 cposure 1 e effect acking, lo discolor	days of to the may be iss of ation.		NOT Immedi Depend effect n crackin discolo	RECO ate dama ling on the nay be see g, loss of ration, de	age may ne plastic vere craz strength eformatic	NDED occur. , the ting, or on,

https://www.pipelinepackaging.com/Images/uploaded/resources/PP-ChemRes-20Degrees.pdf

## When PTFE is used as a gasket, it creeps!



### Why is creep important?

- Material flow = creep
  - Creep is a result of material weakness
- Under pressure, material spreads out while getting thinner
- Creep increases at higher temperatures
- Creep <u>reduces sealing stress</u>  $\rightarrow$  leaks more likely

Different types of PTFE gasket materials:

### Generation 1



### Generation 2



# Different types of PTFE gasket materials:

Generation 1 skived PTFE

Generation 2 filled PTFE



Addition of filler does not significantly improve creep performance

# WHAT IS ePTFE?

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# Discovery of expanded PTFE (ePTFE)

In 1969, Bob Gore discovered how to expand PTFE. His expanded PTFE (ePTFE):

- maintained all key advantages of the base PTFE material
- significantly improved upon the mechanical properties of ordinary PTFE



Gore's ePTFE gaskets show only minimal creep after heat and pressure are applied.



ePTFE structure

# Properties of **<u>ePTFE</u>**

All of the properties of PTFE

- Chemically inert to nearly all media (pH 0-14)
- Wide range of thermal resistance
   -268°C to +315°C (-450°F to +600°F)
- Non-aging, weather and UV resistant
- Wide application versatility

# With significantly improved **mechanical properties**

### Three Generations of PTFE

Skived PTFE Generation 1



Filled PTFE Generation 2



### Expanded PTFE Generation 3



### "It's all about the Structure"





# Gasket Performance Benefits of **<u>ePTFE</u>**

Improved mechanical properties offer key advantages over other PTFE materials. GORE<sup>®</sup> Gaskets more reliably withstand the harsh environment of dynamically operated bolted flange connections:

- Highly conformable to achieve incredible tightness
- Capable of sealing damaged flange surfaces
- Resistance to creep and cold flow
- Superior blowout and high temperature resistance
- Longer service life without the need for retorque
- Superior reliability performance

# TYPICAL APPLICATIONS AND CORE MARKETS

# **Typical applications**

### **Applications that derive the highest value from GORE<sup>®</sup> Gaskets:**

- Industrial process equipment that requires a reliably durable seal for regulatory compliance or for operational efficiency.
- Processes using aggressive media or chemicals (e.g., sulfuric acid, chlorine, phosgene, isocyanates) that require the inert properties of ePTFE.



Strong acids; caustics; corrosives



• Anywhere seal failure would be dangerous and/or costly — needs the reliability of ePTFE.

### **Core Markets**



Chemical Process Industries





Mining & Metals

Pulp & Paper

# GORE® GASKET OVERVIEW

### All GORE<sup>®</sup> Gaskets are 100% ePTFE (expanded PTFE)

GORE® Universal pipe Gasket (Style 800)		<image/>	
	Mono-directional		
Typical use:	Typical use: up to 150 °C (300 °F) and 10 bar (145 psi) Outside this range: call Gore		
For flanges up to DN 800/32"	and custom gasket shapes		

## All GORE<sup>®</sup> Gaskets offer sealing advantages



Our high-performing industrial gaskets, and technical support, provide a proven and long-term reliable sealing solution, to:

- Reduce the risk of safety and environmental incidents
- Reduce unplanned maintenance costs
- Increase facility on-stream time

Gore gaskets come in the various shapes and forms to meet the customer's specific application needs.

# GORE<sup>®</sup> GR SHEET GASKETING

SUPERIOR RELIABILITY FOR THE PROCESSING OF AGGRESSIVE CHEMICALS

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# GORE<sup>®</sup> GR Sheet Gasketing

#### Unmatched sealing reliability for steel flanges, and strength to withstand aggressive fluids

- Superior resistance to creep and cold flow creates a wider margin of seal reliability — especially in thermal cycling and higher-temperature conditions.
- Highly conformable: compression creates an extremely tough gasket that seals tight, even on irregular flanges.

R Sheet Gasketing

asketing

Cut to any shape up to 1524 mm (60 inch) sheet size.



# For Steel Pipes & Equipment

- Pre-cut gaskets: Available for pipe sizes from all global standards
- Sheet form
  - Rapid customization on-site
  - Or by preferred supplier for custom sizes or flanges with complex geometries
- Key Features
  - Exceptional tensile strength
  - Outstanding creep resistance
  - Tight sealing



# Differences between skived/filled PTFE and GORE<sup>®</sup> GR Sheet



- No structure, just particles
- Particles don't add strength, easily move under pressure



 X-Y structure adds strength, improves <u>stability and reduces creep</u>

### Outstanding Creep Resistance of GORE<sup>®</sup> GR Sheet

Difference between leading PTFE options revealed by simple test:
5000 psi (34.5MPa) compression, 446°F (230°C), 15 minutes



# **Exceptional Tensile Strength**

- Indicative of product quality
- Mechanical strength is key to resist creep and cold flow.



Legend: ASTM F152, 3.2mm (1/8") sheet thickness

## Value of Creep Resistance

Increased creep (material flow) increases chances of leaking, which lead to:

- Unplanned downtime
- More frequent maintenance needs like re-torque
- Lost product or decreased operational efficiency
- Higher chances for safety incidences

### **Reduced creep = reduced chances of leaking for:**

- Reduced maintenance time
- Improved operational efficiency
- Improved safety margin

# Summary of GORE<sup>®</sup> GR Sheet

- All of the benefits of PTFE
- Plus: Bi-axial X-Y structure offers performance
  - Creep resistant
  - Conformable for tight sealing
  - Seal damaged flanges
  - Blowout and temperature resistance
- Available in sheet and cut gaskets
  - Standard ASME, EIN, and JIS sizes available in 1/16", 1/8", 1/4"
  - 60" x 60" sheet in 1/8", 1/4" allows for rapid gasket cutting and custom shapes

# GORE<sup>®</sup> UNIVERSAL PIPE GASKET (STYLE 800)

SUPERIOR RELIABILITY FOR THE PROCESSING OF AGGRESSIVE CHEMICALS

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#### How Does Your Plant Choose a Gasket?

#### Many factors to consider:

- Temperature
- Pressure
- Media
- Flange and bolt grades
- Reliability needs
- Availability/lead time
- Regular maintenance needs
- Outside recommendations/influences



### GORE<sup>®</sup> Universal Pipe Gasket (Style 800)

High performance and versatility enable a standardized gasket solution for use across steel, glass-lined steel and FRP flanges

- Unmatched sealing reliability:
  - highly resistant to creep
  - high temperatures and blowout
  - highly conformable to tightly seal irregular flanges.
- Select ring or full-face gaskets sized to DIN / ANSI / JIS standards, with special cut sizes also available.



### For Every Flange Type...









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### GORE® Universal Pipe Gasket Technical Innovation

- Conformable ePTFE core
- Added non-permeable barrier layer resulting in <u>lower stress-to-seal</u>
- Enables standardization at plants



#### Standardization on UPG delivers results for customers

- Reduce inventories up to 60% and carrying costs 20% 36%
- Lower risk of incorrect gasket installation
- Long-life performance

#### Use UPG to Standardize Across Flanges

- Prefabricated Gaskets
  - -Ring and full-face
  - -Custom sizes possible
- Global Piping Standards
  - -ASME
  - -DIN
  - -JIS
- Packaging Options
  - -Supplied in 5- and 10-pack options
  - –Bulk packaging in 50- and 100-packs
  - -Custom/large gaskets sold individually



#### GORE<sup>®</sup> Universal Pipe Gasket Summary

- Bi-axial expanded core delivers all the benefits of ePTFE
- Non-permeable barrier layer enables a highly versatile, <u>low stress to seal</u> gasket
- Significant performance for customers:
  - Compatibility with all flange types (FRP, GLS, Steel)
  - Standardize to reduce inventory
  - Reduced risk of improper gasket selection
  - Improved operational efficiency



#### FORM-IN-PLACE GASKET MATERIAL GORE<sup>®</sup> JOINT SEALANT SUPERIOR RELIABILITY FOR THE PROCESSING OF AGGRESSIVE CHEMICALS

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# Remarkably tight seal for moderately challenging and cost-limited applications

- The original form-in-place ePTFE gasketing.
- Versatile, cost-effective alternative to sheet gasketing for large equipment flanges.
- Reliably seals complex shapes and conforms extremely well to rough or pitted surfaces.

GORE® Joint Sealant

 Easy to install without the scrap of larger single piece gaskets







Best for moderate operating parameters

- Designed to form a thin, wide yet strong gasket.
- Easily installs on irregular surfaces.
- Can seal on pitted and corroded flange surfaces.
- Cross over style joint to complete the seal.



#### **Typical applications include:**

- Large Diameter Equipment Flanges
- Steel Tank Flanges
- Non-Metallic Flanges including Fiberglass, Graphite
- Elliptical Self Energizing Manways (Hand Holes)
- Equipment Access Doors
- Graphite Block Heat Exchangers
- Ductwork
- Pump Housings
- And many more!





# Tensile Strength of GORE<sup>®</sup> Joint Sealant Compared to Competition

- There are commodity Joint Sealants on the market
- Gore's tensile strength is significantly higher
  - Indicative of product quality and performance
- High tensile strength is key to resist creep and cold flow.



# GORE<sup>®</sup> GASKET TAPE SERIES 500

SAVES YOU TIME, MONEY, AND TROUBLE

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#### GORE<sup>®</sup> Gasket Tape Series 500

# Designed to save you time, money and trouble sealing large and irregularly-shaped steel flanges

- High-performance seal fits any shape instantly and reliably.
- Eliminates the need for, and costs associated with, traditional one-piece prefabricated gaskets.
- Outstanding mechanical properties and dramatically improved creep resistance for a very tight, long-lasting seal.
- Maximizes operational reliability of large steel pipe and equipment flanges, especially with thermal cycling.



### Unique Alternative - GORE<sup>®</sup> Gasket Tape Series 500





- Uni-axially expanded PTFE
- Forms thin wide seal
- Incredibly tight / low emissions

#### **Moderate operating parameters**

### GORE<sup>®</sup> Gasket Tape Series 500



- Bi-axially expanded PTFE
- Dimensionally stable
- Overcomes flange deviation

#### **Aggressive operating parameters**

#### GORE<sup>®</sup> Gasket Tape Series 500 Installation

- Spool format allows for fast installation, easy handling, customizable to any flange size
- Strong, bi-axial structure requires a skive cut to complete the seal
- Designed to form a tight seal which compresses into itself to fill heavily pitted flange deviation on steel flanges.



#### Video for Skive Cut

# **GORE® Series 500 Gasket Tape** Superior Tightness vs. One-Piece Gaskets



### GORE<sup>®</sup> Gasket Tape Series 500 Case History

- Large Diameter Flange Application Sulfuric Acid (H<sub>2</sub>SO<sub>4</sub>)
  - Flange has areas of deviation up to 0.040".
  - Current gasket leaking
- Previously used gasket material:
  - Commodity Joint Sealant
  - Filled PTFE multi-piece Gasket



### GORE<sup>®</sup> Gasket Tape Series 500 Case History

#### 15' Diameter Chlorination



Operating Conditions: 50psi, 450°F

Previous kammprofile gasket would no longer seal due to damaged, warped sealing surfaces

GORE<sup>®</sup> Gasket Tape Series 500 sealed the reactor. <u>Ease of installation</u> helped selecting the product

• Equipment > 80 feet off the ground!



#### GORE<sup>®</sup> Gasket Tape Series 500

Available in multiple widths, thicknesses and spool length (25' or 50') combinations

Width	Thickness
3/8″	
1/2″	
3/4″	1/8″
1″	-, -
1.25″	
1.5″	1/4″
2″	,
Products available in all thickness x width combinations. All parts manufactured to metric dimensions.	

### SEALING LARGE GLASS-LINED-STEEL (GLS) FLANGES GORE<sup>®</sup> GASKET TAPE SERIES 1000

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### GLS Traditionally Sealed with Envelope Gaskets



#### **External** environmental attack on core gasket material

#### Potential weaknesses of envelope gaskets:

- Porosity or small holes in PTFE envelope leading to chemical attack
- Loss of bolt load due to creep or hardening of fiber sheet core
- Can't accommodate large deviations
- Increased time, expense to manufacture/install large envelope gaskets easy to break

#### Typical Weaknesses of Traditional Materials





- Leakage / emissions
- Damage to glass

- Production downtime
- Risk to personnel safety

#### GORE<sup>®</sup> Gasket Tape Series 1000



The most reliable seal for  $\geq$  DN 600/ASME 24" glass-lined-steel (GLS) flanges

- Unique stress intensifier optimizes limited bolt force
- Highly-conformable, takes up deviations
- Form-in-place option for ease of handling and installation





#### GORE<sup>®</sup> Gasket Tape Series 1000

- 1. Highly creep resistant to maintain gasket load
- 2. Highly conformable to seal surface deviations
- **3.** Barrier core for extra sealing tightness at low loads
- **4.** 100% PTFE for chemical inertness across flange



### Reliable and long-term seal

- Barrier core concentrates stress, seals even highly permeating media
- Strong, bi-axial structure resists creep and bolt load loss
- Chemical protection across full flange width



Finite Element Analysis (FEA) model. Red indicates optimal sealing stress.



Cross section of GORE<sup>®</sup> Gasket Tape Series 1000 after service in challenging process conditions

#### Installation of GORE<sup>®</sup> Gasket Tape Series 1000

- Customizable to any large flange size
- Fast handling and installation speed
- Spool format = less waste and no risk of losing money by breaking gasket on install
- Easily installed with skive cut. Shim tape used for deviations > 1.7 mm



### GORE<sup>®</sup> Gasket Tape Series 1000: ideal for large GLS Flanges

- GLS is a critical/difficult application (Fragile flanges, Limited bolt force, aggressive media)
- Traditional seals have inherent weaknesses (chemical and environmental attack, unreliable sealing of surface deviations, high fabrication/installation cost)
- Gore<sup>®</sup> Gasket Tape Series 1000 solves these problems
  - -Unique stress intensifier lowers stress to seal
  - -Form-in-place for ease of handling and installation
  - –100% ePTFE, inert to nearly all media and seals deviations commonly found in GLS
- GLS portfolio: 1/4" thick UPG for small flanges, S1000 for large flanges

### STANDARDS AND TESTING

#### Flange Standards

Engineering standards for the design of pipe flanges

- Issued by organizations, either government or non-government USA: ASME – B16.21 and B16.47
  Europe: EN – 1514-1
  Japan: JIS B2220
- All are organized into pressure class or pressure number for designs at ranges of pressure

### How do ASME standard, GLS ID and Old ANSI differ?

#### Standard/ID Option ASME B16.21 EN 1514-1

#### Comments/Use

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- ID per applicable standard
- General use in steel flanges

#### Standard/ID Option ASME B16.21 / GLS ID

EN 1514-1/GLS ID

#### Comments/Use

- ID reduced to protect glass lining
- Best option for glass lined steel flanges

#### Standard/ID Option ASME B16.21 / NPS ID

#### Comments/Use

- ID equals nominal pipe size in inches ("old standard")
- Required for ductile iron pipe and other specialty applications



# Some sizes may not be available for some GORE® Gasketing products.

#### Dimensions applicable to:

- ASME B16.5 Pipe Flanges
- ASME B16.47 Series A, Large Diameter Steel Flanges

#### Tolerances

#### Inside Diameter:

For NPS 12 and smaller	±1.5 mm
For NPS 14 and larger	±3.0 mm

#### Outside Diameter:

For NPS 12 and smaller	+0/–1.5 mm
For NPS 14 and larger	+0/-3.0 mm

### GORE TECHNICAL SUPPORT

### Gore Technical Support

Gore's "Fitness for Use"  $\rightarrow$  ensure our products perform as we say they will.

- Gore can help with:
  - Product selection
  - Bolted flange models
  - On-site training
  - Training documentation
  - Data sheets











### Gore has Comprehensive Lab Capabilities to perform:

- Industry/Standards testing (i.e., EN13555)
- Product characterization
- Failure analysis

Gore has >50-year history with ePTFE gaskets, the expertise & resources to solve problems



#### **Gasket Installation Best Practices**

# Gasket selection is just one part of the equation

Best practices are critical to customers to:

- Reduce risk of leaks or safety incidences
- Save customer money
- Ensure product value is realized

And best practices trainings are <u>cheap</u> and <u>can be done virtually</u> or in person by a Gore associate.


### Engineered performance reduces risk

Improved chance of design wins and better position to defend business



#### Thank you for participating!

#### Future training sessions 2025 (EST)

- June 9, 2025 @ 8:30 10:00 am
- September 8, 2025 @ 11:30 am 1:00 pm
- December 8, 2025 @ 1:00 2:30 pm

To register for upcoming training sessions, click on <u>this link</u> to complete the survey and select the session that will work best with your schedule!

# Gore® Industrial Gaskets Team



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## CONCLUSION

## OBRIGADO GRACIAS THANK YOU 고맙습니다 ありがとう 谢谢



Together, improving life