



## VALVE AND PACKING DEVELOPMENT TESTING

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Sealing for a Safer and Greener Tomorrow

# Agenda

- 1. Introduction**
- 2. Minimum Seating Stress**
- 3. Packing Drag and Force Transmission**
- 4. Thermal Expansion**
- 5. Corrosion Test**
- 6. Fugitive Emission Test Rigs**
- 7. Conclusions**

# Introduction

## Low Emission Packing Design

**Testing Devices: Simulate actual field conditions**

## Parameters that influence performance

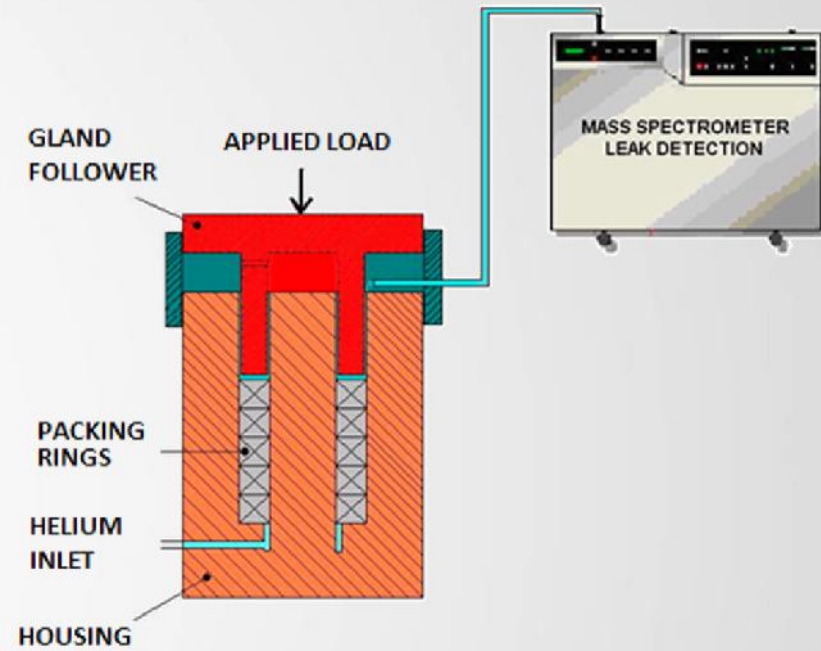
**Seating Stress**

**Number of Packing Rings**

**Stem x Packing Friction**

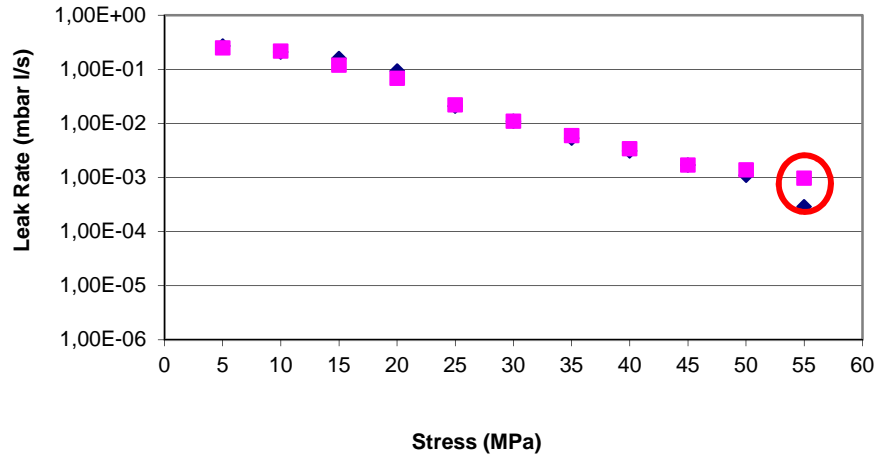
**Thermal Expansion and Contraction**

# Packing Minimum Seating Stress

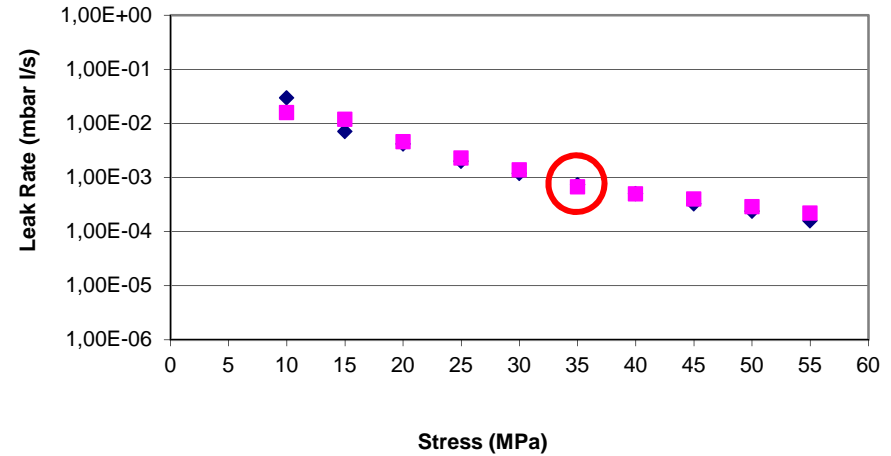


# Packing Minimum Seating Stress

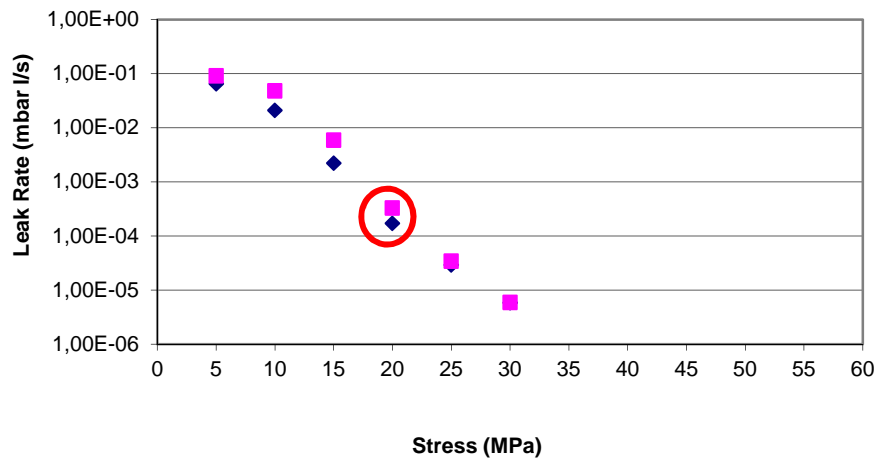
Ni-Cr Wire Mesh Reinforced Yarn Flexible Graphite Packing  
(no impregnation)



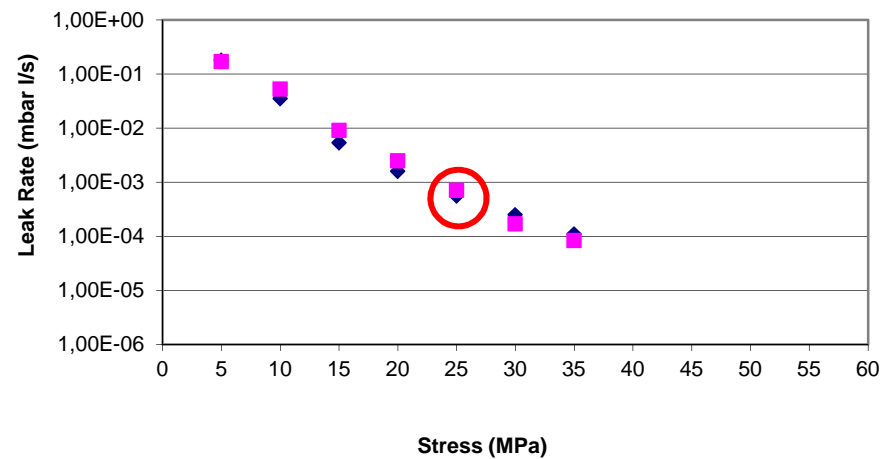
Ni-Cr Wire Reinforcement Flexible Graphite Packing



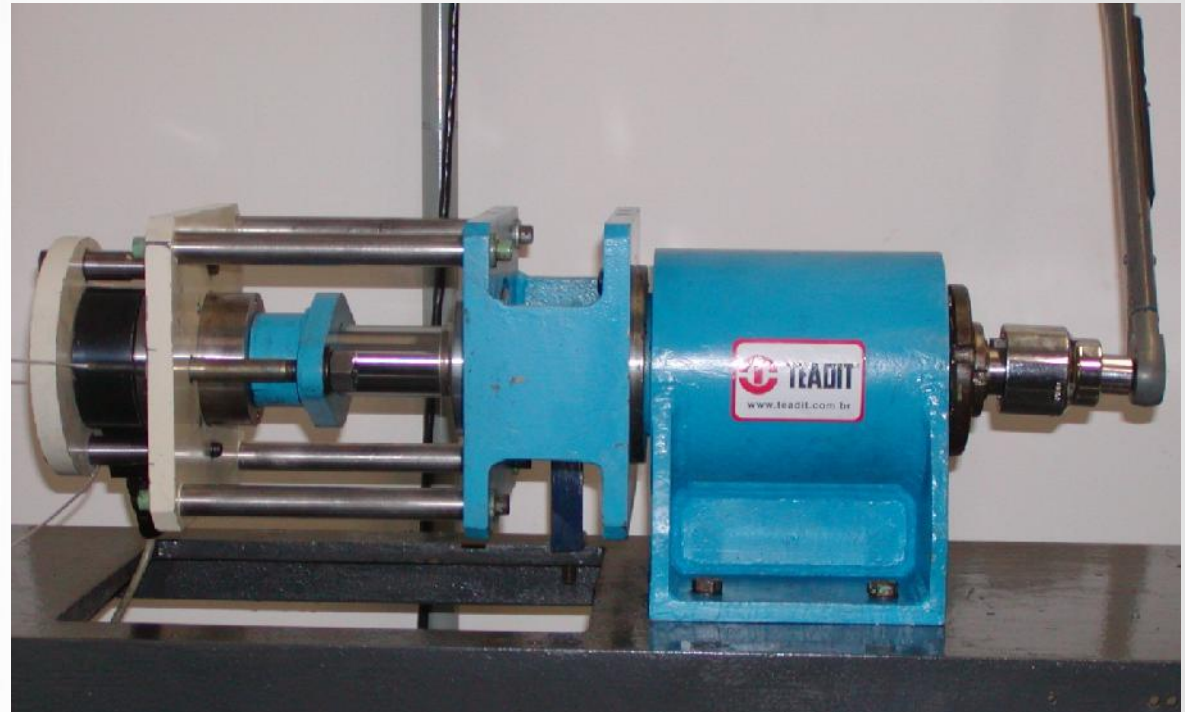
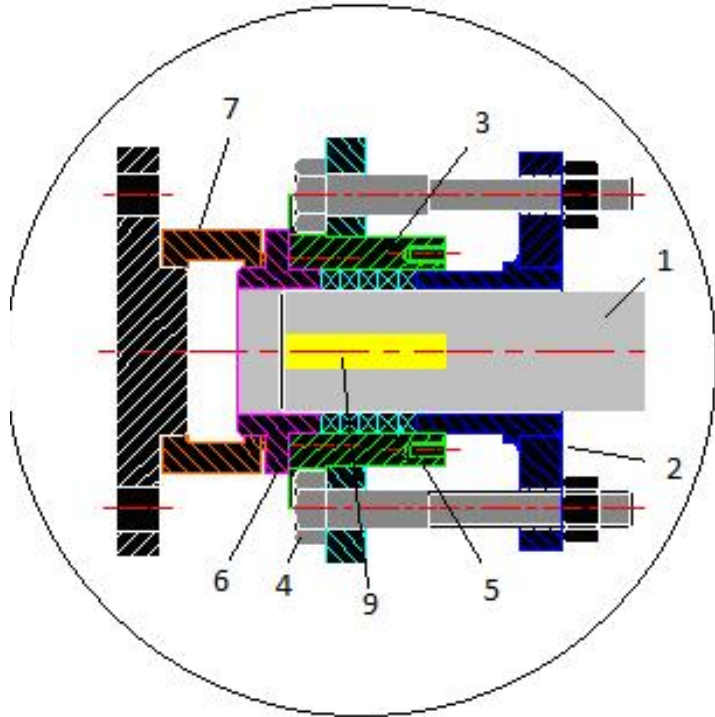
Carbon and Flexible Graphite Packing with Graphite  
impregnation



Expanded PTFE filled with Barium Sulphate Packing



# Packing Drag, Force Transmission and **Thermal** Expansion



1 – Stem

2 – Gland

3 – Bonnet

4 – Internally Gaged Bolt

5 – Packing

6 – Bushing

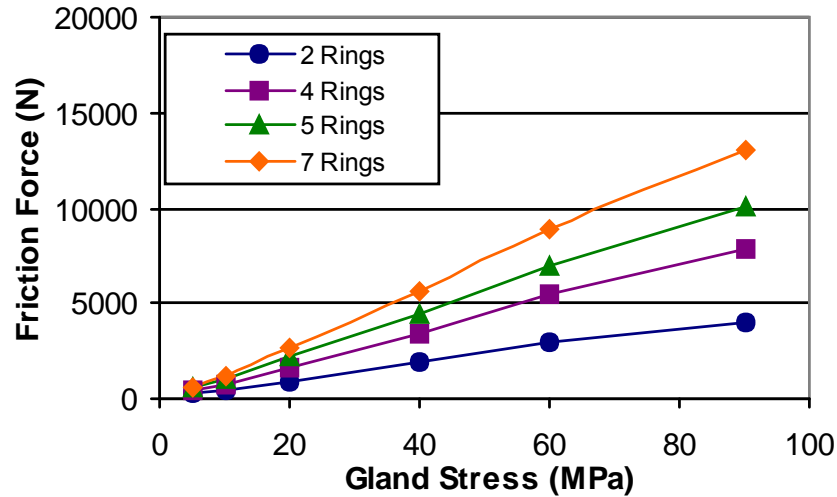
7 – Load Cell

8 – Load Cell Base

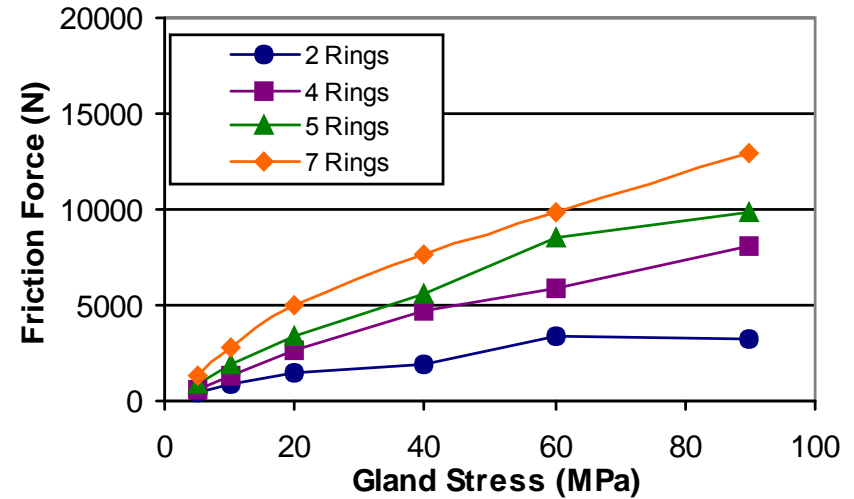
9 – Electrical Resistance

# Packing Drag

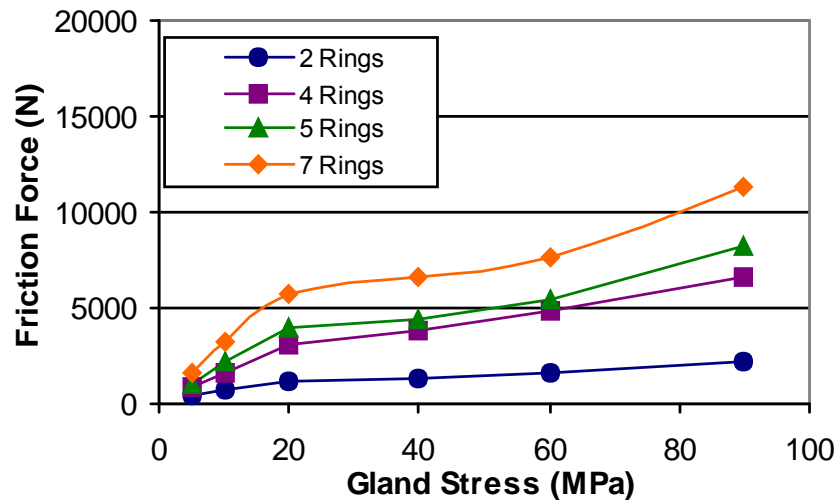
Ni-Cr Wire Mesh Reinforced Yarn Flexible Graphite Packing  
(no impregnation)



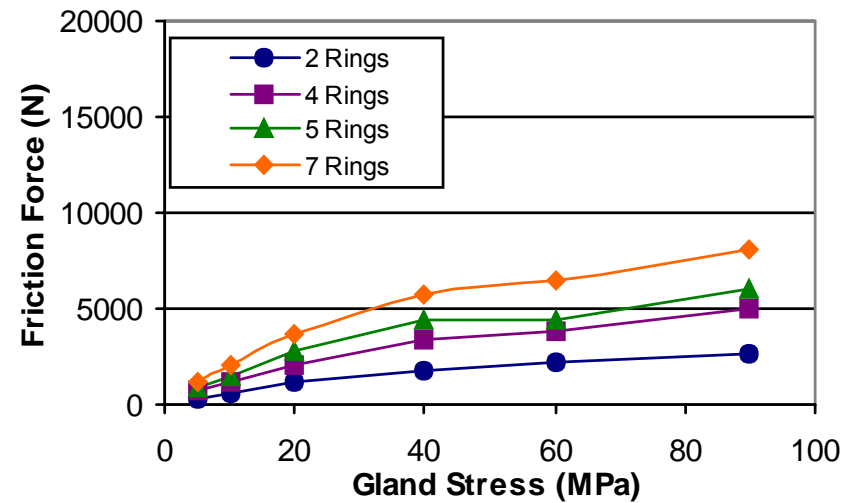
Ni-Cr Wire Reinforcement Flexible Graphite Packing



Carbon and Flexible Graphite Packing with Graphite impregnation

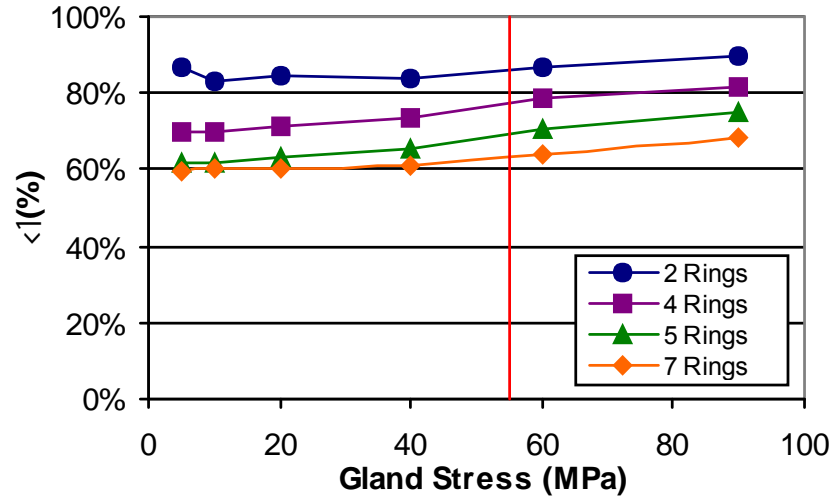


Expanded PTFE filled with Barium Sulphate Packing

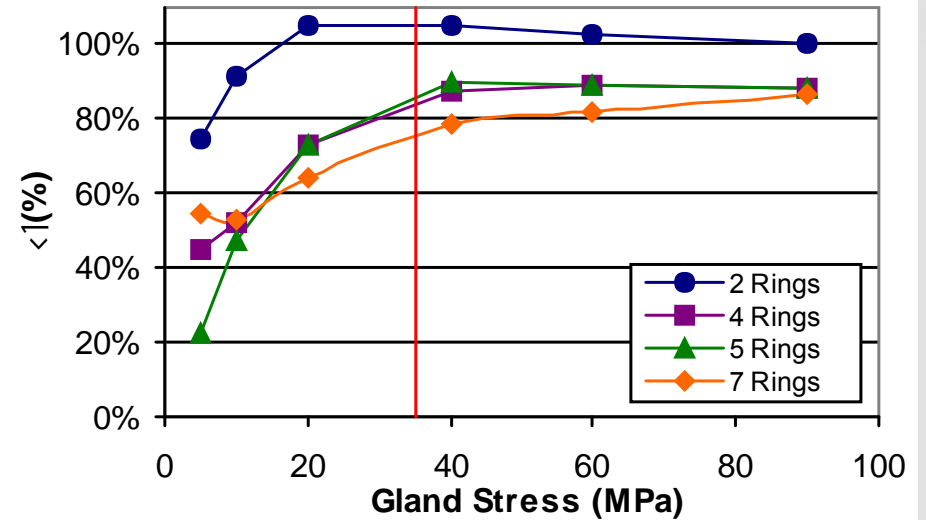


# Force Transmission

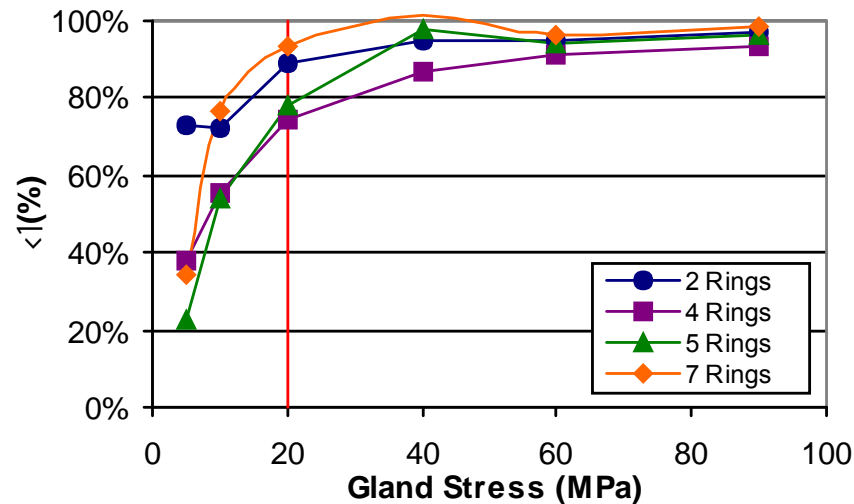
Ni-Cr Wire Mesh Reinforced Yarn Flexible Graphite Packing (no impregnation)



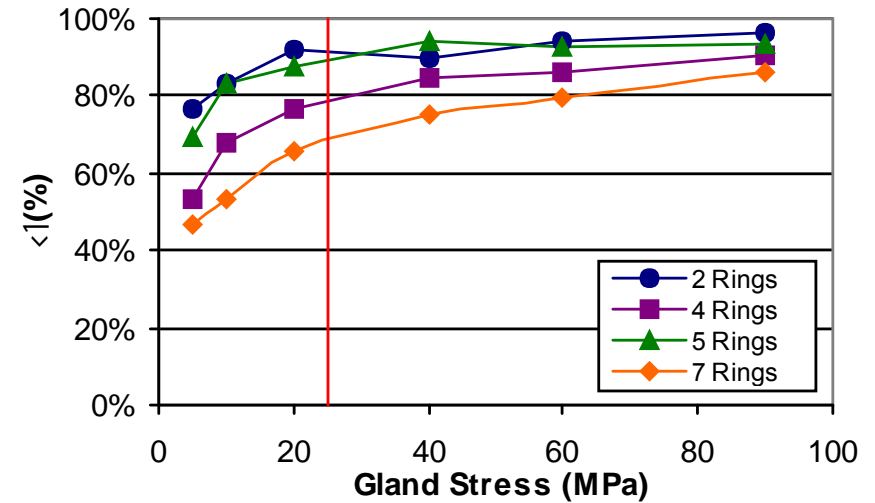
Ni-Cr Wire Reinforcement Flexible Graphite Packing



Carbon and Flexible Graphite Packing with Graphite impregnation



Expanded PTFE filled with Barium Sulphate Packing



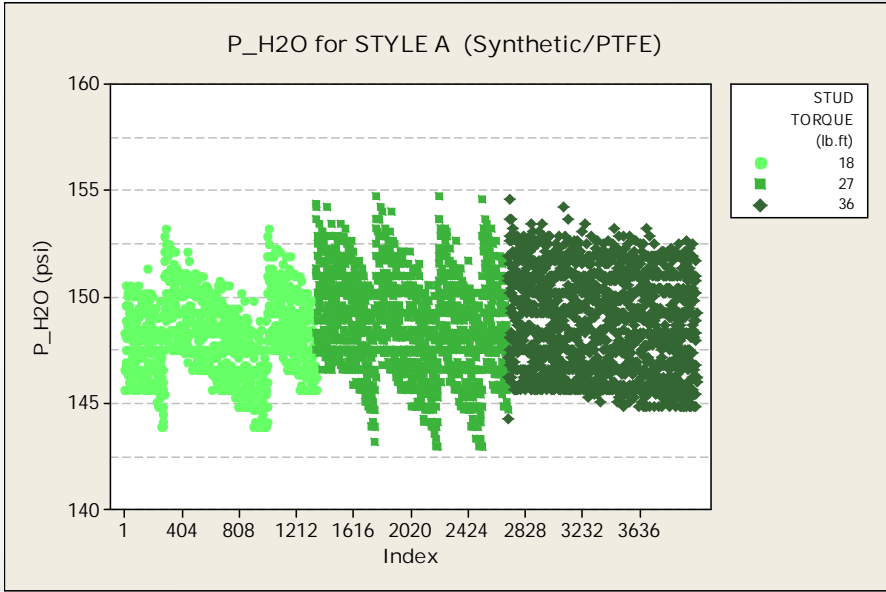
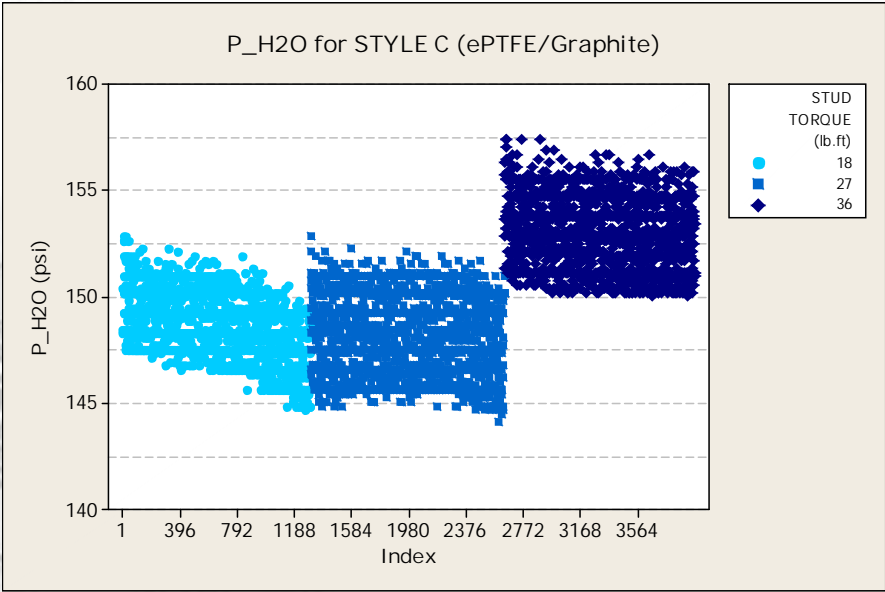
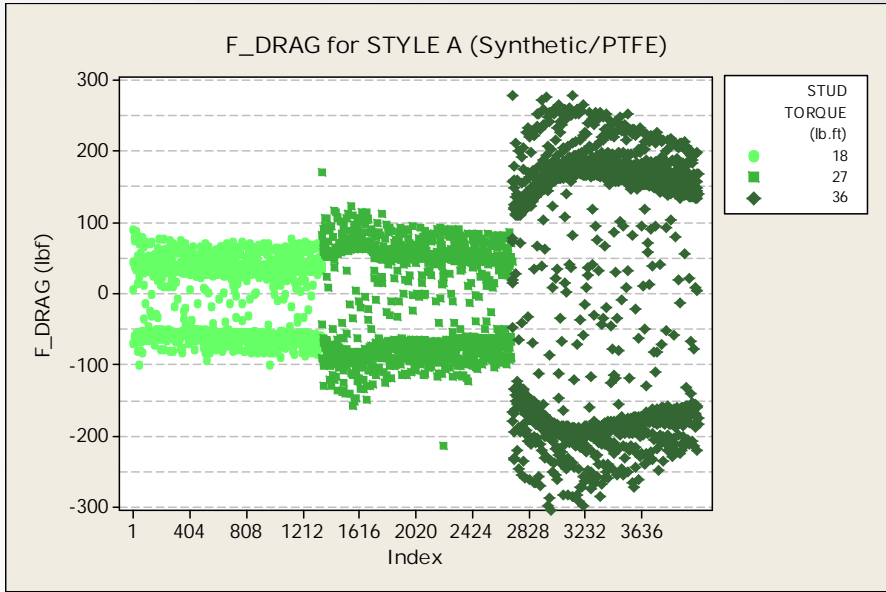
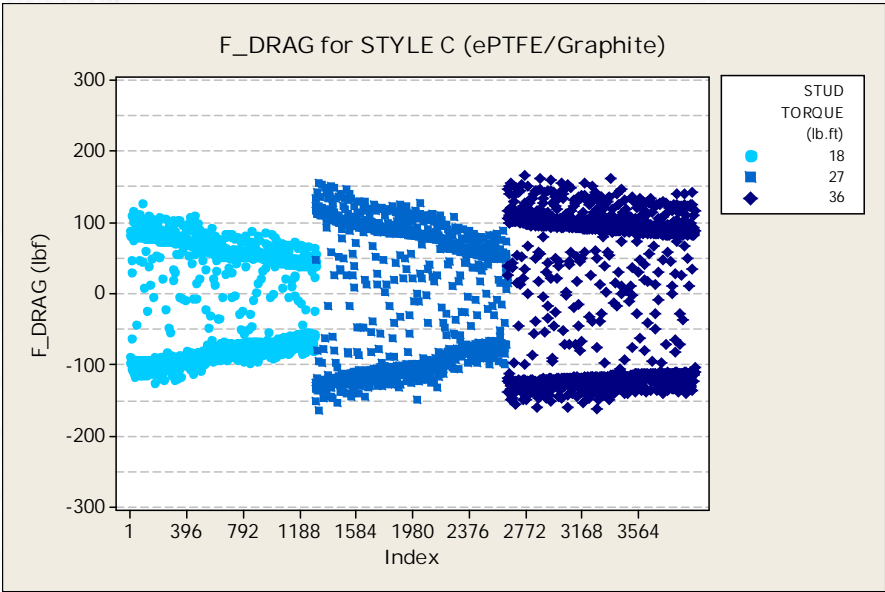


# Other Rigs for Testing Drag - Knife Valve Test

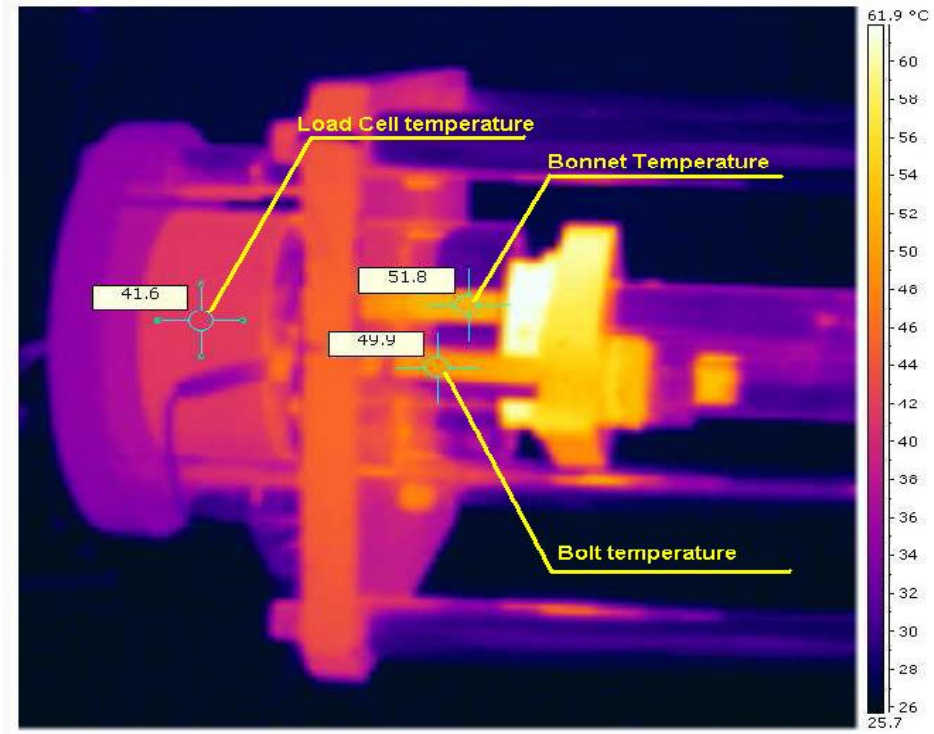
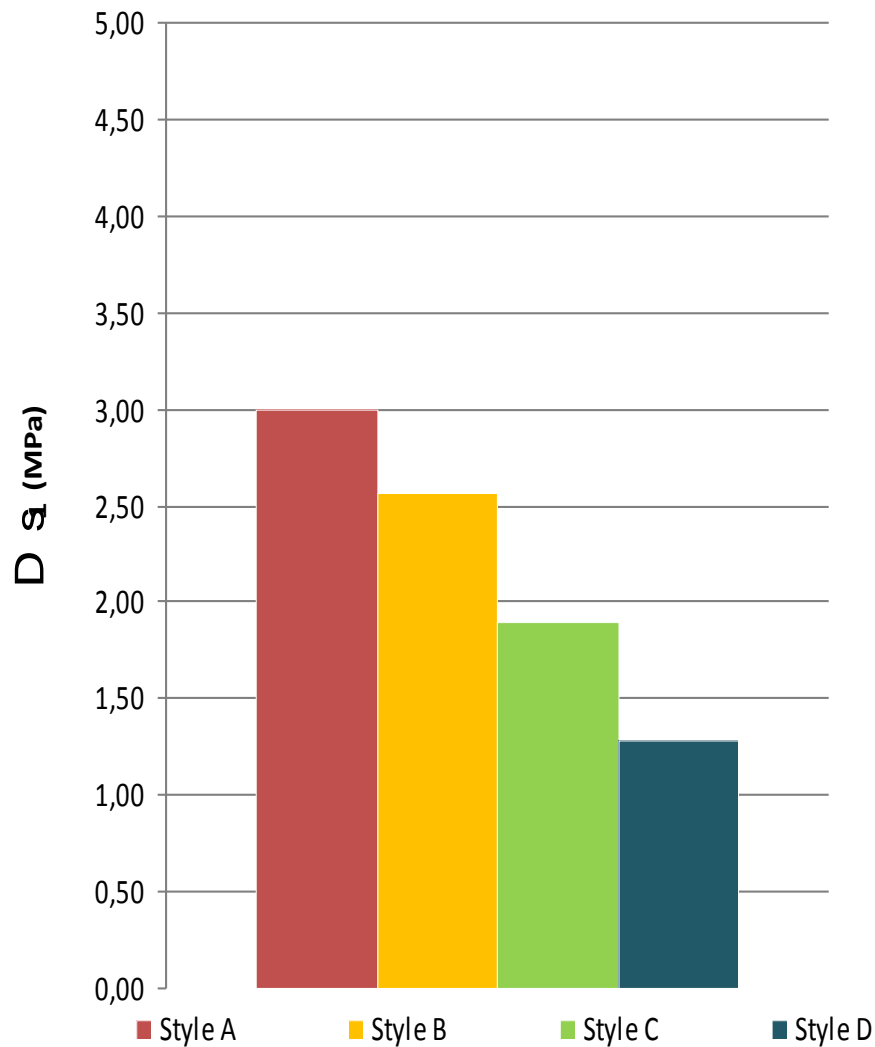
- Drag forces
- Sealability



# Drag and Sealability Test Results



# Thermal Expansion Test Results Ambient to 212F (100C)



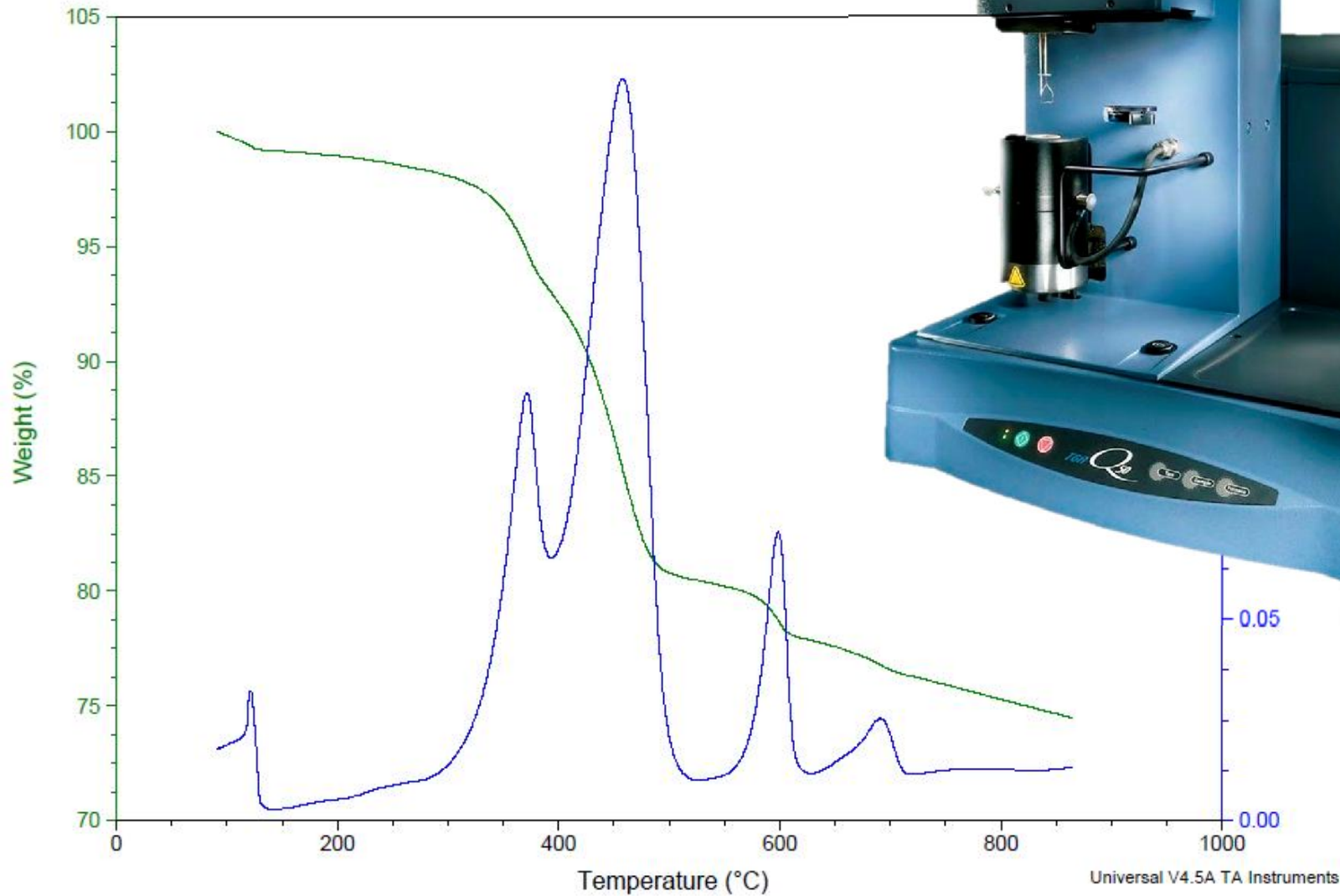
Style	Yarn	Filler	Comparative e-PTFE content
<i>A</i>	e-PTFE	None	100% e-PTFE
<i>B</i>	e-PTFE	Barium Sulphate	B% < A%
<i>C</i>	e-PTFE	Barium Sulphate	C % < A% & B%
<i>D</i>	e-PTFE	Graphite	D% < A%, B% & C%

# Thermal Expansion Test Results Ambient to 212F (100C)



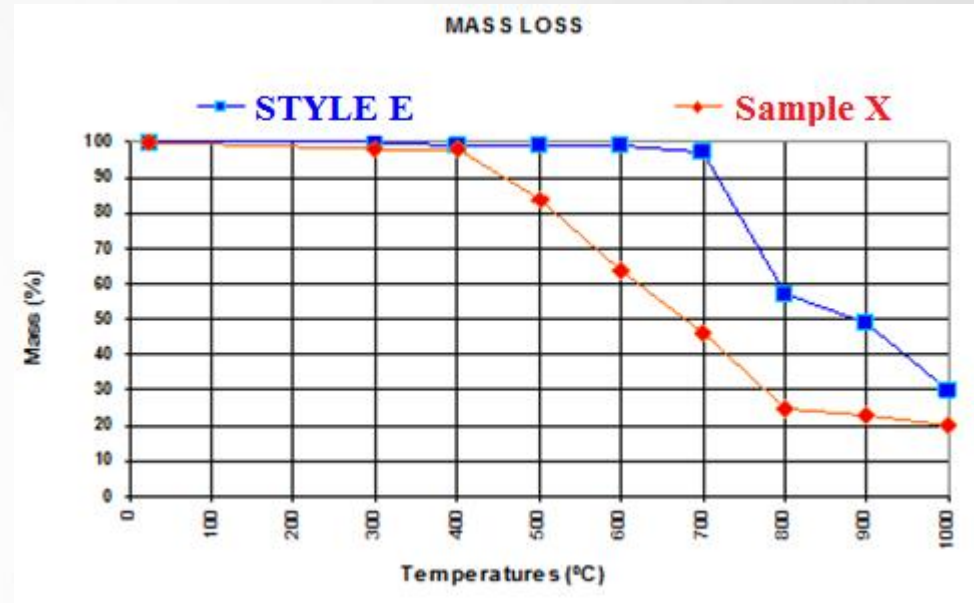
PTFE Packing Extrusion due to Thermal Expansion

# Thermal Gravimetric Analysis - TGA



Universal V4.5A TA Instruments

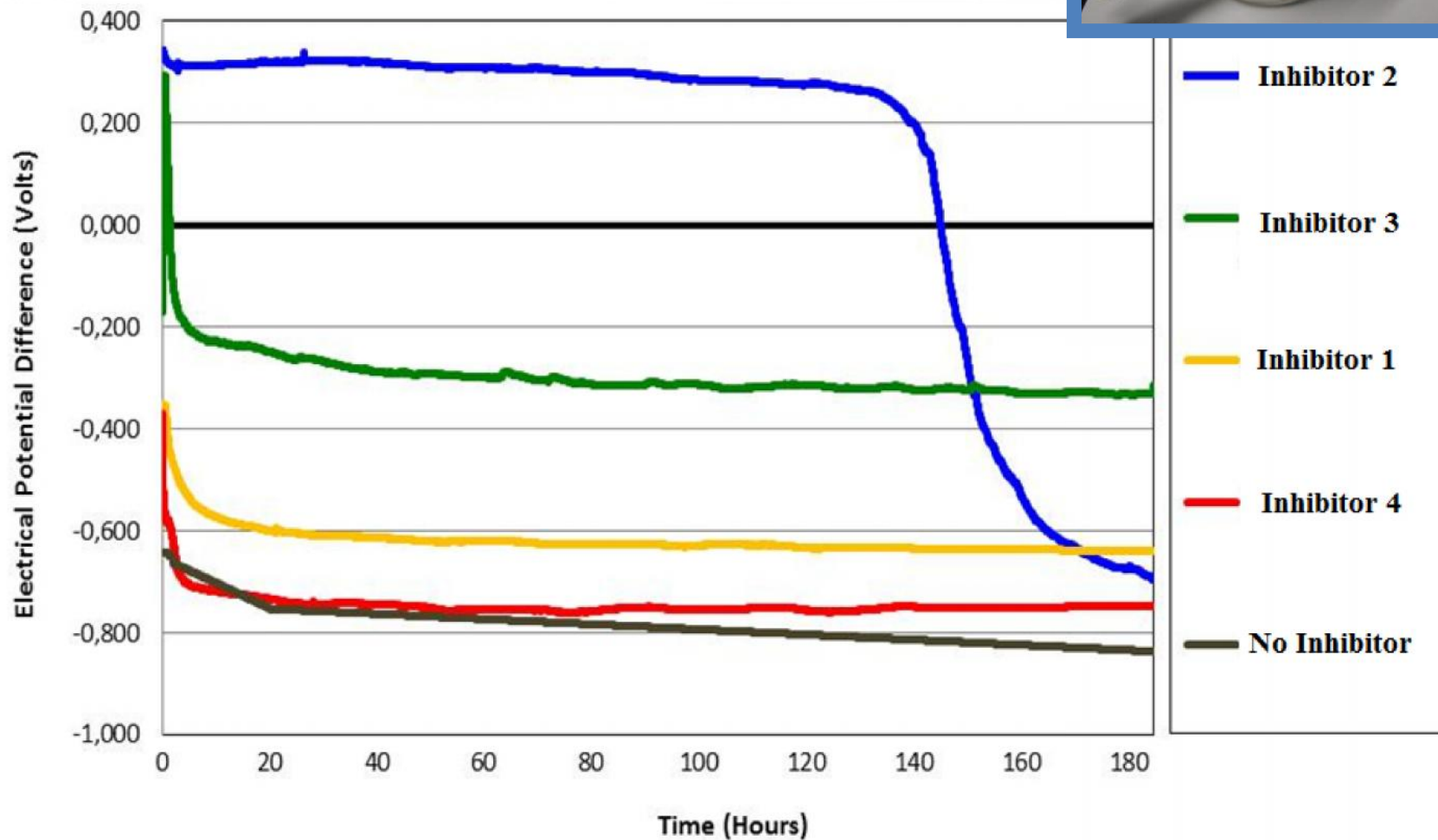
# Material Degradation and API 607 Simulation



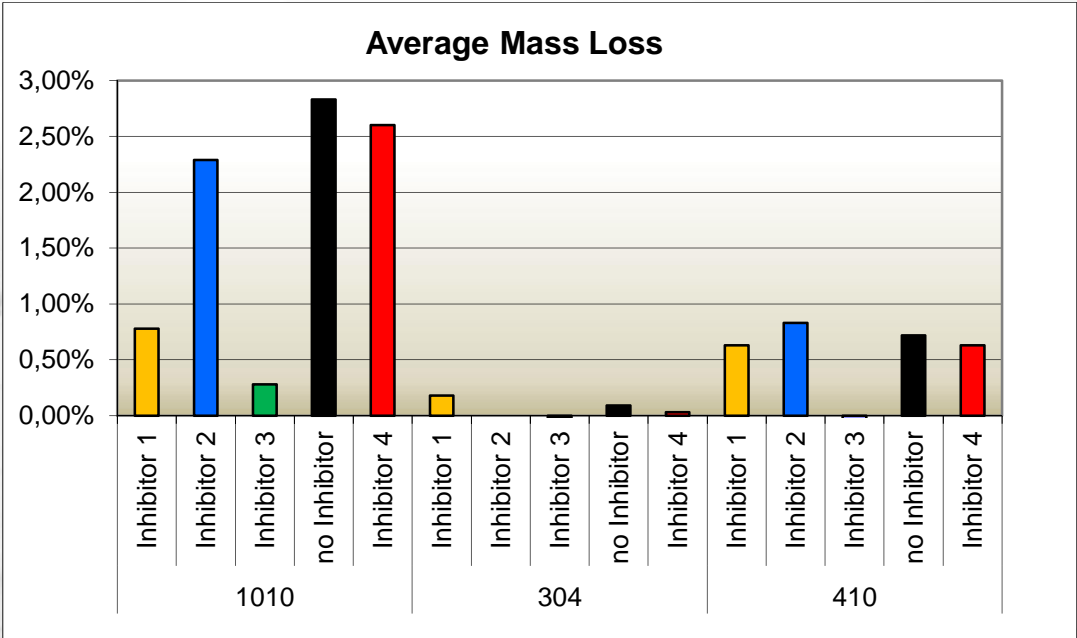
Packing	External Leakage	<b>Validation</b> API 607 Test
	After burn and cool-down (5min)	
<b>Style E</b>	0.0 mL/min	CERTIFIED
<b>Style F</b>	0.0 mL/min	CERTIFIED
<b>Style H</b>	0.2 mL/min	CERTIFIED



# Galvanic Cell Corrosion Test



# CorroTest





# Low Emission Valves Test Rigs

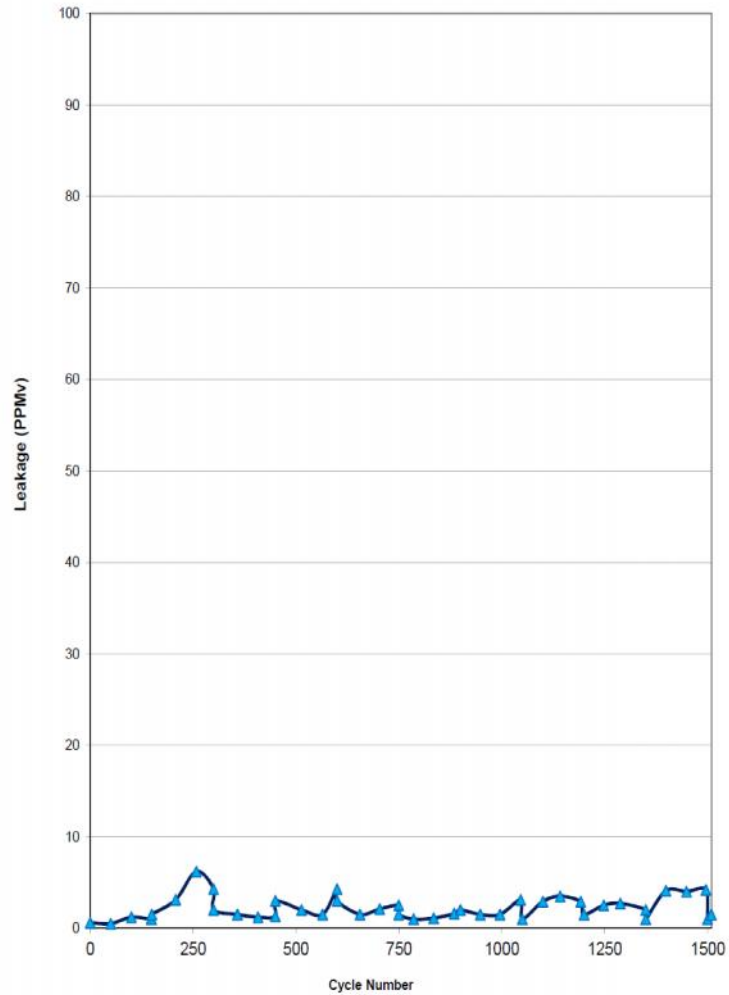


# R&D Results

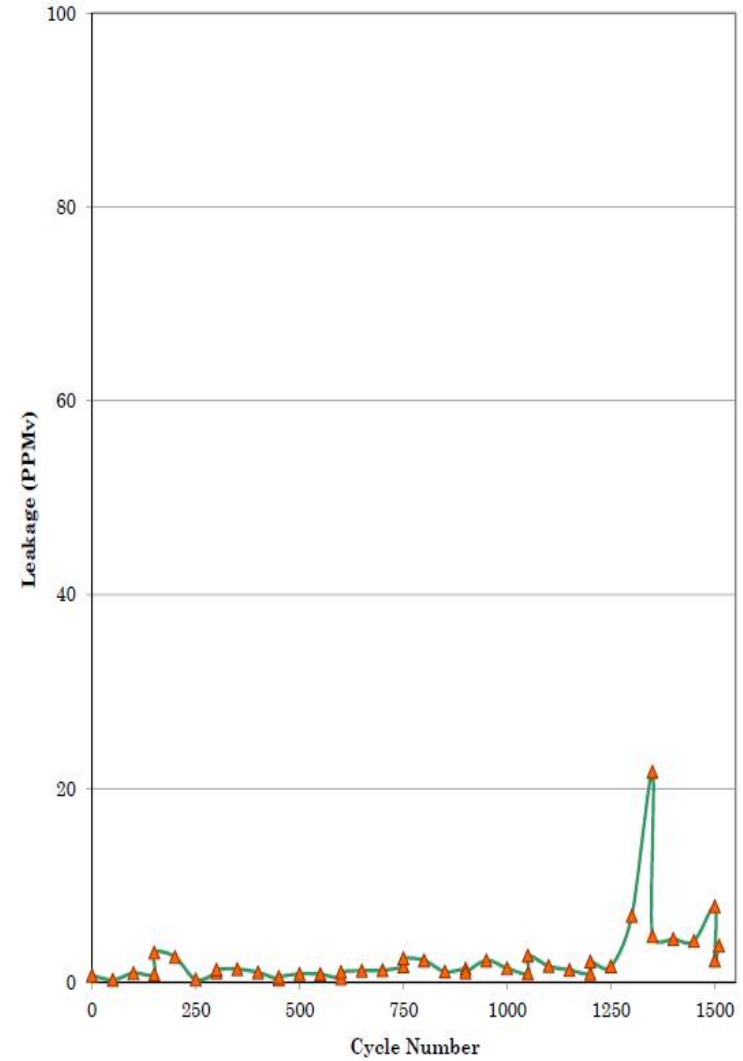


API Standard 622 2nd Ed. Simulation (4" CL300) Test Report

Static Leakage Chart  
Reading



Static Leakage Chart  
Maximum Reading



# Conclusions

## **Minimum Seating Stress**

**Leak free installation and start-up**

**Increase plant safety and reduce costs**

## **Stem Torque or Drag determination**

**Design of actuation devices**

## **Thermal Expansion and Contraction Effects**

**Develop lower thermal expansion packings**

**Installation procedures**

**Fire Safe**

## **Corrosion Inhibitors**

**Protection of Equipment**

**API 622, API624 (valve), ISO 15848, VDI2440, others**

**Consolidation - Development of Low Emission Packings**



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# Thank you!