

VALVE SEALING RESEARCH AND DEVELOPMENT EQUIPMENT

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Sealing for a Safer and Greener Tomorrow

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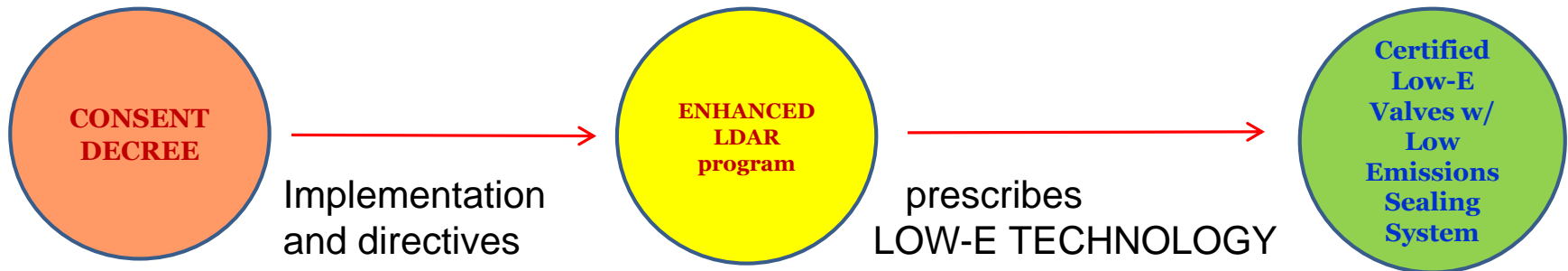
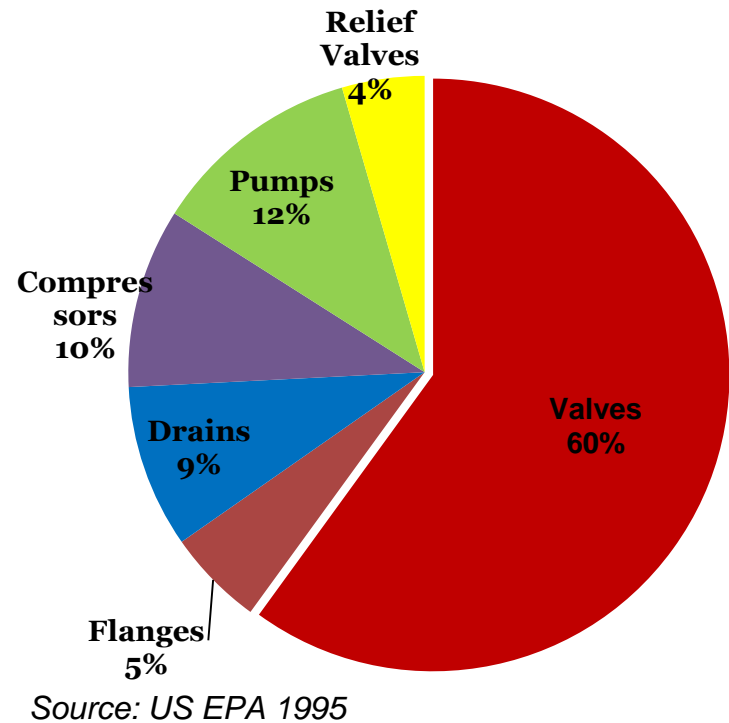


AGENDA

- INTRODUCTION
- MINIMUM SEATING STRESS
- PACKING DRAG AND FORCE TRANSMISSION
- THERMAL EXPANSION / RESISTANCE
- CORROSION TEST
- FUGITIVE EMISSION TEST RIGS
- OTHER RIGS - PACKING DRAG (KNIFE VALVES)
- CONCLUSIONS

INTRODUCTION

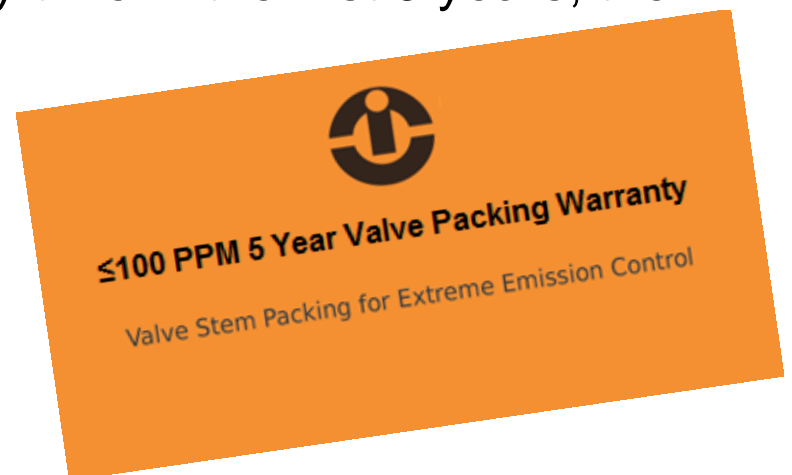
- Enhanced LDAR: 100 ppm as the target for valve stem seals.



INTRODUCTION

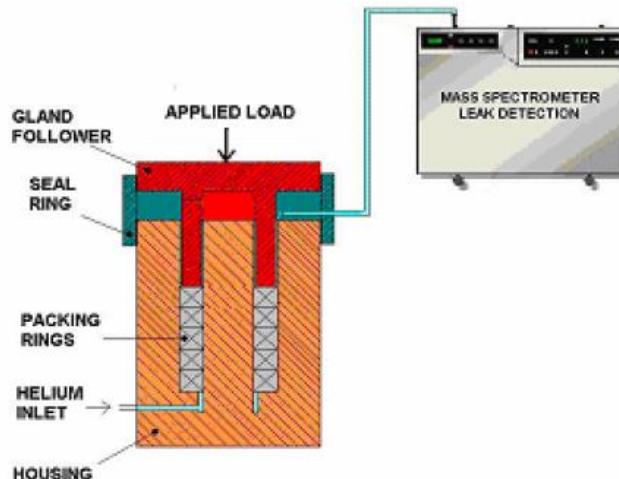
Low-E Technology:

- A valve (including its specific packing assembly or stem sealing component) for which the manufacturer has issued a written warranty that it will not emit fugitives at greater than 100 ppm, and that, if it does so emit at any time in the first 5 years, the manufacturer will replace the valve.

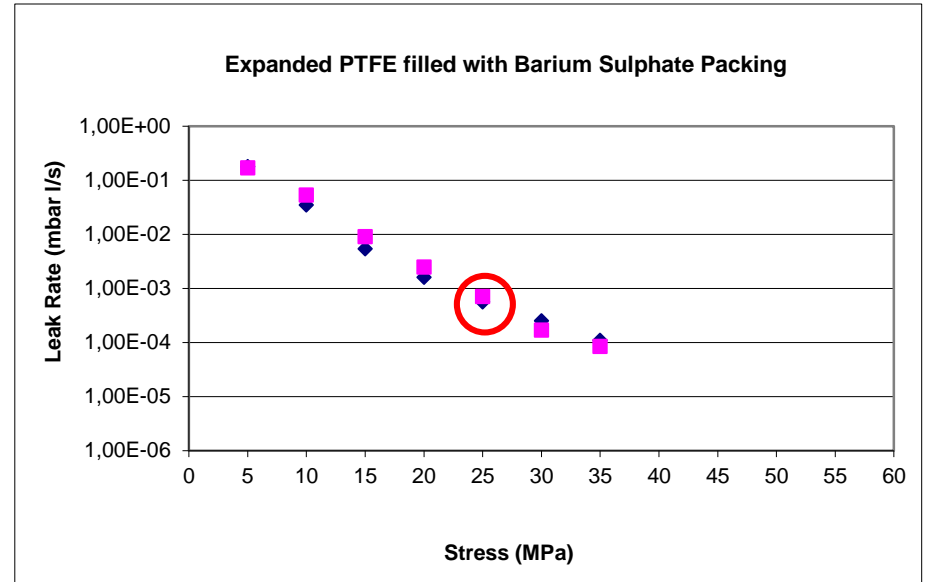
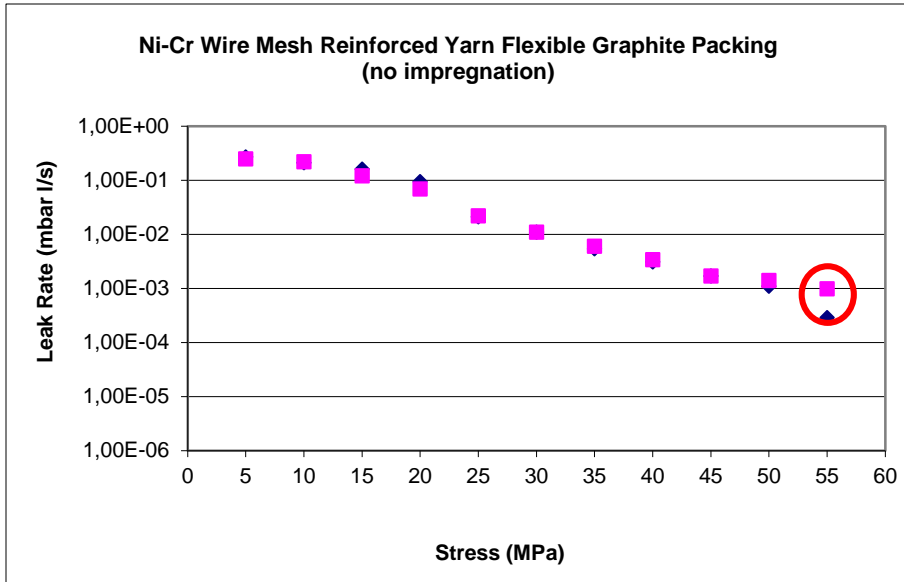


MINIMUM SEATING STRESS

- Packing:
 - Style A: Flexible Graphite Yarn reinforced with an Inconel wire mesh.
 - Style D: Expanded PTFE filled with Barium Sulphate.

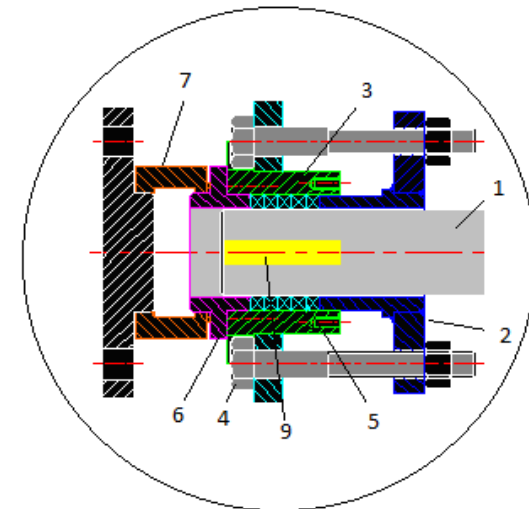
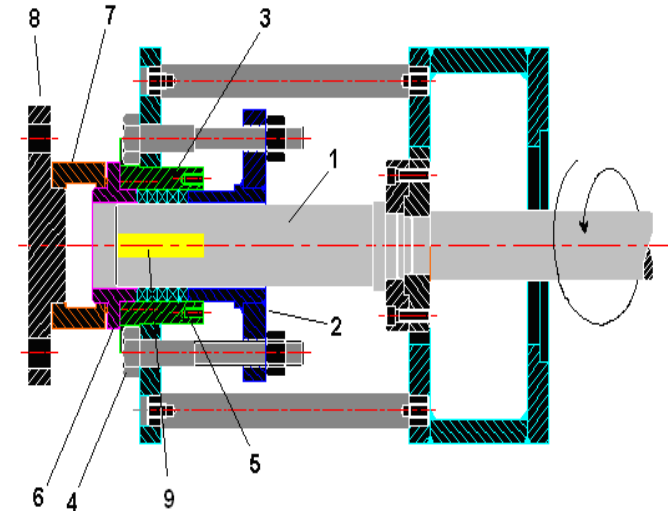


MINIMUM SEATING STRESS



Packing Style	$S_{\min(0.01)}$	
	MPa	psi
A	55	7975
D	25	3625

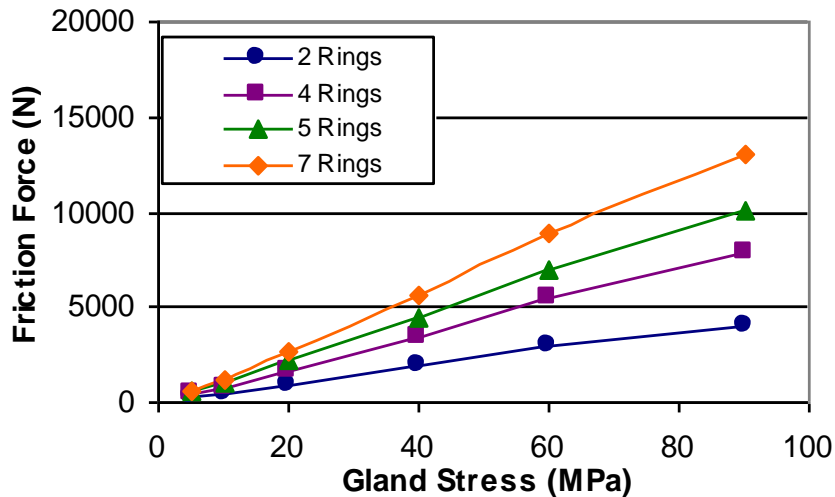
PACKING DRAG AND FORCE TRANSMISSION



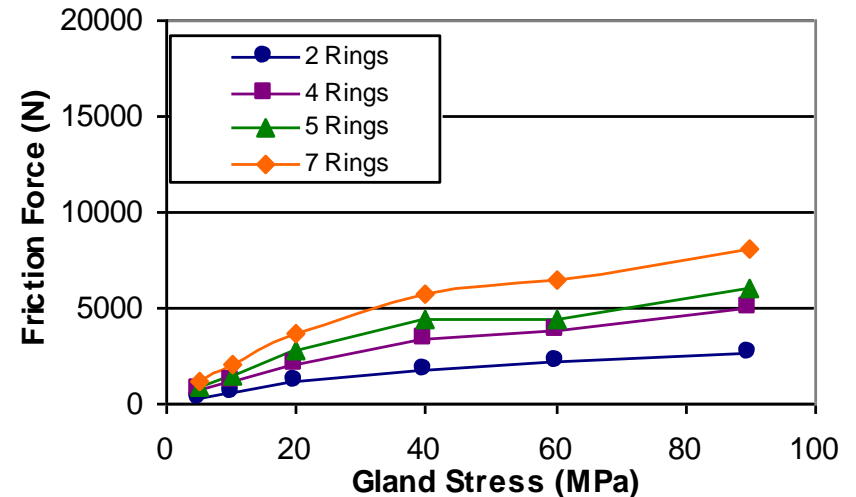
- | | |
|---------------------------|---------------------------|
| 1 - Stem | 6 - Bushing |
| 2 - Gland | 7 - Load Cell |
| 3 - Bonnet | 8 - Load Cell Base |
| 4 - Internally Gaged Bolt | 9 - Electrical Resistance |
| 5 - Packing | |

PACKING DRAG AND FORCE TRANSMISSION

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



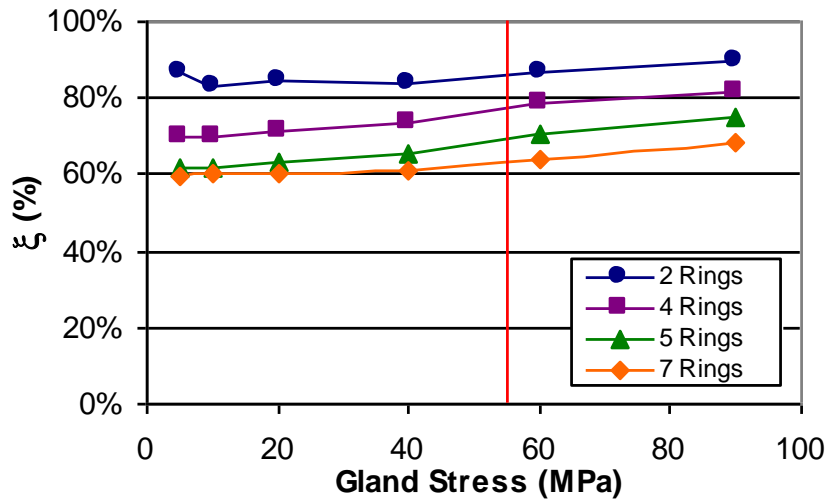
Expanded PTFE filled with Barium Sulphate Packing



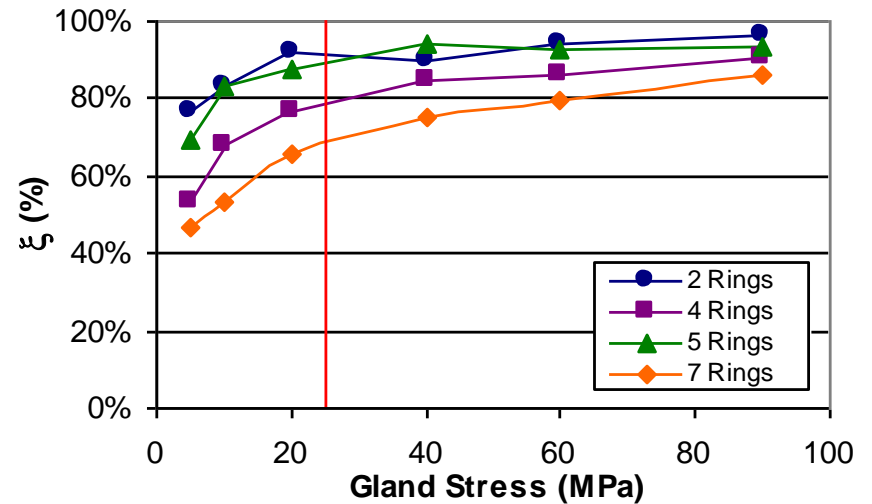
Friction force difference between Graphite and PTFE packings

PACKING DRAG AND FORCE TRANSMISSION

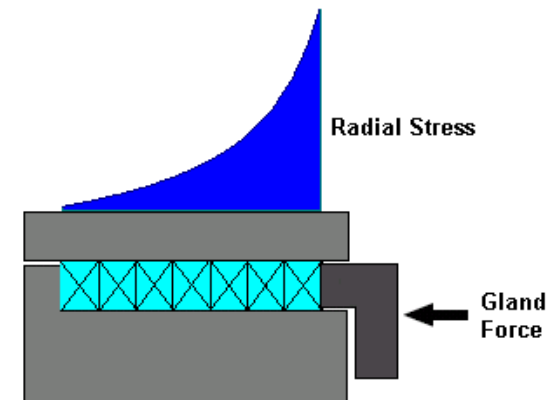
Ni-Cr Wire Mesh Reinforced Yarn Flexible Graphite Packing (no impregnation)



Expanded PTFE filled with Barium Sulphate Packing



Results incompatible with the traditionally used Radial Stress Distribution graph for stresses above the MSS



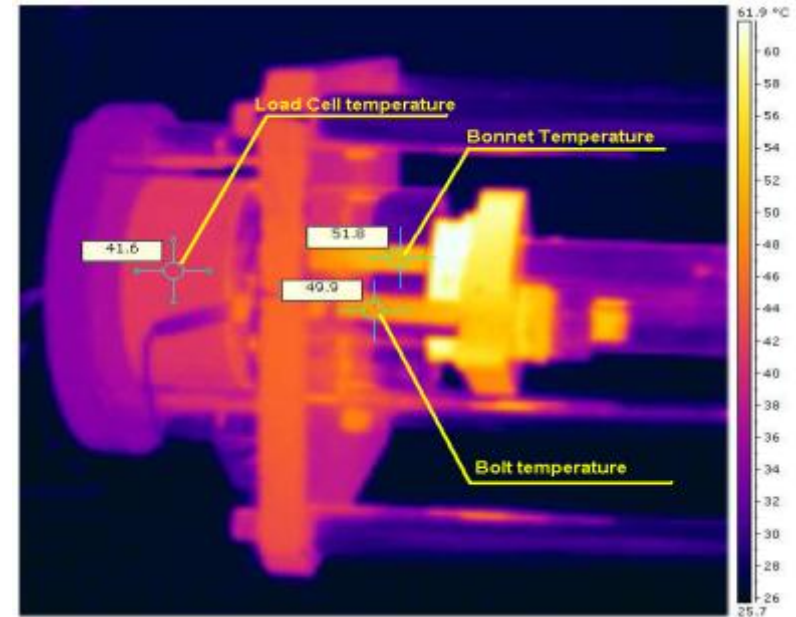
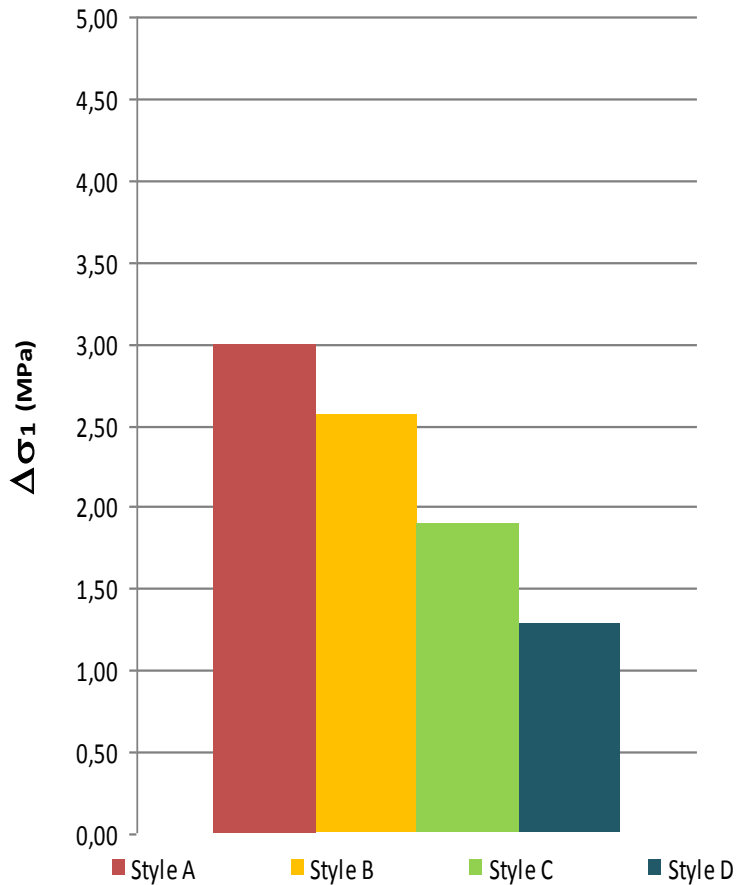
THERMAL EXPANSION



Material	(10^{-5} K^{-1})
Steel	1
Barium Sulphate	1
Graphite	1
PTFE	12

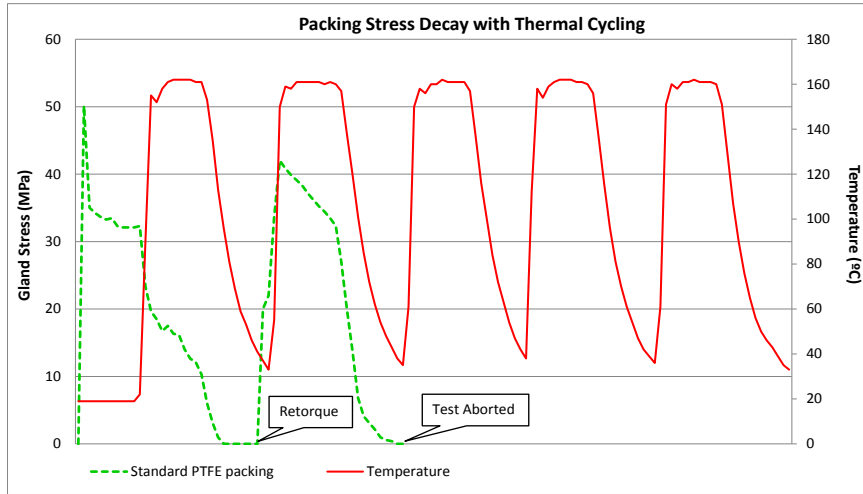
PTFE Packing Extrusion due to Thermal Expansion

THERMAL EXPANSION

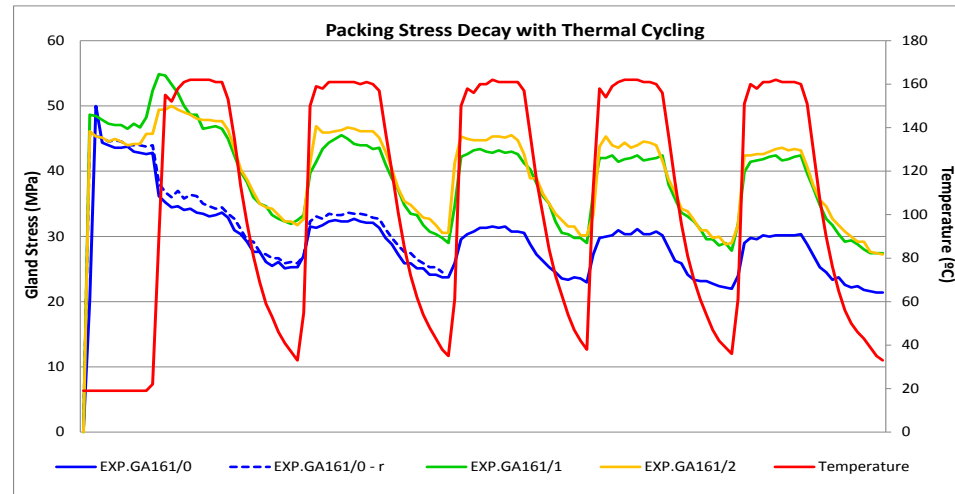


Style	Yarn	Filler	Comparative e-PTFE content
A	e-PTFE	None	100% e-PTFE
B	e-PTFE	Barium Sulphate	B% < A%
C	e-PTFE	Barium Sulphate	C % < A% & B%
D	e-PTFE	Graphite	D% < A%, B% & C%

THERMAL EXPANSION



TOTAL LOAD LOSS AFTER 1 THERMAL CYCLE (160°C)

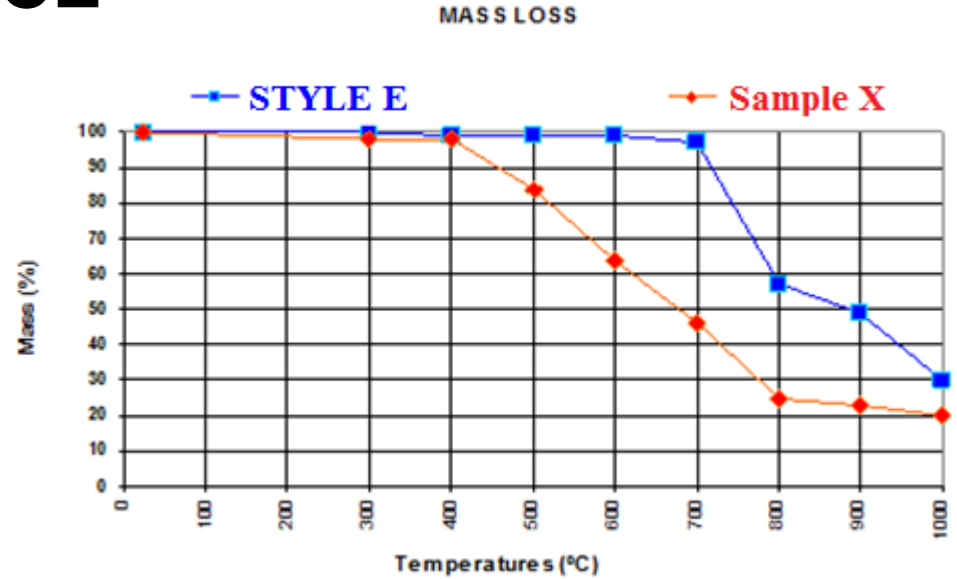


LOAD MAINTAINED AFTER 5 THERMAL CYCLES (160°C)

With DLS



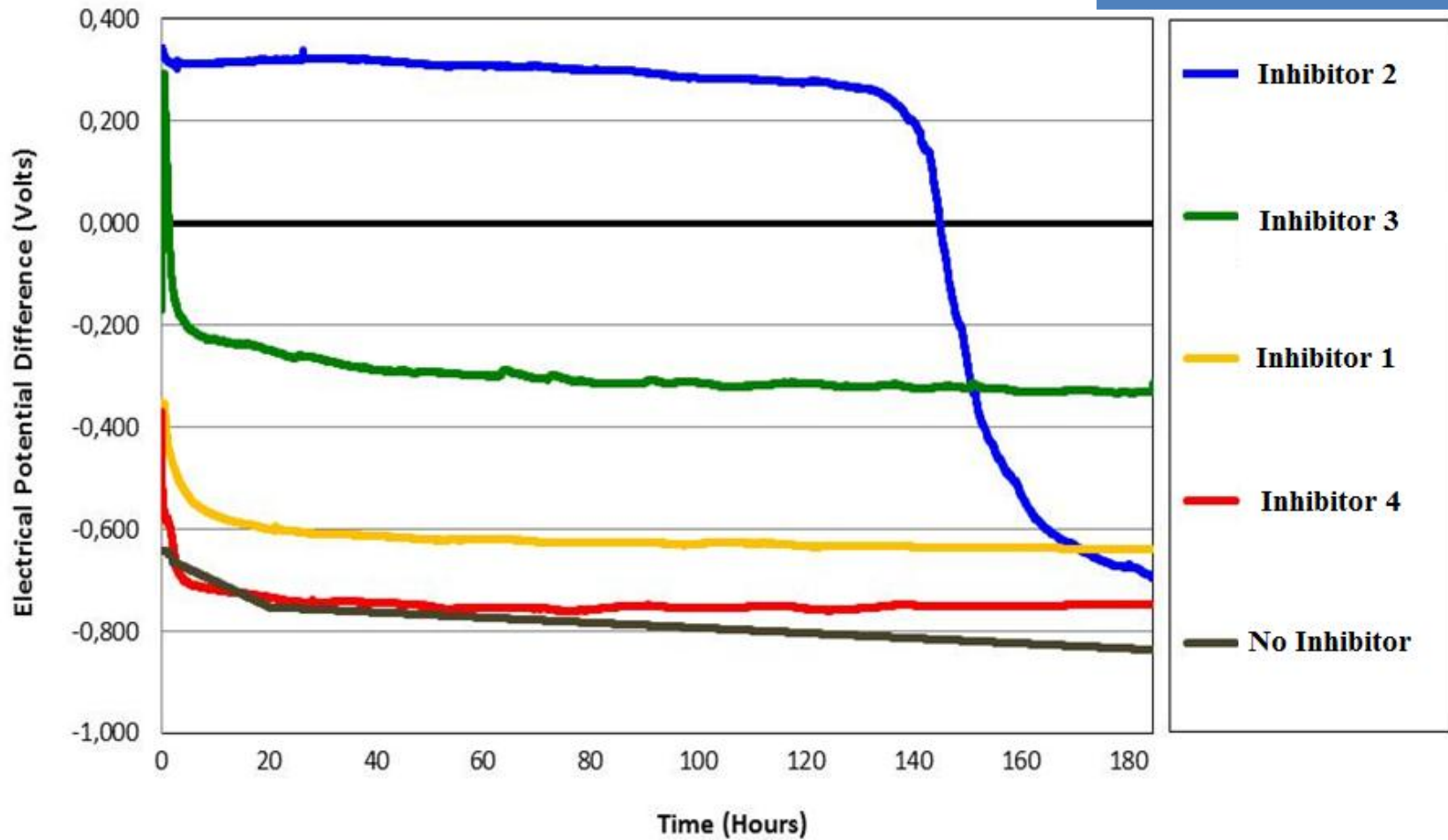
THERMAL RESISTANCE

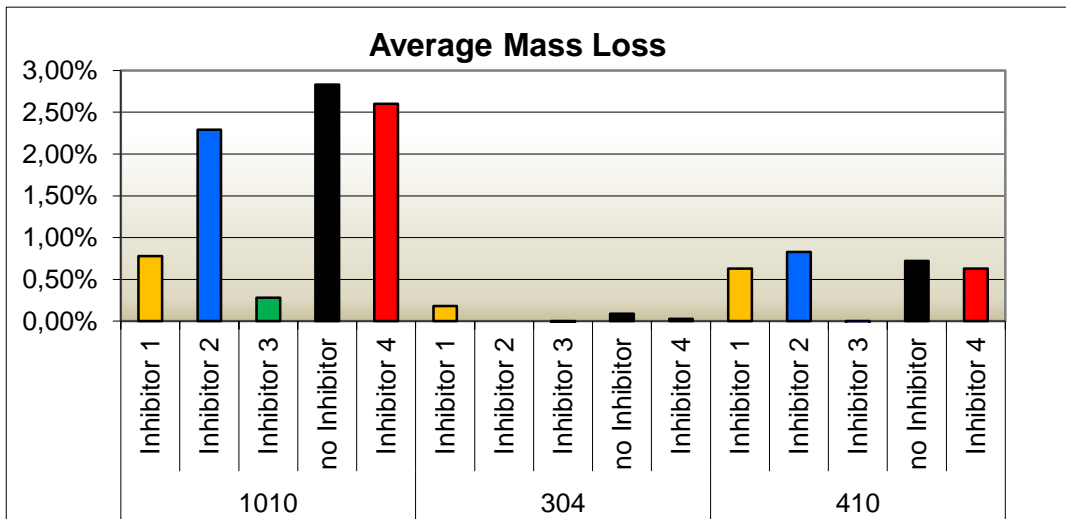


Packing	External Leakage	API 607 Test
	After burn and cool-down (5min)	
Style E	0.0 mL/min	CERTIFIED
Style F	0.0 mL/min	CERTIFIED
Style H	0.2 mL/min	CERTIFIED

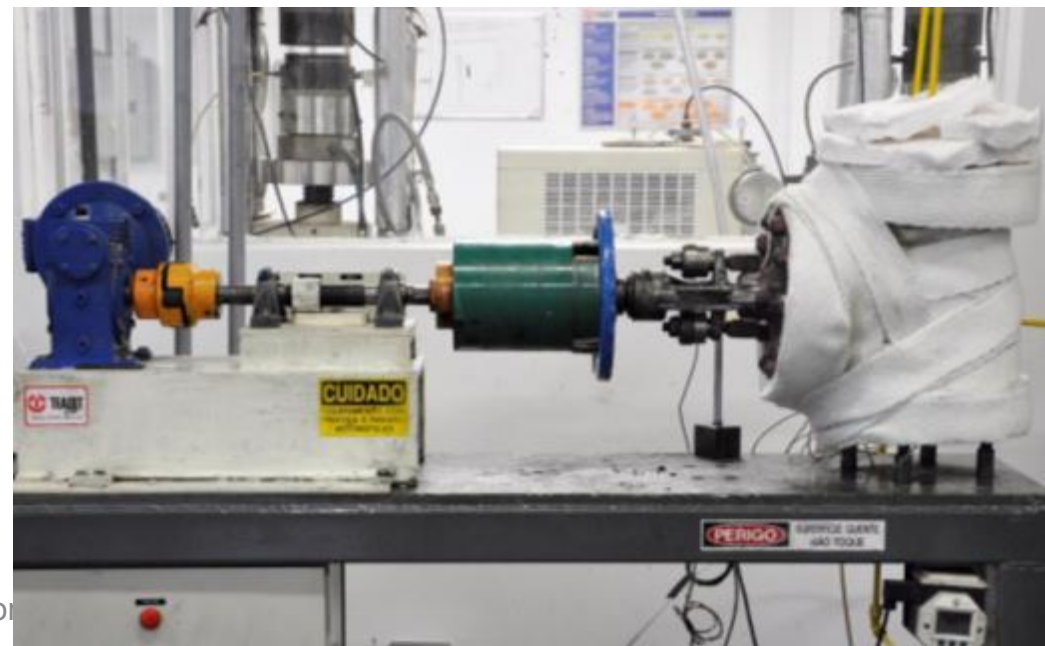


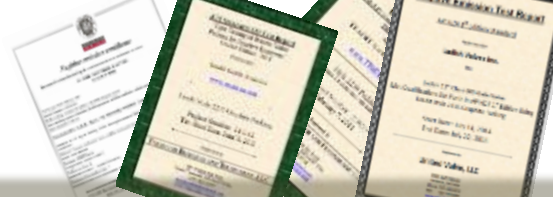
GALVANIC CELL - CORROSION





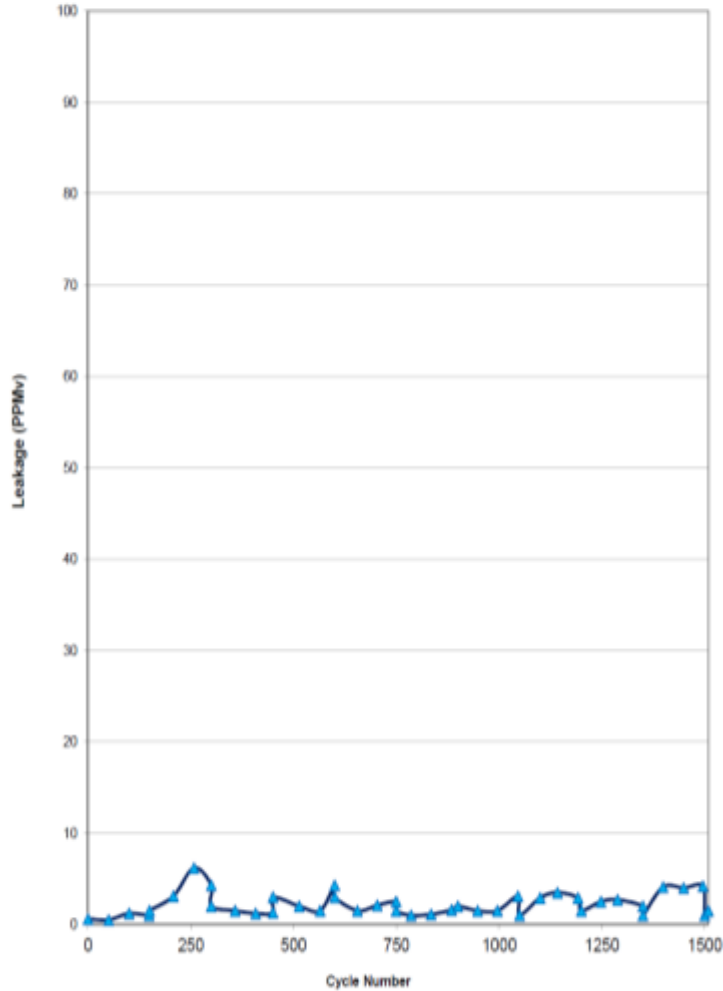
FUGITIVE EMISSION TEST RIGS



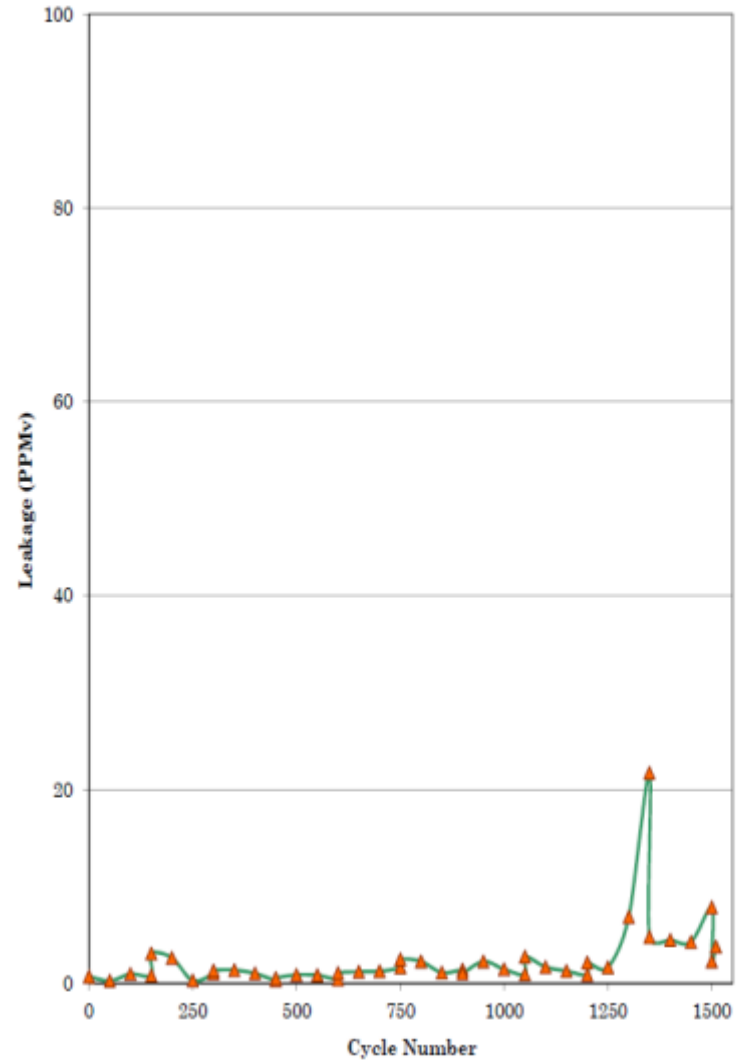


API Standard 622 2nd Ed. Simulation (4" CL300) Test Report

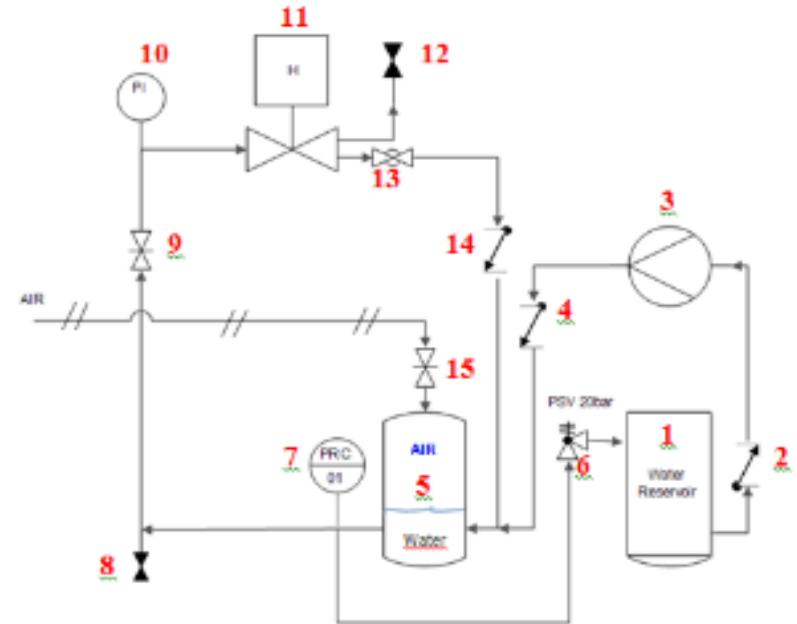
Static Leakage Chart
Reading



Static Leakage Chart
Maximum Reading

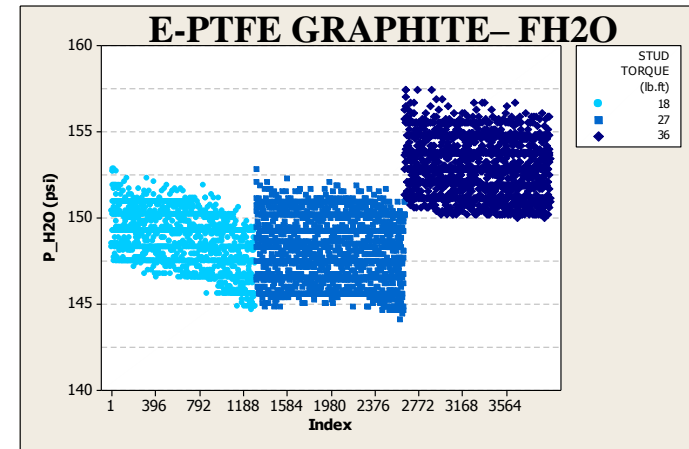
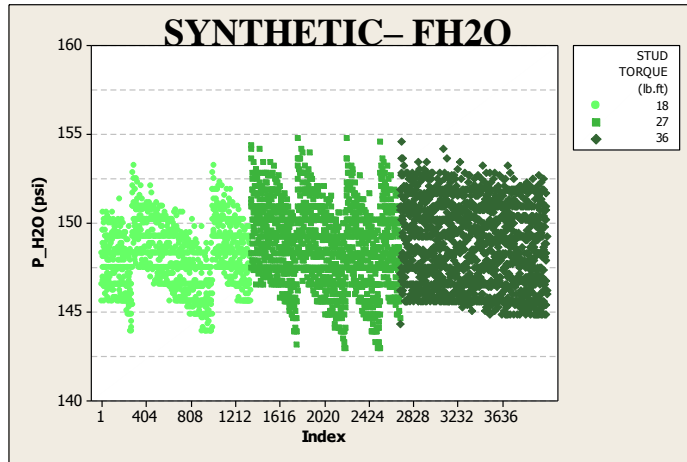
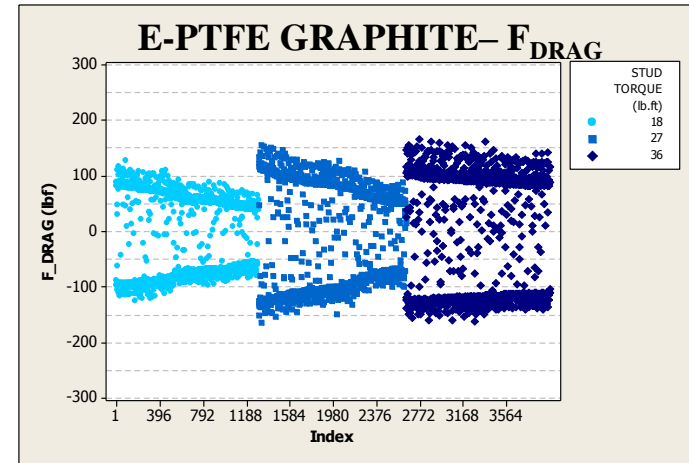
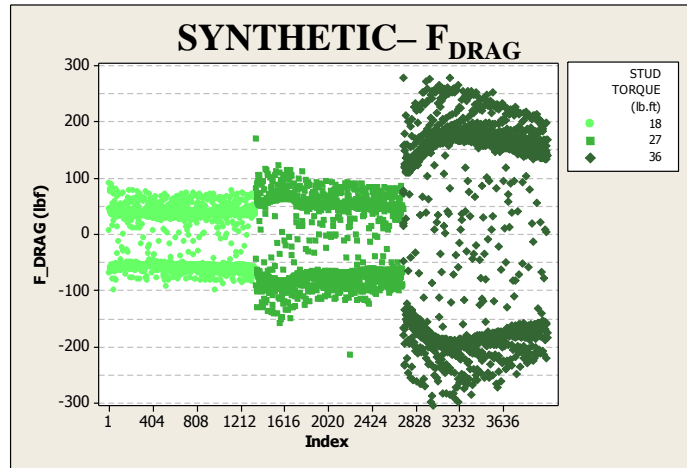


OTHER RIGS - PACKING DRAG (KNIFE VALVES)



- | | | |
|------------------------------|------------------------|-----------------------|
| 1) Water Reservoir | 7) Pressure register | 13) Ball Valve |
| 2) Check Valve | 8) Water Bleed Valve | 14) Check Valve |
| 3) Alternative Pump | 9) Needle Valve | 15) Needle Valve |
| 4) Check Valve | 10) Pressure Indicator | 16) Pressure Register |
| 5) Water/Air Pressure Vessel | 11) Tyco Valve | 17) Pressure Register |
| 6) Relief Valve | 12) Air Bleed Valve | 18) System Controller |

OTHER RIGS - PACKING DRAG (KNIFE VALVES)



CONCLUSIONS

- **MINIMUM SEATING STRESS RIGS**

 - Leak free installation and start-up

 - Increase plant safety and reduce costs

- **STEM TORQUE OR DRAG DETERMINATION RIGS**

 - Design of actuation devices

- **THERMAL EXPANSION AND CONTRACTION STUDIES**

 - Develop lower thermal expansion packings

- **CORROSION TESTS**

 - Increase equipment life

- **FE TEST RIGS**

 - API 622, AP I624 (valve), ISO 15848, VDI 2440, API 641 and others



Consolidation - Development of Low Emission Packings and Technology to Enhance Packing and Valve Performance

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QUESTIONS?



Thanks!

