Fugitive Emissions Summit China, Shanghai, 20-21 September 2016

逸散泄漏中国研讨峰会，上海，2016年9月20-21日

FUGITIVE EMISSIONS SUMMIT CHINA

WHAT MAKES A GOOD FE PACKING FOR NEW/USED VALVES?

TEADIT®

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Teadit Packing & Gasket Pvt. Ltd.

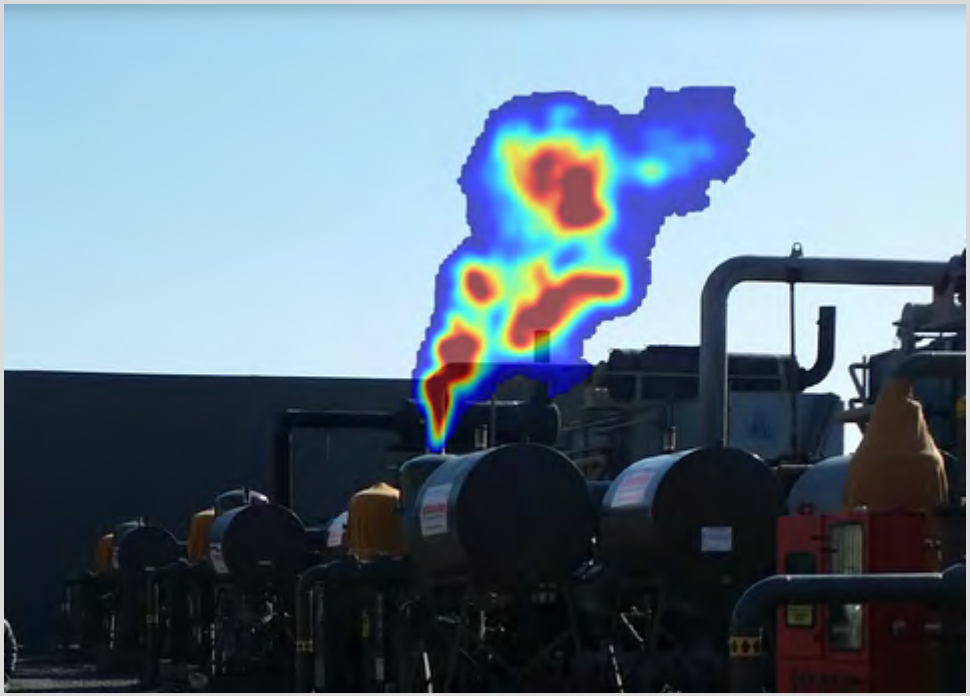
BACKGROUND – 20YEARS AGO

Lack of Clear Directions!

- Consult packing manufacturer and/or plant engineering department for guidance on torque (FSA)
- Tighten the gland bolts to the point where heavy resistance to wrenching is felt
- X% of Compression
- FE Emission Labs being Set up

FUTURE

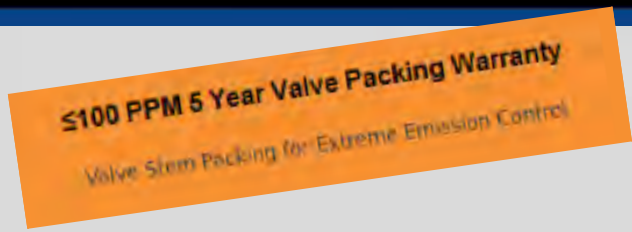
USA announced in 2015 ambitious new goal to cut methane emissions from the oil and gas sector by 40 to 45 percent below 2012 levels by 2025.



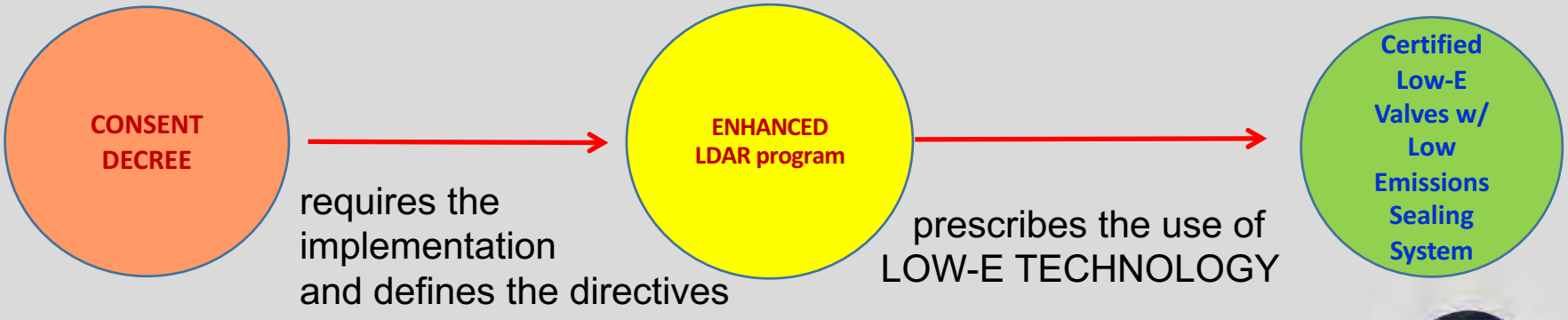
http://www.cbsnews.com/news/worlds-first-hyperspectral-video-camera-detects-explosive-gas-leaks/ (Match 4th 2015)

TODAY - LOW-E VALVE TECHNOLOGY R&D + INTRO

Low-E Valve is defined as:
(http://www.epa.gov)

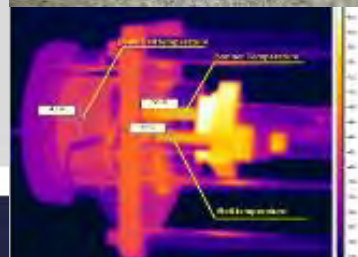


- "Certified Low-Leaking Valve Packing Technology" shall mean valve packing technology for which a manufacturer has issued: (i) **a written guarantee** that the valve packing technology **will not leak above 100 ppm for five (5) years**; (ii) a written guarantee, **certification or equivalen**t documentation that the valve packing technology has been tested pursuant to generally-accepted good engineering practices and has been found to be leaking at no greater than 100 ppm



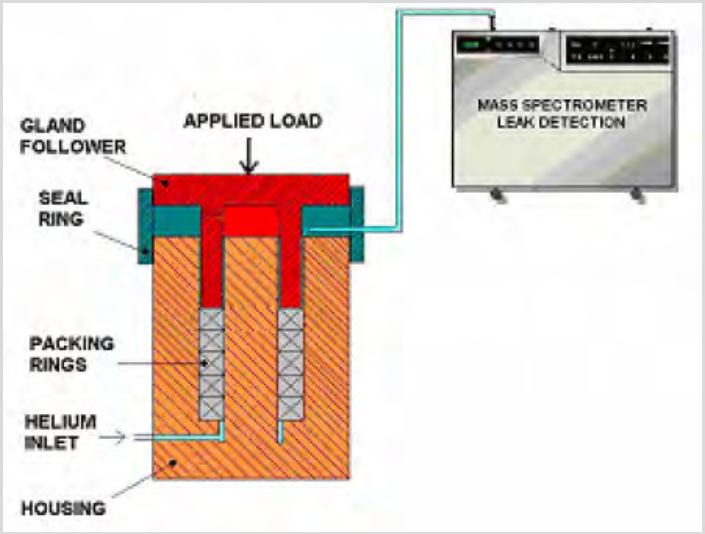
PACKING R&D

- ✓ Installation with Controlled Torque (ASME PVP Paper 2008-61214)
- ✓ Optimum Number of rings (ASME - PVP2009-77467)
- ✓ Otimization of Corrosion Inhibitors (VW2010)
- ✓ Limitation on the Maximum use of PTFE (ASME – PVP2011-57751)

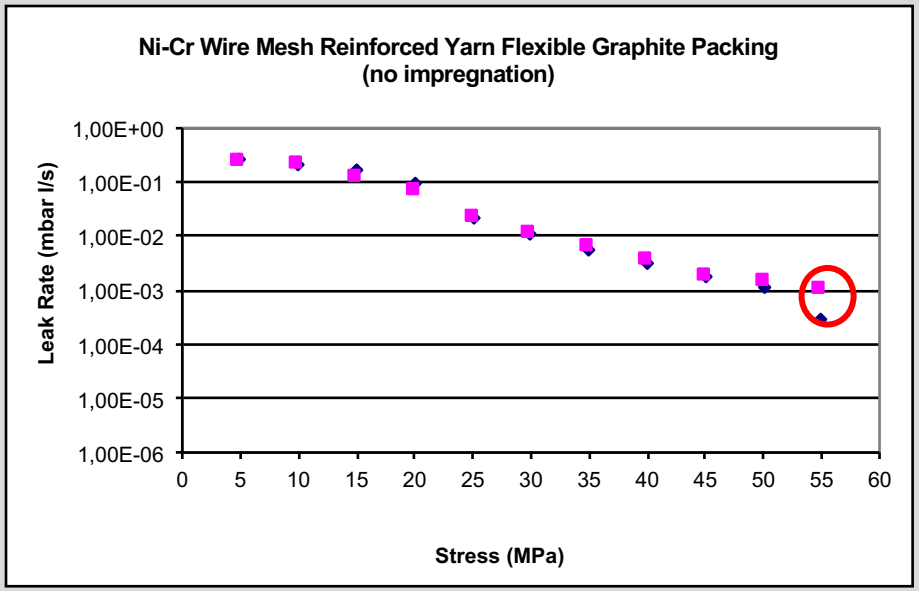


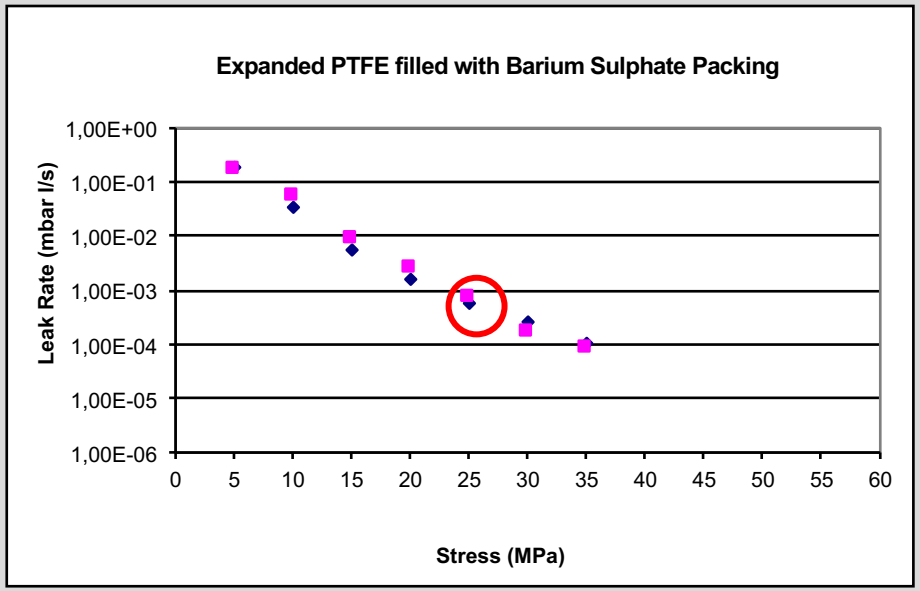
MINIMUM SEATING STRESS

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



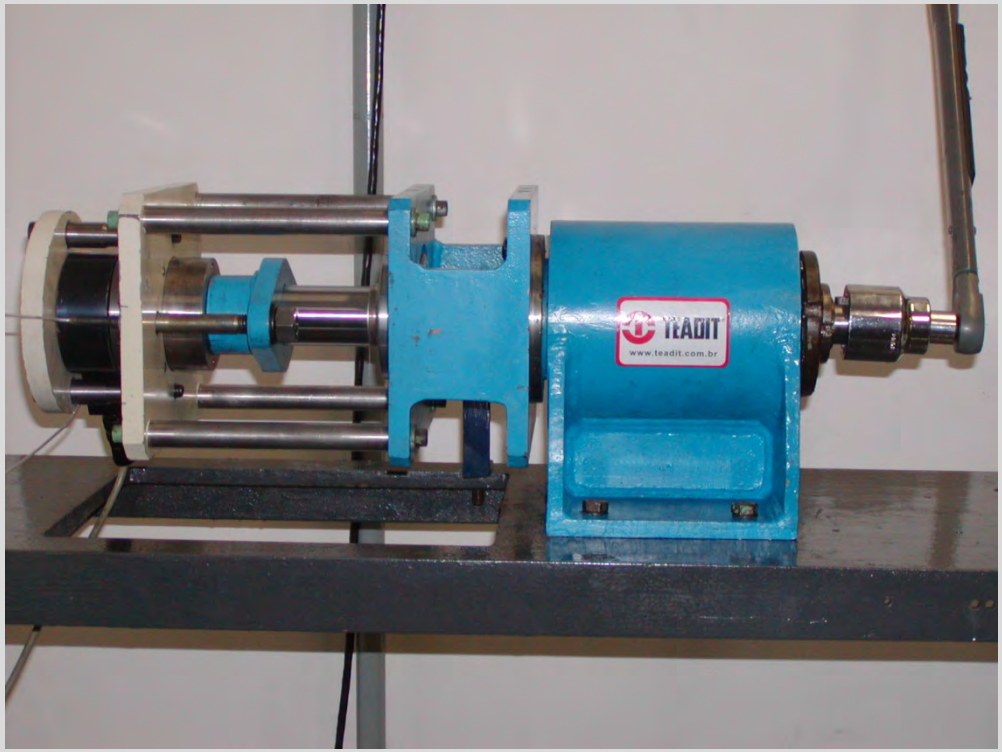
MINIMUM SEATING STRESS

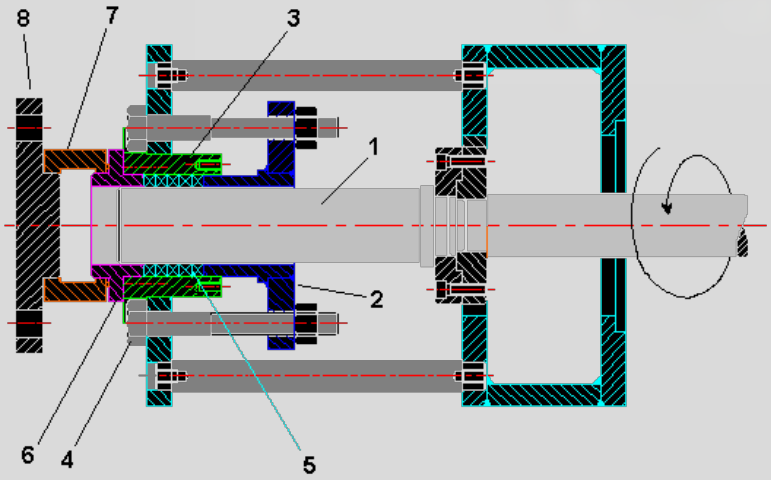


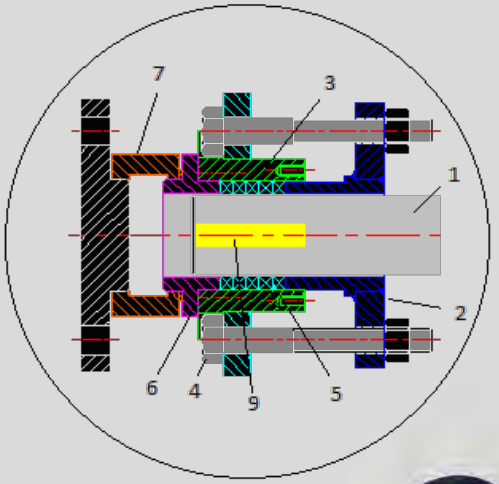


Packing Style	$S_{min(0.01)}$	
	MPa	psi
A	55	7975
D	25	3625

PACKING DRAG AND FORCE TRANSMISSION

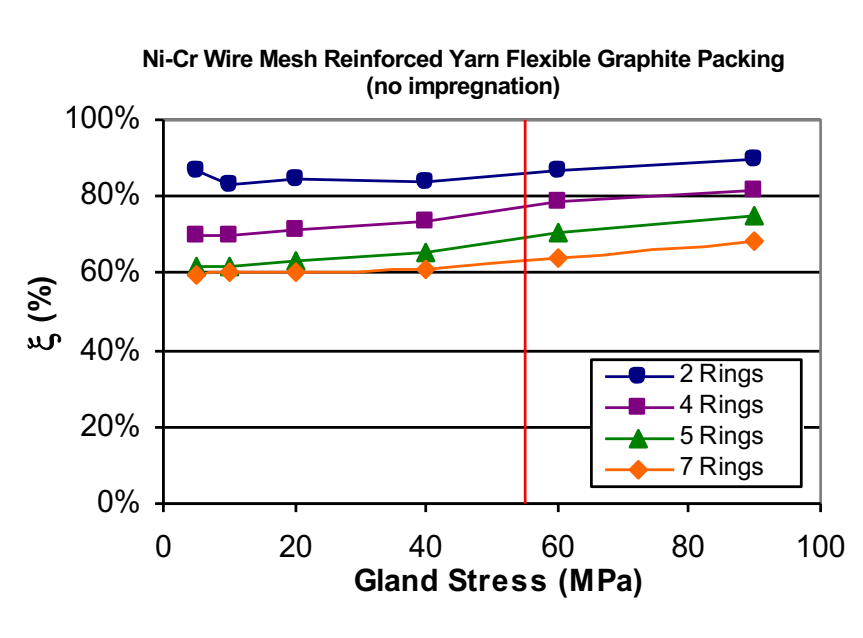


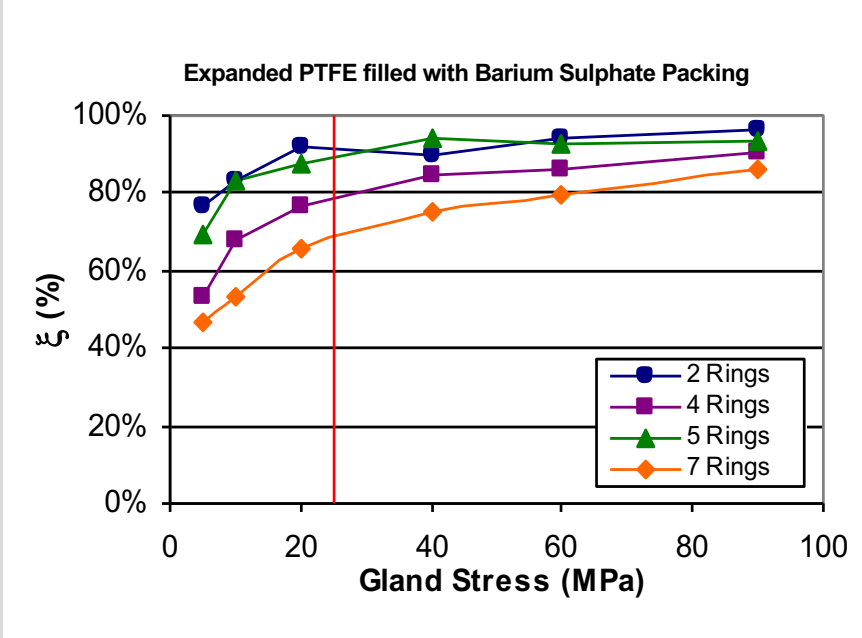




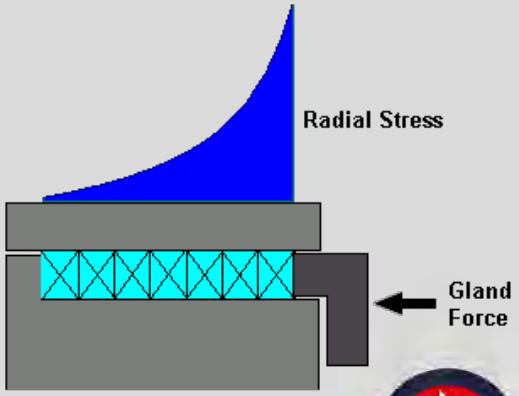
1 - Stem
2 - Gland
3 - Bonnet
4 - Internally Gaged Bolt
5 - Packing
6 - Bushing
7 - Load Cell
8 - Load Cell Base
9 - Electrical Resistance

PACKING DRAG AND FORCE TRANSMISSION





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



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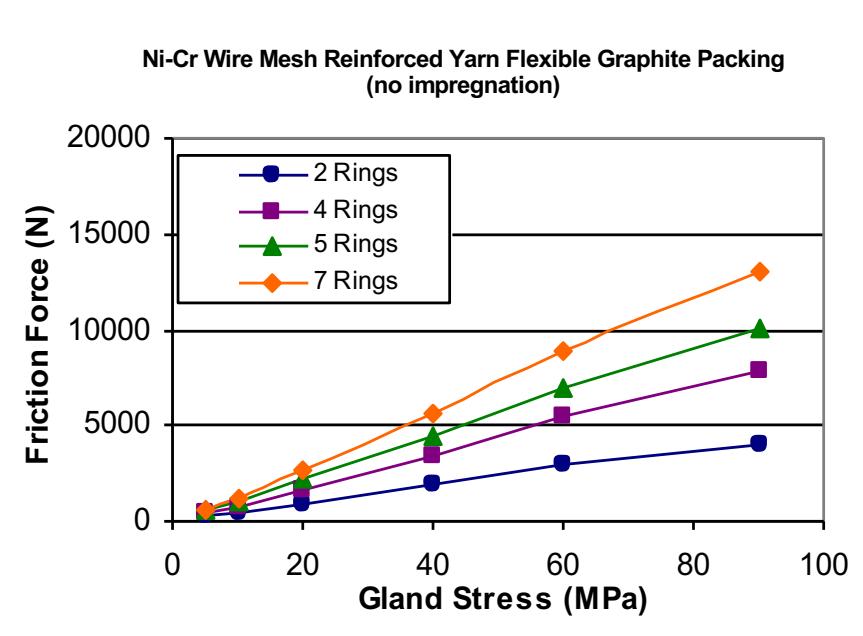
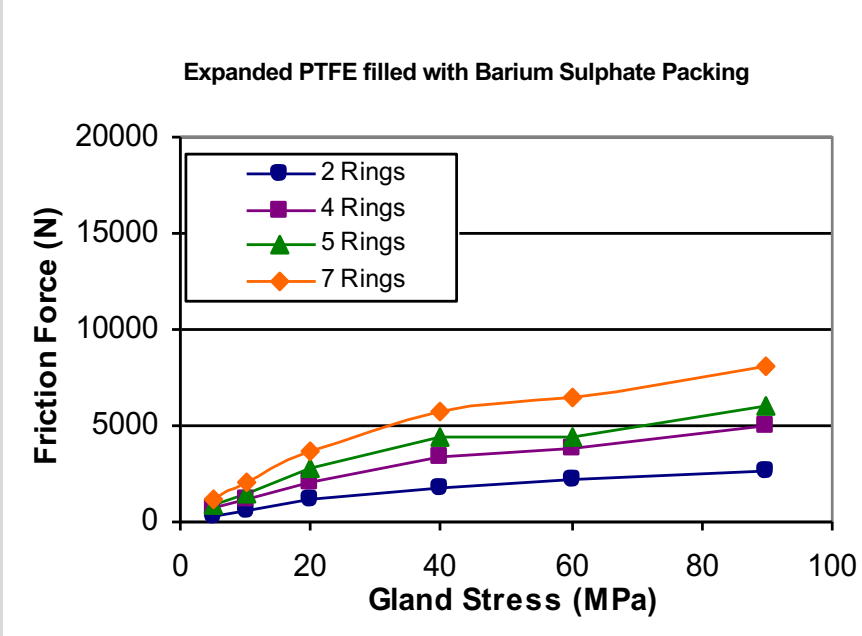
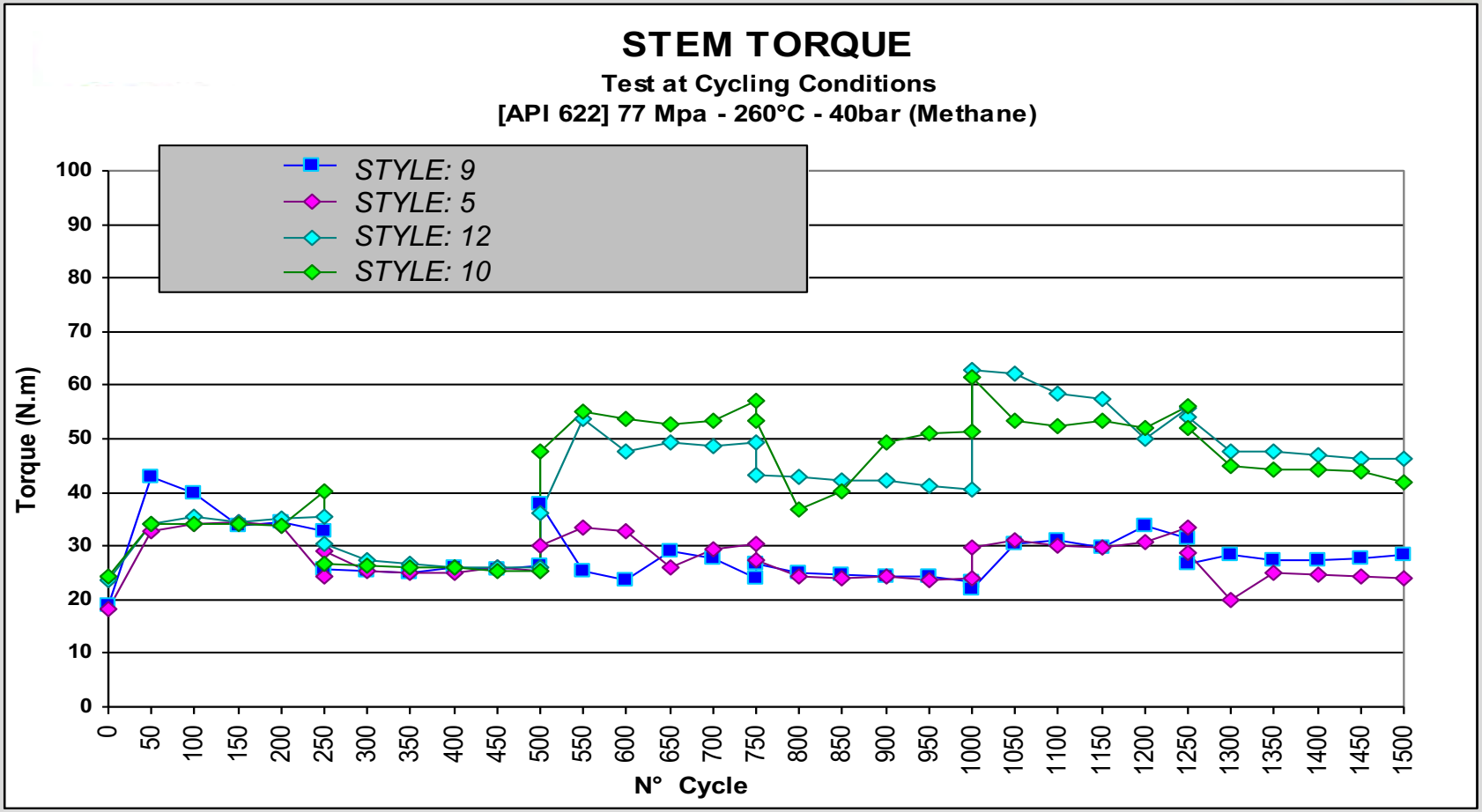




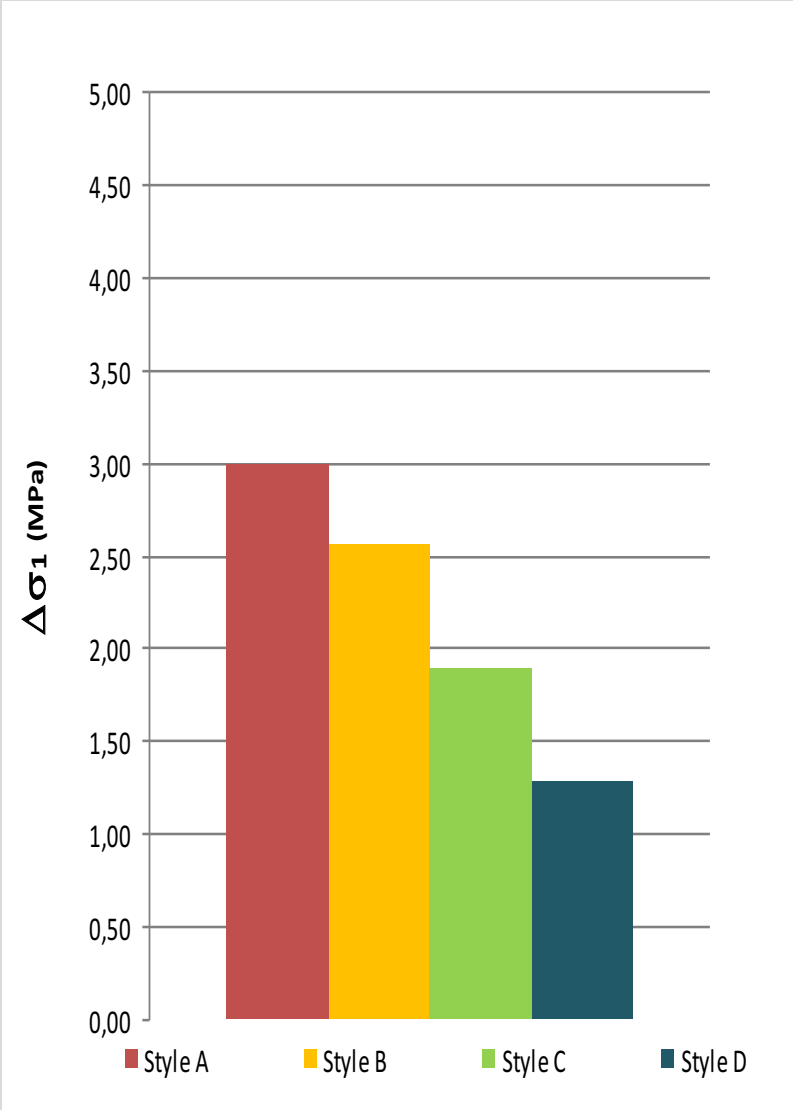
Friction force difference between Graphite and PTFE packings

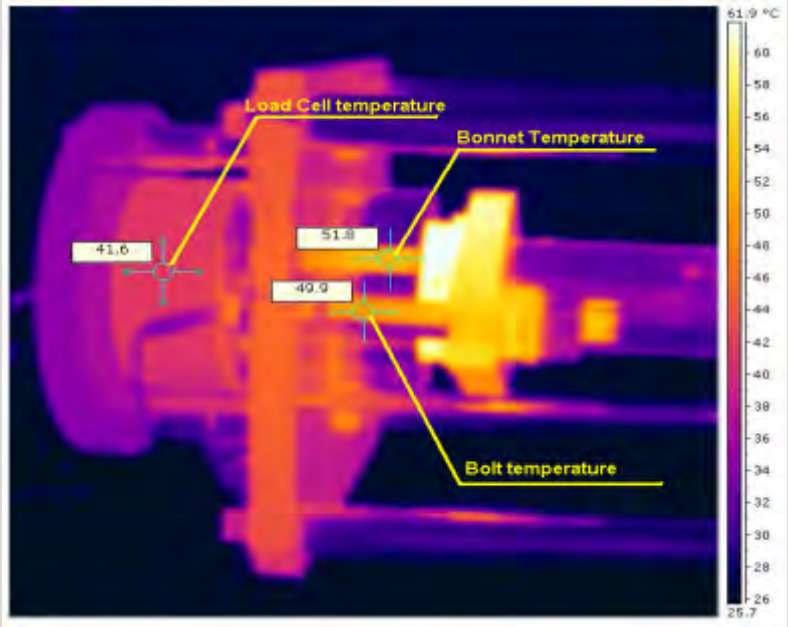
COATING



STYLE 10 and 12 = High Torque
STYLE 5 and 9 = Torque OK!

THERMAL EXPANSION





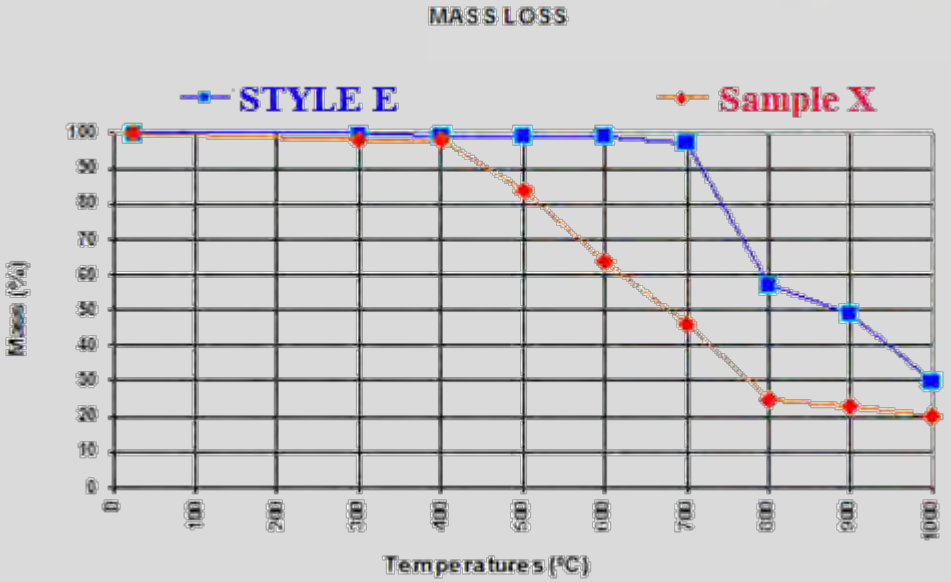
Style	Yarn	Filler	Comparative e-PTFE content
A	e-PTFE	None	100% e-PTFE
B	e-PTFE	Barium Sulphate	B% < A%
C	e-PTFE	Barium Sulphate	C % < A% & B%
D	e-PTFE	Graphite	D% < A%, B% & C%

THERMAL EXPANSION

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

PTFE Packing Extrusion due to Thermal Expansion

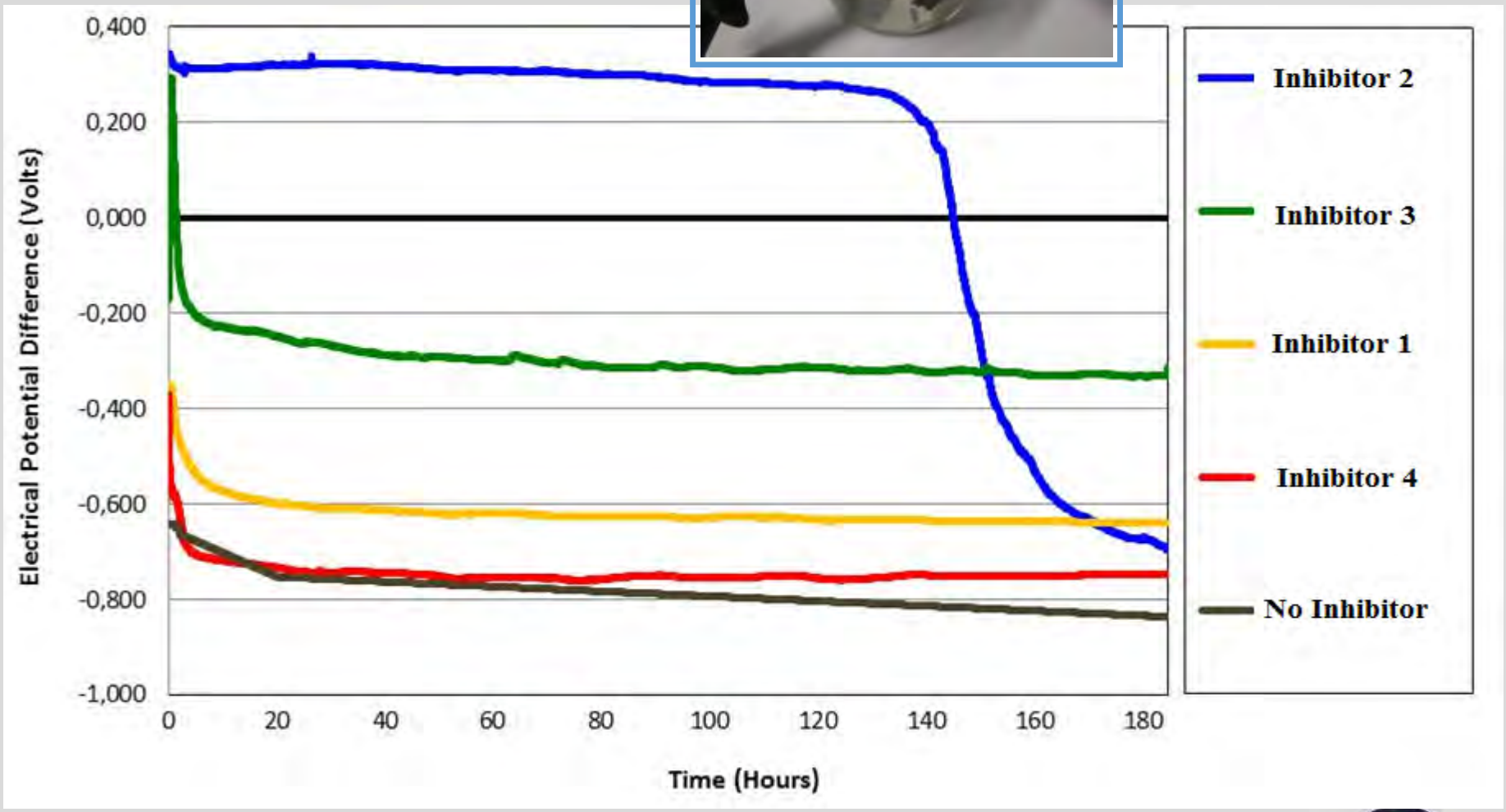
THERMAL RESISTANCE



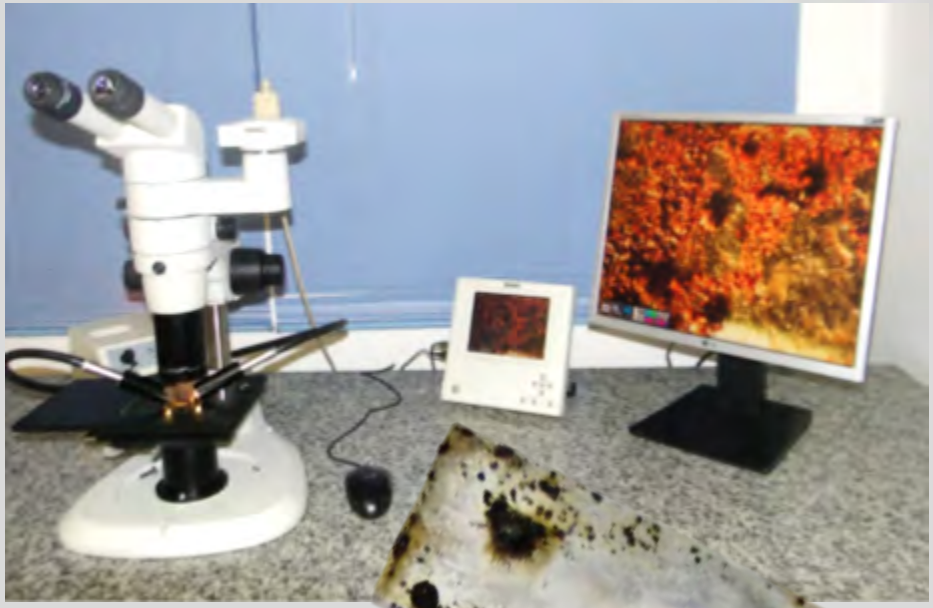
	STYLE A	LE 1	LE2	LE3	LE4
500°F/1 h (260°C/1 h) [%]	0,8	0,9	1,3	2,6	2,6
900°F/1 h (480°C/1 h) [%]	1,6	11,1	26,5	24,7	25,6
1000°F/1 h (540°C/1 h) [%]	2	12,7	44,1	26,4	34,9

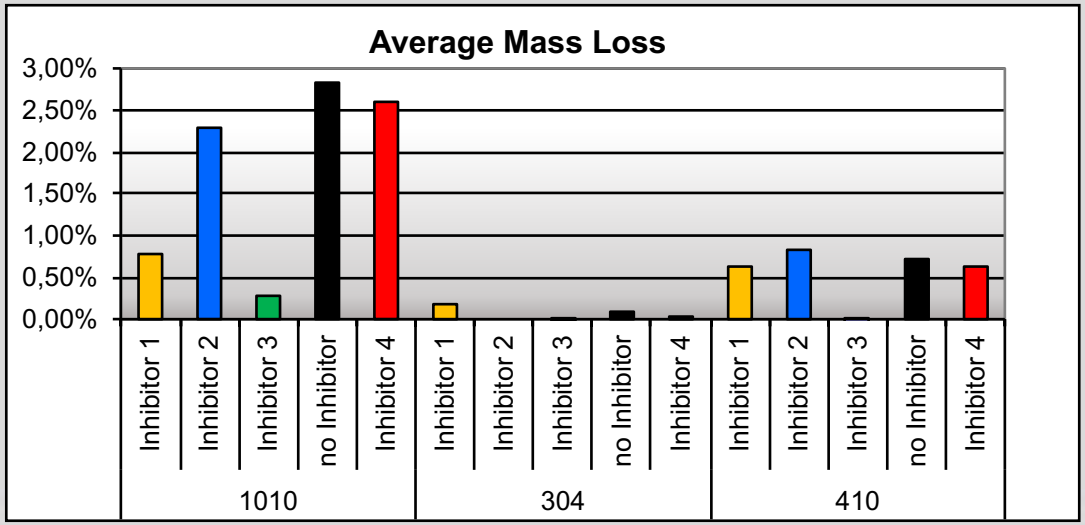
Table 3.1 – Thermal properties

GALVANIC CELL - CORROSION

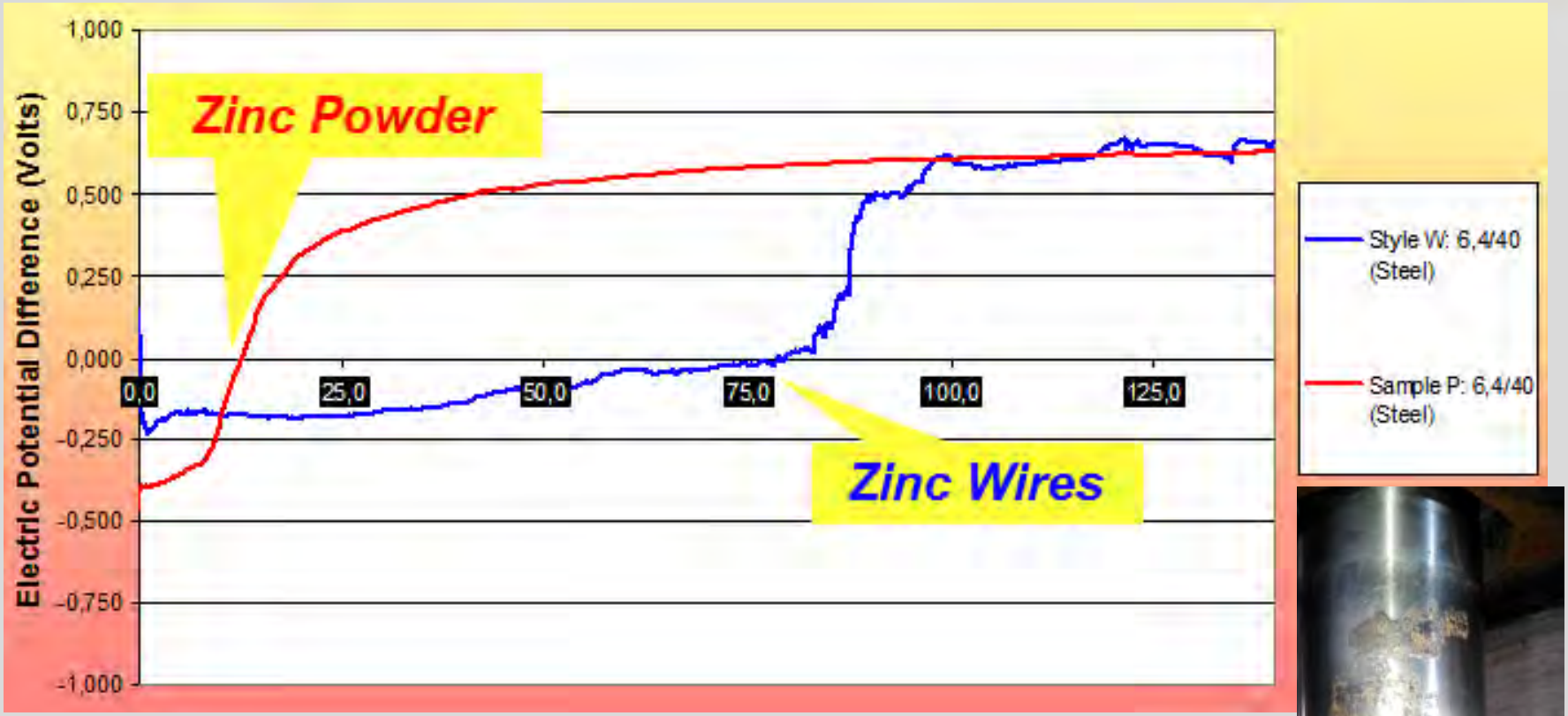


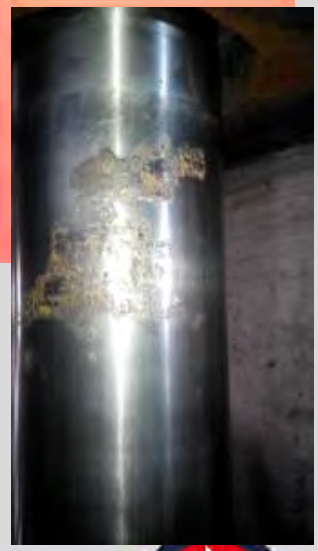
CORROSION INHIBITOR





CORROSION INHIBITOR





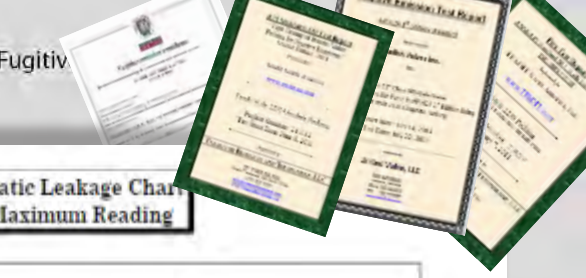
- **Packing Sample P**: with **Zinc Powder**.
- **Packing Sample W**: with **Zinc Wires** in the core.

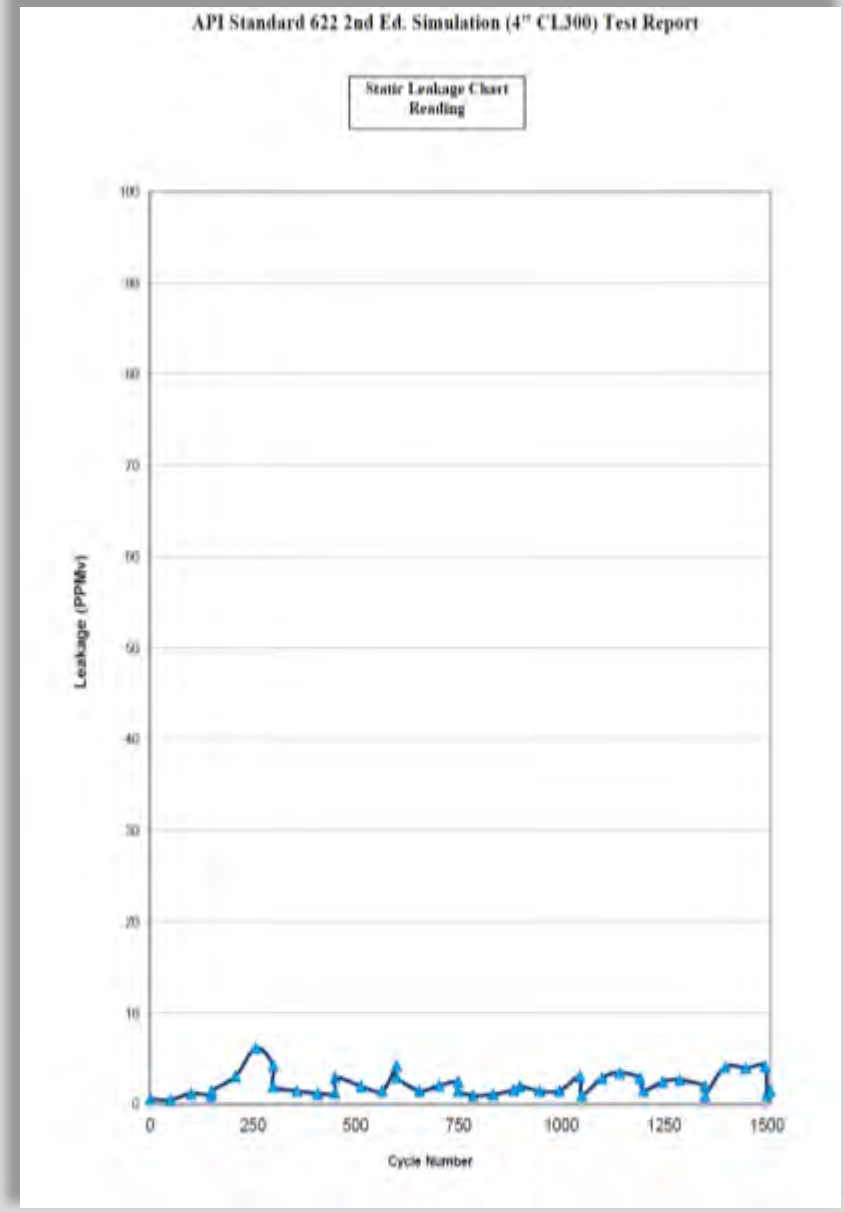
DENSITY CONTROL

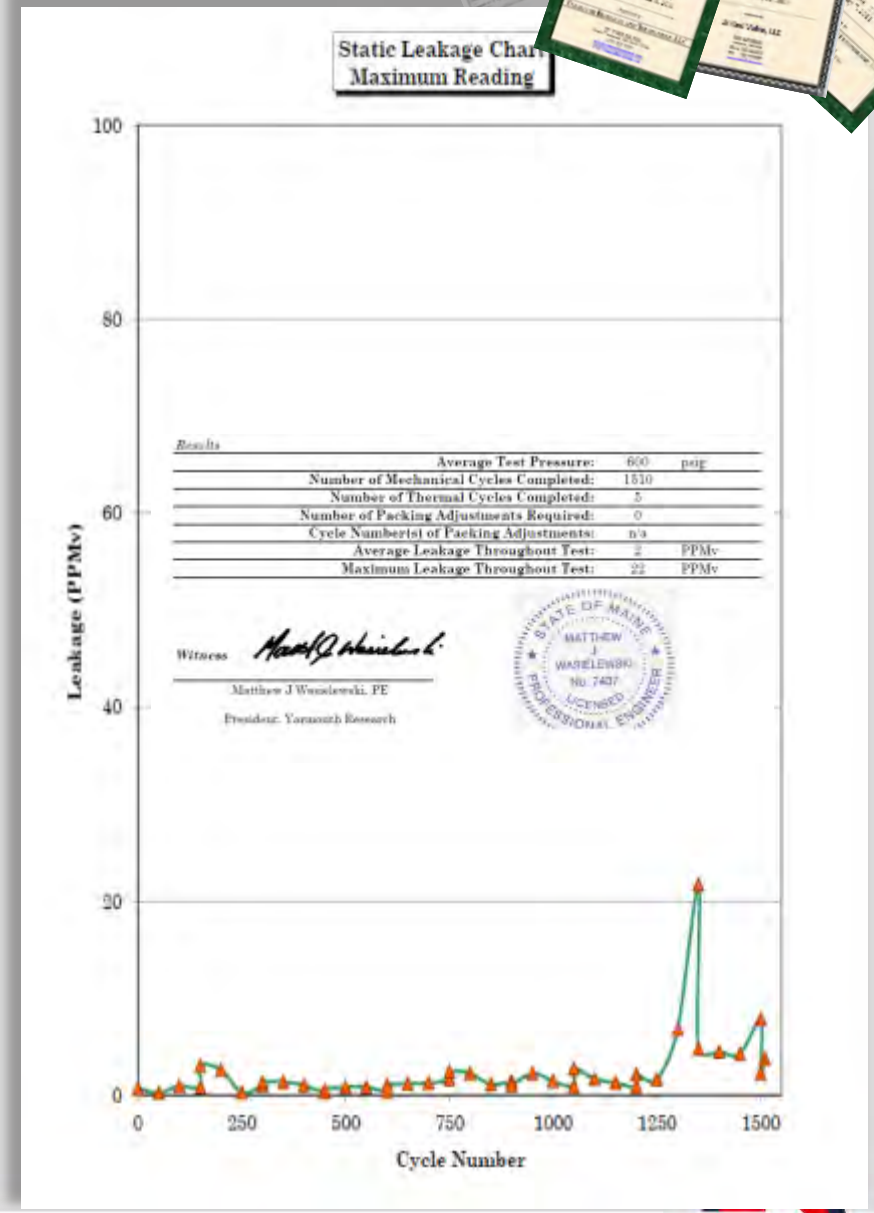
- **Density Control**
- **Specially on Molded Rings – Over Compressed rings will NOT be able to fill the voids**

FUGITIVE EMISSION TEST RIGS

R&D Results




API Standard 622 2nd Ed. Simulation (4" CL300) Test Report
Static Leakage Chart
Reading
Leakage (PPMv)
0
10
20
30
40
50
60
70
80
90
100
0
250
500
750
1000
1250
1500
Cycle Number


Static Leakage Chart
Maximum Reading
Leakage (PPMv)
0
20
40
60
80
100
0
250
500
750
1000
1250
1500
Cycle Number
Results
Average Test Pressure: 600 psig
Number of Mechanical Cycles Completed: 1510
Number of Thermal Cycles Completed: 5
Number of Packing Adjustments Required: 0
Cycle Number(s) of Packing Adjustments: n/a
Average Leakage Throughout Test: 2 PPMv
Maximum Leakage Throughout Test: 22 PPMv
Witness
Matthew J Wasielewski, PE
President, Yarmouth Research
STATE OF MAINE
MATTHEW
J
WASIELEWSKI
No. 7407
LICENSED
PROFESSIONAL ENGINEER

WHAT MAKES A GOOD FE PACKING FOR NEW/USED VALVES?

- Controlled Packing Density
- Reduced Stem Drag - the least PTFE possible
- Thermal Resistant and Fire Safe
- Corrosion Inhibition
- Designed Assembly Stress

SUCCESS FACTORS - TESTING

API 624 Key Success Factors

- Valve and packing manufacturer relationship
- Quality product and good communication yields good results
- Eyebolt nut / Gland flange torque values
- Machining tolerances (stem, stuffing box, gland, etc.)
- Lubrication
- Third-party tester that is competent – Integrity of test stand (Revolution speed, Safety, etc..)

INSTALLER TRAINING: 3 KEY ELEMENTS

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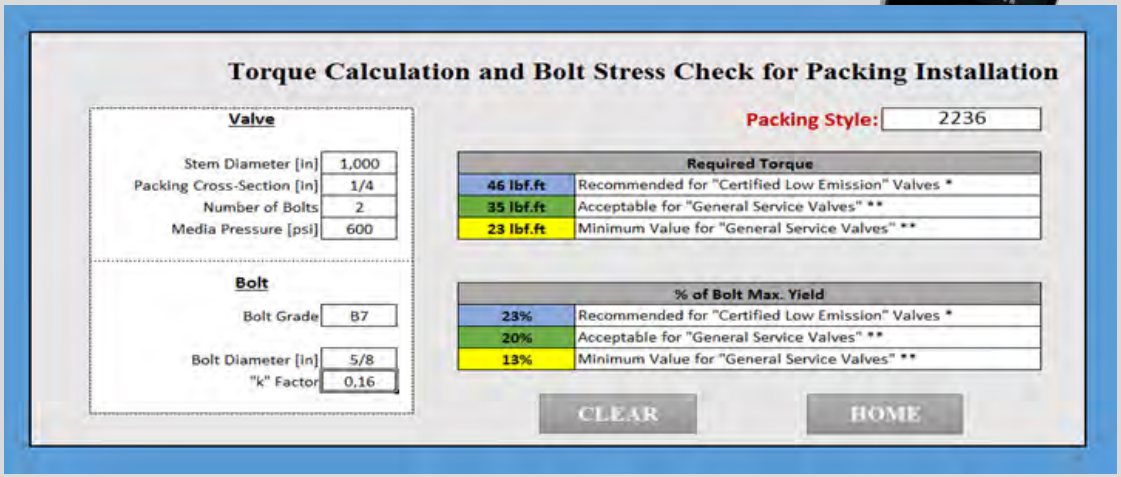
1° PRODUCT

2° TORQUE



Torque Calculation and Bolt Stress Check for Packing Installation

Valve

Stem Diameter [in]	1,000
Packing Cross-Section [in]	1/4
Number of Bolts	2
Media Pressure [psi]	600

Bolt

Bolt Grade	B7
Bolt Diameter [in]	5/8
"k" Factor	0,16

Packing Style: 2236

Required Torque	
46 lbf.ft	Recommended for "Certified Low Emission" Valves *
35 lbf.ft	Acceptable for "General Service Valves" **
23 lbf.ft	Minimum Value for "General Service Valves" **

% of Bolt Max. Yield	
23%	Recommended for "Certified Low Emission" Valves *
20%	Acceptable for "General Service Valves" **
13%	Minimum Value for "General Service Valves" **

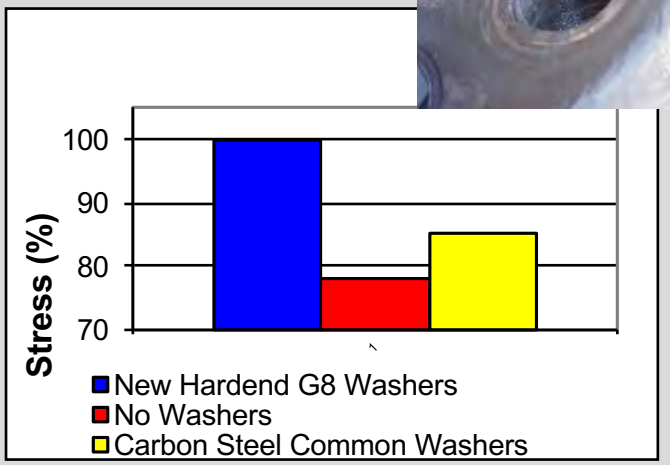
CLEAR HOME

3° INSTALLATION

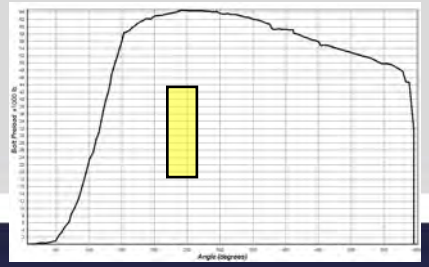
INSTALLATION

- Stuffing Box and Stem finish as per STD
- Tolerances as per best practice as per STD
- Rings with Cuts 90º apart
- 5 Rings = Desirable
- Proper torque (k factor influence)

Applied Torque N.m (lb. Ft)	Rusted Bolt - Dry	Rusted Bolt - with lubrication	New A193 B7 – Dry	New A193 B7 - Lubricated
				
Friction factor	0.49	0.16	0.17	0.12

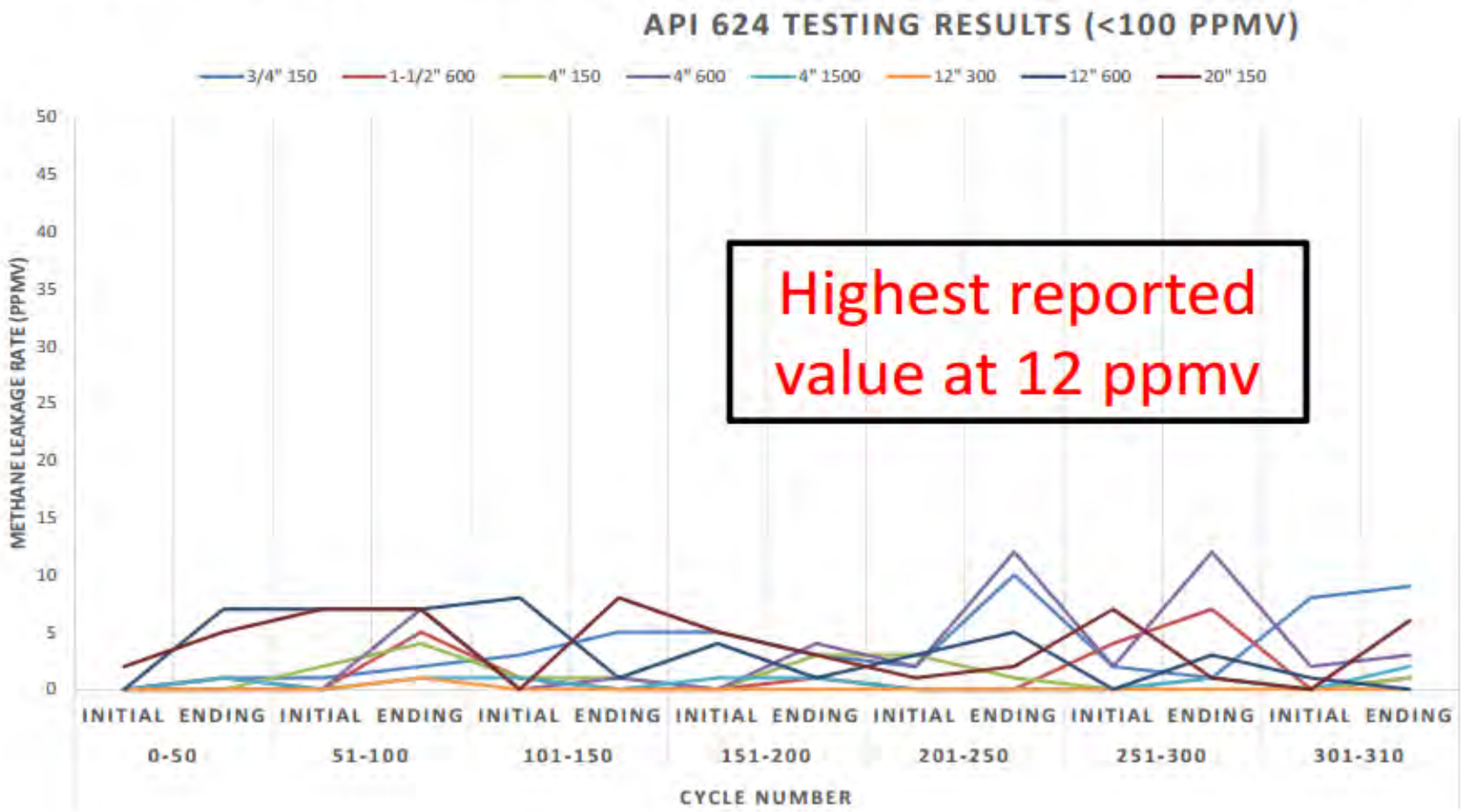


- Bolt Design



API 624 RESULTS

API 624 Type Testing Results



FIELD MONITORING RESULTS – 4Years

"Since the introduction of LE packing at our TCO Tengiz facility in Kazakhstan four years ago, we have experienced zero leaks on every reconditioned valve we have repacked with…" (Bill Ross)

The financial impact of unscheduled plant shutdown due to Valve Packing Blow out was $50,000,000.

Good Practice: recommend retightening once after initially being put into service.

What makes a good FE packing for new/used valves?

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Thank you!