



SILICONE  
TECHNOLOGY

# Silicone Coatings for Aircraft

Brian Burkitt: Senior Technical Sales - Engineering Materials

Bill Riegler: Product Director – Engineering Materials

Rob Thomaier: Research Director

Summer Sivas, Ph.D.: Technical Specialist

Kelly Hoover: Senior Technical Engineer - Pratt & Whitney

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# Ice Engineering

- Aircraft
  - Aerodynamic Surfaces
  - Engines
  - Leading edges of wings
- Marine Vessels
- Surface Vehicles
- Communication and power lines
- Hydroelectric Intakes
- Lock Walls



# Current Solutions in Aircraft Industry

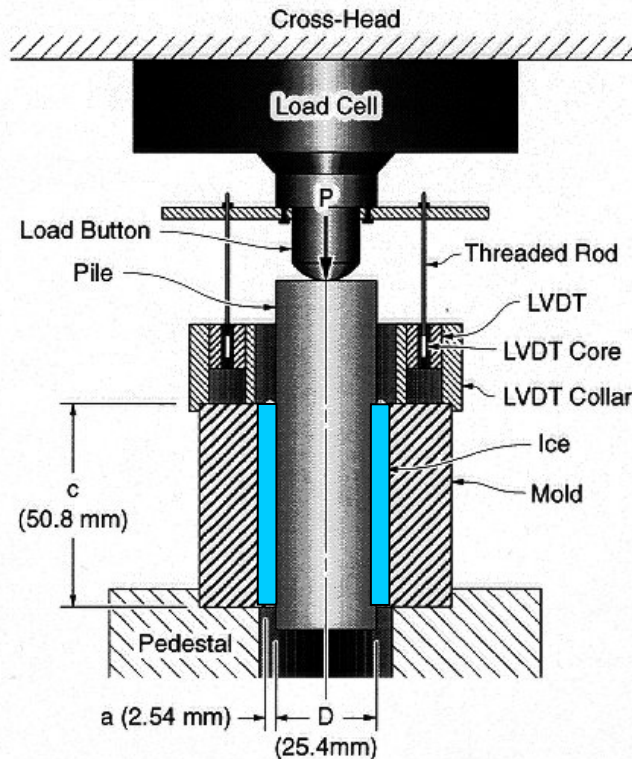
- Keep Surface above 0°C
  - Store in heated hangers
  - Built in heating systems
  
- Chemical De-icing
  - Glycol
  - 2-Methoxyethanol – banned
  
- Costly and Impractical



**∴ Need to develop an icephobic coating**

# Cold Regions Research & Engineering Laboratory (CRREL)

## 0° Cone Test



# Cold Regions Research & Engineering Laboratory (CRREL) Ice Adhesion Test

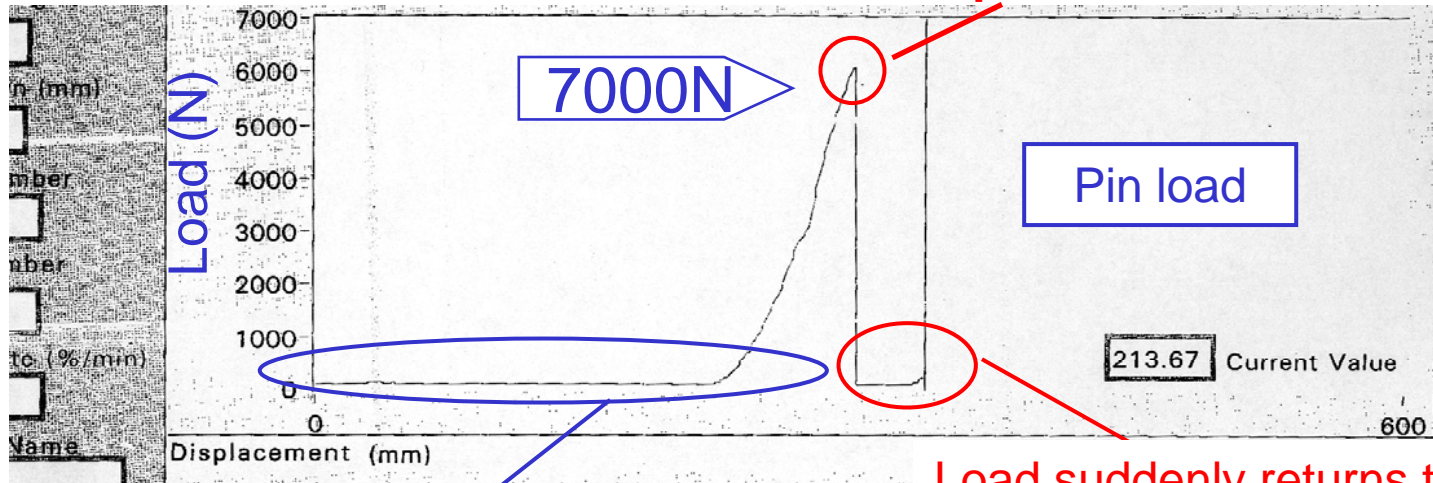
- Aluminum cylinders are spray coated with Material
- The coated cylinders are frozen into an ice mold
- The sample is placed in fixture and a load applied

Coated  
cylinder



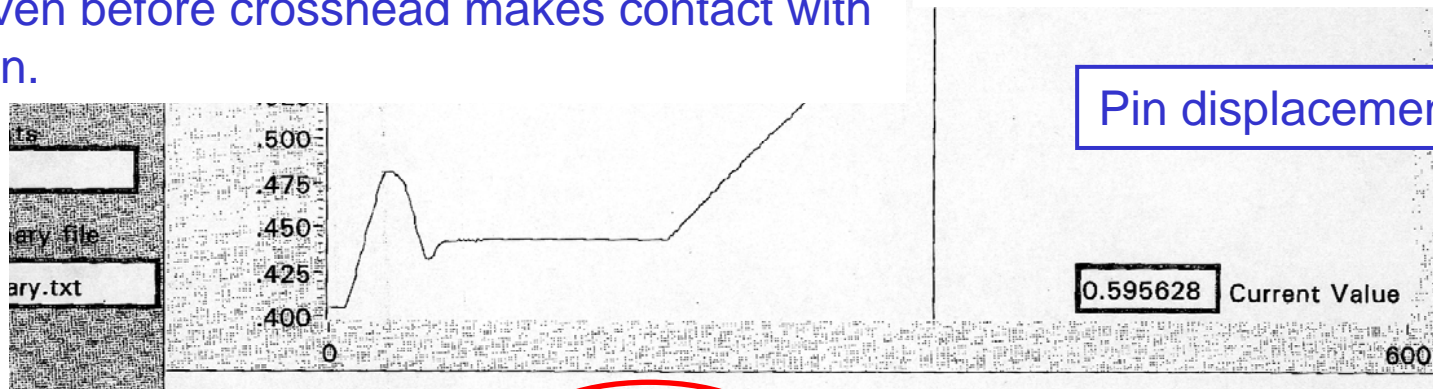
# Aluminum Ice Adhesion Test

**Max load used to calculate shear stress required for ice release**



Load suddenly returns to 0.  
**Ice broke free!**

Offset due to signal from instrumentation, even before crosshead makes contact with pin.

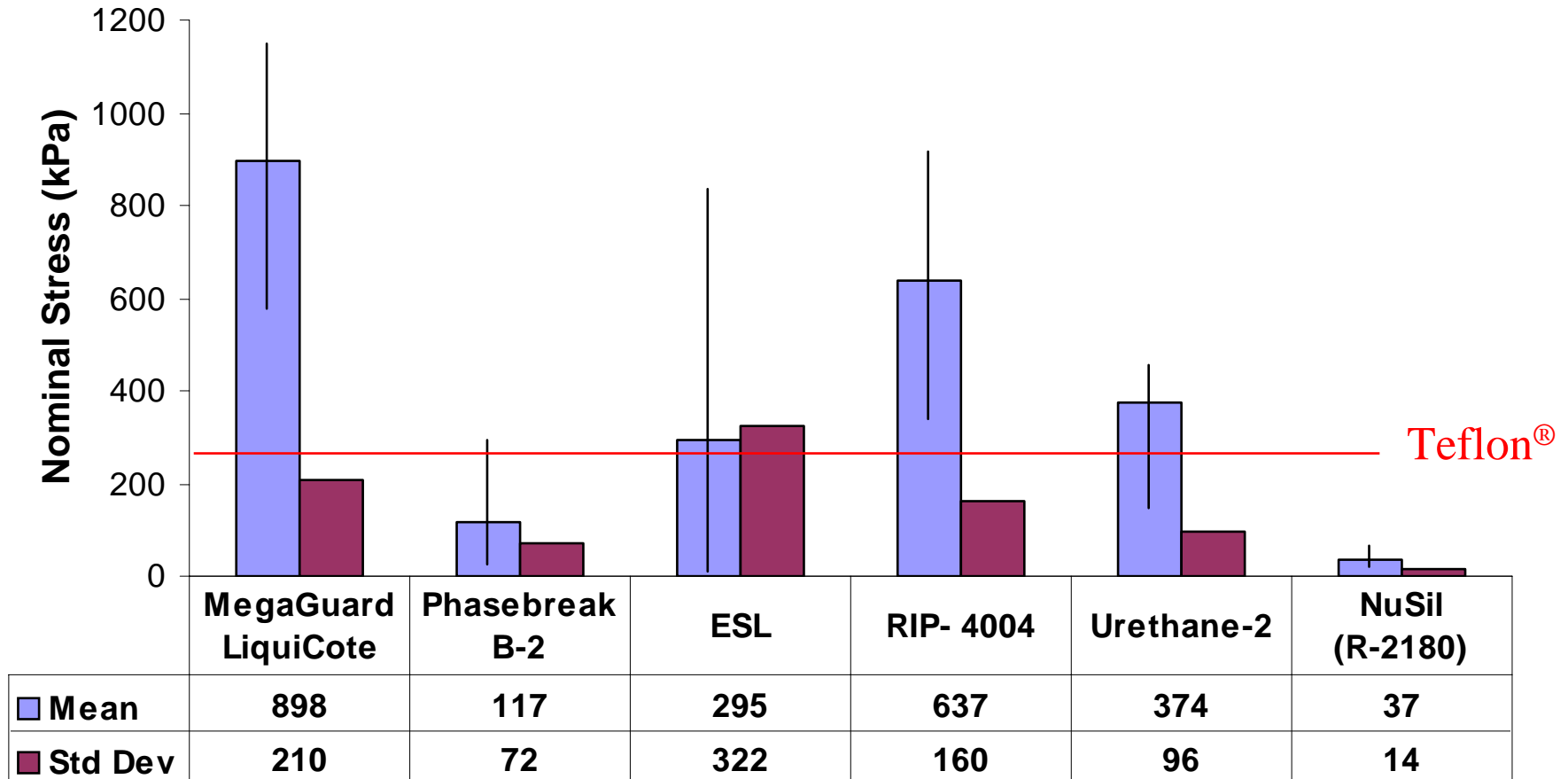


Peak Load(N)	Ice Contact Area(m <sup>2</sup> )	Stress (kpa)	slope	ChRact (%/min)	Strain rate (1/s)
6164.12	0.004054	1520.62643	0.001026	4.85	0.00020213

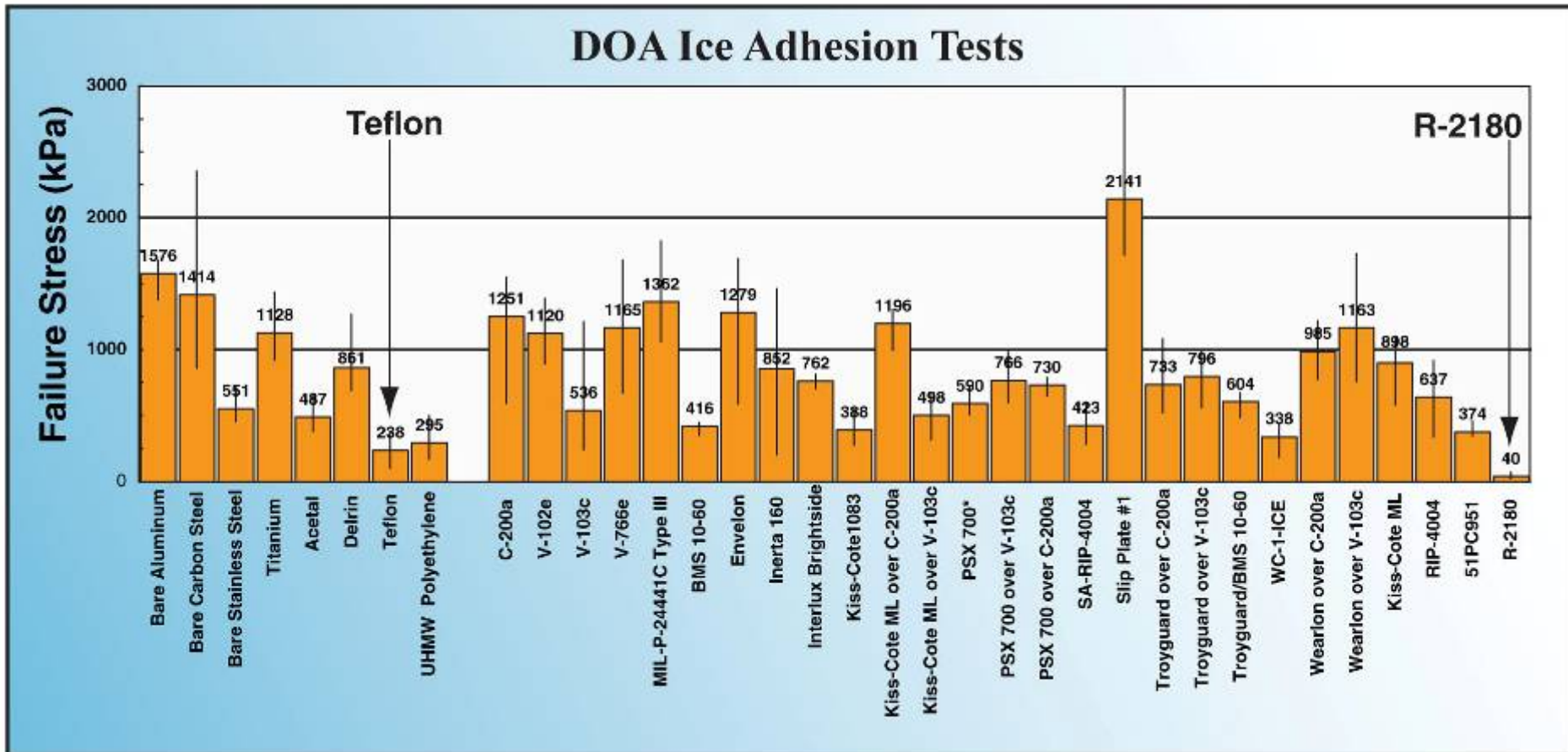
# Comparison of Ice-Phobic Coatings:

Sample Name	Manufacturer
MegaGuard LiquiCote	KissCote, Inc
Phasebreak B-2	Microphase Coatings
ESL	Microphase Coatings
RIP-4004	S&A Fernandina, Inc.
Urethane-51PC951	21 <sup>st</sup> Century
R-2180	NuSil Technology

# Comparison of Ice-Phobic Coatings: CRREL Ice Adhesion Results

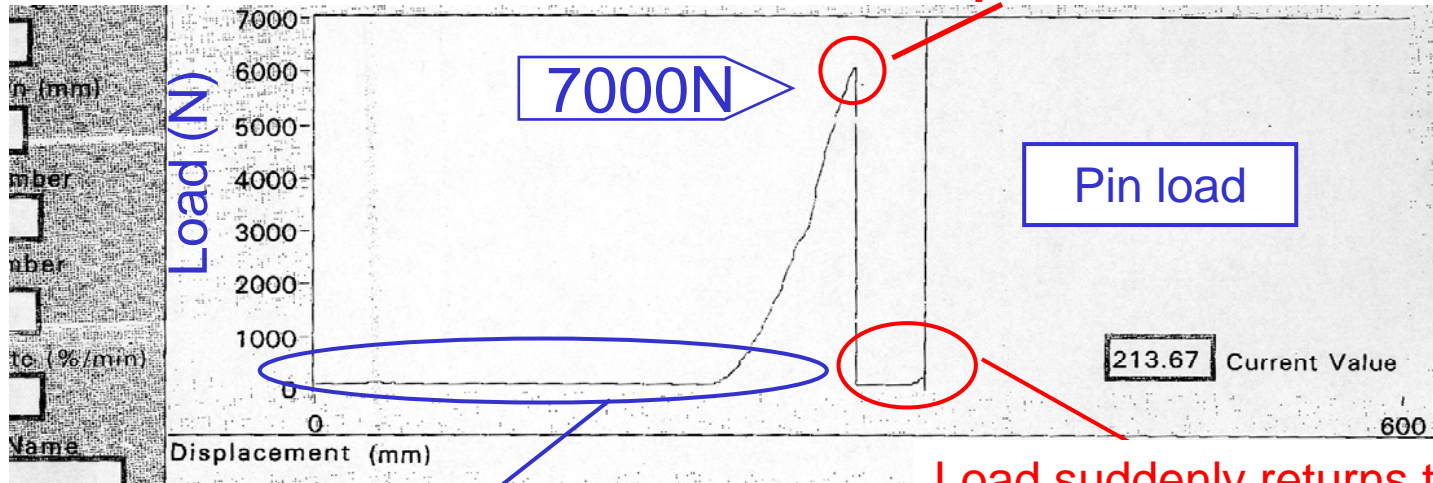


# Department of the Army Ice Adhesion Test Results



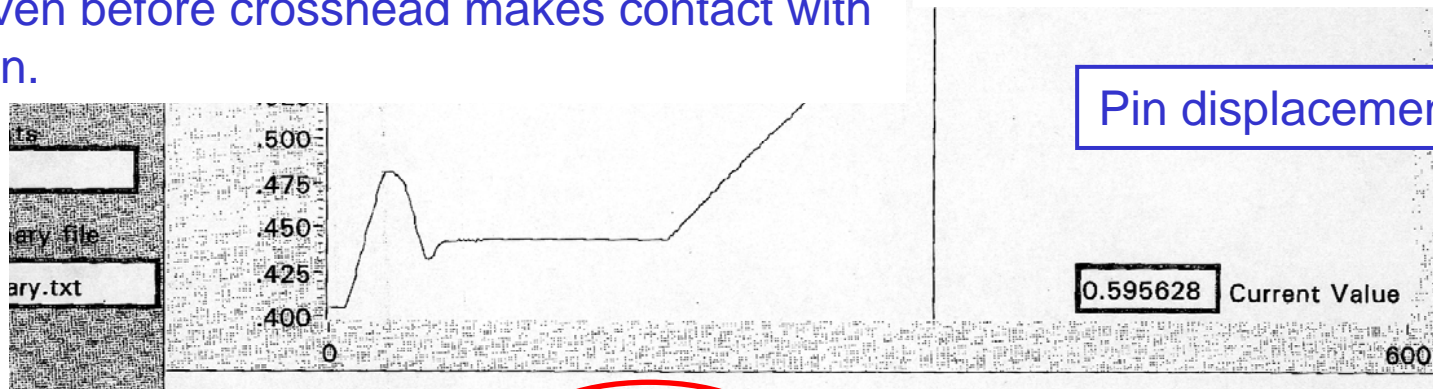
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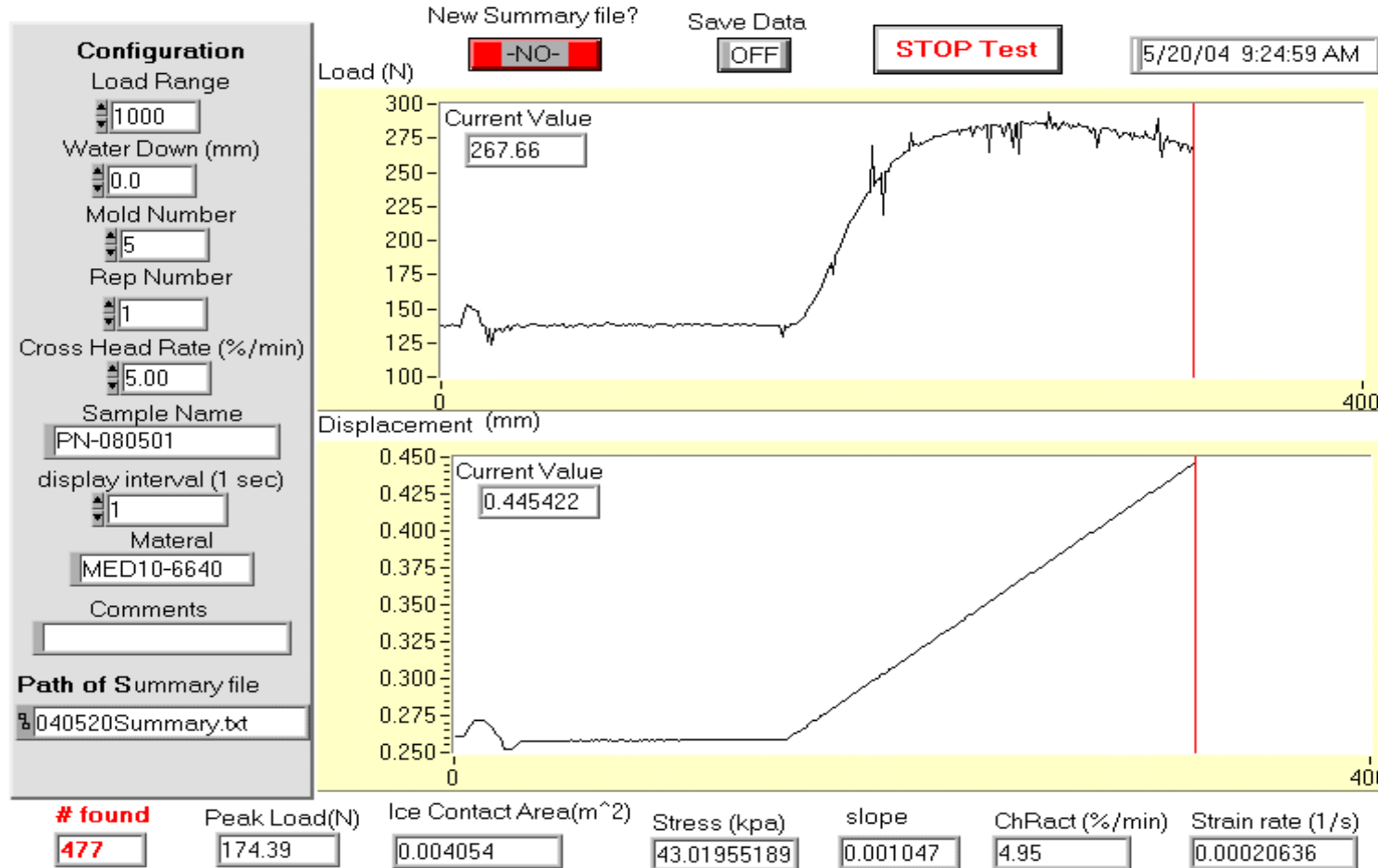
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# R-2180 Ice Adhesion Test



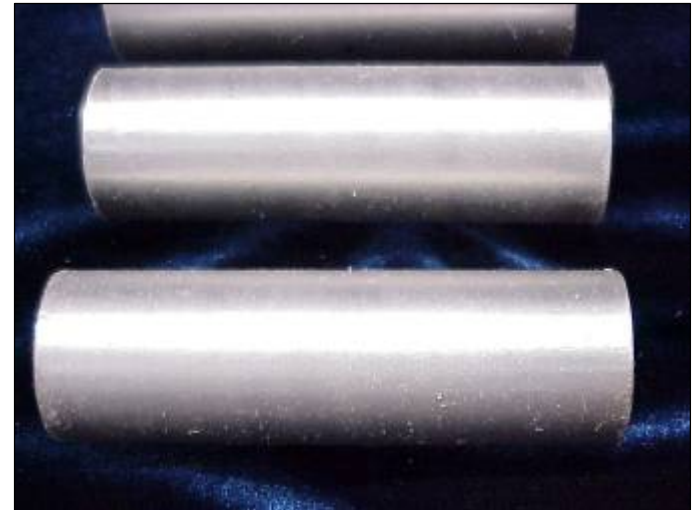
ad

ice

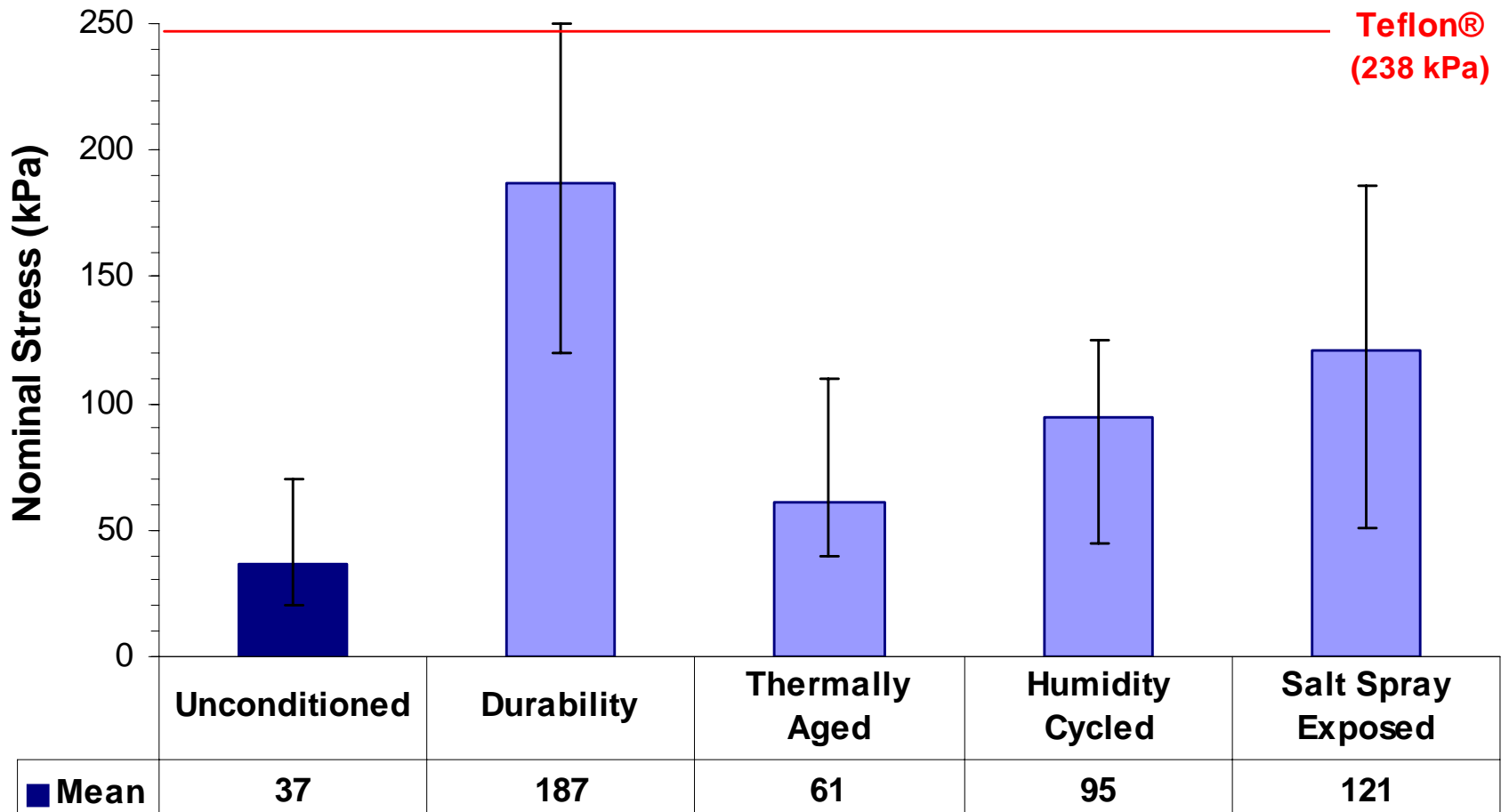


# Environmental Exposure

- Durability - Coated Aluminum Pins were roughened w/ sand paper to simulate wear
- Thermal Aging
- Humidity Cycles
- Salt Spray Exposure



# R-2180 After Environmental Exposure



# R-2180 Summary

- Although ice continues to form under static conditions, R-2180 significantly reduces ice adhesion
- Performs 10x better than any other commercially available coating or material
- Shows favorable performance after wear and environmental exposure



# Acknowledgments

- Kelly Hoover - Pratt & Whitney

- CRREL

- Thank You for Listening