ENGINEERED POLYMER SOLUTIONS

Science Simplified

Architectural Binder Technology for Institutional and Commercial Paint Applications

Western Coatings Show 2017

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Agenda

- Institutional and Commercial Architectural Coatings Market
  - Benefits of Acrylic Technology
  - Performance Gaps
- Benchmark Evaluation
- Summary

Institutional and Commercial for Architectural Coatings

Basic Paint Criteria

- Return to service minimized
  - No ‘green’ feel
  - Very low VOC / odor
- New or previously painted surfaces

Performance Attributes

- Abrasion resistance for high traffic public places
- High degree of resistance properties:
  - Cleaners
  - Chemicals (acids, bases, solvents, etc.)
- Light-duty corrosion resistance
- Early water resistance

Institutional and Commercial Coatings

High-Performance Architectural coatings professionally applied:

- Doctors' offices
- Hospitals
- Laboratories
- Hotels
- Schools
- Office buildings
- Retail stores
- Factories
- Churches
- Etc.

Waterborne Acrylic Technology in Commercial Applications

Benefits	Performance Gaps to Overcome
• Low-VOC Capable	• Abrasion Resistance
• Low Odor	• Chemical Resistance
• Water-Based	• Cleaner Resistance
• 1K System	• Water Sensitivity
• No Solvents	• Early Hardness Development
• Ease of Cleanup	• Low-Tack Finishes

Benchmark Evaluation

- Commercially available water-based (WB), 1K, white paints in the commercial and institutional market

- Target application spaces:
  - High performance interior latex
  - Institutional low-VOC
  - Light industrial

	EPS Acrylic	Pre-cat WB Epoxy #1	Pre-cat WB Epoxy #2	Acrylic #1	Acrylic #2	Acrylic #3
VOC Level	<5 g/L	<100 g/L	<150 g/L	<5 g/L	<50 g/L	175 g/L
Chemistry	All-acrylic	1K WB acrylic epoxy	1K WB acrylic epoxy	All-acrylic	All-acrylic	All-acrylic

MPI Testing Criteria	#141	#147	#153	#215
Title	High Performance Latex	Institutional Low VOC	Light Industrial	WB 2K Epoxy Modified
VOC Requirement (g/L)	Environmental Standards (<50-150)	<10	Environmental Standards (<50-250)	Environmental Standards (<50-150)
Chemical / Solvent Resistance	Not Listed (NL)	NL	pass	pass
Water Resistance	NL	NL	NL	pass
Adhesion	NL	NL	NL	pass
Scrubbability (%Gloss Loss)	4000 (20%)	4000 (20%)	4000 (no break)	5000 (5%)
Abrasion Resistance (w/ shims)	NL	NL	NL	500
Cleansability	pass	pass	NL	pass
Flexibility	pass	pass	pass	pass

- MPI #215 2K Modified Epoxy used to challenge EPS all-acrylic performance

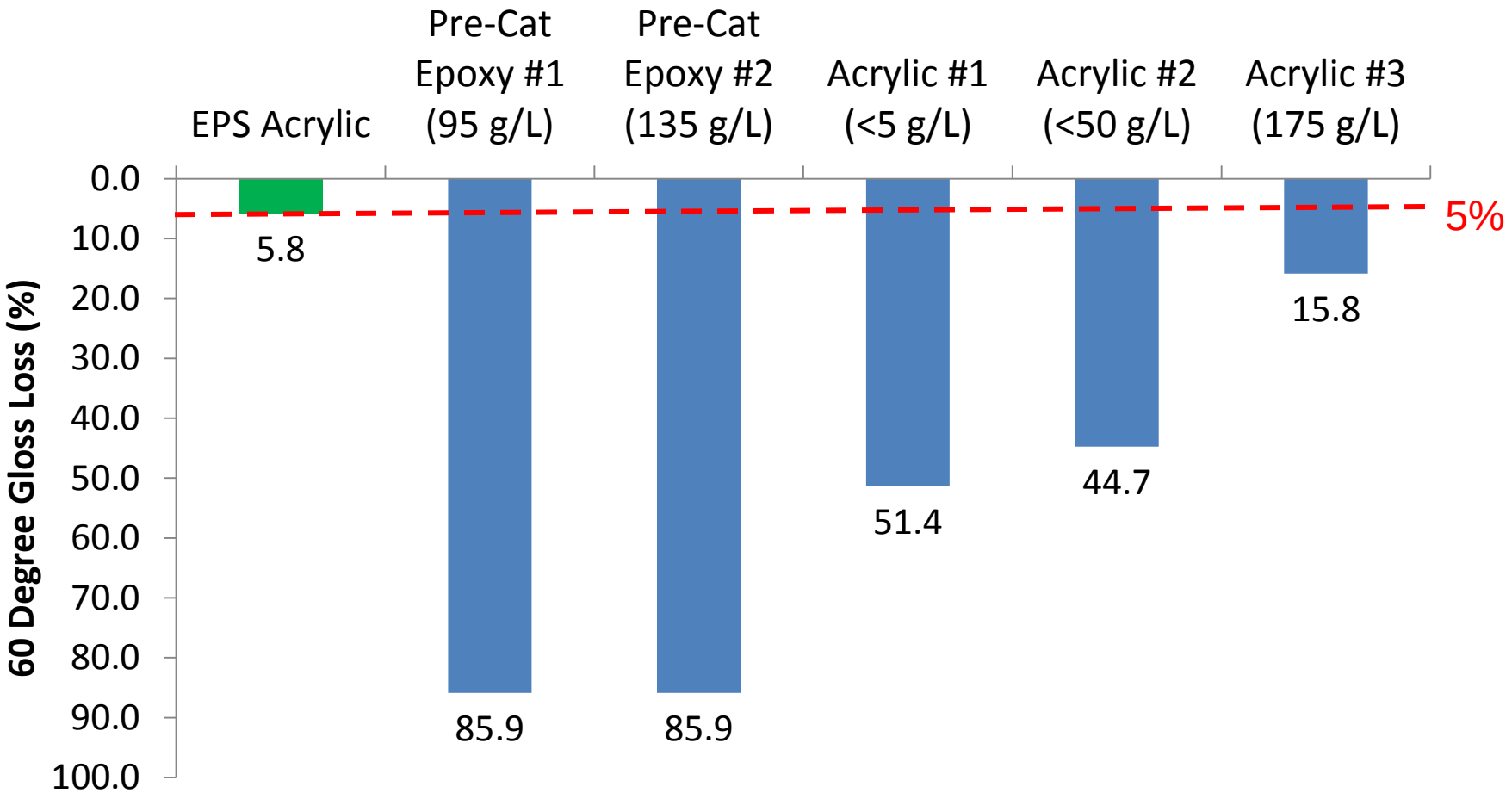
eps CCA

Physical Properties

	EPS Acrylic (<5 g/L)	Pre-Cat Epoxy #1 (95 g/L)	Pre-Cat Epoxy #2 (135 g/L)	Acrylic #1 (<5 g/L)	Acrylic #2 (<50 g/L)	Acrylic #3 (175 g/L)
HT Block 1 day	9	8	0	0	8	0
HT Print Resistance 1 day	10	6	8	8	9	6
HT Tack Resistance 1 day	10	4	2	2	8	6
Total (out of 30)	29	18	10	10	25	12

MPI Scrubbability – 5000 Cycles without shims

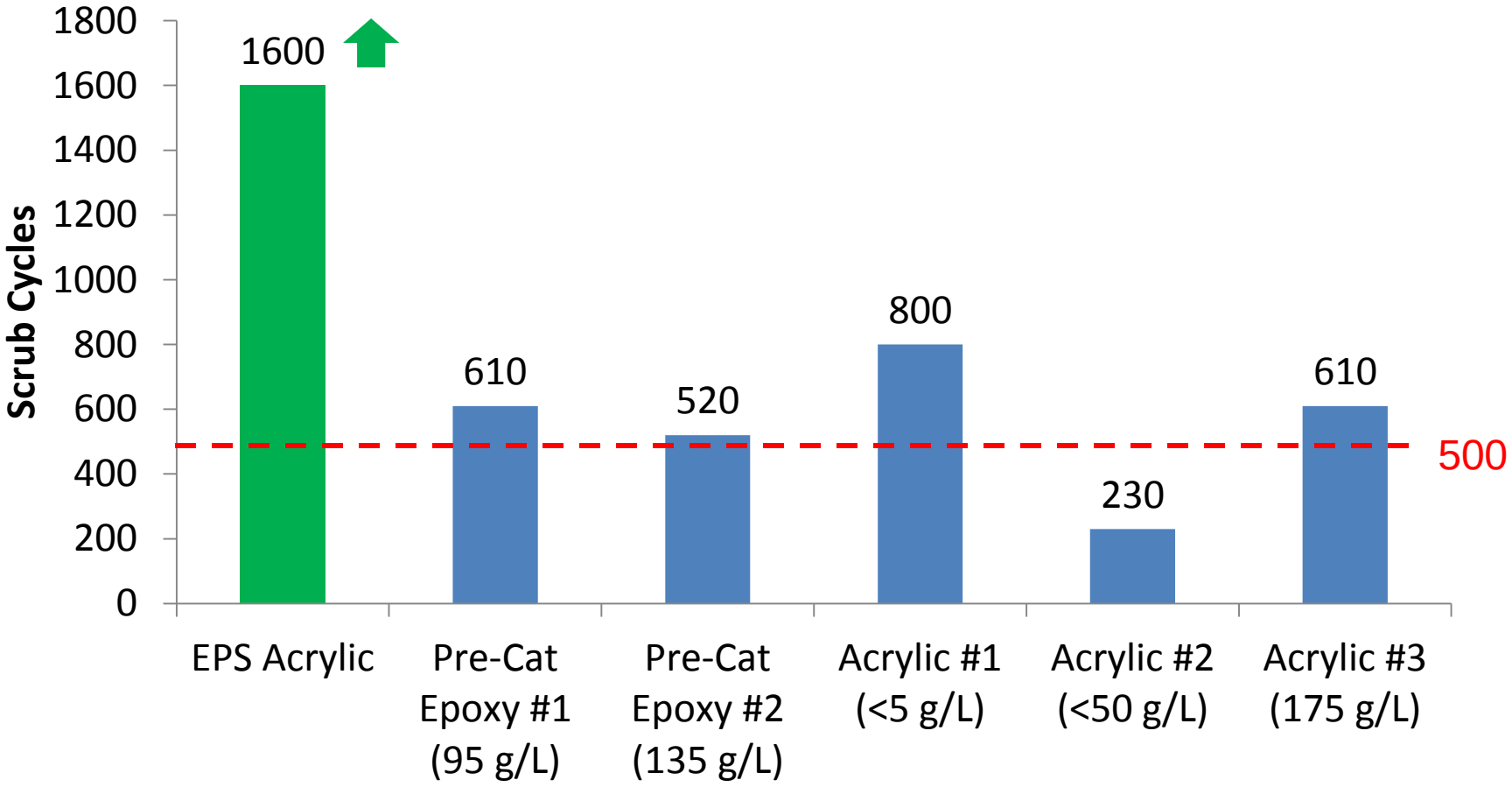
EPS Testing (Not certified by MPI)



- EPS Acrylic was only paint to be close to the 5% gloss loss threshold after 5000 cycles

MPI Abrasion Resistance – Minimum 500 cycles w/ shims

EPS Testing (Not certified by MPI)



- EPS Acrylic stopped at 1600 scrub cycles, still had not shown break-through

MPI Chemical Resistance

EPS Testing (Not certified by MPI)

	EPS Acrylic (<5 g/L)	Pre-Cat Epoxy #1 (95 g/L)	Pre-Cat Epoxy #2 (135 g/L)	Acrylic #1 (<5 g/L)	Acrylic #2 (<50 g/L)	Acrylic #3 (175 g/L)
50% H_2SO_4	Pass	Pass	Fail	Pass	Pass	Pass
10% HCl	Pass	Fail	Fail	Pass	Pass	Pass
5% H_3PO_4	Pass	Fail	Pass	Pass	Pass	Pass
25% NaOH	Pass	Pass	Pass	Pass	Pass	Pass
Mineral Spirits	Pass	Pass	Pass	Pass	Pass	Pass
Methanol	Pass	Fail	Pass	Fail	Fail	Pass
Motor Oil	Pass	Fail	Pass	Fail	Fail	Pass
Vegetable Oil	Pass	Fail	Pass	Fail	Fail	Pass

Failures noted are significant gloss change, film degradation or discoloration.

Institutional and Household Chemical / Cleaner Resistance

EPS Developed Test Method

- Test to evaluate the softening of coatings due to chemical and cleaner exposure and measure the recovery of the hardness of the films overtime.

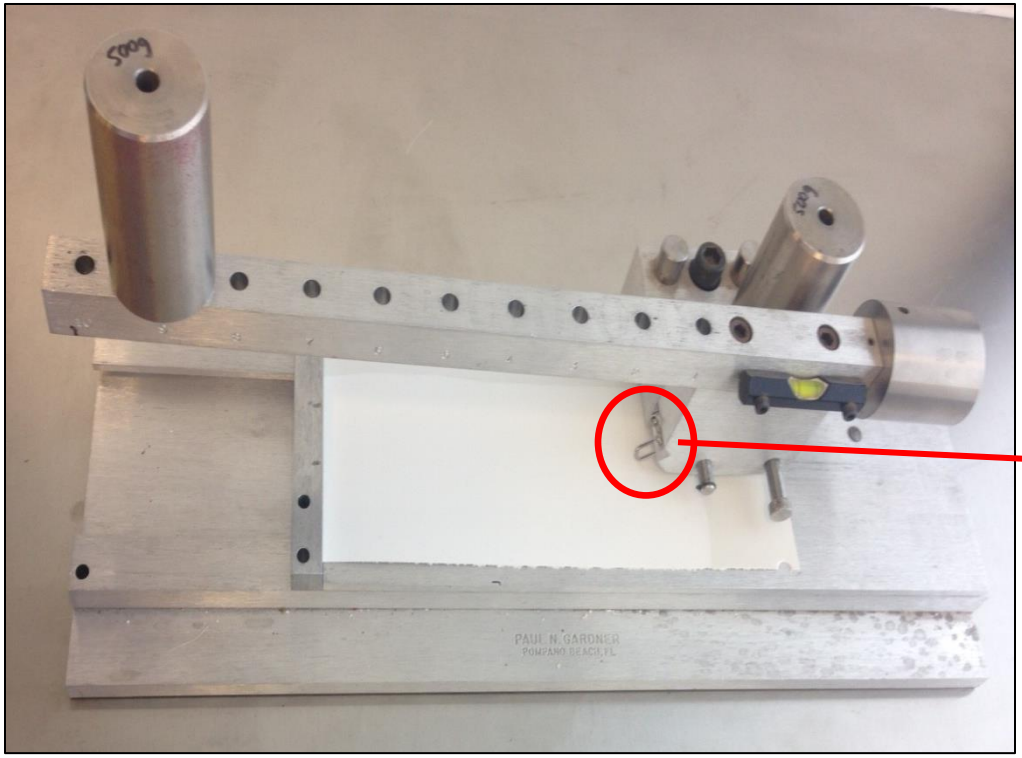
Cleaners Tested (9 Total)

- Formula 409
- Bleach (full strength)
- Clorox Green Works
- Fantastik
- Lysol 4 in 1
- Pinesol
- Purell Hand Sanitizer
- TSP (tri-sodium phosphate)
- Windex

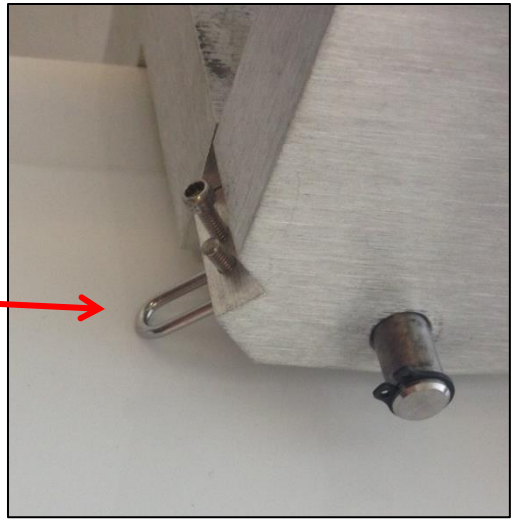
Test Procedure (EPS Developed)

- 7 day cure
- 30 minute cleaner exposure
- Scrape hardness measured at 5, 15 and 30 minutes recovery time
- Possible scrape hardness measured in 0 – 5000 grams

Scrape Hardness – ASTM D2197 w/ Metal Loop Stylus

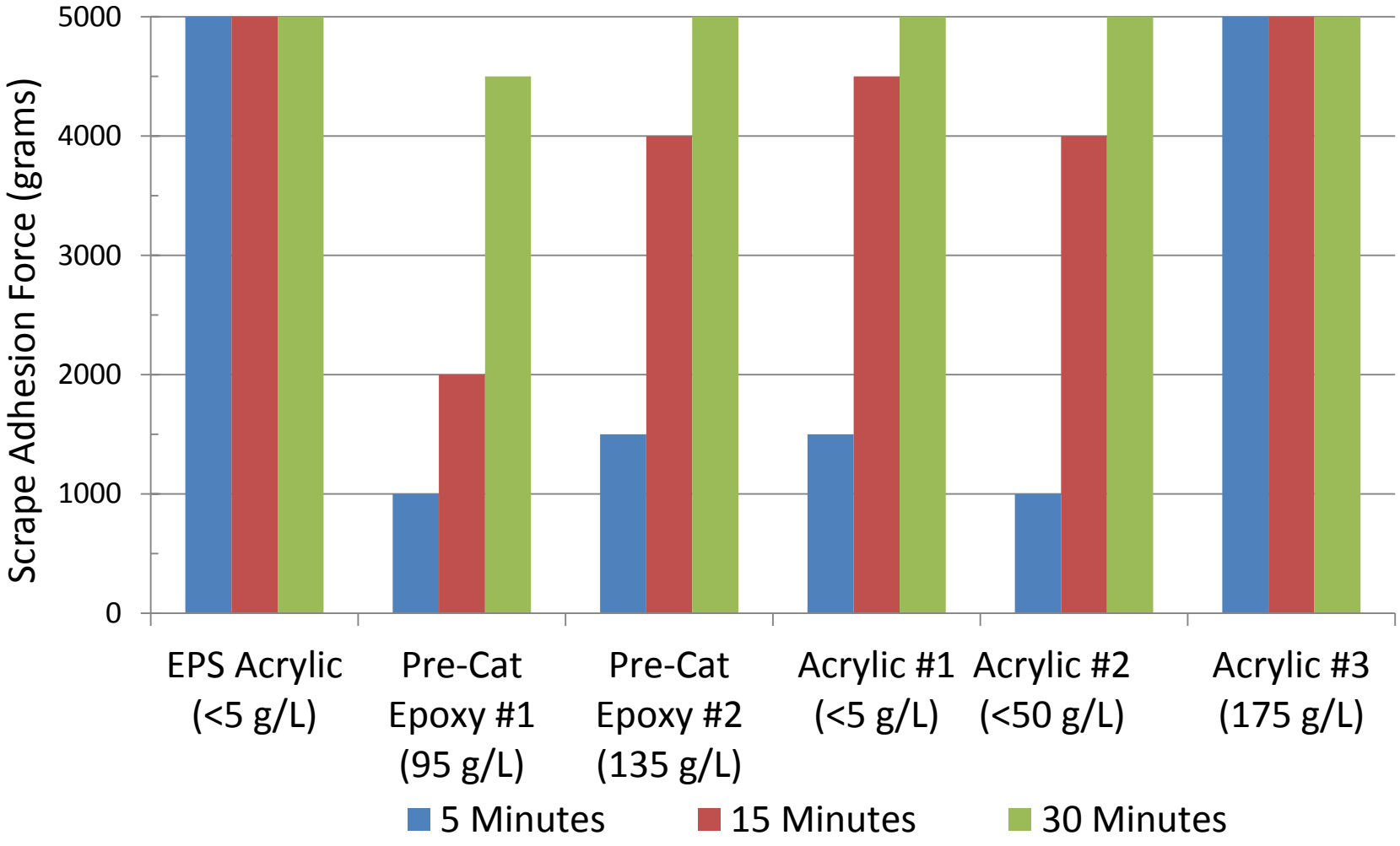


- Substrate – Leneta Chart
- Film Thickness – 3 mil wet

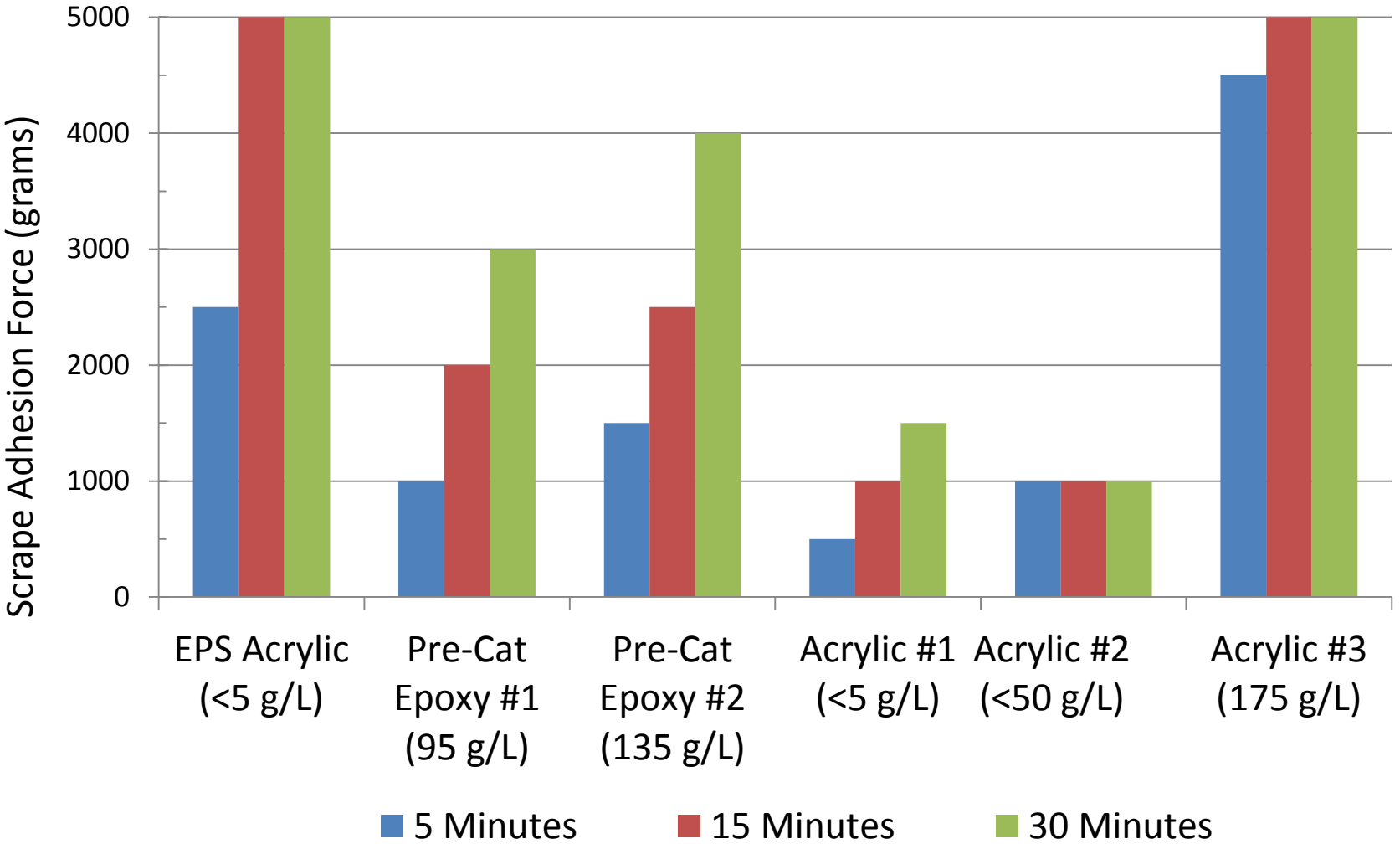


- Scrape adhesion force represent in mass in grams until failure (0 to 5000 grams possible)

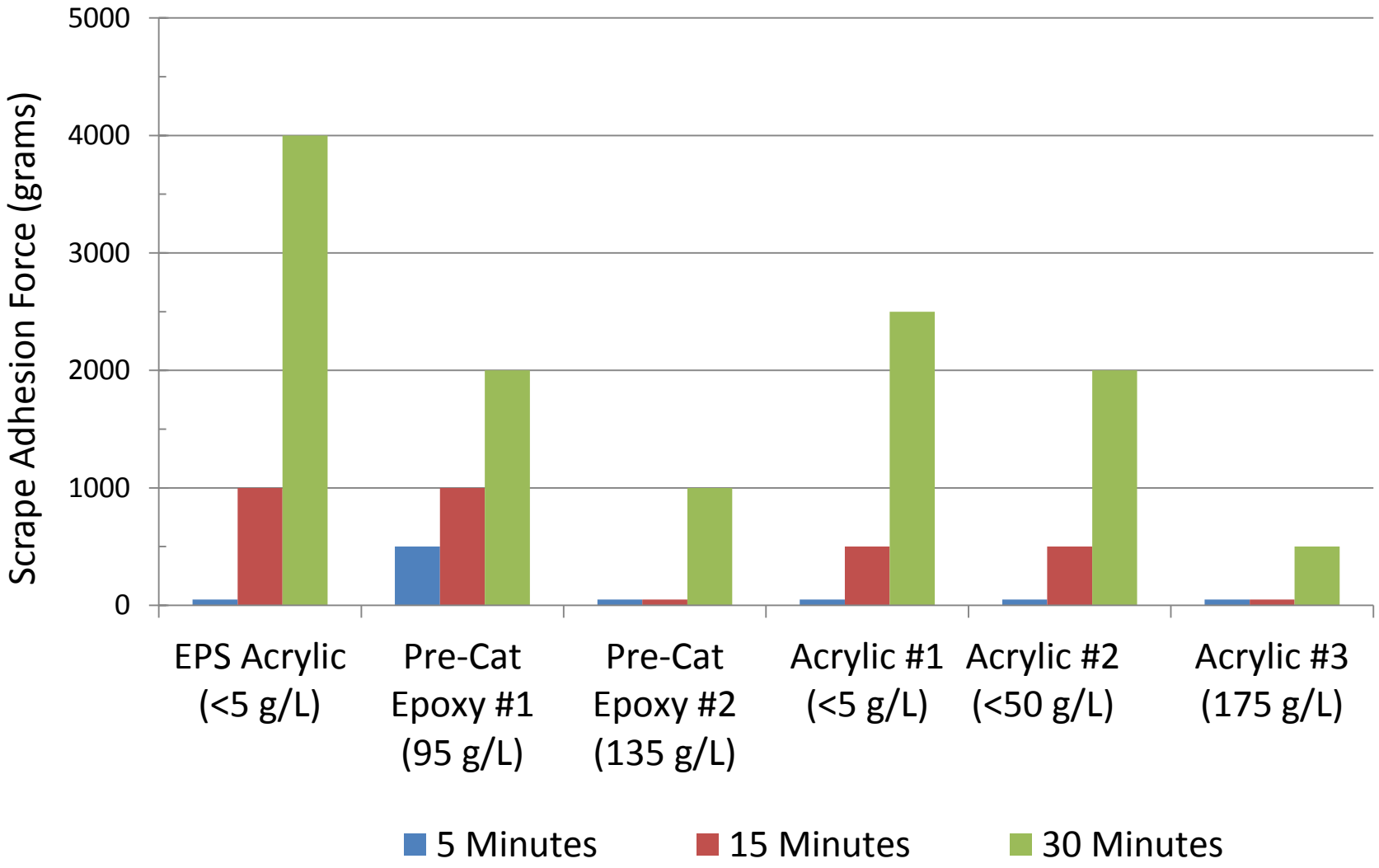
Formula 409


Scrape Adhesion Force (grams)
5000
4000
3000
2000
1000
0
EPS Acrylic (<5 g/L)
Pre-Cat Epoxy #1 (95 g/L)
Pre-Cat Epoxy #2 (135 g/L)
Acrylic #1 (<5 g/L)
Acrylic #2 (<50 g/L)
Acrylic #3 (175 g/L)
5 Minutes
15 Minutes
30 Minutes

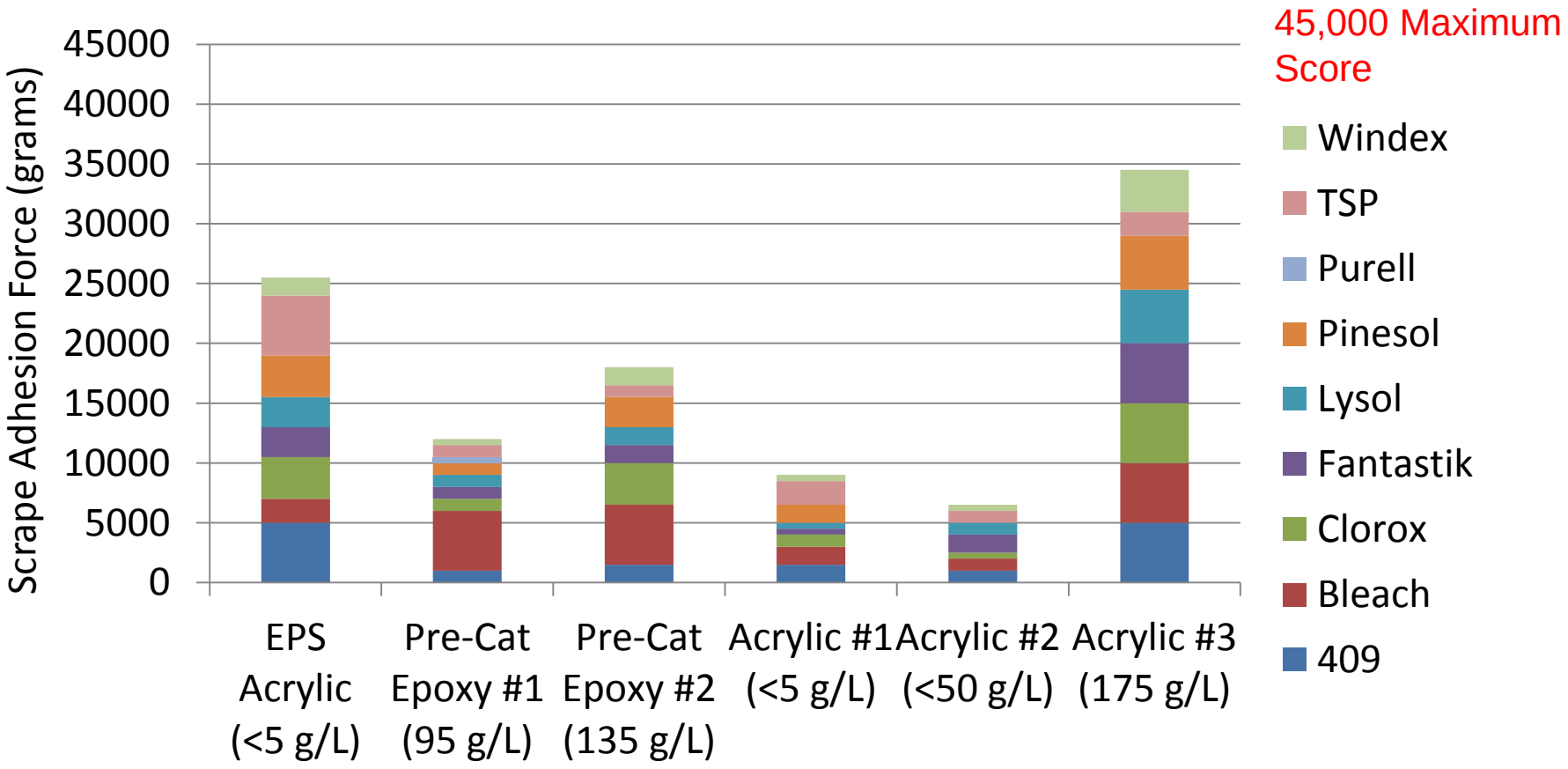
Lysol


Scrape Adhesion Force (grams)
5000
4000
3000
2000
1000
0
EPS Acrylic (<5 g/L)
Pre-Cat Epoxy #1 (95 g/L)
Pre-Cat Epoxy #2 (135 g/L)
Acrylic #1 (<5 g/L)
Acrylic #2 (<50 g/L)
Acrylic #3 (175 g/L)
5 Minutes
15 Minutes
30 Minutes

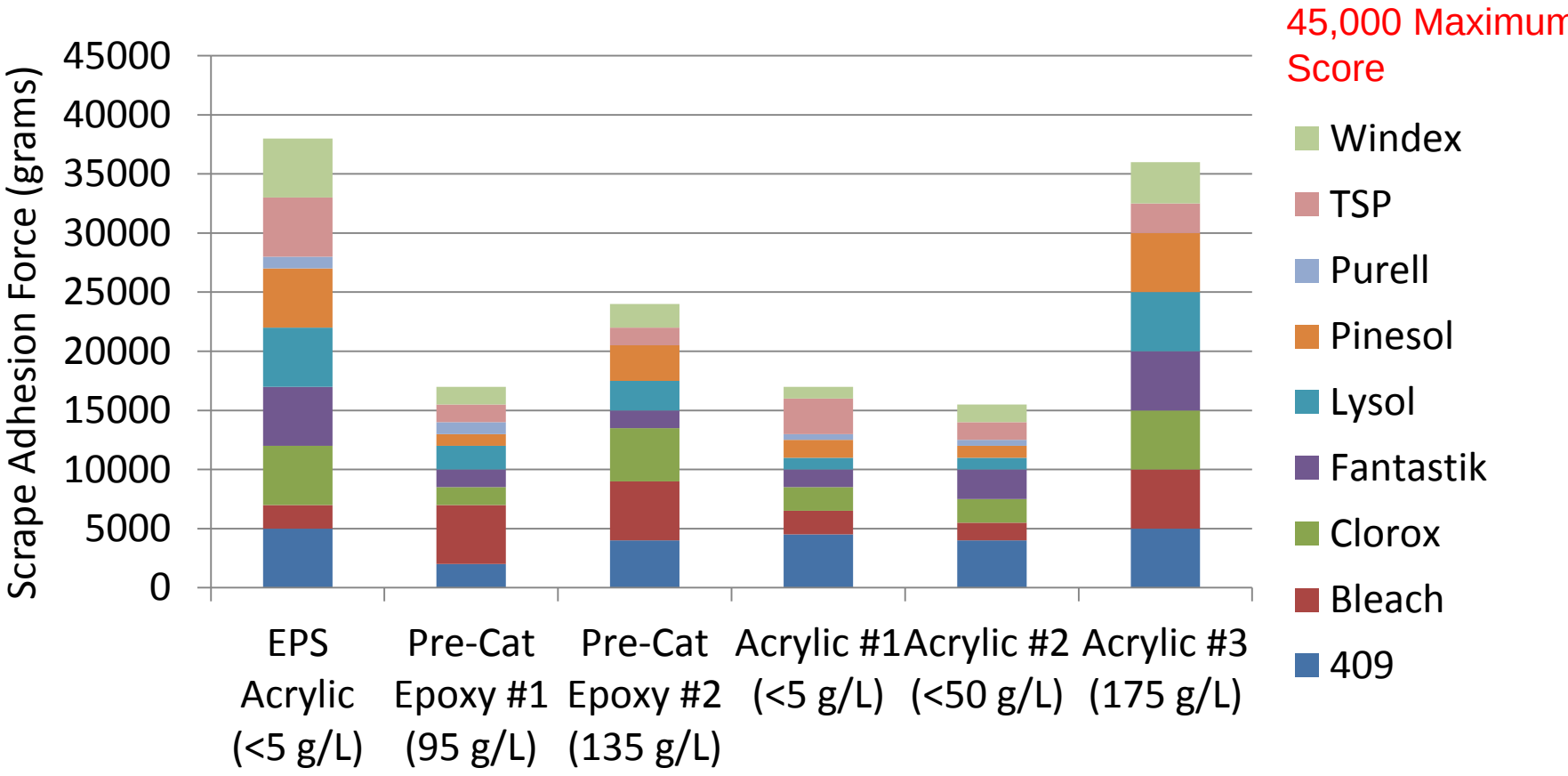
Purell


Scrape Adhesion Force (grams)
5000
4000
3000
2000
1000
0
EPS Acrylic (<5 g/L)
Pre-Cat Epoxy #1 (95 g/L)
Pre-Cat Epoxy #2 (135 g/L)
Acrylic #1 (<5 g/L)
Acrylic #2 (<50 g/L)
Acrylic #3 (175 g/L)
5 Minutes
15 Minutes
30 Minutes

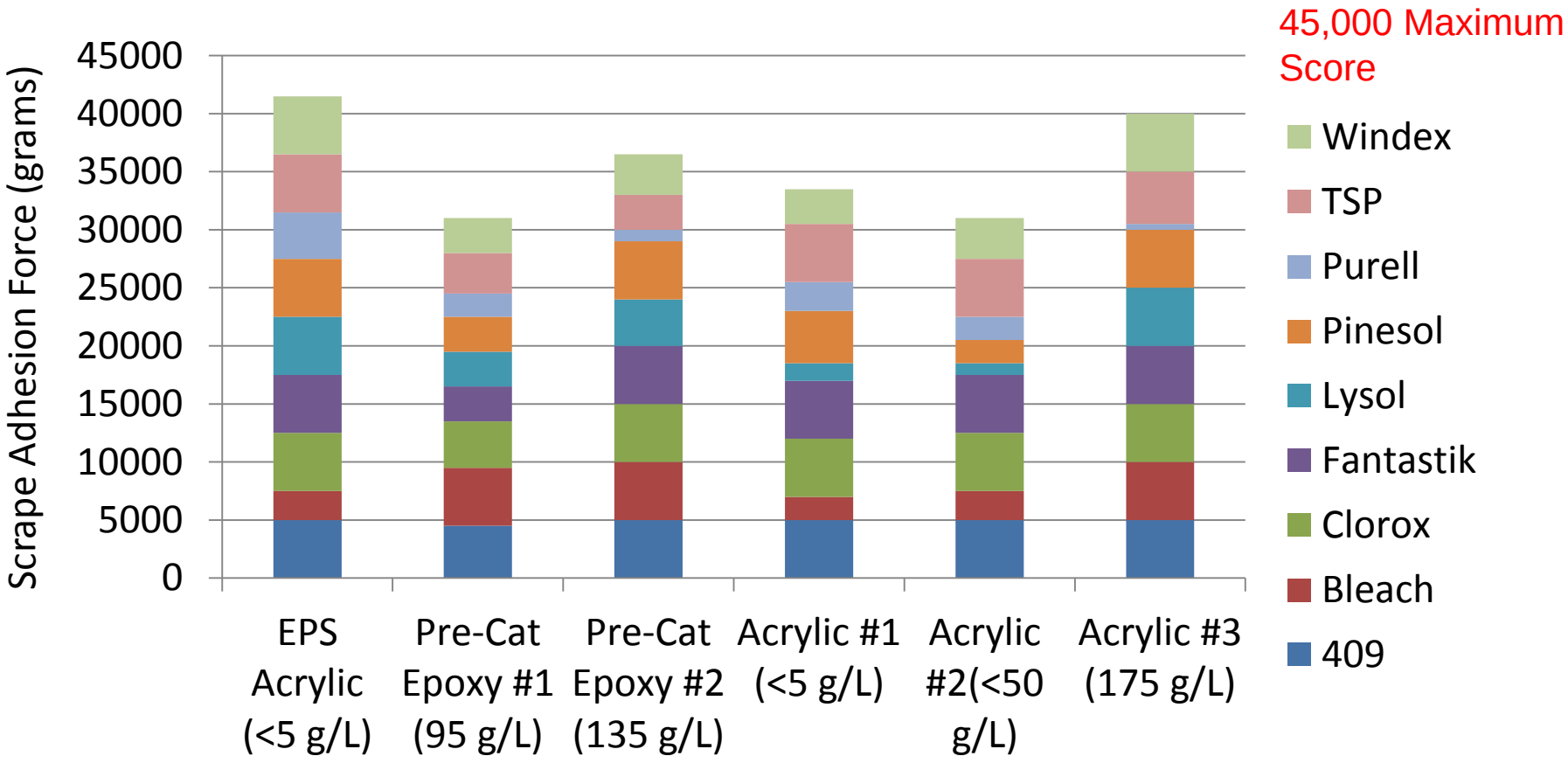
Chemical / Cleaner Resistance Results (5 Minute Recovery)



Chemical / Cleaner Resistance Results (15 Minute Recovery)



Chemical / Cleaner Resistance Results (30 Minute Recovery)



MPI Stain Resistance / Cleansability

EPS Testing (Not certified by MPI)

Stain (max. dE allowed)	EPS Acrylic (<5 g/L)	Pre-Cat Epoxy #1 (95 g/L)	Pre-Cat Epoxy #2 (135 g/L)	Acrylic #1 (<5 g/L)	Acrylic #2 (<50 g/L)	Acrylic #3 (175 g/L)
Coffee (2.0)	1.6	2.5	0.5	1.7	0.5	0.6
Nigrosin (1.0)	0.9	2.2	0.7	0.7	1.0	0.8
Graphite (1.5)	1.6	1.7	2.8	2.2	0.6	2.6

Other MPI Testing

EPS Testing (Not certified by MPI)

Test Method	EPS Acrylic (<5 g/L)	Pre-Cat Epoxy #1 (95 g/L)	Pre-Cat Epoxy #2 (135 g/L)
Tin - Dry	5B	5B	5B
Tin - Wet	5B	4B	4B
CRS - Dry	5B	5B	4B
CRS - Wet	4B	5B	4B
Adhesion Pass/Fail	Pass	Pass	Pass
Early Water Resistance	10	8d	10
Flexibility (Mandrel Bend)	Pass	Pass	Pass

Benchmark Summary

- Various paints evaluated for performance in the commercial / institutional space
- New EPS Acrylic technology delivered the following performance:
  - Passed a 2K WB epoxy specification (EPS tested)
  - Outperformed VOC containing 1K epoxy acrylics, and all-acrylic paints available today
  - Matched or beat a 175 g/L VOC all-acrylic paint

Conclusions

Performance Gaps Overcome

- ✓ Abrasion Resistance
- ✓ Chemical Resistance
- ✓ Cleaner Resistance
- ✓ Water Sensitivity
- ✓ Early Hardness Development
- ✓ Low-Tack Finishes

- New all-acrylic technology delivers superior performance for chemical, cleaner, and abrasion resistance for institutional and commercial paint applications.
- Superior performance achievable at low-VOC and low-odor
- Suitable to replace both 1K and 2K WB acrylic epoxies in the commercial and institutional space