RESTORE, ENHANCE, EXTEND & PROTECT

NANO-CLEAR® FOR FLEET VEHICLES

- Industry Award Winning, Eco-Friendly Coatings Guaranteed to Extend the Service Life of Valuable Assets
- Unmatched Durability, Even in the Harshest Environments

(For Oxidized or Newly Painted Surfaces)

v-2023.04.19-1

Nano-Clear®

ASSERO Coating Technologies

PROTECTION WITHOUT COMPROMISE

TRANSPORTATION MARKETS

Industrial asset owners commonly apply protective coatings over metal surfaces to mitigate the damaging effects from various environmental factors, to maintain optimal performance, and to extend asset service life thereby increasing profitability. However, conventional industrial coatings "alone" are still very susceptible to:

- Corrosion
- Rain Erosion
- UV Degradation
- Weathering
- Moisture / Water Intrusion
- Acid Rain / Chemical Damage
- Scratch / Abrasion / Chip Damage
- Normal Wear & Tear

What is needed?

- A combined basecoat - clearcoat system with a multifunctional clearcoat that protects surfaces more thoroughly than any existing technology.
- A permanent surface coating that enhances and extends the surface life of freshly painted or highly oxidized paint by 10+ years.

Nano-Clear® NCI

Nano-Clear® NCI dramatically improves surface protection and brand image while significantly reducing surface maintenance expenses.

- **Extreme Corrosion Resistance**
  No Rust after 6,360 Hour Salt Spray Testing
- **Extreme Abrasion Resistance**
  Only 8.4 mg Loss after 1000 Cycles, 1 kg
- **Low VOC**
  1.25 lbs / Gal (150 g / L)
- **Weatherproof Gloss**
  99% Gloss Retention after 4000 Hours; Xenon WOM
- **1K Coating, Ambient (Humidity) Cured**
  Dry-To-Handle in 4 Hours; Return to Service in 24 Hours
- **Reduce Re-Paint Cycle by 2X - 3X**
  As Documented in Production Case Studies
- **Improve Brand Appearance**
  Achieve Deeper Colors & Dramatically Higher Gloss
- **Achieve Lower Operating Costs**
  By Reducing Maintenance Time & Extending Recoat Cycle by 10+ Years

What Makes Nano-Clear® Unique?

Nano-Engineering (not nano-particles) Creates Exceptional Crosslink Density

Nano-Clear® NCI is manufactured using proprietary 3D nano-structured polymers (*not* nano-particles) which results in extreme crosslink density.

NCI dramatically improves corrosion, weathering, abrasion, scratching, chipping, marring, chemical & UV resistance and reduces surface maintenance. NCI penetrates deep into the pores of freshly painted or highly oxidized paints to enhance color, improve gloss, and significantly increase surface hardness.

Nano-Clear® is a one-component, humidity cured, highly cross-linked, polyurethane/polyurea, hybrid nanocoating.

With this exceptionally high crosslink density, we have the test data to prove that NCI is the world's best all-around clearcoat for resistance to scratches, chips, abrasion, chemicals, weathering, and more. Please see the back cover for test results or visit www.assero.co/tests.

BMW validated Nano-Clear® coating to have the highest gloss levels and DOI of any clear coating system they had ever tested.

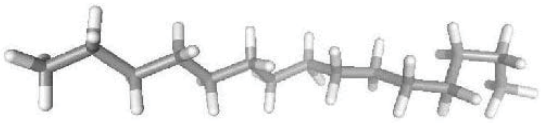
AMAZING FLEXIBILITY!

Before / After

- ✓ *Nano-Clear® has both remarkably high surface hardness and flexibility.*
- ✓ *Steel panel coated with Nano-Clear®, bends in-half without cracking or any other failure to the coating.*

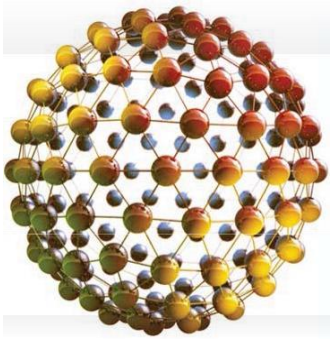
Why is Crosslink Density So Important?

Coatings contain "building blocks" with functional groups. The chemical reaction of these groups during curing forms a network. In most traditional polymers, the network is a linear chain of molecules with low crosslink density.



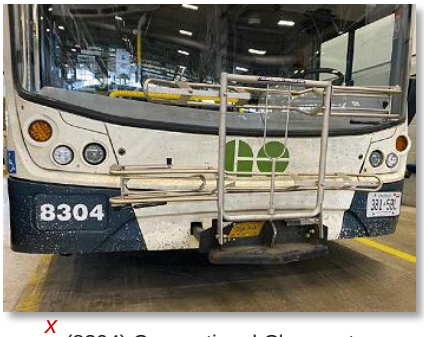
Linear chain of molecules

Conversely, we "nano-structured" our clearcoat to have a 3D molecular architecture. The 3D polymer network has an exponentially higher number of crosslinked sites. The result is a tightly knit mesh with unprecedented DMA density.



3D molecular architecture

High crosslink density provides highly functional surface properties, including unmatched corrosion resistance, scratch resistance, chemical resistance and UV durability. It also means low surface energy, repelling water (hydrophobic) and aiding in the release of ice, dirt, brake dust, and even concrete dust.



✗ (8304) Conventional Clearcoat

✓ (8305) **Nano-Clear®**

After a demanding 3 year field evaluation by Metrolinx, results demonstrated the extreme protective capabilities of Nano-Clear® (NCI):

- ***82%** Reduction of Damage*
- ***33+%** Reduction of Product Costs*

Even sticky concrete dust releases easily from Nano-Clear® NCI.

Unrivaled Performance Enhancement for Newly Painted or Highly Oxidized Coatings

For decades, conventional coating systems have relied on numerous variations of the same linear chain polymers as noted above. As a result, in order to properly protect equipment, it's necessary for industrial customers to perform frequent, costly, labour intensive maintenance cycles every 6 months to 5 years which includes surface preparation & repair, and then repaint & recoat using the same *conventional* technology.

Nano-Clear® Coatings on the other hand, are designed from the bottom up with nano-structuring properties and no matter how badly oxidized your existing coating is, **Nano-Clear® NCI for Fleet Vehicles** will restore its color and provide unmatched surface protection.

Put Simply: NCI restores the color, gloss, surface hardness and extends the surface life of conventional coatings by 10+ years.

Nano-Clear® NCI is also designed to be applied directly over freshly coated surfaces including 2K epoxies, 2K polyurethanes and powder coatings.

Nano-Clear®

How Does NCI Enhance Color & Physical Properties?

NCI has a low (200 cps) viscosity, so it penetrates deep into the smallest pores of newly painted of oxidized coatings, **turning the white, chalked layers transparent**, allowing the original underlying color to show through while fortifying/hardening the surface.

Humidity-cured at ambient temperatures, NCI quickly hardens and fortifies the painted surface, "locking-in" color and preventing future chalking with its long-term UV absorbers.

Please note: NCI must be applied over the existing coating system before the coating has deteriorated into a powdered, peeled and/or eroding state. NCI *is not a rust converter*. Rust or peeling paints must be removed and repainted first (prior to applying NCI) with a coating such as a high-solids, two-component epoxy.

For additional details, please review the Nano-Clear® NCI Technical Data Sheet at: www.assero.co/resources.

Industrial Users of Nano-Clear®

OSG

Altec

CASE CONSTRUCTION

STERLING CRANE

DOW

Chevron

City of Sioux Falls

TOPROCK DRILLING

ODEBRECHT Oil & Gas

Where Can Nano-Clear® Be Used?

On New or Highly Oxidized Coatings:

Nano-Clear® (NCI) has been engineered to be applied over 2K epoxies, 2K polyurethanes, powder coatings, polyesters, gel coats, e-coats, latexes, fibreglass, and anodized aluminum (to prevent filiform corrosion, etc.).

For Fleet Vehicles & Equipment:

NCI is the premiere solution for a diverse range of applications:

- Lifeboats
- Cargo Ships / Ocean Going Vessels
- Chemical, Oil and Gas Storage Tanks
- Pumps & Valves
- Locomotives, Tank & Chemical Railcars
- Oil & Gas Pipelines
- Oil Field Platforms, Pipes and Tubes
- Drinking Water Pipelines
- Epoxy Coated Floors
- Shipping Containers
- Generators
- High & Low Voltage Utility Boxes
- Bridge Structures
- Mass Transit Vehicles & Equipment
- Emergency Response Vehicles & Equipment
- Concrete Warehouse Floors
- Painted & Concrete Building Structures
- Interior and Exterior Concrete / Wood Architectural Structures
- Agriculture, Construction, & Earth Moving Equipment
- Aircraft and Equipment
- Naval and Military Air, Ground & Marine Equipment
- And much more.

Problem: *Leading soda pop company owns a global fleet of distribution trucks in need of paint restoration*.

Solution: *Nano-Clear® is used to dramatically improve the overall image of this leading soda brand, while reducing the re-paint cycle and reducing fleet maintenance. See other Nano-Clear® case studies*: www.assero.co/resources

Industry Recognition

Nano-Clear® has been recognized for its innovative engineering by:

- **NACE MP 2019 / 2020 Corrosion Innovation of the Year Award**
  NACE (the National Association of Corrosion Engineers) sets the standards for surface preparation, coating selection, coating application, painting contractor certification, and testing.
- **Frost & Sullivan Technology Leadership Award 2020**
  Frost & Sullivan is the premiere business consulting firm to the Paints and Coatings Industry.
- **PaintSquare Prestige Award 2020 (Top Product: Coatings for Steel)**
  PaintSquare is the premier industry publication to the Paints & Coatings Industry.

To arrange a Nano-Clear® application demonstration, contact Assero at:

info@assero.co

ASSERO COATING TECHNOLOGIES

Assero Coating Technologies delivers Exceptional Surface Protection™ which extends the useful service life of valuable assets that operate in harsh environments. Assero is built around an ethos of delivering eco-innovative / eco-responsible, sustainable, green chemistry solutions with a line of Protective Clearcoats that reduce damage to the environment.

Nano-Clear® Third Party Test Results

Chemistry: 3D Nano-Structured Polyurethane / Polyurea Hybrid

High Cross-Link
3D® Molecules Inside™

TABLE 1

	TEST METHOD DETAILS			
	PRIMARY SPECIFICATIONS	**TEST STANDARD**	**RESULTS**	
1	VOC	ASTM D3960	1.25 lb / gal / -150 g/l	1
2	Recommended Dry Film Thickness *(DFT)*	ASTM D5796	1.0 mil - 2.5 mils (/ 50.4µm to 63.5µm)	2
3	Coverage: *1 US Gal / 3.8 Ltr.*	Nanovere Inhouse	1,122ft² @1.0 mil	3
4	Specular Gloss: *@ 20° / 60°*	ASTM D523	86.0 / 92.2	4
	IN SERVICE PHYSICAL DAMAGE RESISTANCE	**TEST STANDARD**	**RESULTS**	
5	Abrasion Resistance by Taber: *CS-17, 1 kg, 1,000 cycles*	ASTM D4060	8.4 mg loss	5
6	Coating Hardness by Pencil Test: *Scratch*	ASTM D3363	4H	6
7	Coating Hardness by Pencil Test: *Scratch*	SASO 2833	2500 gm	7
8	Coating Hardness by Pencil Test: *Gouge*	ASTM D3363	5H	8
9	Coating Hardness by Pendulum Damping: *Persoz*	ASTM D4366	> 250 oscillations	9
10	Coating Rapid Deformation by Impact: *18°C Direct in./lbs.*	ASTM D2794	50 Pass / 60 Fail	10
11	Coating Rapid Deformation by Impact: *18°C Reverse in./lbs.*	ASTM D2794	10 Pass / 20 Fail	11
12	*Coating Rapid Deformation: Impact Strength*	ASTM D2794	145 kg - cm	12
13	Impact Resistance: *Single or Multi-coat Systems*	SASO ISO 3248	1kg-160cm	13
14	Chip Resistance of Coatings: *23°C / 73.4°F @ 2.0 mils DFT*	ASTM D3170	7A	14
15	Chip Resistance of Coatings: *-29°C / -9.4°F @ 2.0 mils DFT*	ASTM D3170	7B	15
16	Abrasion Resistance by Falling Abrasion: *100 liters*	ASTM D968	Pass	16
17	Mar Resistance of Organic Coatings	ASTM D5178	5.0 kg	17
18	Flexibility - Conical Mandrel Bend	ATSM D522	1/4" Pass	18
19	Flexibility - Cylindrical Mandrel Bend	ASTM D522	Zero (0) - T	19
	ENVIRONMENTAL RESISTANCE	**TEST STANDARD**	**RESULTS**	
20	Controlled Xenon Arc-Lamp-Exposure Resistance: *4,000 hrs*	SAE J1960 ASTM G155	100% Gloss Retention 99% Gloss Retention	20
21	Fluorescent UV-Condensation Exposure: QUV 313 > 1,500 hrs	ASTM D4587	100% Gloss Retention	21
22	Water Immersion Resistance: *240 hrs @ 50°C / 122°F*	ISO 2812-2	Pass	22
23	Humidity Testing: @ 100% RH, 100°F / 37.8°C -240 hrs	ASTM D1735-02	No loss of adhesion - No change	23
24	Corrosion Resistance: *PASS 240 hrs @ 50°C / 122°F*	JIS H8502	Pass	24
25	Salt Spray Fog: *6,360 hrs*	ASTM B117 / 2018	No corrosion points - Approved	25
26	Thermal Shock Test for Adhesion: *Heat: @ 100°F / 37.8°C for 3 hrs, Freeze for 3 hrs, Steam Blast for 30 Sec*	GM9525P	No loss of adhesion - No Change	26
	CHEMICAL RESISTANCE	**TEST STANDARD**	**RESULTS**	
27	Effect of Household Chemicals on Clear & Pigmented Coatings: *10% Sulfuric Acid*	ASTM D 1308	No effect	27
28	Effect of Household Chemicals on Clear & Pigmented Coatings: *10% Hydrochloric Acid*	ASTM D 1308	No effect	28
29	Effect of Household Chemicals on Clear & Pigmented Coatings: *10% Sodium Hydroxide*	ASTM D 1308	No effect	29
30	Effect of Household Chemicals on Clear & Pigmented Coatings: *10% Ammonium Hydroxide*	ASTM D 1308	No effect	30
31	Effect of Household Chemicals on Clear & Pigmented Coatings: *Isopropyl Alcohol*	ASTM D 1308	No effect	31
32	Effect of Household Chemicals on Clear & Pigmented Coatings: *Xylene*	ASTM D 1308	No effect	32
33	Immersion Testing of Industrial Protective Coatings: *Skydrol® 500Fluid*	ASTM D6943-A	No effect	33
34	Measuring MEK Resistance by Solvent Rubs: *1,500 Double Rubs*	ASTM D4752	No effect	34
	FIRE RESISTANCE	**TEST STANDARD**	**RESULTS**	
35	Fire Resistance Testing of Building Materials	ASTM E84 / BS476	Class1(Excellent)	35

TABLE 2

DMA (Dynamic Mechanical Analysis)

	SAMPLE PANEL TESTED	E' @ 23ºC/73.4ºF MPA	XLD (Kmols/cc)	Tg (ºC)	
36	Nano-Clear® (NCI)	2110	2.17	57.7	Based on historical data XLD has a 95% confidence interval of ~ +/- 0.5 Based on historical data Tg has a 95% confidence interval of ~ +/- 2.5

UNIAXIAL EXTENSION (INSTRON)

	SAMPLE PANEL TESTED	YOUNG'S MODULUS MPa	YIELD STRAIN %	YIELD STRESS MPa	STRESS @ BREAK %	STRAIN @ BREAK %	TOUGHNESS MPa	
37	Nano-Clear® (NCI)	1506	4.59	51.6	52.7	52.4	5.09	
38	95% *CI +/-	35	0.14	1.6	1.3	1.5	0.59	*Confidence Intervals based on 5 tests of this sample

Q. What is ***DMA***?
A. ***Dynamic Mechanical Analysis*** is performed by a *Dynamic Mechanical Analyzer.*

Q. What does a ***DMA*** do?
A. ***DMA*** measures the mechanical/rheological (crosslink density; XLD) properties of a material as a function of time, frequency, temperature, stress, and strain.
NOTE: The *Dynamic Mechanical Analyzer* used for **Table 2** tests, was a ***TA Instrument Q800*** unit.

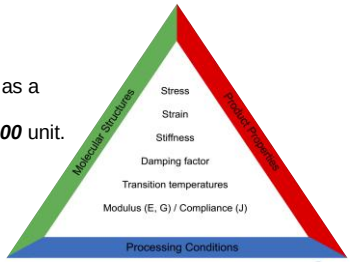


TABLE 3

TEST METHOD DETAILS	TEST STANDARD
The Japanese Industrial Standard is a quantitative antimicrobial surface test method that tests for antimicrobial activity and efficacy	non-GLP Modified JIS Z 2801Study

	Test Microorganism	Contact Time	Test Substrate	Replicate	CFU/Carrier	Average CFU/Carrier	Percent (%) Reduction Compared to 24 Hour Control	Log10 Reduction Compared to 24 Hour Control
39	*E. coli* ATCC 8739	Time Zero	Control Glass Substrate	1	3.30E+05	2.80E+05	N/A	N/A
				2	2.60E+05			
				3	2.50E+05			
40		24 Hours	Control Glass Substrate	1	3.70E+05	3.97+05	N/A	N/A
				2	3.80E+05			
				3	4.40E+05			
41	*S. aureus* ATCC 6538		Nano-Clear® NCI 4.0	1	1.63E+02	4.87E+02	99.9993%	5.59
				2	1.48E+02			
				3	1.15E+03			
42			Nano-Clear® NCI 5.0	1	3.03E+01	1.53E+01	99.99998%	6.87
				2	6.00E+00			
				3	9.50E+00			

TABLE 4

ANTI-ICE SCREENING

TEST SAMPLE INFO	T-PANEL (4" X 12") SUBSTRATE	NUMBER OF PANELS TESTED	SCOPE OF TESTING
Control	Aluminum	2	Contact angle - ice de-bond (shedding)
NCI +NCFP@5%	Aluminum	1	Contact angle - ice de-bond (shedding)
VX-SC	Aluminum	1	Contact angle - ice de-bond (shedding)
VX+SC+5% Fluoropolymer	Aluminum	2	Contact angle - ice de-bond (shedding)
NCI+NCIM@30%+NCFP@5%	Aluminum	2	Contact angle - ice de-bond (shedding)

ICE / FROST BUILD TESTING

1. Test sample panels were attached to the evap-cooler's fins along with thermo-couplers.
2. Freezer door propped open by .5" for an 1 hour.
3. Two pans of 40ºC tap water (500 grams) was added and the freezer door was then closed shut.
4. The closed freezer was run for 16 hours and monitored using a picolog with thermocouplers and a computer.
5. After 16 hours of run time the amount of ice/frost generated on the test panels was evaluated.

CONTACT ANGLE TEST RESULTS

	TEST SERIES 1	TEST SAMPLE INFO	CONTACT ANGLE
43		Control	43.12°
44		NCI +NCFP@5%	102.41°
45		VX-SC	103.15°
46		VX+SC+5% Fluoropolymer	98.535°
47		NCI+NCIM@30%+NCFP@5%	101.07°

ICE DE-BOND (SHEDDING) TEST RESULTS

	TEST SERIES 2	TEST SAMPLE INFO	ICE DE-BOND (SHEDDING) TIME IN SECONDS
48		Control	58s
49		NCI +NCFP@5%	32s
50		VX-SC	49s
51		VX+SC+5% Fluoropolymer	47s
52		NCI+NCIM@30%+NCFP@5%	40.5s

TABLE 5

SCRATCH TESTING PARAMETERS - ASTM D7027

SCRATCH MODE	MAX. LOAD (N)	SCRATCH LENGTH (MM)	SCRATCH SPEED (mm/sec)	LOADING RATE (N/min)	PRE/POST SCAN LOAD (N)	SCRATCH TRACKS PER SAMPLE	SCRATCH TIP TYPE	TIP MATERIAL	SCRATCH TIP RADIUS (µM)
Progressive	100	2	2	200	1	3	Sphero-conical	Diamond	20

TEST REQUIREMENTS

1. Room temperature micro-scratch experiment using a micro-scratch technique.
2. The goal is to study and compare coating adhesion, strength / scratch resistance of the coatings through progressive scratch tests.
3. The testing procedures follow a modified ASTM D7027 standard to scratch polymeric thin coatings with a diamond tip.

SYSTEM EMPLOYED FOR TESTING

1. An Anton Parr Revtest (Macro) Scratch System.
2. The system was calibrated on 04/30/2021.
3. A 100 µm radius diamond spherical tip was employed for the scratch measurements.
4. The system and the scratch tip were validated on a **TiN** reference sample before the experiments were conducted on the Assero supplied samples conducted as a blind test **(X vs Y)**

	COMPARISON OF CRITICAL LOADS OF FAILURE ROOM TEMPERATURE			LC1	OPTIC
	TEST 1 SAMPLES			DATA 1	DATA 2	STD DEV
53	X*	38.393	38.032	37.962	38.129	0.231
54	Y**	43.622	42.386	45.551	43.853	1.595

NOTE: X* (submitted sample) Nano-Clear® Gel-coated fiberglass *unsanded* pre-application

	COMPARISON OF CRITICAL LOADS OF FAILURE HEATED 8 HOURS @ 50ºC-COOLED OVERNIGHT				LC1	OPTIC
	TEST 2 SAMPLES	DATA 1	DATA 2	DATA 3	MEAN	STD DEV
55	X*	38.486	32.869	35.433	35.929	3.336
56	Y**	1.294	1.338	1.963	1.532	0.374

**Y (submitted sample) BASF DC92 *sanded* Gel-coated fibreglass pre-application

Why Micro-Scratch Testing?

"Data from the nano-scratch test also proved best for determining how well the coating responded to physical assault based on its crosslink density, the measure of how tightly the polymer components are bound together," *Sung said.

"With this molecular-level understanding, clearcoat formulas can be improved so that they yield materials dense enough to be scratch resistant and resilient but not so hard that they cannot be worked with easily."

"The researchers concluded that to get the truest evaluation of clearcoat performance, the nano-, micro- and macro-scratch tests should be conducted in conjunction with the current industry standard methods." ***Li-Piin Sung *NIST* research Physicist**

NCI SuperCARC™

TABLE 6

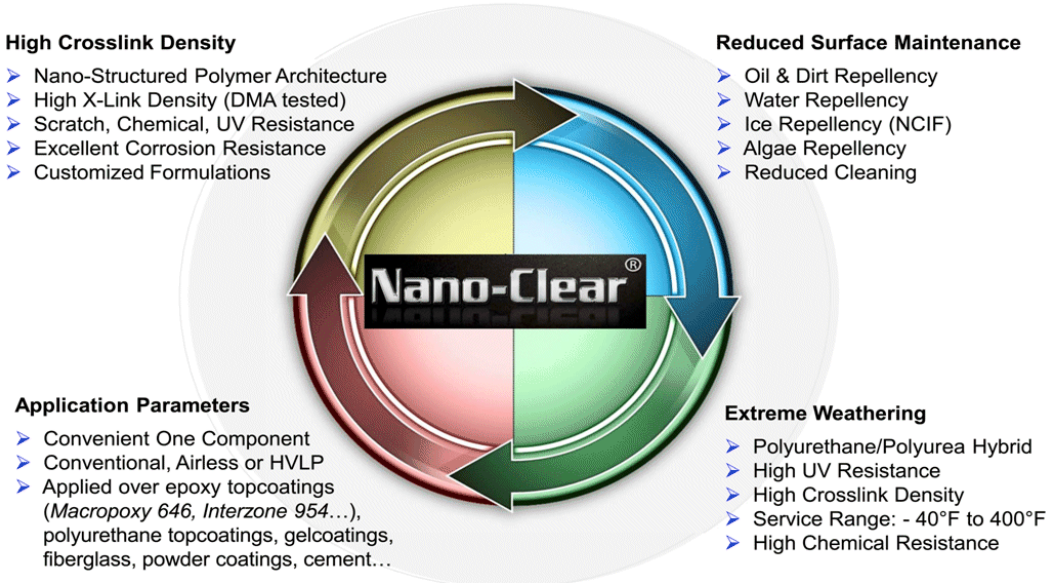
	TEST METHOD DETAILS			
	OPTICAL PROPERTIES	**TEST STANDARD**	**CONVENTIONAL CARC RESULTS**	**NCI SuperCARC (NCI +MAT) RESULTS**
57	Specular Gloss: *@ 20º - 60º - 85*	ASTM D534	0.7 - 3.6 - 7.4	0.6 - 1.3 - 7.8
58	Calculating color differences from instrumentally color measured color coordinates: *L-, a-, b-*	ASTM D2244	66.66 - 6.02 - 20.71	66.66 - 6.02 - 20.71
59	Measurement of spectral absorptance, reflectance, and transmittance: *IR signature*	ASTM E-903	PASS	PASS
	PHYSICAL PROPERTIES	**TEST STANDARD**	**CONVENTIONAL CARC RESULTS**	**NCI SuperCARC (NCI +MAT) RESULTS**
60	Rating Adhesion by Tape Test	ASTM D3359	5B	5B
61	Rating Film Hardness by Pencil Test	ASTM D3363	2B	>6H
	CHEMICAL AND PHYSICAL DAMAGE RESISTANCE	**TEST STANDARD**	**CONVENTIONAL CARC RESULTS**	**NCI SuperCARC (NCI +MAT) RESULTS**
62	Acid Spot Resistance	MIL-DTL-53039E Sec 4.6.24	No Effect	No Effect
	MEK Resistance	ASTM D4752		
63	Double rubs to substrate		>200	>1,500
64	Double rubs to start of coating Dissolution		20	>1,500
	Water Immersion Testing:	MIL-DTL-53039 Sec 4.6.24		
65	Visual Observation		No Effect	No Effect
66	Pencil Hardness		4B	>6H
67	Adhesion		5B	5B

INTRODUCING A NEW APPROACH TO CARC

"The effectiveness of US military forces is highly dependent on the readiness (and safety) of the equipment and vehicles they use. Spray-applied coatings are used for many types of equipment, components and vehicles including aircraft, ground vehicles, water-borne vessels and ordnance. Improved.....quality therefore results in reduced cost and readiness."
Lea Ann Schellhorn, Iowa Waste Reduction Center, Cedar Fall - Spray Technique Analysis and Research for Defense (STAR4D)

STAR4D Est. 2003

Multi-Functional Nanocoatings with Remarkable Properties



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Assero On Top™ NCI
3D-9™ Technologies
Engineered For Sustainability
LOW Volatile Organic Compounds (VOCs) contribute to atmospheric pollution.