



**RESTORE, ENHANCE,  
EXTEND PROTECT**

## **NANO-CLEAR<sup>®</sup> FOR MARINE/NAVAL APPLICATIONS**

- ❖ 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<sup>®</sup>**

**ASSERO Coating Technologies**

**PROTECTION WITHOUT COMPROMISE**



## INDUSTRIAL/MARINE 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<sup>®</sup> NCI

Nano-Clear<sup>®</sup> 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](http://www.assero.co/tests).

#### AMAZING FLEXIBILITY!



#### Before / After

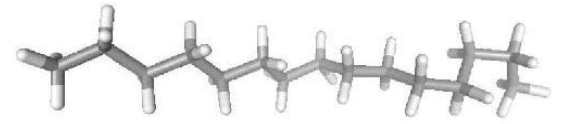
- ✓ Nano-Clear® has both remarkably high surface hardness and flexibility.
- ✓ Steel panel coated with Nano-Clear®, bends in-half without cracking or any other failure to the coating.



**Nano-Clear®**

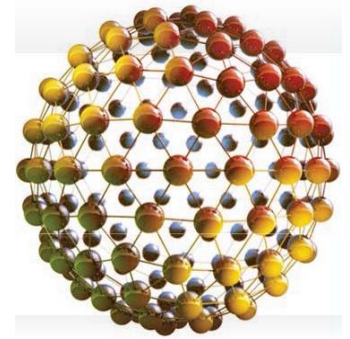
# Why is Crosslink Density So Important?

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.

BEFORE Application of Nano-Clear®



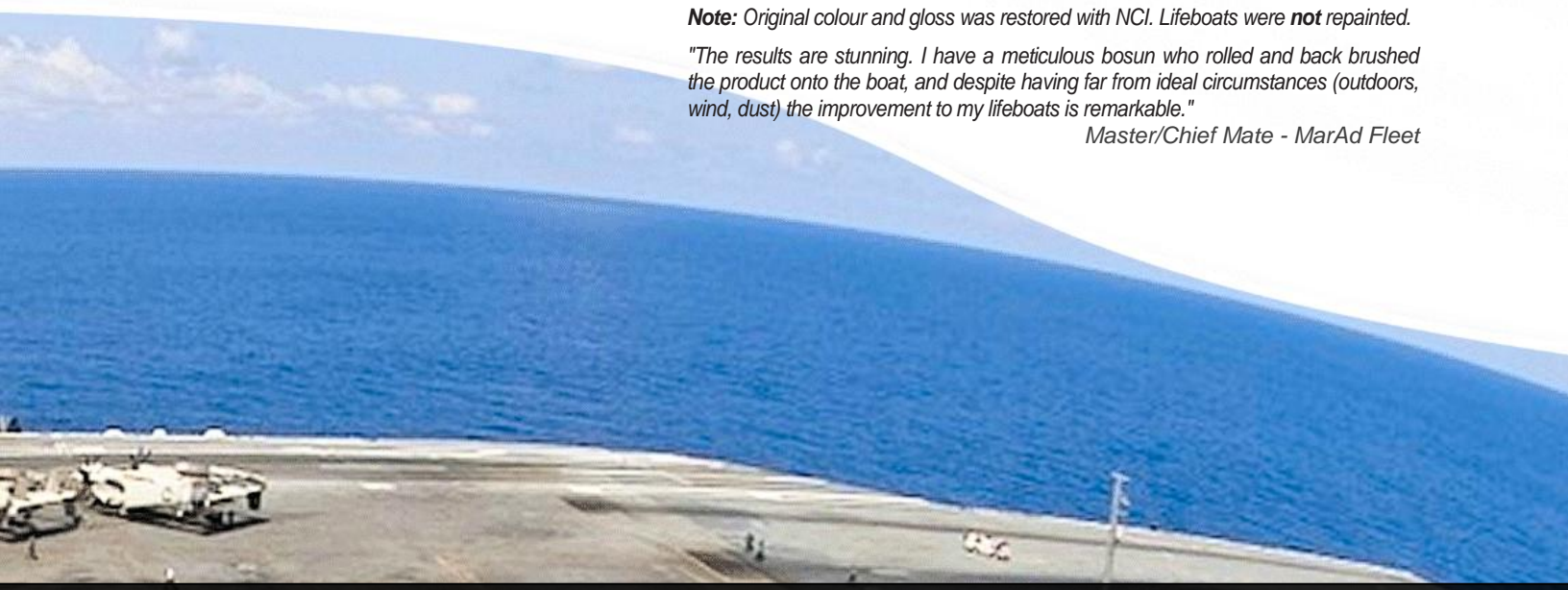
AFTER Application of Nano-Clear®



**Note:** Original colour and gloss was restored with NCI. Lifeboats were **not** repainted.

*"The results are stunning. I have a meticulous bosun who rolled and back brushed the product onto the boat, and despite having far from ideal circumstances (outdoors, wind, dust) the improvement to my lifeboats is remarkable."*

*Master/Chief Mate - MarAd Fleet*



# Unrivalled 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 Marine Naval Applications** 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® Coatings** are also eco-responsible and engineered with protective qualities that are non-leaching and will not harm the environment.

**NCI** is a high performance, low VOC, green chemistry, sustainable solution.

**Nano-Clear®**

## How Does Nano-Clear® Enhance Color & Physical Properties?

NCI has a low (200 cps) viscosity, so it penetrates deep into the smallest pores of newly painted or 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.asserco/resources](http://www.asserco/resources).

### Industrial Users of Nano-Clear®



**STERLING CRANE**



Celebrity **X** Cruises®

**CASE**  
CONSTRUCTION

 **Carnival**

**ODEBRECHT**  
Oil & Gas

# Where Can Nano-Clear<sup>®</sup> Be Used?

## On New or Highly Oxidized Coatings:

Nano-Clear<sup>®</sup> (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 Marine Applications:

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:** The US Army amphibious forces required a solution for the decks of their Landing Craft Utility ship to reduce surface corrosion, and to extend the service life of painted surfaces. Using conventional epoxy topcoats, the deck also suffered chipping & abrasion from tracked vehicle/tank traffic.

**Solution - NCI:** After cleaning & drying the surface, NCI was then applied with a conventional sprayer. NCI was selected in order to protect the surface against 10+ years of UV degradation, to dramatically improve corrosion, chipping, chalking, abrasion & chemical resistance, and to reduce surface maintenance. The LCU ship was back to service within 24 hours post-application. See other Nano-Clear<sup>®</sup> case studies:

[www.assero.co/resources](http://www.assero.co/resources)



# Nano-Clear<sup>®</sup>

# 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:

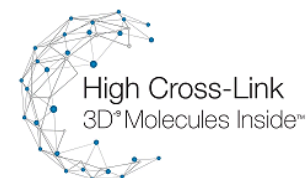
[info@assero.co](mailto:info@assero.co)



## 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.





**TABLE 1**

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

**TABLE 2**

DMA (Dynamic Mechanical Analysis)			
SAMPLE PANEL TESTED	E' @ 23°C/73.4°F MPA	XLD (Kmol/cc)	Tg (°C)
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

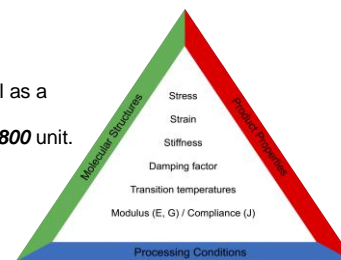
Q. What is DMA?

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 2801 Study			
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 <i>E. coli</i> 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 <i>S. aureus</i> ATCC 6538	24 Hours	Control Glass Substrate	1	3.70E+05	3.97E+05	N/A	N/A
			2	3.80E+05			
			3	4.40E+05			
41		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 evaporator's fins along with thermo-couplers.
2. Freezer door propped open by .5" for an 1 hour.
3. Two pans of 40°C 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		ICE DE-BOND (SHEDDING) TEST RESULTS			
TEST SERIES 1	TEST SAMPLE INFO	CONTACT ANGLE	TEST SERIES 2	TEST SAMPLE INFO	ICE DE-BOND (SHEDDING) TIME IN SECONDS
43	Control	43.12°	48	Control	58s
44	NCI+NCFP@5%	102.41°	49	NCI+NCFP@5%	32s
45	VX-SC	103.15°	50	VX-SC	49s
46	VX+SC+5% Fluoropolymer	98.535°	51	VX+SC+5% Fluoropolymer	47s
47	NCI+NCIM@30%+NCFP@5%	101.07°	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					
TEST 1 SAMPLES	DATA 1	DATA 2	DATA 3	MEAN	STD DEV
X*	38.393	38.032	37.962	38.129	0.231
Y**	43.622	42.386	45.551	43.853	1.595

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

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

\*\*Y (submitted sample) BASF DC92 sanded Gel-coated fiberglass 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

**TABLE 6**

TEST METHOD DETAILS				
OPTICAL PROPERTIES		TEST STANDARD	CONVENTIONAL CARC RESULTS	NCI SuperCARC (NCI +MaT) RESULTS
57	Specular Gloss: @ 20° - 60° - 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 absorbance, 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
63	<i>MEK Resistance</i> Double rubs to substrate	ASTM D4752	>200	>1,500
64	Double rubs to start of coating Dissolution		20	>1,500
65	<i>Water Immersion Testing:</i> Visual Observation	MIL-DTL-53039 Sec 4.6.24	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)



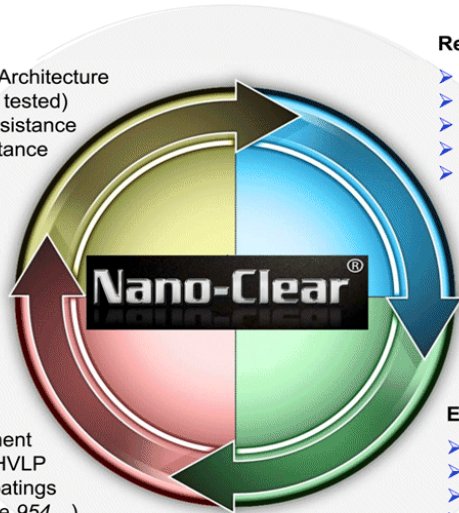
**Multi-Functional Nanocoatings with Remarkable Properties**

**High Crosslink Density**

- > Nano-Structured Polymer Architecture
- > High X-Link Density (DMA tested)
- > Scratch, Chemical, UV Resistance
- > Excellent Corrosion Resistance
- > Customized Formulations

**Reduced Surface Maintenance**

- > Oil & Dirt Repellency
- > Water Repellency
- > Ice Repellency (NCIF)
- > Algae Repellency
- > Reduced Cleaning



**Application Parameters**

- > Convenient One Component
- > Conventional, Airless or HVLP
- > Applied over epoxy topcoatings (Macropoxy 646, Interzone 954...), polyurethane topcoatings, gelcoatings, fiberglass, powder coatings, cement...

**Extreme Weathering**

- > Polyurethane/Polyurea Hybrid
- > High UV Resistance
- > High Crosslink Density
- > Service Range: - 40°F to 400°F
- > High Chemical Resistance



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