ASSERO COATING TECHNOLOGIES

PROFESSIONAL COATING PRODUCTS

TECHNICAL GUIDE

FOR CONCRETE APPLICATIONS

- **Nano-Clear® (NCI) Industrial Coating**
- **WB-2K (Waterborne) Industrial Coating**

Version: 2023.05.12

PROTECTION WITHOUT COMPROMISE

CORPORATE COMMUNICATIONS

Technical Guide
For Concrete Applications

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Revised May 12, 2023

WELCOME

Assero Coating Technologies is pleased to present you with the following information and Technical Guide for our industrial nano-structured coating products: **Nano-Clear® Industrial Coating (NCI) and WB-2K™**. **This Technical Guide, focused on concrete applications**, has been prepared in order to provide you with the proper understanding required for the preparation and application of **Nano-Clear®** and **WB-2K™**, along with their long term benefits and features.

We suggest that you take your time to carefully review this Technical Guide and make notes on any information that may not be clear, or that you feel requires further clarification. It would be our pleasure to assist you in answering any additional questions that you may have regarding **Nano-Clear® Industrial Coatings (NCI) and WB-2K™** clear topcoat technologies. You may contact us by individual or general corporate email accounts. Or, for quicker and more direct communication, we're also just a phone call away.

While reading the manual, please make notes of questions that you may have and phone the office for assistance in getting answers for your questions. A thorough knowledge and understanding on how **Nano-Clear® (NCI)** and **WB-2K™** works is important in being able to properly and accurately explain its properties to customers. Please keep in mind that the actual formulation(s) are a trade-secret and are, therefore, proprietary in nature; so it's possible that some questions you may have cannot be answered.

As a representative for **Assero**, it's important to remember that you are the front line source of information for **Nano-Clear® (NCI)** and **WB-2K™.** How you interact with a client reflects upon all of us as a team. There is a complete support team of scientists, technicians, and management personnel behind you, ready to assist at a moment's notice. So, if you have questions or concerns with regards to any technical details about the product or its application, please take advantage of these valuable resources to ensure that proper, accurate and qualified information is being provided in a professional manner to both current and potential clients.

Thank you for becoming a member of the **Assero Coating Technologies** international team**.**

Sincerely yours,

The **Assero** Board of Directors

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1.0 - MULTIFUNCTIONAL NANO COATINGS

Coatings can be colorless or pigmented; they are thin, solid films that are transparent, translucent, or opaque in nature. The terms “coatings” and “paint” should be synonymous, but often coatings refer to industrial coatings such as those used on appliances, office furniture, paper, automobiles, beverage cans, etc. and paint refers to architectural coatings such as house paints, wall and ceiling paints, trim paints, etc.

Functional coatings often protect substrates – wood, metal, plastic, or other – from the ravages of nature’s hostile environment and can cause wear through the natural processes of rusting, erosion, UV attack, weathering, and more.

The protection provided by functional coatings preserves assets and is friendly to the environment because they minimize corrosion and other means of degradation allowing a substrate to last for a much longer period of time than it would without a protective coating. Coatings can be divided into two broad groups: *architectural* and *industrial coatings*.

Industrial coatings are coatings that are applied to factory manufactured products. These include, but are not limited to, transportation (aircraft, appliances, automobiles, buses, recreational vehicles, trucks, and trains), beverage-cans, packaging items, business machines and office furniture, wood cabinets and furniture, pipelines, printed circuit boards, signs, marine vessels, and masonry.

Mechanical properties such as tensile strength, elongation, toughness, and related parameters are important characteristics of coatings. Coatings are the first-line defense for a product that contacts hostile environments. They also protect many products from a variety of chemicals. In addition to protecting products, it is preferable that a coating does not stain, lose adhesion, gloss, and is not permanently altered in any way by its contact with hostile environments.

> **“Coatings can do more than decorate and protect, as enhanced functionality in coatings brings significant improvements to the sustainability of downstream industries …”** - Paint & Coatings Industry

1.01 - The Science of Nanotechnology

Nanotechnology provides us with the ability to develop and alter materials at the molecular level. Manufacturing at the atomic levels allows chemists, master chemists, chemical engineers, and scientists world-wide to alter physical characteristics of parent materials atom-by-atom to create entirely new substances.

All products are produced from raw materials. These raw materials are composed of particles which are usually invisible to the naked eye. Conventional materials have particles with sizes varying from 100's of a micron (a millionth or 10^{-6} of a meter) to a millimetre (a thousandth or 10^{-3} of a meter). A nano material has a particle size of 1 - 100 nano-meters/nm (10^{-9}), which exhibits unusual physical and electronic properties.

Nanotechnology is very diverse, ranging from extensions of conventional device physics to completely new approaches based upon molecular self-assembly, from developing new materials with dimensions on the nano-scale, to investigating whether we can directly control matter on the atomic scale.

1.02 - Multifunctional Concepts

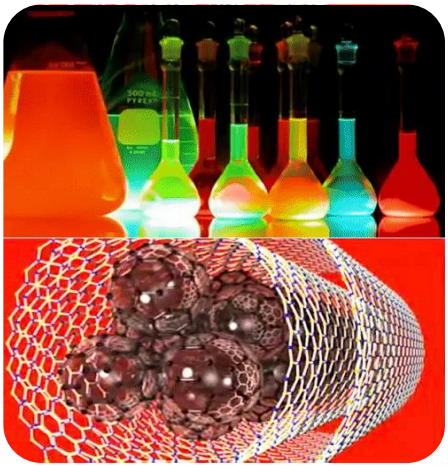
One nanometer (nm) is one billionth, or 10^{-9}, of a meter. By comparison, typical "carbon-carbon" bond lengths, or the spacing between these atoms in a molecule, are in the range of 0.12 – 0.15 nm. And a DNA double-helix has a diameter around 2 nm. On the other hand, the smallest cellular life-forms of the bacteria genus Mycoplasma are around 200 nm in length.

To put that scale in another context, the comparative size of a nanometer to a meter is the same as that of a marble to the size of the earth. Or another way of putting it: a nanometer is the amount a man's beard grows in the time it takes him to raise the razor to his face.

Two main approaches are used in nanotechnology. In the "bottom-up" approach, materials and devices are built from molecular components which assemble themselves chemically by principles of molecular recognition. In the "top-down" approach, nano-objects are constructed from larger entities without atomic-level control.

1.03 - Defining a Nano Coating

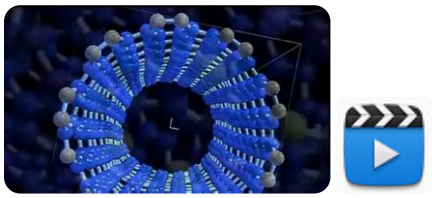
It is best to begin by defining a conventional nano coating. By adding nano-particles to a coating or polymer system, there will be improvements to physical properties such as UV ray absorption, scratch resistance, its anti-bacterial function, odour absorption, and its hydrophobic or hydrophilic properties.



In this design, nano-particles act as a filler or additive to a conventional coating system. These added nano-particles do not form the "building blocks" of a polymer structure or change the overall physical properties of the coating system. These physical properties are inherent within the polymer itself.

If the coating polymer is inferior, so is the coating system. Adding nano-particles to an inferior coating polymer will only incrementally improve the system. The “key” to a superior high performance coating system is a superior polymer system (http://en.wikipedia.org/wiki/Nanotechnology).

See also: **Nano Technology**
World of Nanotechnology Video
- 10:38 minutes, 33 MB



1.04 - Benefits of Nano Materials

With the addition of nano materials, some benefits can include exceptional lightness, strength, hardness, durability, high wear resistance, high chemical resistance activity, and even claimed self-cleaning characteristics. It can be noted that materials built from nano-sized particles can generate tremendous useful properties for further exploration.

1.05 - Protective Polymer Coatings

Numerous different polymer-based coatings are used for protective coatings. The word polymer comes from Greek where poly means many, and the word meros means unit, hence "many units". Polymers refer to compounds of high molecular weight derived from the addition of many smaller molecules or by the condensation of many small molecules along with the elimination of water, alcohol, or the like.

Coatings are based on polymers such as epoxies, polyesters, vinyl esters, polyurethanes, polyureas, and others. A higher degree of chemical crosslinking or crosslink density produces coatings with much greater chemical and thermal resistance.

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Section 2

2.0 - Introducing Nano-Clear® & WB-2K™ Industrial Coatings

Nano-Clear® & WB-2K™ Industrial Coatings are transparent, aliphatic*, humidity cured, single component (1K) (WB is two component / 2K), polyurethane/polyurea hybrid formulated coatings. Nano-Clear® Industrial Coatings (NCI) & WB-2K™ solutions are manufactured using proprietary 3D nano-structured polymers. These 3D nano-scale networks form the polymer backbone of all Nano-Clear® & WB-2K™ Coating Systems.

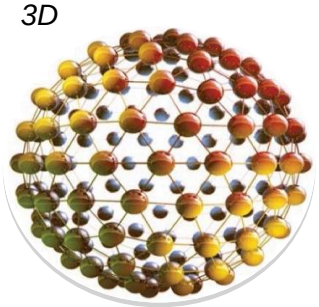
* Aliphatic coatings offer superior UV resistance for applications with stringent color requirements.

2.01 - Why is Crosslink Density So Important?

Dynamic Mechanical Thermal Analysis (DMTA) has been utilized to effectively evaluate the "crosslink density" of coating polymer systems. Recorded DMTA measurements support an unprecedented high crosslink density of Nano-Clear® & WB-2K™ Coating Systems, a result that is 3X higher than conventional industrial, marine, aerospace, or fleet coating systems.

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

Conversely, Nano-Clear® & WB-2K™ use a "nano-structure" to produce a *3D Molecular Architecture*. This 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

Extreme crosslink density provides a platform for the development of multi-functional surface properties, which include, but are not limited to, unmatched corrosion, UV, scratch, abrasion, chip, and chemical resistance with extended durability.

This also leads to low surface energy, repelling water (hydrophobic), and aiding in the ease of release for common surface contaminants such as ice, dirt, brake dust, concrete dust, and oil/grease, and bio-fouling.

Nano-Clear® & WB-2K™ coatings impart these dramatic functions **without** the addition **or need** of nano-particles as is common to many marketed Nano Coatings.

All Nano-Clear® & WB-2K™ Coating systems rely on high crosslink density so they can easily meet and exceed OEM automotive, aerospace, marine, and industrial manufacturing technical specifications.

2.02 - Limitations

If contaminates including oil, grease, silicone, curing compounds, soil, dust, bio-fouling, and/or other materials are present within the concrete substrate they will have an effect on the long term performance of Nano-Clear® & WB-2K™. All surface contaminates must be removed prior to application.

2.03 - Recommended Applications for NCI & WB-2K™

Industrial
Products designed for the repair & protection of concrete structures in:

- Pulp & paper, petrochemical and chemical plants
- Mining, metallurgy sites and metal refineries
- Hydroelectric, nuclear or other types of power generating stations
- Industrial waste-water treatment structures

Commercial
Products designed for the repair and protection of concrete in various commercial applications:

- Commercial flooring & institutional flooring
- Parking structures
- Patios and balconies
- Ramps and walkways
- Building facades

Infrastructure
Products designed to repair and protect concrete infrastructure in:

- Bridges, Tunnels and Dams
- Parking garages and building envelopes
- Potable water and wastewater infrastructure
- Transportation industry (road, rail, airports & seaway)

Section 3

3.0 - NANO-CLEAR® & WB-2K™ PROPERTIES, FEATURES & BENEFITS

Nano-Clear® & WB-2K™ Industrial Coatings feature remarkable properties that far surpass normal standards in terms of its strength, durability, resilience and its environmental responsibility.

"There is hardly any technology that has attracted such an immense amount of interest in the short spell of just a few years. Whether it's with regards to advances in materials development, chemistry, physics or engineering sciences, there are numerous examples of how nano-science (or nanotechnology) is creating positive and exciting new developments in each field.

The Chemical Industry has played a very important role in developing new nano-materials for use in various applications. Paint coating solutions is one field in particular where nanotechnology has created a significant ripple effect. Whether it's improvements in chemical resistance, erosion and abrasion resistance, resistance to U.V. light, or the enhancement of anti-fouling properties, nano-modified paints have shown great potential in several industrial applications.

"Small is beautiful" is a very famous statement from the past; but now it should be modified to "small is not only beautiful, but powerful too". It's a new age of nanotechnology where rapid developments are occurring at the smallest of scales in the molecular world, but creating big impressions. Nanotechnology is one of hottest fields drawing attention from all over the world, and it has the potential to quickly make most of today's existing technology obsolete in a short period of time.

Because of the promise nanotechnology holds for a wide range of applications in our future, well renowned chemists, physicists, biologists and other scientists from many other fields are collaborating in a worldwide movement that promises to bring about a new Industrial Revolution.

Virtually every industry and business will be affected by nanotechnology. The ability to create new materials from building blocks of matter that are comparable in size to a virus provides tremendous potential. Whether one considers automobiles or aircraft, computers or chips, medicines or cosmetics, chemicals or coatings, construction or energy – all of these industrial sectors, and many more, are facing significant change from advances in nanotechnology and will benefit immensely from its application." - ResearchGate, January, 2008. Nanotechnology in High Performance Paint Coatings.

3.01 - Nano-Clear® Coating Systems Physical Properties

- Polymer Chemistry — Nano-structured Polyurethane/polyurea hybrid coating
- Mixing Ratio — No mixing required
- Recommended Dry Film Thickness (DFT) — 1.5 to 2.5 mils (38 - 64 µm)
- Tested

Pencil Hardness	- 4H
Pendulum Hardness (Persoz)	- 220
Abrasion Resistance	- 8.4 mg loss
Impact Strength	- >140
Water Immersion	- Pass
QUV Resistance	- 99%
MEK Resistance	- >1500
Salt Spray	- 6,360 hours, No rust, No blisters
DMA Crosslink Density (x103 mol/m^3)	- 2.17
VOC (less exempts)	- 1.25 lbs/gal or 150 g/L (Exceeds Canada's Industrial maintenance coating figure of 340 g/L. This is the common format.)
Viscosity	- 20 cps (23 Seconds #3 Zahn Cup)

- Weight per gallon — - 8.0 lbs (3.63 kg)
- Packaging* — - 1 gal (3.8 L); - 5 gals (19 L); - 55 gals (208 L)
- Shipping weight

1 gal container	- 8 lbs (3.63kg)
5 gal container	- 40 lbs (18.14 kg)
55 gal drum	- 440 lbs (200 kg)

- Surface Coverage per gal (3 wet coats @ 2.0 mils WFT / coat) — - 333 ft^2 / gal @ 2.0 mils **DFT**; - 31 m^2 / 3.8 L @ 2.0 mils **DFT**

IMPORTANT NOTE:

* All Nano-Clear® products are packaged in plastic, UN compliant containers and drums for domestic and international shipping and storage. One gallon containers are shipped in single (1x1), or multiples of four (1x4), UN compliant cartons. Five gallon containers are shipped in a single (1x1) UN compliant carton.

3.02 - Nano-Clear® Shelf Life, Storage, and Package Stability

1. **Transportation:** Min. at 40ºF / 4ºC to Max. at 86ºF / 30ºC
2. **Storage & Shelf Life:** (Unopened Containers, from date of manufacturing)
   Min: 40ºF / 4ºC - 12 months **Max:** 72ºF / 22ºC: 12 months
   80ºF / 27ºC: 6 months
   90ºF / 38ºC: 2 months
3. **Storage & Shelf Life:** (Opened***** Containers)
   Max: 80ºF / 27ºC: 2 months
4. **General Storage Information:**
   Storage location must be dry with temperatures between 40ºF / 4ºC and 72ºF / 22ºC

*** Opened** is defined as cap is opened and closed immediately (tightly recapped) after dispensing the contents in order to avoid solvent evaporation and moisture contamination.

Nano-Clear® is a humidity-cured coating and, as such, is sensitive to moisture contamination. It is **VERY** important to quickly recap and tightly close the Nano-Clear® container once the product has been dispensed. **DO NOT** leave the container open for any short or extended periods of time. Doing so will allow the solvents to evaporate and cross-linking will begin.

NOTE: Moisture contamination or higher storage temperatures will cause Nano-Clear® to gel and decrease shelf life. Discard the contents if Nano-Clear® liquid has turned WHITE or has entered into a GEL state (gelatinous consistency).

WARNING:

It is also **NOT** recommended to repackage Nano-Clear® into smaller containers without first consulting Assero for instructions on proper container types, as well as the procedures and usage of nitrogen gas blanketing.

3.03 - Nano-Clear® Limitations

DO NOT apply Nano-Clear® to:

- Bare untreated aluminium
- Bare untreated steel
- Bare untreated chrome
- Ceramic Tile
- Glass
- Nylon
- PMMA Plastic
- PPO Plastic
- HDPE Plastic

It is CRITICAL that a **test panel/patch** be coated prior to a large scale application to confirm coverage rate and to ensure that the substrate to be coated with Nano-Clear® will accept it without negative aesthetic effects.

3.04 - Nano-Clear® Features and Asset Benefits

Nano-Clear® was designed from the beginning to provide not just an alternative to the status quo of products currently available on the market, but to exceed and far surpass the qualities of standard coatings.

Development of NCI's cutting edge, densely cross-linked, polymer technology provides the optimum in surface protection possible, which results in many additional valuable benefits including a highly reduced impact on the environment.

3.04 a - Nano-Clear® Features

NCI's protective coating provides the following in terms of premium protection:

- Low Viscosity
- Extreme Scratch, Abrasion, Chip, Impact, and Mar Resistance
- Extreme Chemical Resistance
- Extreme Corrosion Resistance
- Extreme UV and Weathering Resistance
- Extended Gloss Retention
- Highly Oxidized Coating Restoration
- Extended Service Life

3.04 b - Nano-Clear® Benefits

NCI's protective coating solutions have direct beneficial impacts on time and cost expenses, as well as the environment.

- Reduces Shipping & Handling
- 10 Year Recoat Cycle Lowers Maintenance Costs
- 2X - 4X Lower in Coating Volume Needs
- Increased Sustainability
- Higher Resale Value of Asset(s)
- Reduces Down Time During Maintenance Periods
- Reduces Storage Needs, Less Product Required
- Higher and Sustained Visibility of Asset(s)
- Shorter Recoating Cycle (24 hour cure time)
- Low VOC Meets & Exceeds Global Environmental Responsibility Standards
- Low VOC Reduces Health Risks for Application Personnel
- Lower Recoating Inventory Needs, Reduces Costs
- Lowers Costs Due to Reduction and Elimination of Corrosion

3.05 - Nano-Clear® Cured Properties and Testing Results

NOTE: Additional Test Results are available upon request.

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	1,122 ft² @ 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*	SA SO 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*	SA SO ISO 3248	1kg - 160 cm
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 ASTMG155	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: *240 hrs @ 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 240 hrs @ 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 3hrs, 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® 500 Fluid*	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)

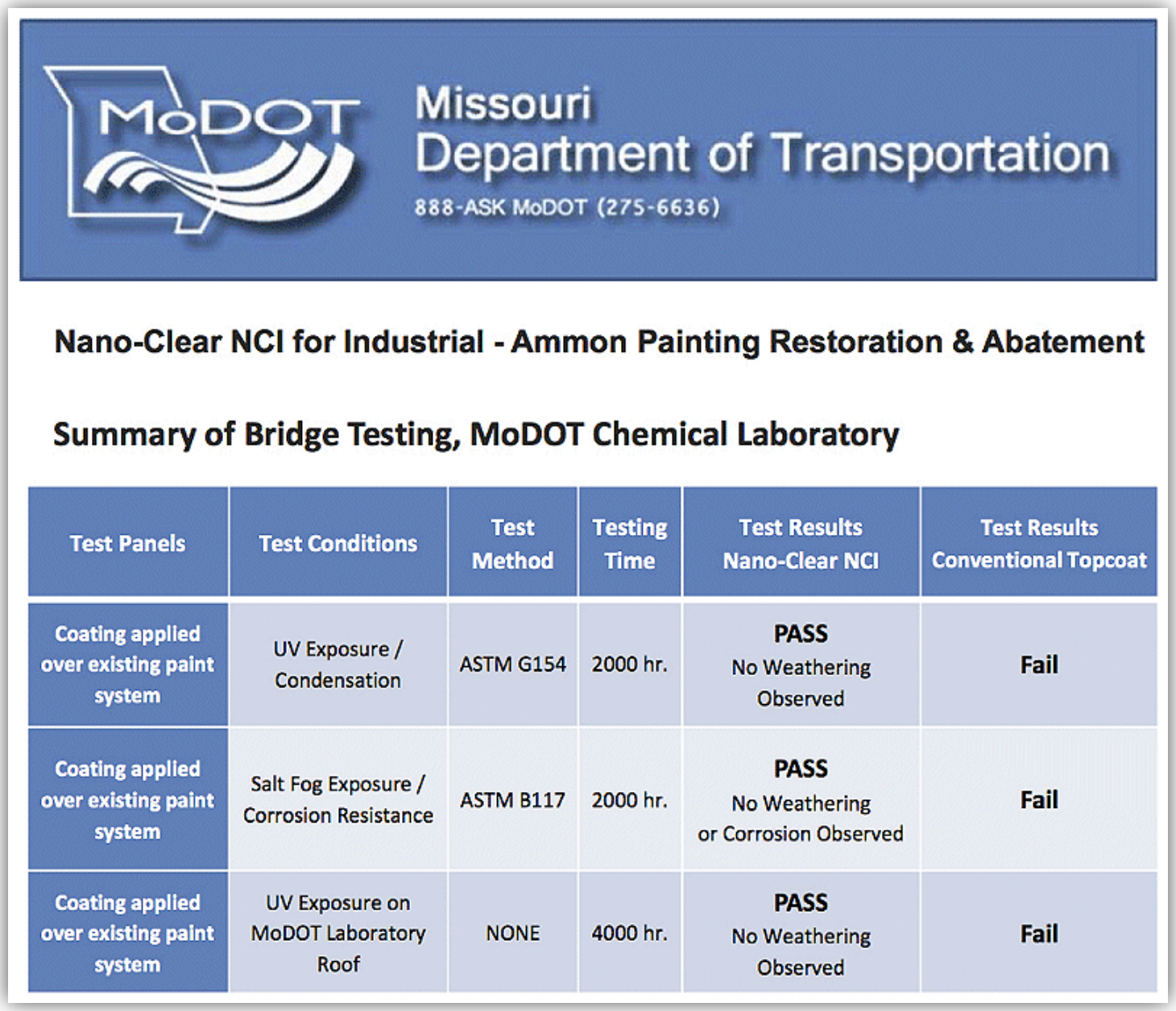
	SAMPLE PANEL TESTED	E' @ 23°C/73.4°F MPA	XLD (Kmols/cc)	Tg (°C)	
36	Nano-Clear™ (NCI)	2110	2.17	57.7	Based on historical data XLD has a 95% confidence interval of ~ +/- 0.5 Based on historical data Tg has a 95% confidence interval of ~ +/- 2.5

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.



Nano-Clear NCI for Industrial - Ammon Painting Restoration & Abatement

Summary of Bridge Testing, MoDOT Chemical Laboratory

Test Panels	Test Conditions	Test Method	Testing Time	Test Results Nano-Clear NCI	Test Results Conventional Topcoat
Coating applied over existing paint system	UV Exposure / Condensation	ASTM G154	2000 hr.	**PASS** No Weathering Observed	**Fail**
Coating applied over existing paint system	Salt Fog Exposure / Corrosion Resistance	ASTM B117	2000 hr.	**PASS** No Weathering or Corrosion Observed	**Fail**
Coating applied over existing paint system	UV Exposure on MoDOT Laboratory Roof	NONE	4000 hr.	**PASS** No Weathering Observed	**Fail**

3.06 - WB-2K™ Coating Systems Physical Properties

- Polymer Chemistry - Nano-structured Polyurethane/polyurea hybrid coating
- Mixing Ratio - 1:1 by volume
- Recommended Wet Film Thickness (WFT) - 1.5 to 2.0 mils (38 - 64 µm) per coat
- Evaporation Rate - Slower than ether
- Solubility in Water - Miscible
- pH - > 2.0, < 11.5
- Tested
  - Pencil Hardness - 4H
  - VOC (less exempts) - Zero VOC, Zero HAP
- Weight per gallon - 8.1 lbs (3.7 kg)
- Packaging* - 5 L (1.3 US gal)
  - 20 L (5 US gal)
  - 208 L (55 US gal)
- Shipping weight
  - 5 L container - 19.8 kg (43.6 lbs)
  - 20 L container - 98.9 kg (218 lbs)
  - 208 L container - 1,087.7 kg (2,398 lbs)
- Surface Coverage per litre
  - 211 ft^2 / 19.60 m^2 @ 1.0 mils (0.0254 mm)
  - 105 ft^2 / 9.75 m^2 @ 2.0 mils (0.0508 mm)
  - 70 ft^2 / 6.50 m^2 @ 3.0 mils (0.0762 mm)

IMPORTANT NOTE:

* All WB-2K™ products are packaged in plastic, UN compliant containers and drums for domestic and international shipping and storage. 5L containers are shipped in single (1x1), or multiples of four (1x4), UN compliant cartons. 20 L containers are shipped in a single (1x1) UN compliant carton.

3.07 - WB-2K™ Shelf Life, Storage, and Package Stability

Inspect condition of all containers and totes to ensure compliance. WB-2K™ should be stored in tightly sealed containers between 45°F - 80°F (7.2°C - 26.7°C) to ensure long shelf life.

WB-2K™ has a storage life of approximately 12 months from the date of manufacture, and provided that the product is stored in its sealed original containers.

DO NOT ALLOW TO FREEZE

3.08 - Testing WB-2K™ Before Application

IMPORTANT: always conduct a pre-test patch on an uncoated surface prior to a large scale application to confirm coverage rate and to ensure suitability that the substrate to be coated with WB-2K™ will accept it without negative aesthetic effects.

NOTE that the proper application of WB-2K™ is very important in order to achieve its optimum properties and performance. The substrate type (material composition) and its surface preparation are CRITICALLY important prior to the application of WB-2K™. All surfaces to be coated must be clean, free of loose debris, stains, rust, vegetative growth, efflorescence, graffiti, oil, grease, moss, mildew, chalked/oxidized paint, and any other unsound or foreign materials which can inhibit the penetration, chemical bond, adhesion and long-term performance of WB-2K™.

3.09 - WB-2K™ Advantages and Asset Benefits

Based on NCI's industry award-winning, disruptive coating technology, WB-2K™ leads the way in sustainability with its ability to successfully address the long term durability, care and maintenance of commercial and industrial concrete assets in a cost effective manner.

WB-2K™ penetrates deep into the substrate of concrete to form a slip resistant, protective barrier against destructive elements. WB-2K™ excels in scratch, chip, marring, abrasion, UV and chemical resistance; and it provides extreme protection from the effects of weathering, salt, and moisture/water damage that concrete will encounter during its service life. For cleaning purposes, WB-1K™ also enables the easy release of surface fouling such as grease, oil, dirt and bio-staining.

3.09 a - Advantages of WB-2K™

- Prevents and eliminates damage from: extreme UV, Abrasion, Chip, Marring and Chemical Resistance
- Zero VOC and HAP
- Convenient 1:1 mix ratio by volume
- Prevents biological efflorescence and lime staining
- Fast dry, high throughput
- Extended pot, shelf and service life
- Excellent flexibility
- Penetrates substrate to fill voids and micro-cracks
- Chemically and mechanically bonds to the concrete substrate and surface

WB-2K™ also facilitates the cleaning & easy release of oil, grease, dirt and bio-staining.

Section 4

4.0 - NANO-CLEAR® & WB-2K™ SAFETY DATA SHEETS

Safety Data Sheets include information about the properties of the substance or mixture, its hazards and instructions for handling, disposal and transport and also first-aid, fire-fighting and exposure control measures. However, if the substance or mixture is also sold to the general public, an SDS does not need to be provided unless requested by a downstream user or distributor.

For mixtures which are not classified as hazardous, but which contain certain hazardous substances, an SDS should be provided if requested by downstream users or distributors. The safety data sheet should be updated without delay if new information becomes available on the hazards or the need for more stringent risk management measures.

When downstream users receive a safety data sheet, they need to identify and apply appropriate measures to adequately control the risks. Suppliers and recipients of SDSs are encouraged to check that the required information is provided. Downstream users are encouraged to inform their suppliers about inaccuracies or inconsistencies in the SDS received.

When safety data sheets are not required, the supplier must still provide sufficient information for safe use. If restriction or authorization applies to any substance, the necessary details should be provided. Suppliers of articles that contain more than 0.1% w/w of a substance on WHMIS have to provide enough information to allow the safe use of the article to downstream users and distributors

4.01 - Safety Data Sheets (Source Links)

The link below provides a source for current SDS files, as well as further technical resources and details on our line of Nano-Clear® and WB-2K™ products.

Nano-Clear® and WB-2K™ Technical Resources

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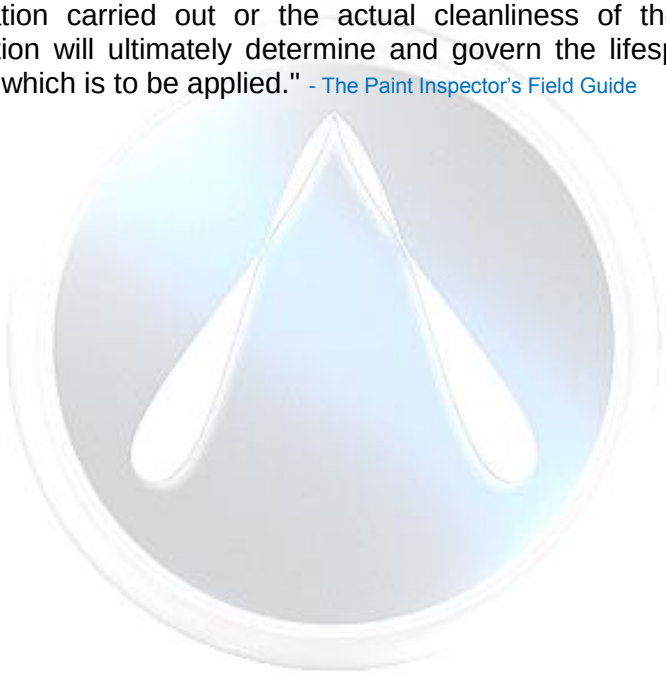
5.0 - SURFACE PREPARATION

Surface preparation is regarded and accepted by the corrosion control industry as the most important factor during any painting and coating operation. The amount of surface preparation carried out or the actual cleanliness of the substrate prior to coating application will ultimately determine and govern the lifespan of the protective coating system which is to be applied." - The Paint Inspector's Field Guide



5.01 - Substrate Consideration

Prior to the application of Nano-Clear® or WB-2K™, all concrete surfaces (raw and/or epoxy coated) must be structurally sound, clean, free of loose debris, oil, grease, silicone, wax, stains, rust, vegetative growth, organic fouling, moss, mildew, surface hardeners, or any other unsound or foreign materials that will inhibit the proper adhesion of Nano-Clear® or WB-2K™.

Moisture and moisture vapour transmission rates are dynamic in nature and can change over time. Do not apply Nano-Clear® or WB-2K™ if there is excessive moisture in the concrete, or if the vapor transmission (MVT) rate is high. The relative humidity (R.H.) and MVT rate should be determined before the application of Nano-Clear® or WB-2K™. Two test methods that can be used to measure MVT are the plastic sheet test (ASTM D 4263), and the "Calcium Chloride" test (ASTM F 1869).

After proper surface preparation and moisture testing, it is highly recommended to perform an application of Nano-Clear® or WB-2K™ to a small test section in a low visibility area to confirm good adhesion and compatibility with the concrete surfaces.

5.02 - Surface Preparation

The following recommended preparation methods for the removal of surface contaminants will greatly assist in the long-term service life and performance of Nano-Clear® or WB-2K™. Here is a list of the cleaning agents and tools that can be used for the preparation of concrete surfaces:

- An appropriate water based, multi-surface, multi-purpose degreaser
- An appropriate water based, multi-surface, bio-organic cleaner
- Cold-warm-hot, low pressure (~400 to 600 psi) washing and rinsing
- Combination of soft to medium bristled brush and/or sponge
- Clean compressed air or a leaf blower, to assist with drying
- Solvent based cleaners such as MEK, acetone, and paint thinner

All cleaning agents are to be applied according to the manufacturer's instructions. A recommended multi-purpose effective cleaner is **Safe Care SC-1000 Aqueous Industrial Cleaner**. Please contact Assero for information regarding other appropriate multi-surface degreasers and bio-organic cleaning agents. It is also important that you follow the manufacturer's recommendation for personal protective gear before proceeding with the preparation stage.

Details of some relevant SSPC cleaning standards are also provided in Nano-Clear® and WB-2K™ TDS documentation. It is strongly advised to review the appropriate and recommended industry cleaning standards that pertain to the project and the conditions of the substrate / surface to be coated.

In all cases the surface cleaning agents must be thoroughly rinsed away using fresh, clean tap water and the surface allowed to dry for at least 24 hours, prior to the application of Nano-Clear® or WB-2K™.

IMPORTANT NOTE:

All disposal (waste and used) methods must be in compliance with Federal, State, Provincial, and local laws and regulations. These regulations may vary in different locations. Waste characterizations and compliance with applicable laws are the sole responsibility of the waste generator.

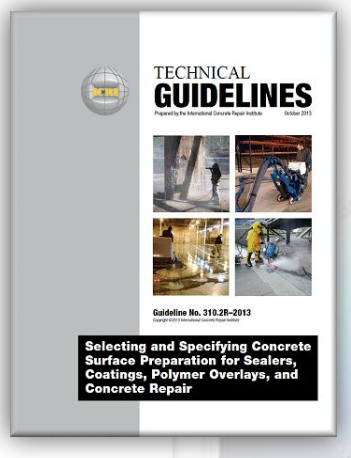
Every effort made during this preparation stage is critical to the performance and longevity of the Nano-Clear® or WB-2K™ Coating system. It may require a combination of cleaning agents and tools for proper preparation of the surface in order for Nano-Clear® or WB-2K™ to achieve an optimum adhesion level.

5.03 - Surface Preparation Standards

The concrete's surface profile (CSP) should be equal to CSP 2 - 5 (see illustration samples on the next page) in accordance with Guideline 310-2R published by the International Concrete Repair Institute (**ICRI**), and preparation standards should follow the Joint Surface Preparation Standards under NACE No.6/SSPC-SP 13 (Surface Preparation of Concrete). The following 2 PDF files may be downloaded from the link provided and used as a reference source with regards to the guidelines mentioned above.

Concrete Repair & Surface Preparation

Technical Guidelines (Prepared by the International Concrete Repair Institute, October, 2013)
- Selecting & Specifying Surface Preparation for Sealers, Coatings, Polymer Overlays, & Concrete Repair
- PDF: 54 pages, 1.9 MB



Joint Surface Preparation Standard (NACE No. 6/SSPC-Sp 13)
- Surface Preparation of Concrete
- PDF: 18 pages, 116.8 KB

5.04 - Concrete Surface Profiles

Concrete Surface Preparation Profiles for Overlay or Restoring Existing Concrete

Proper surface preparation of existing concrete is essential for achieving a successful project including resurfacers, polymer-modified or self-leveling overlays, sealers, coatings, or stains. Since there are many products available for overlays and restoration, it is important you know the surface condition requirements for the specific product you plan to use. Taking steps to correctly prepare the existing concrete surface will save you time and money, and can substantially reduce the possibility of coating failure.

These Concrete Surface Profiles were developed by the International Concrete Repair Institute (ICRI), are divided into ten classifications (CSP 1-10) of surface textures based on the average distance from the peaks of the surface to the valleys. They are accepted industry standards to help guide the installer achieve the proper texture for successful bonding of the overlay or coating. The lower number profiles are smoother (CSP 1 is nearly flat), and the higher numbers have more "tooth" and get progressively rougher.

- **These surface profile pictures provide guidelines based on the requirements of the system or products being used.**
- **Use the chart on the next page to validate the method for surface preparation.**

CSP 1 (acid etched)

CSP 2 (grinding)

CSP 3 (light shotblast)

CSP 4 (light scarification)

CSP 5 (medium shotblast)

CSP 6 (medium scarification)

CSP 7 (heavy abrasive blast)

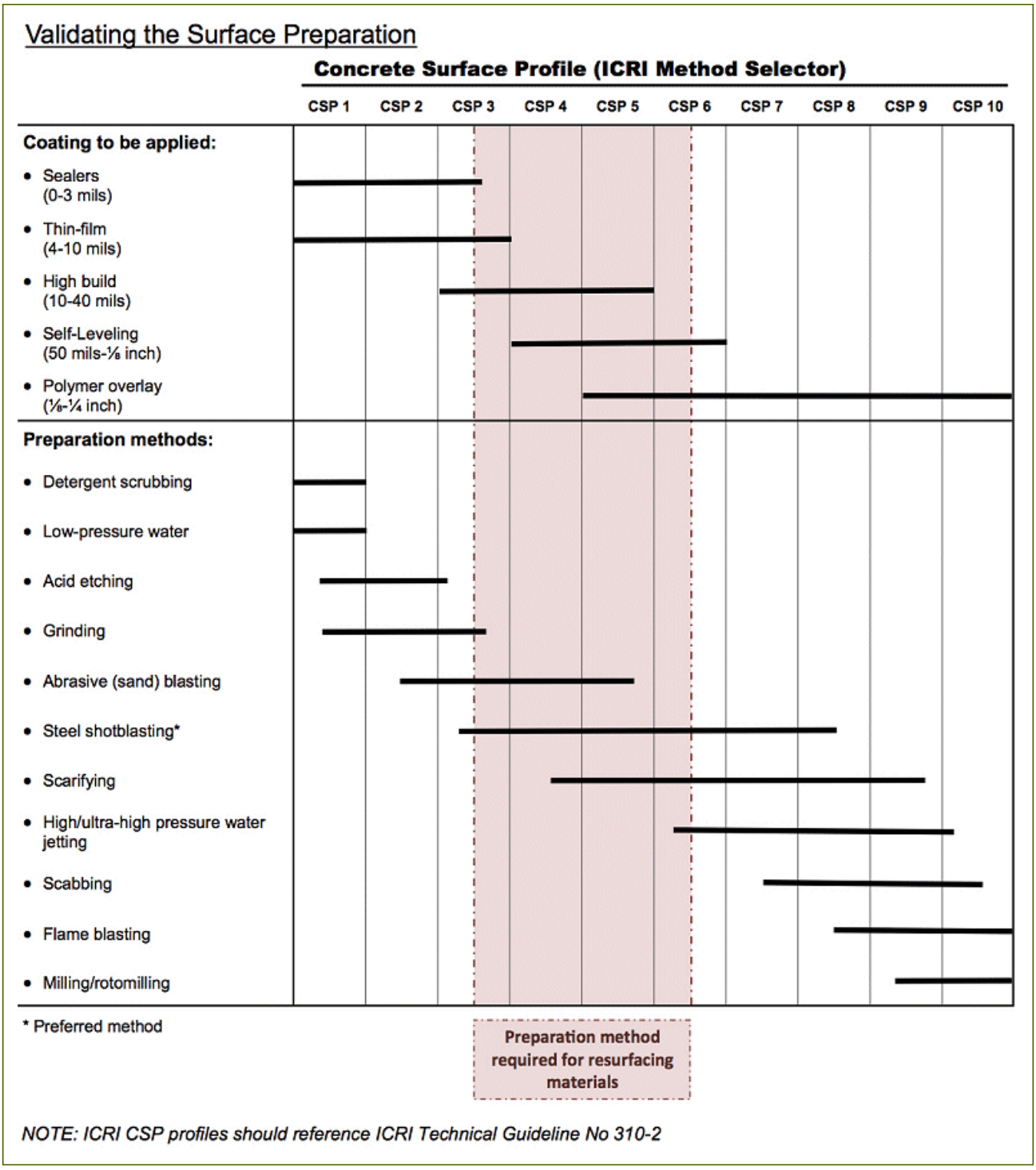
CSP 8 (scabbed)

CSP 9 (heavy scarification)

CSP 10 (course planing)

NOTE: ICRI CSP profiles should reference ICRI Technical Guideline No 310-2

5.05 - Validating the Surface Preparation



5.06 - Concrete Preparation Notes

Notes

- In addition to having the surface clean, with all chemicals, oil, grease, curing compounds, or other contaminants removed, the surface profile of the existing concrete needs to be suitable for the selected overlay. Always consult with the manufacturer for the recommended surface profile.
- Mechanical profiling or acid etching are techniques used to prepare floors for overlays and restorations. Mechanical profiling should always be the first method of choice for roughening the concrete; it is also the safest method. Acid etching can provide adequate surface preparation for some coatings, sealers and toppings, however, acids can be difficult to rinse completely and neutralize, require a well-ventilated area, and they will not remove petroleum-based products or animal vegetable oils from the existing concrete.
- More aggressive surface preparation techniques (flame blasting, scarifying, scabbling and milling/ rotomilling) risk the introduction of micro-cracking. Additional surface preparation is required when micro-cracking occurs.
- Repairs for cracking or spalling should be done in the surface preparation process, before the final overlay.
- It is important to always honor control/construction expansion joints.
- Apply the coating to a mock-up or test area under the same conditions of ambient temperature and surface moisture as the installation to verify the surface profile is adequately prepared.

Reference the following industry standards for preparation of concrete from the ASTM International (formerly known as American Society for Testing and Materials-ASTM), NACE International (formerly National Association of Corrosion Engineers), Society for Protective Coatings (SSPC), and the International Concrete Repair Institute (ICRI):

ASTM D4258, Standard Practice for Surface Cleaning Concrete for Coating

ASTM D4259, Standard Practice for Abrading Concrete

ASTM D4260, Standard Practice for Liquid and Gelled Acid Etching of Concrete

ASTM D4261, Standard Practice for Surface Cleaning Concrete Unit Masonry for Coating

ASTM D7682, Standard Test Method for Replication and Measurement of Concrete Surface Profiles Using Replica Putty

SSPC-SP13/NACE 6, Surface Preparation of Concrete

ICRI Standard 310.2 Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair with CSP Chips.

Section 6

6.0 - NANO-CLEAR® & WB-2K™ APPLICATION PROCESS

Nano-Clear® (NCI) & WB-2K™ are high gloss, transparent, multifunctional industrial clear topcoats. They are industrial coatings that are able to deeply penetrate and adhere to a concrete substrate. With the appropriate film build, they will form a long lasting, protective barrier that will minimize surface fouling and reduce maintenance while stopping water and moisture migration.

Nano-Clear® & WB-2K™ Industrial Coatings are disruptive, eco-innovative coating technologies. Each is a transparent, aliphatic, humidity cured, one component (1K) (two component / 2K for WB), nano-structured, polyurethane / polyurea hybrid coating that enhances existing coating systems, provides greatly increased protection against corrosion and surface degradation, and significantly extends the service life of coated assets.

6.01 - Application Considerations and Recommendations

The following application information for Nano-Clear® is very important in order to achieve the outlined physical properites and subsequent benefits it provides. The substrate type (material composition) and surface preparation are critical factors to be considered prior to the application of Nano-Clear® Coatings.

IMPORTANT NOTE:

Nano-Clear®, WB-2K™	without Proper Surface Adhesion	**= FAILURE**
Nano-Clear®, WB-2K™	with Proper Surface Adhesion	**= LONG TERM SERVICE LIFE**

6.02 - Personal Protection Gear

As with all hazardous chemicals, you must select and use the appropriate respiratory protection and personal protective equipment (PPE) and follow safe handling procedures to ensure your well being.

6.02 a - Respiratory Protection

The general requirements for personal protective equipment can be found at OSHA under **29 CFR 1910.132** and the Respiratory Protection Standard is **29 CFR 1910.134 (**OSHA **- USA)** and **(**CCOHS **- Canada)**.

When choosing a respirator, keep in mind that most do not have an end-of-service life indicator (ESLI). Because cartridge respirators can't warn you to exposure, a positive pressure fresh air respirator with a full face piece is recommended.

6.03 - Application Environment

Nano-Clear® is designed to cure (crosslink) in the presence of humidity. As a general rule, higher humidity will result in a fast cure cycle. Higher humidity may also reduce flow and levelling of Nano-Clear®. Lower humidity will result in a slower cure cycle.

A method for improving flow and levelling during higher humidity is to reduce the wet-on-wet recoat time to 2 or 3 minutes from the lower humidity time of 5 to 10 minutes.

It is very important that Nano-Clear® be applied in a dust-free environment in order to avoid surface contamination. Please use appropriate ventilation, approved personal respiratory equipment, and personal protective wear suitable for industrial spray painting.

Please review the SDS for detailed information on proper handling, clean up, disposal, and personal protective gear. Circulate sufficient air to maintain a safe working environment below the PEL* and LEL** recommendations. Nano-Clear® should be applied according to local, provincial, state, and federal OSHA regulations. - * Permissible Exposure Level, ** Lower Explosive Level

6.04 - Application Parameters for Nano-Clear®

Parameter	Minimum	Maximum
Ambient Temperature	40°F / 4°C	90°F / 32°C
Relative Humidity - R.H.	20%	90%
Metal Temperature	40°F / 4°C	90°F / 32°C
Metal Temperature Above the Dew Point	At least: 5°F / - 5°C	NA
Material Temperature	40°F / 4°C	90°F / 32°C

6.05 - Environmental Conditions Consideration for Nano-Clear®

Unless otherwise specified, the coating application should not be carried out under the following conditions:

- The **Temperature** is below 40°F / 4°C,
- The **Surface Temperature** is less than 5.3°F / -15.4°C above the dew point,
- The **Surface Temperature** is above 90°F / 32°C.
- The **Relative Humidity** is above 90%,
- And the **Surface** to be coated is wet,

In addition to the above for exterior applications, other ambient conditions may apply, e.g. - strong winds. This may require consultation with the client prior to initiating or continuing the coating process.

KEY ADVICE

To mitigate and prevent the entrapment of solvent, the drying/curing and re-coating times provided are (unless otherwise stated) based on:

- ✓ Temperatures of 40°F / 4°C and 90°F / 32°C,
- ✓ Relative Humidity (RH) of 20 - 90%, and
- ✓ A well ventilated and controlled working environment.

6.06 - Substrate Consideration

Nano-Clear® is engineered to deeply penetrate into properly prepared, untreated and uncoated concrete surfaces that are physically sound and free from contaminates.

6.07 - Recommended Film Build for Nano-Clear®

6.07 a - General Film Build

- **Recommended Number of Sprayed Wet Coats:** Apply a minimum of **3 - 4** wet coats, with **2 - 5** minutes (at 72°F / 22°C) before the application of additional coats. This waiting period is done to allow for the solvent to evaporate / flash off.
  NOTE: Failing to follow this evaporation time frame can lead to "solvent entrapment".
- **Recommended Wet Film Thickness (WFT): 2.0 - 3.0** mils (50 - 76 µm) per wet coat.
- **Recommended Dry Film Thickness (DFT): 1.5 - 2.5** mil (38 – 64 µm) depending on the surface properties desired.

IMPORTANT NOTE:

AVOID the application of additional coats **after 20 minutes** have passed as flow and levelling will be negatively affected. Take and record the ambient and surface temperatures, along with the relative humidity (R.H.), which will greatly assist in film build timing.

6.07 b - Nano-Clear® Applied to Concrete Surfaces

The first wet coat of Nano-Clear will penetrate to fill the many voids in the concrete substrate. Depending on the porosity of the concrete, 1 or 2 additional wet coats may be needed to properly "fill" these voids.

The number of wet coats required should be evident by the overall gloss level 5 minutes after the application process is completed:

High Gloss = Good film build
Low Gloss = Low film build (It is recommended to apply an additional wet coat.)

Nano-Clear® Video

NCI for Cement/Concrete
- 1:58 minutes, 23.5 MB

6.08 - Recommended Film Build for WB-2K™

Components A & B are supplied in s ready-to-mix form. **Do Not Dilute!**

6.08 a - General Film Build

WB-2K™ will penetrate deeply into uncoated concrete, so an application of two wet coats of WB-2K™ @ **1.5** - **2.0** mils per coat is required (with 5 - 10 minutes between coats).

- **Recommended Number of Wet Coats:** Apply **3** wet coats, with **5** - **10** minutes (@ 72°F / 22°C) before the application of additional coats.
  NOTE: a dwell time of **20** - **30** minutes must be allowed **after the 2nd coat** so that the third "top finish coat" can be established without further penetration.
- **Recommended Wet Film Thickness (WFT): 1.5** - **2.0** mils (38 - 50 µm) per wet coat.
- **Recommended Finish Top Coat (WFT Build): 1.0** - **2.0** mils (25 – 50 µm) depending on the surface properties desired.
- **Top Finish Recoat Time: 10** - **15** minutes
- **Ambient Cure Time:** Pot life is **30** minutes @ 72°F / 22°C
- **Dry-To-Touch Time:** 1 hour @ 72°F / 22°C
- **Recommended Dry Film Thickness (DFT): 2.5** - **3.0** mils (64 - 76 µm) per wet coat.
- **Full Cure Time / Return To Service:** 24 hrs

IMPORTANT NOTE:

DO NOT apply **WB-2K™** if the material or substrate temperature is below 55°F (12.8°C). WB-2K™ is best applied when the surface and air temperature are between 55°F to 90°F (12.8° to 32°C) and the relative humidity (R.H.) is at 50% during both application and cure time.

6.08 b - WB-2K™ Applied to Concrete Surfaces

The first wet coats of WB-2K™ will penetrate to fill the many voids in the concrete substrate. Depending on the porosity of the concrete, additional wet coats may be needed to properly “fill” these voids.

A 3rd "finish top coat" (or 4th if needed) must be applied with the addition of a slip resistant additive such as "**Sure Step**" or "**Shark Grip**". Please follow instructions of these products for adding to WB-2K™.

NOTE: always pre-test WB-2K™ on uncoated concrete to verify suitability of the application.

Section 7

7.0 - APPLICATION EQUIPMENT

For Optimum results, it is recommended to use the equipment noted on the next pages for each of the three different methods of applying Nano-Clear® or WB-2K™ to properly prepared surfaces. Please contact your Assero Representative if you require clarification or have questions regarding equipment for particular projects and/or unique environments.

7.01 - Application Equipment for Nano-Clear®

Nano-Clear® can be applied using the following methods:

- ✓ Air Spray System
- ✓ Airless Spray System
- ✓ Roller Brush

7.01 a - Air Spray Equipment

Spray Gun:	HVLP or LVLP (Sata, Devilbiss, Krautzberger, Binks, or Iwata)
Fluid Tip:	1.3, 1.4, or 1.5 mm
Fan Pattern:	Full
Fluid Control:	2 ½ turns out
Spray Pattern:	50% overlap
Pressure at Gun:	29 - 30 psi (1.9 - 2.0 bar)

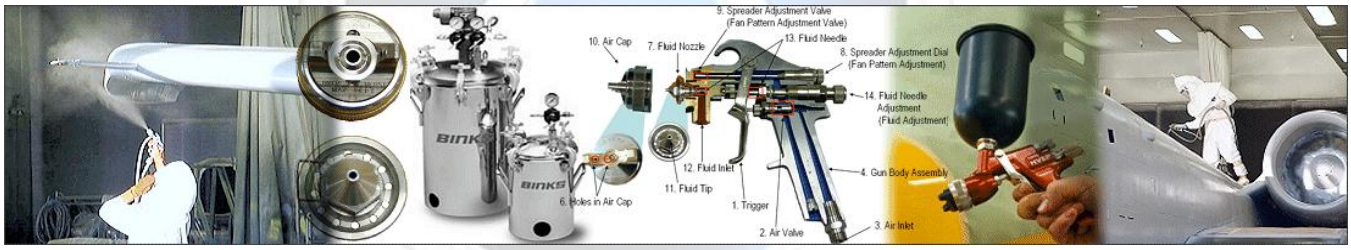
Note: a "Pressure Feed Tank" can add Portability.

IMPORTANT NOTE:

The link below provides two files with valuable information related to:

- **how to use the appropriate spray application equipment to provide a quality finish**
- **how to properly set up your spray equipment**

Spray System/Equipment Setup



IMPORTANT REGULATORY NOTE:

Some regulatory agencies prohibit the operation of HVLP guns above 10 psi (0.7 bar) nozzle atomization pressure. Users subject to this type of regulation should not exceed 10 psi (50 psi inlet pressure). It is recommended that the nozzle test gauge be used to confirm actual nozzle operating pressure.

It may also be a requirement of some regulatory agencies that users have this test gauge nozzle available on site to verify that the gun is being operated within the limits of applicable rules.

7.01 b - Airless Spray Equipment

Tip Size:	Graco 519 or 619
Pump:	30:1 or 40:1
Pump Pressure:	800 psi (55.1 bar)

IMPORTANT NOTE:

- Avoid recoating after 20 minutes as flow and levelling will be affected.
- Avoid contact with skin and hair as Nano-Clear® will adhere much like an industrial grade cyanoacrylate (Super Glue).
- Nano-Clear® is a moisture sensitive coating. It is **VERY** important to recap and tightly close containers immediately to avoid moisture contamination.
- Use dedicated clean and pressurized air supply lines and equipment for best results. Clean spray equipment immediately upon completion of job using paint thinner or acetone. Avoid contact with skin and hair.

7.01 c - Roller Brush Equipment

Paint Roller: Wooster Pro/Doo-Z® *FTP*, semi-smooth (4, 7, 9, 18, and 18" size)

- more Wooster Paint Roller details (PDF file, 7 pages, 27 MB)

Paint Tray: A plastic polypropylene paint tray can be used for paint rollers that are 14"+

7.02 - Application Equipment for WB-2K™

WB-2K™ can be applied using the following methods.

Manual Application Equipment

- ✓ Roller brush
- ✓ Construction grade hand pump pressurized sprayer
- ✓ Acetone resistant pressurized T-Bar sprayer, or
- ✓ Paint pad

Power Application Equipment

HVLP:	Tip Size - 1.4 or 1.5 mm
Airless:	Tip Size - 0.015 or 0.019 inch

NOTE: Components A & B are supplied in s ready-to-mix form. **Do Not Dilute!**

CLEANUP: Before WB-2K™ is fully cured, equipment and minor spill cleanup can be accomplished using acetone, butyl acetate or MEK.

7.03 - Slip Resistance & Floor Markings

A newly coated indoor floor or outdoor concrete area can be a thing of beauty to behold once completed. But if done without taking some important factors into consideration ahead of time, 1) it can quickly become a dangerous hazard zone and lead to potential liability issues, or 2) it may be too late to add or make changes that would have offered extra benefits for staff or people who utilize the area.

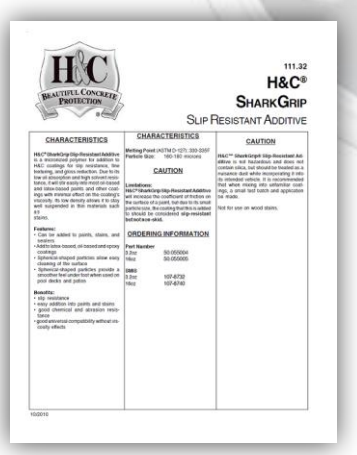
7.03 a - Non-Slip Additives for Coated Floors

Newly coated floors can be quite slippery especially if/when they become wet; for example during/after a rain on an outdoor area, or during/after cleaning an indoor area). It's important to pre-plan and determine if a non-slip additive may be required in order to protect workers and/or public safety.

The most recommended additive to create a non-slip surface for floor coatings is ground polymer grit such as **SharkGrip** or **Sure-Step**. This grit consists of very small micronized polymer beads that provide traction (for example to hard-soled shoes) and are soft to the feet and skin. It becomes translucent when added to a coating and will create very small bumps for grip when mixed into the final top coat of your floor.

For more information about these popular additives, download review the following PDF files below.

SharkGrip & Sure-Step
- PDF: each 4 pages, 157 KB and 385 KB



Note that Sure-Step "may help contribute to LEED credits".

7.03 b - Floor Markings

For many businesses, floor markings are a must for optimum productivity. This means using visual cues such as signs and floor markings to direct employees and equipment in the most efficient and safe way, all in an effort to reduce waste and maintain a high level of productivity.

In a production facility, marked floors (whether painted or taped) are going to experience degradation due to equipment traffic and/or pallets and storage containers being dragging around the facility. It's important to plan ahead and determine how the flooring area will be marked and maintained in order to comply with safety standards and to maximize productivity levels.

IMPORTANT NOTE:

Nano-Clear® must be applied after the floor markings have been placed in order to provide long term protection from degradation to the marked areas. Apply the floor marking before applying NCI.

8.0 - WARRANTY & LEGAL DISCLAIMER

8.01 - Warranty & Legal Disclaimer

The recommendations made and information herein is based on the manufacturer, our own, and independent laboratory experience, and is believed to be accurate under controlled conditions. We cannot, however, cover every possible application of Nano-Clear® and / or WB-2K™ nor anticipate every possible variation encountered in weather condition, job-site condition, application methods used, and types of surfaces upon which the coating is being applied. It is strongly recommended that the applicator perform test patches to review suitability for their intended coating project.

Assero reserves the right to have the true cause of any difficulty determined by accepted test methods.

Nothing herein shall be construed as granting a license to, or recommendation for use of, any proprietary rights.

Product performance is affected by many factors, including storage, methods of application and use.

Pre-testing of the surface to be coated is essential in determining the suitability of Nano-Clear® or WB-2K™ based on its intended method of application use.

Assero's SOLE WARRANTY is that Nano-Clear® and WB-2K™ has been manufactured to designed specifications.

No oral or written information or advice shall increase the warranty or create new warranties.

Assero's SOLE WARRANTY is to replace product proven defective. ***Assero*** is not responsible for reimbursing costs of application or removal. In no event shall ***Assero*** be liable for any consequential, indirect, or other damages whether arising from negligence or otherwise.

THIS WARRANTY AND LIABILITY MAY NOT BE MODIFIED OR EXTENDED BY REPRESENTATIVES OF ASSERO, ITS RESELLERS, OR ITS CONTRACTED APPLICATORS.

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Section 9

9.0 - GLOSSARY, CONVERSIONS & PROLOGUE

To correctly describe the painting process, a range of industry-specific terms and vocabulary are used in standards, working instructions, data sheets and package labels etc. with regards to protective coatings.

The intention of the terms and definitions in the following glossary is to make it easier to understand the purpose of the words used and to improve communication between those who are involved. It also serves as a handy reference tool which helps to find additional information. (Source References to standards and other documents).

Following that is a useful **Coating Thickness Conversion** table which demonstrates where NCI's and WB-2K's thin film coatings can be found within the spectrum of a variety of industry-standard thickness measurements.

This section wraps up with a thought-provoking Prologue which provides some insight into the reliability of proper and informed communication surrounding nano materials and the nanotechnology industry.

9.01 - Glossary of Terms & Definitions

Adhesion Promoter
This refers to a coating which improves the adhesion between different coats and/or prevents certain problems in connection with over-coating. (EN ISO 12944- 5)

Airless Spray
Airless spray is a method where paint under high pressure is sprayed through a nozzle onto the substrate.

Anti-Corrosive Paint (Anti-Corrosion Paint)
A paint containing active pigments, e.g. zinc phosphate, which prevent corrosion.

Application Viscosity
This is the viscosity the paint should have when applied, after any necessary thinner has been added. Generally, the viscosity is stated as the time (in seconds) that it takes for the paint to pour through a viscometer (ISO 2431).

Artificial Aging Test
This is a method developed to accelerate the ageing of a paint system, e.g. to degrade the corrosion protective properties faster than in the natural environment (EN ISO 12944-2).

Atmospheric Corrosion
Corrosion caused by the atmosphere. (ISO 8044)

Certification
To prove, by the presentation of official signed documents, that stated demands have been observed.

This also refers to the qualification system which ensures that a manufacturer´s quality control is confirmed by a certificate.

Chalking
This refers to a fine, powdery layer on the paint surface caused by UV attack of the coating surface and which will have a pale, whitish appearance.

Classification
Standard concerning environmental conditions in the standard EN ISO 12944-2 the atmospheric environment is classified into six corrosion categories:

C1 - very mild
C2 - mild
C3 - moderate
C4 - severe
C5-I - very severe (industrial)
C5-M - very severe (maritime)

Objects in immersion are divided in three categories:
Im1 - fresh water
Im2 - sea and brackish water
Im3 - soil

Climate
The weather in a certain place or region, statistically specified on the basis of meteorological factors over a long period. (EN ISO 12944-2)

Coat
This refers to a uniform layer of paint which is achieved by one application. (EN ISO 12944- 1)

Coating
A layer of resin based material applied to a surface for protection or decoration.

Colour
A sense observation caused by light reflected from a surface. The colour can be described by three properties; hue, chromaticness and brightness.

Compatibility
1. Products in paint systems: the possibility to use two or more products in a paint system that no problems occur;

2. The product and the substrate: The properties of the product should be such that it can be applied on the substrate without causing any harm.

Corrosion
Corrosion is a physical/ chemical reaction between a metal and the environment which changes the properties of the metal and often causes damage to the metal, its environment or the technical system (ISO 8044).

Corrosion Damage
That affect of corrosion which is functionally harmful to metals, environment or technical systems. (ISO 8044)

Corrosion Prevention
To change the corrosion system, e.g. by painting, in order to reduce the damage caused by corrosion. (SFS 8044)

Corrosion System
A system which consists of one or several metals and all the environmental factors which have a corroding influence.

Corrosion Strain (Stress)
This refers to environmental factors which cause corrosion. (EN ISO 12944-1)

Coverage

1. The practical coverage: The practical coverage depends on the application method and application conditions, the shape of the construction and the surface quality and the skill of the painter.

2. Theoretical coverage: The theoretical coverage (TC) is stated as m^2/litre and it can be calculated on the basis of volume solids (VS-%) and specified dry film thickness (DFT- µm). TC = 10 x VS%/DFT

Degreasing
Grease, oil and contamination, which make rust removal and painting difficult, are removed by degreasing.

Density
The density is the weight of one litre of paint at 23°C (kg/l). ISO 2811-2

Dew Point
This is the temperature at which the humidity in the air condenses onto the surface (ISO 8502-4).

Dry Film Thickness DFT
This refers to the thickness of the remaining coat on the substrate when the paint/coating has dried (EN ISO 12944-5).

Drying Time
The drying times are stated, if not otherwise mentioned, at a temperature of 23°C, relative humidity 50% and sufficient ventilation.

A lower temperature, too thick coats, bad ventilation and high relative humidity extend the drying time.

By raising the temperature, the drying and over-coating times can often be reduced. In most paint data sheets, the following drying times are stated; dust dry, touch dry, over-coatable and fully cured (ISO 1517).

Durability
This refers to the expected life of a protective paint system to the first major maintenance painting.

Important additional information: see the standard EN ISO 12944-1.

Dust
A fine powder, caused by blast cleaning, other pre-treatment work or from the neighbourhood, which lays on the surfaces which shall be painted (ISO 8502-3).

Emulsion Wash
A cleaning method with a solution containing organic solvents, water and detergents which binds grease and oil particles and removes them together with the rinsing water.

Evaporating Time
See: flash-off time

Film
This refers to a uniform layer of metal or a homogeneous coat of paint which has been received by one application. (EN ISO 12944-1)

Finishing Paint (Finish, Topcoat)
This is the last coat in a paint system. For this the colour and gloss grade are usually specified in accordance with the demands for the object.

Flash-off Time
Flash-off time is the time after application during which the majority of the solvents evaporate, before more thorough drying occurs.

The flash-off time depends on the type of paint, the solvent composition, the film thickness, the temperature and the ventilation.

Flash Rust
This refers to the thin rust layer which is formed very quickly on a prepared surface (EN ISO 12944-2).

Gloss (Gloss Level, Limit, Value, Group, Grade)
The gloss grade is the relative gloss of the paint surface or the capacity to reflect light.

The relative gloss is usually specified at an angle of 60° (EN ISO 2813). According to their capacity to reflect light, paints are divided in gloss groups.

The definition below is used in the RAL EFFECT colour collection by RAL Institute.

Nominal marking	Gloss level
Full gloss	x ≥ 90
High gloss	80 ≤ x < 90
Gloss 60	≤ x < 80
Gloss 60	≤ x < 80
Semi gloss	35 ≤ x < 60
Semi matt	10 ≤ x < 35
Matt 5	≤ x < 10
Full matt	x < 5

Grade of Pre-treatment
See: preparation grades.

Hardener
This is the part of a two component paint which, when added to the base, causes the curing process. By choosing the type of hardener, it is possible to adjust the properties of the paint.

High-build Coat
A property of the coating which allows for a thicker coat than would generally be the case for that kind of paint to be applied.

In the standard EN ISO 12944, this means dry film thicknesses over 80µm.

High-solid Paints
High solid paints are paints with a high content of volume solids. Generally the volume of solids exceeds 70% by volume.

Hot Spraying
This refers to an airless spraying method in which the temperature of the paint is risen, in a way or another, to a higher temperature than usual.

Generally a temperature range of 30-60°C is used, depending on type of paint and kind of equipment.

Industrial Environment (Atmosphere, Climate)
An atmosphere which contains pollution, mainly Sulphur dioxide, from local and regional industries (EN ISO 12944-2).

Influence of Corrosion (Corrosive)
The corrosion caused by the surrounding atmosphere in a certain corrosion system (ISO 8044).

Inhibitor
An inhibitor is a material which slows down the rate of metal corrosion. There are several types of inhibitors.

Intermediate Paint
This is the paint between the primer and the topcoat used to increase the film thickness. Generally a primer or a topcoat is used as an intermediate paint.

ISO 9000
This refers to a standard concerning quality management and verification. Instructions for how to choose and how to use are found in ISO 9000, 9001 and 9004.

Maintenance
This is the entirety of all factors in standard EN ISO 12944 which ensure that the corrosion prevention of the steel construction can be maintained.

Maritime Environment
This refers to the atmosphere at sea and in coastal areas. The maritime environment reaches a certain distance inland, depending on the shape of the landscape and current winds.

The salinity, mainly chlorides, in this environment is high (EN ISO 12944-2).

Maximum Dry Film Thickness
This is the thickest dry film which can be approved. If it is exceeded it is possible that the properties of the paint or the paint system may deteriorate (EN ISO 12944-5).

Micro Environment
Environmental conditions close into the surfaces of the construction. The micro environment is an important factor when the corrosion strains are estimated. (EN ISO 12944-2)

Mixing Ratio
Information about the mixing ratio is found in the data sheets and the labels. The mixing ratio is the relation between base and hardener.

Generally the mixing ratio is stated as "parts by volume", or in exceptional cases in "parts by weight".

Nominal Dry Film Thickness (NDFT)
This is the dry film thickness which is specified for each layer or the whole paint system.

The dry film thickness ensures that the paint system achieves the durability which is required (EN ISO 12944-5).

One-component Paint (1K)
This is a paint which does not need any additive to start the drying and curing process. One component paints include e.g. alkyds, chlorinated rubber paints and vinyl.

Paint
A pigmented liquid, paste or powder like coating material, which applied on the substrate forms a hiding, opaque coat, which has protective, cosmetic or other special properties (ISO 4618).

Paint System
A paint system consists of the pre-treatment and the paint film that is formed by the protective paints used.

The paint system can consist of only one paint, applied one or several times.

Usually the paint system consists of several paints which each have complimentary properties.

Painting
Painting is a surface treatment where one of the treatment components is paint.

Pickling
This is a chemical method to remove mill scale and rust from the substrate by immersion of the metal in a suitable pickling agent.
At pickling, a white metal surface should be achieved.

Pigment
Pigments are pulverized dyestuff which gives the paint hiding power and colour. Furthermore, the pigments protect the paint and the substrate from ultraviolet radiation.

Anti-corrosive pigments can prevent or retard the corrosion process.

Pot-life
The pot-life is the time within which it is possible to use a "two component" paint after mixing.

Preparation Grades
In standard ISO 8501-1 several pre-treatment grades are specified. Rust removing methods and preparation grades are described.

The preparation grades are specified by a photographic description of the appearance of the surface after the treatment has been completed.

Every preparation grade is marked with a sign for the pre-treatment method. “Sa”, “St”, or “Fl”.

The number after the sign describes the preparation grade (removal of mill scale, rust or earlier coating).

Pre-treatment
The cleaning of the surface and other steps taken in order to protect the surface to be painted or to promote the adhesion and durability of the coat is called pre-treatment.

Primer
The first layer in a paint system and this determines the quality demands on the preliminary cleaning and the preparation grade.

Project
A project is a complete program of work for which the specification is made. A project can include one or several constructions (EN ISO 12944-8).

Project Specification
The specification describes the project and the special demands which are included.

The writer of the specification may be the owner or the main contractor (EN ISO 12944-8).

Protective Coating System
This is the total coating, formed by metallic material and/or paints or similar products which are applied on the substrate in order to protect it from corrosion (EN ISO 12944-1).

Protective Paint System
This is the total coat, formed by paints or similar products which are applied on the substrate in order to protect it from corrosion (EN ISO 12944-1).

Protective Paint System Specification
In the specification is described how the construction should be pre-treated and which protective paint systems should be applied in accordance with the project specification.

The writer of the specification can, for instance, be the paint manufacturer.

Quality
The quality includes all the properties of a product or service which are necessary so that they fulfil stated or presumed demands (ISO 9000).

Quality Control (QC)
Quality control of corrosion prevention Is supervision and inspections of methods, material, equipment and application conditions.

The contractor is responsible for the quality of the painting work and executes the quality control.

The customer may, in addition to the quality control done by the contractor, make his own inspection if he finds it necessary (EN ISO 12944-7).

Relative Humidity
The relative humidity is the amount of water held by the air as a percentage of the greatest amount it can hold at that temperature.

Resin
The resin forms a coat which sticks to the substrate. Into this coat the pigments are bound.

The resin characterizes the properties of the coat, such as the adhesion to the substrate, the internal strength (cohesion) and chemical properties.

Rust
This is a visible corrosion product (iron, steel) which mainly consists of iron oxides.

Solids by Weight
The solids are specified in percentage of the weight of the paint (ISO 3251).

Solids by Volume (Volume Solids)
The solids are specified in percentage of the volume of the paint. The determination of volume solids is usually calculated according to ISO 3233.

Solvent
This is a component in solvent-borne paints which shall dissolve the firm resins and polymers and reduce their viscosity.

Solvent-free Paints
Paints which do not contain solvents, e.g. powder coatings and solvent free epoxy and polyurethane coatings.

Solvent-free Paints (High solids)
Paints with a "Solids by Volume" of 70-98% are called solvent-less paints. E.g. epoxy and polyurethane paints can be solvent-free paints.

Specific Gravity
See: Density.

Specification
This refers to a document where the demands on the work or the service are described. This document should specify the methods and criteria to ensure that the demands have been fulfilled (ISO 9000).

It can also be a detailed working specification, including details of the working methods and materials to be used.

By following this, the work or the service can be carried out so that it fulfils the demands in the specification or in the agreement.

Spreading Rate
See: Coverage.

Storage Time
This is the time during which the paint preserves its properties and usefulness.

This assumes that the paint is stored in its original packaging in normal, dry, dust free warehouse conditions, and at a temperature between +3°C and +30°C (EN ISO 12944-5).

Substrate
The surface on which the coating is or has been applied (EN 971-1).

Supervision (Control, Inspection)
This refers to the measuring, inspection, testing, estimation of one or several properties of the work or service and to compare how well these fulfil the demands in the specification and other corresponding actions.

Supervisor
This is a person who is responsible for ensuring that the actions are compatible with the demands in one or several documents concerning the project (EN ISO 12944-8).

Surface Treatment
This is a general term that refers to alteration of the surface, e.g. pre-treatments and painting.

The term is also used in a limited sense excluding metallic coatings.

Surface Pre-treatment
This refers to any method which is used to prepare the surface before coating.

Surrounding Atmosphere
This is a mixture of gases and generally also aerosols and particles which is the environment for a certain object (EN ISO 12944-2).

Thinner
Thinner is an evaporating liquid, solvent or water, which is added to the paint in order to reduce the viscosity. The thinner is often the same as the solvent in the paint.

Tinting System
This refers to an economical, accurate and quick method to produce coloured paints. It is suitable for most types of paints.

The tinting system generally includes tinting pastes, base paints, tinting formulas, a tinting machine and a mixer (shaker).

Topcoat
See: Finishing Paint

Treatment System
The treatment system means the treatment which concern a certain object, including pre-treatment and painting work with material included.

The term is usually used for painting of buildings.

Two-component Paint (2K)
This is a paint to which another component is added in order to start the curing process. The components react with each other and form the coat.

Two component paints can be solvent or water-borne or solvent-free. E.g. epoxy, polyurethane and oxirane ester paints are two component paints.

Type of Paint
The paints can be divided in different groups depending on the way they dry or their resin. E.g. alkyd, epoxy and polyurethane paints.

Type of Surrounding Atmosphere
A classification of the atmosphere based on the quantity and type of corrosive agents present.

The compounds of most importance are gases (particularly sulphur oxide) and salts (mainly chlorides and sulphates) (EN ISO 12944-2).

VOC
This refers to Volatile Organic Compounds (i.e. solvent).

Viscosity
Viscosity describes a fluid's internal resistance to flow and may be thought of as a measure of fluid friction.

The greater is the viscosity, the worse the consistency of the paint. Consistency of the liquid is measured with a flow cup.

The measured viscosity is generally expressed in seconds of flow time.

Volume Solids
See: Solids by Volume

Water-borne Paints
In water-borne anticorrosive paints the polymer is dispersed, emulsified or dissolved in water.

Typical resins are alkyd, polyester, acrylic, polyurethane and epoxy resins and modifications of them.

Wet Time
This is the period during which the metal surface is covered by electrolyte which can cause corrosion.

The wet time can be calculated as that period when the relative humidity exceeds 80% and the temperature exceeds 0°C (EN ISO 12944-2).

Working Manual (See also Specification)
This refers to a specification which describes the working process, the paint system, inspection and estimation specifications (EN ISO 12944-8).

Includes the writer of specification; the person who is responsible for the specification.

9.02 - Coating Thickness Conversion Table

Micrometers (um)	Millimeters (mm)	Inches	Mils (Thousandths)	"Tenths" (Ten-Thousandths)	Millionths (Micro-inch)	Comments
0.1	0.0001	0.000004	0.004	0.04	3.94	
0.5	0.0005	0.000020	0.020	0.20	19.69	
1.0	0.0010	0.000039	0.039	0.39	39.37	
1.5	0.0015	0.000059	0.059	0.59	59.06	
2.0	0.0020	0.000079	0.079	0.79	78.74	
2.5	0.0025	0.000098	0.098	0.98	98.43	
3.0	0.0030	0.000118	0.118	1.18	118.11	
3.5	0.0035	0.000138	0.138	1.38	137.80	
4.0	0.0040	0.000157	0.157	1.57	157.48	
4.5	0.0045	0.000177	0.177	1.77	177.17	
5.0	0.0050	0.000197	0.197	1.97	196.85	
5.5	0.0055	0.000217	0.217	2.17	216.54	
6.0	0.0060	0.000236	0.236	2.36	236.22	
7.0	0.007	0.000276	0.276	2.76	275.59	
8.0	0.008	0.000315	0.315	3.15	314.96	
9.0	0.009	0.000354	0.354	3.54	354.33	
10.0	0.01	0.000394	0.394	393.70		
12.0	0.012	0.000472	0.472	4.72	472.44	
15.0	0.015	0.000591	0.591	5.91	590.55	
20.0	0.02	0.000787	0.787	7.87	787.40	
25.0	0.025	0.000984	0.984	9.84	984.25	
25.4	**0.025**	**0.001**	**1**	10	1,000	**Min. Nano-Clear® DFT**
50.8	**0.051**	**0.002**	**2**	20	2,000	**Avg. Nano-Clear® DFT**
76.2	**0.076**	**0.003**	**3**	30	3,000	**Max. Nano-Clear® & WB-2K DFT**
101.6	0.102	0.004	4	40	4,000	
127.0	0.127	0.005	5	50	5,000	
152.4	0.152	0.006	6	60	6,000	
177.8	0.178	0.007	7	70	7,000	
203.2	0.203	0.008	8	80	8,000	
228.6	0.229	0.009	9	90	9,000	
254.0	0.254	0.010	10	100	10,000	10 point business card stock
304.8	0.305	0.012	12	120	12,000	12 point business card stock
381.0	0.381	0.015	15	150	15,000	
508.0	0.508	0.020	20	200	20,000	
635.0	0.635	0.025	25	250	25,000	

Inches = mm / 25.4 mm = Inches * 25.4

Mils = microns / 25.4 microns = mils * 25.4

0.001 inch = 1 mils = 10 "tenths" = 1,000 micro-inches

0.001 mm = 1 microns = 1 micrometers = 1,000 nanometers = 10,000 Angstroms

9.03 - Prologue, Communication of Nano-chemistry

When learning about nano-technology (or any new technology), it's important to keep an open mind and to filter out opinions from facts. In order to accomplish this, one must also learn to be able to differentiate the reliability of the source of information (experts, technoliterates, pseudo-technoliterates, biased and vested-interest parties, etc.) from which one is deriving new knowledge. The importance of this can be demonstrated in the following excerpt from Professor Pagliaro's book "Nano-Age - How Nanotechnology Changes Our Future".

> "As Berube put it (Figure 9.10): “What too many of us sometimes forget is that, absent extensive efforts to educate the citizen consumer, pseudo-technoliterates will people the ranks of both techno-utopians and technophobes. A failure to speak to the citizen-consumers risks fueling pervasive popular misunderstanding. Such misunderstanding could, in turn, produce formidable resistance as pseudo-technoliterates become prominent and ridicule nanotechnology.
>
> 
>
> The hyperbole surrounding this new technology comes not only from the media, but also from scientists who exaggerate the anticipated benefits of nanotechnology to justify research funding, as well as from environmentalists and globalization opponents, who sometimes indulge in doom-and-gloom prophecies to advance their own agendas. The result is widespread misinformation and an uninformed public.
>
> People listen to Mander, Rifkin and even Limbaugh. In turn, their works become rallying points for technophobic dissent. On the other hand, if those who understand nanotechnology educate the citizen-consumers, they may be able to mitigate many of the effects … …
>
> A true chemistry of materials has emerged in the last 15 years as scientists from all corners of the discipline of chemistry have learned how to synthesize and exploit new types of materials from individual or groups of nano-scale building-blocks that have been intentionally designed to exhibit useful properties with purposeful function and utility.
>
> The properties of a (nano) material in fact emerge from the composition, size, shape, and surface properties of these individual building-blocks, as well as self-assembled architectures made from these building blocks. In brief, we have witnessed the inorganic, organic, polymer, and materials chemistry communities re-engineer and consolidate their skills and research interests. The boundaries that have separated these traditional chemistry disciplines in the twentieth century have broken down to create one large multidisciplinary community with a keen scientific and technological interest in “all” aspects of the chemistry of materials at the nano-scale.
>
> The result of this evolution is that chemists are increasingly able to synthesize from the bottom-up, tailor-made (nano) materials for a myriad of applications of immense practical importance, spanning the fields of chemistry and physics, materials science and engineering, biology, and medicine.” - 2010 “Nano-Age – How Nanotechnology Changes Our Future.” - Prof Mario Pagilaro, CNR Ist. Materiali Nanostrutturati

Section

10

ADDENDUMS

The information on the following pages provides further details regarding the history of development of Nano-Clear®, its introduction into industrial markets, and the dedication involved in its continuing advancement as the premier industrial coating solution.

Additional addendum information is provided on the following topics:

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Nanovere Technologies, LLC

"Nanovere Technologies is dedicated to solving complex coating application issues as the world's leading developer of nano-structured multifunctional nano-coatings. Our success will be measured by our "first-to-market" approach, innovative focus, market share, value based partnerships and customer referencing. We will only achieve these objectives through listening and quickly responding to the needs of our partners and customers".

- Thomas F. Choate Founder and Chief Technology Officer.

Thomas (Tom) F. Choate began his scientific journey at the early age of 16 while working for the Progressive Dental Laboratory in Brighton, MI. While there, he mastered skills in the art and science of manufacturing porcelain teeth (crowns), dental metallurgy, polymer synthesis, high heat ceramics and high heat porcelain glazes.

By 1986, Thomas singularly founded Felix Dental Arts which focused on creating "life-like" dental prosthetics for local sport celebrities. In 1989, Felix Dental Manufacturing was established with a mission to develop highly functional dental materials.

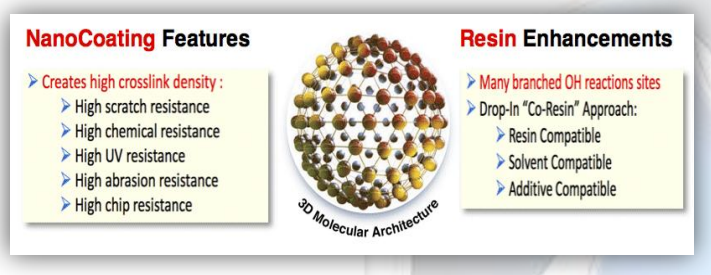
Under Mr. Choate's creative direction, Felix Dental went on to create the world's first polyurethane, hybrid dental polymers with a thermal expansion of 0.05%, novel dental adhesives, super-hydrophobic coatings, silicone mold release agents and educational study models for dentists and dental technicians. Felix Dental was later sold to American Dental Supply (ADS) in Pennsylvania. Today, ADS continues to market the Felix branded products including Plastical, Petrosil & Diax to leading dental laboratories, dentists, and Dental Universities.

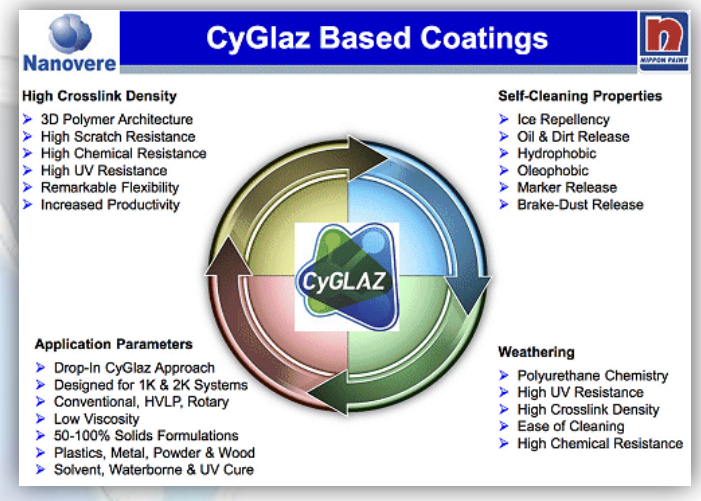
In 2003, Thomas formed Nanovere Technologies, LLC to expand upon the disruptive scientific concepts, materials, and processes he had invented for the dental industry. With Nanovere Technologies, Thomas primarily focused on research, development, and the manufacturing of "first-to-market" nano-structured coatings with extreme multifunctional properties. This evolved into the development of highly functional scratch, chemical, and UV resistant coating platforms. An additional technical challenge was to expand to these platforms into multifunctional, nano-structured coatings that would outperform "all" leading automotive and aerospace OEM competitive coating systems.

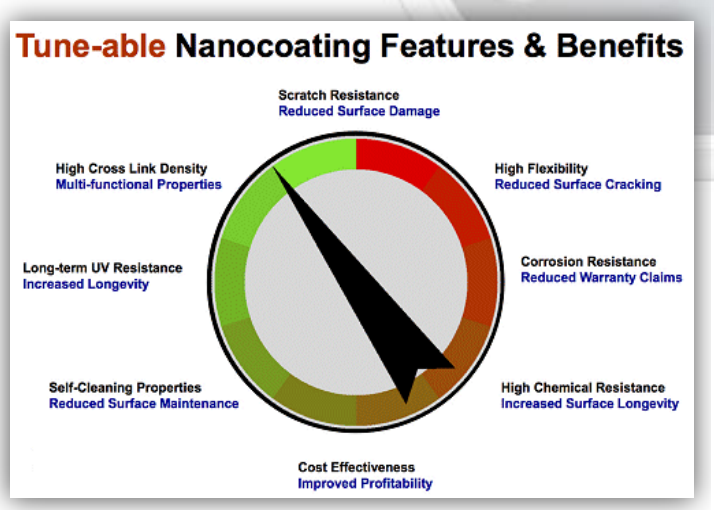
After 5 years of intense research and product development, Nanovere stepped forward to introduce the world's first Dendritic Polyurethane Coating systems in 2008. Not one to sit idle for long, Thomas began working closely with leading multi-national validation organizations such as GM, Jaguar, BMW, Boeing, Club Car & Polaris. A year later in 2009, Thomas structured joint development efforts with companies such as Bayer Material Sciences, Alcoa, and Sveza Les OOO, a wood product manufacturing company located in Russia. Nanovere's proprietary dendrimer based coating resins, applied as a modified additive, were used to dramatically improve the overall physical properties of leading coating resins and formulated coating systems.

In 2011, Nanovere chose to partner with Nippon Paint in Asia under a global licensing agreement to form Vecdor (CyGlaz) Dendrimers. Nippon is recognized as the largest paint manufacturer in Asia and maintains a spot in the top ten of the world's foremost paint and coating manufacturers. Today, Nippon manufactures and markets Nanovere's proprietary coating dendrimers with a goal to dramatically improve crosslink density, scratch, chemical, and UV resistance within Nippon's portfolio of coating systems. Nippon markets the Nanovere dendrimer platform under the trade name CyGlaz.

By 2013, Nanovere once again introduced a "first-to-market", ambient-cured Nano-Clear® Coating platform on its continuing mission to exceed global automotive OEM, industrial, and aerospace OEM technical specifications. The Nano-Clear® product portfolio is manufactured by Nanovere in Brighton, Michigan and is sold globally through select distributors. Nano-Clear® Coatings continue to be validated and utilized by leading chemical tank car manufacturers, Toshiba Industrial Products, John Deere, Nippon Paint, Carnival Cruise Lines, Queen Elizabeth & Queen Mary Cruise Lines, Princimar Chemical Carriers (now part of the transnational Teekay Shipping Corp), and many more.







Value Proposition

While it's true that high-performance industrial coatings are more expensive (on average) than architectural coatings, there's far more to the cost of a coating than the "price on the can". A more accurate way to analyze cost is to consider the expense incurred over the life cycle (LC) of the coating.

For example, some pertinent questions can include:

- How durable is the coating?
- Can it withstand frequent cleaning with harsh chemicals?
- Will it retain its glossy sheen and fresh color despite intense UV exposure?
- Is the coating hard enough to resist abrasion and tough enough to protect the substrate from corrosive environments?
- Does moisture threaten to cause poor adhesion or blistering?

How well a coating stands up to these types of challenging conditions has a direct bearing on the long-term cost of keeping substrates protected and looking clean and attractive.

Of equal consideration is the labor factor. While every project is different, depending on the scope of the work, the contract price for a commercial paint project is typically comprised of 15% for the coating material and 85% for the applicator's labor. The labor cost usually remains the same whether the painter is applying standard architectural paint or a high-performance industrial coating. Therefore, if the paint material cost is increased by 50 percent to upgrade the paint to a high-performance industrial coating, this only increases the total paint project cost by ~7.5%.

The right high-performance coating is designed to take a lot of abuse and still look great, year after year. That reduces the need for frequent retouching or repaints, minimizes labor expenses, decreases the burden on local landfills, and helps to limit costly downtime. This has an obvious appeal on projects where long-term value outweighs initial cost considerations.

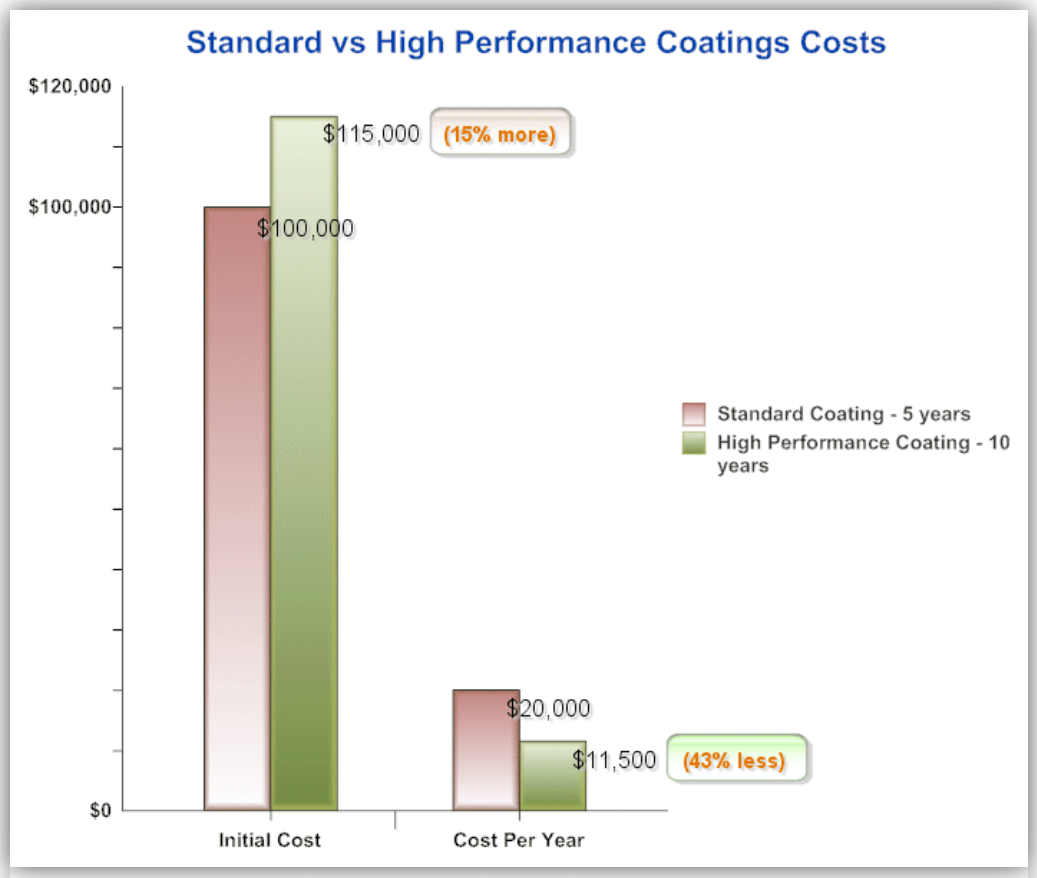
A client wants to know, "What am I getting, and what is it going to cost me?". If they can see a return value, they'll consider the higher cost product if they think it's going to pay off in the long run. Everything comes back to cost.

To gain a better understanding of the likely cost of a coating over its life cycle, add the cost of the labor to the initial cost of the paint and materials, and divide that number by the expected service life of the coating.

To illustrate this point, we can compare the cost of painting a commercial interior space with a standard coating versus a high-performance coating. Assume that the initial cost of the standard coating plus the applicator's labor is $100,000. The expected service life of the standard coating is five years, resulting in a cost of $20,000 per year over the life cycle of the paint job.

By comparison, a high-performance coating has a higher cost initially of $115,000. However, the expected service life of the high-performance coating is more than twice that of the standard coating at 10 years. This reduces the per-year cost of the high-performance coating to just $11,500. Based on this example, that's nearly 43% less than the cost of a standard coating based on life cycle!

Nano-Clear® adds an additional value proposition with its ability to provide the same life cycle of 10 years for highly oxidized (aka - chalked) coatings, first by eliminating the need for a basecoat re-coating, and second by reducing subsequent re-coating cycles. As a high performance multifunctional coating, Nano-Clear® meets and exceeds “challenging conditions” and will have “a direct bearing on the long-term cost of keeping substrates protected and looking clean and attractive”.



Spray Technique on Flat Surfaces

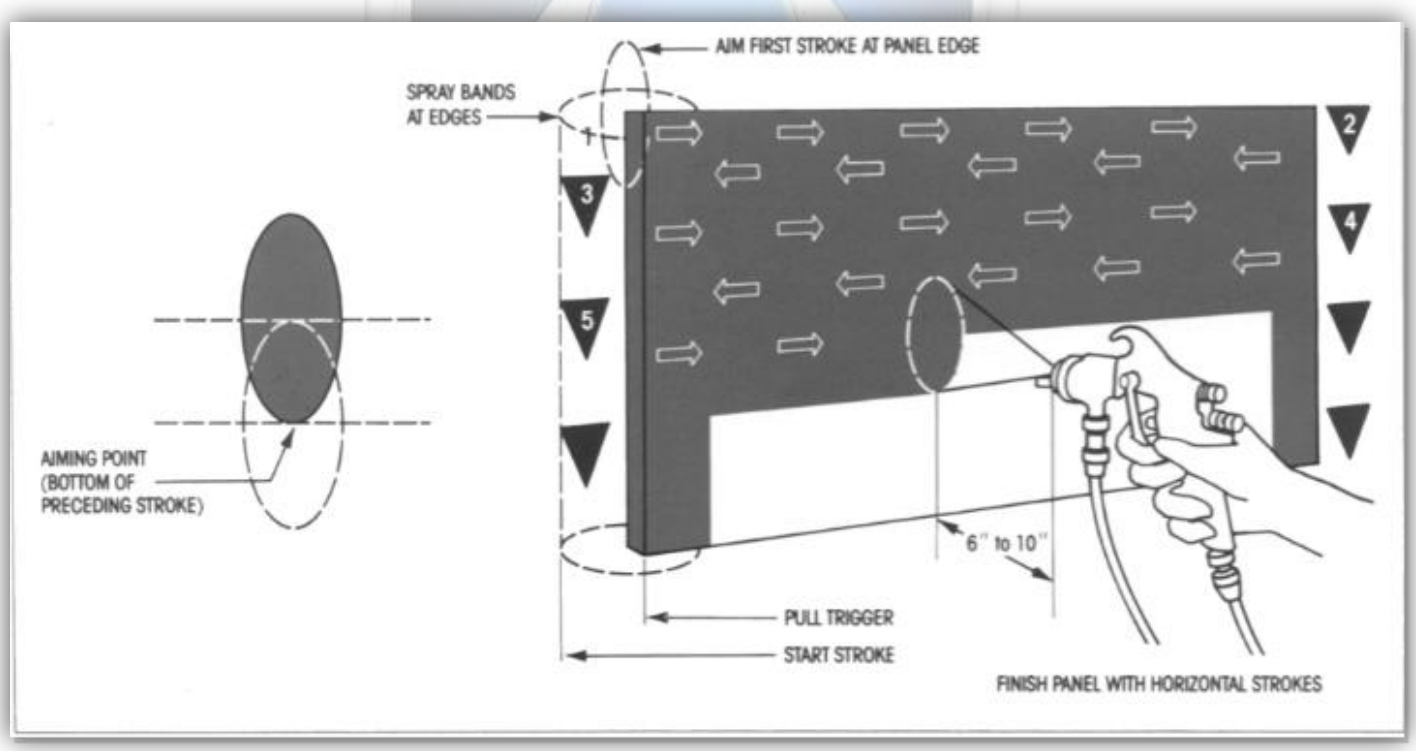
The technique of spraying a flat surface is shown in the diagram below. Every stroke is "triggered". The stroke is started off the work area surface, and the trigger is pulled when the gun is just opposite the edge of the surface being coated. The trigger is released at the other edge of the panel, but the stroke is continued for a few more inches before reversing to begin the next stroke.

Triggering is the key to good spray technique. The goal is to time your triggering to hit the exact edge of the work. This maintains full coverage while minimizing over-spray. A cross hatch pattern should be maintained during film build for good flow and leveling of Nano-Clear®.

Proper handling of the spray gun is critical for results that will produce a professional finish.

The gun should be held perpendicular to the surface being coated, and moved parallel across the surface. It's very important to begin the stroke before the gun is triggered so as not to build up coating at the beginning of the stroke. Also, releasing of the trigger should happen before the stroke has ended so one keeps an even film build.

The distance between the gun and the surface must be held even throughout the entire stroke, somewhere between 6 - 12 inches, depending on the material and atomization pressure. High-Volume-Low-Pressure (HVLP) spraying is usually sprayed closer. By overlapping each stroke by approximately 50%, one can achieve an even film build.



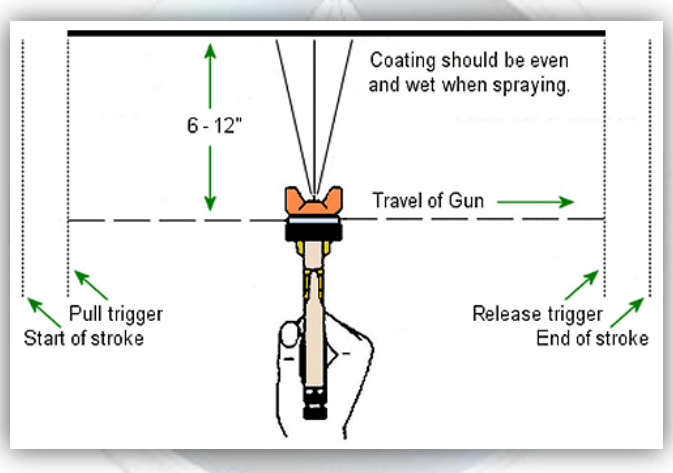
Using the HVLP Gun

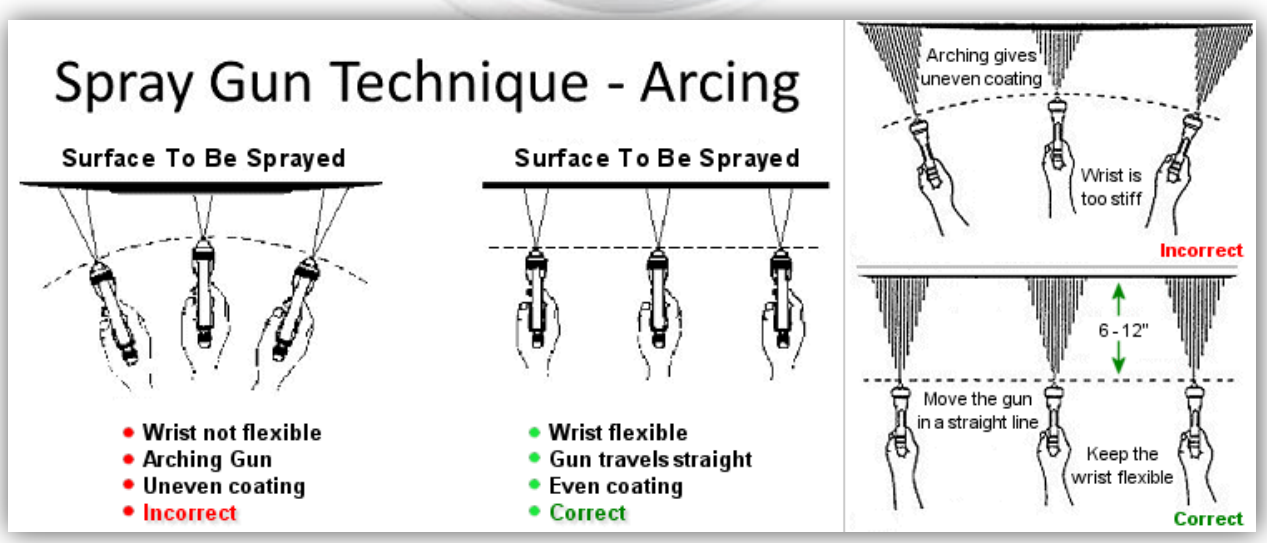
Movement with an HVLP gun should be about half as fast as compared to moving with a normal spray gun. Applicators accustomed to standard guns usually move at a speed about two (2) feet per second; however, with an HVLP gun, the recommended speed should be one (1) foot per second. Newer HVLP guns use less air pressure at the cap (maximum 10 psi) for compliant areas. These guns can be moved at approximately the same rate of speed as conventional guns at two (2) feet per second.

Because coatings can result in "drying rough" when applied with an HVLP gun, “tack” coats are not always recommended. The reason for the roughness has to do with the volume of air required to atomize the coating and the resulting droplet size – droplets tend to land further apart when applied dry, and larger droplets with a lower air pressure behind them will not flatten out as much when they make contact with the surface.

Rather than a “tack” coat, it's recommended that HVLP gun users start the coating application with a medium wet coat and follow the product manufacturer’s recommendation for film build to achieve the proper flow, leveling, and final finish quality. - C.A. Technologies.

Holding the spray gun at a proper distance will help to ensure a uniform coating across the surface and avoid issues such as running (held too close) or uneven results (held too far away). Holding the spray gun at a constant perpendicular angle is also important in preventing uneven results.





Prevention: HVLP, Viscosity and Hot Spraying

One of the limitations of conventional air spray coating is its poor transfer efficiency. This happens because of severe bouncing of the atomized coating particles from the substrate after impact. If, however, the speed of the atomized coating particles is reduced, the bouncing effect can be reduced considerably, leading to an improvement in coating transfer. This reduction has been accomplished with the development of a High Volume Low Pressure (HVLP) spray gun.

The development of the HVLP spray gun allows for a reduction of the supplied compressed gas (air), while using the same volume of coating. The speed of the atomized coating particles is reduced, severe bouncing is reduced, and spray transfer efficiency reaches a healthy 65% - 90%. When setting up a spray gun, the choice of air caps and fluid tips is highly dependent on the flow rate and viscosity of the coating being sprayed. The choice of fluid and air pressures is also based on flow rate and viscosity. The lower the viscosity, the lower the air and fluid pressure required. The lower the air and fluid pressures, the more efficient the spray gun. More efficiency translates to lower costs.

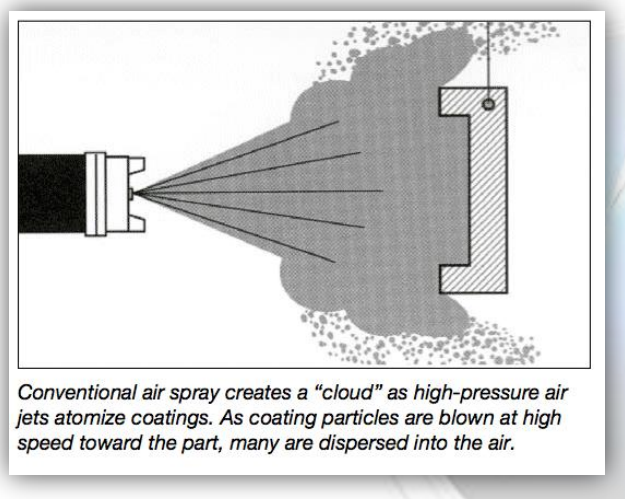
Many industrial coatings are high in solids (low in solvent). The temperature effects on a high-solids coating are the same as that of syrup. The thicker the syrup, the more of an effect heat will have on its viscosity. If viscosity varies due to temperature fluctuations, the atomization of the coating will also vary.

In spray painting operations, temperature-related variations can result in significant quality problems with film build, color matting, surface finish, adhesion, and more. While a common method of lowering viscosity is thinning or reducing, warming a coating up is more environmentally friendly and lower in cost. Many environmental laws limit the amount of solvent that may be added to the coating.

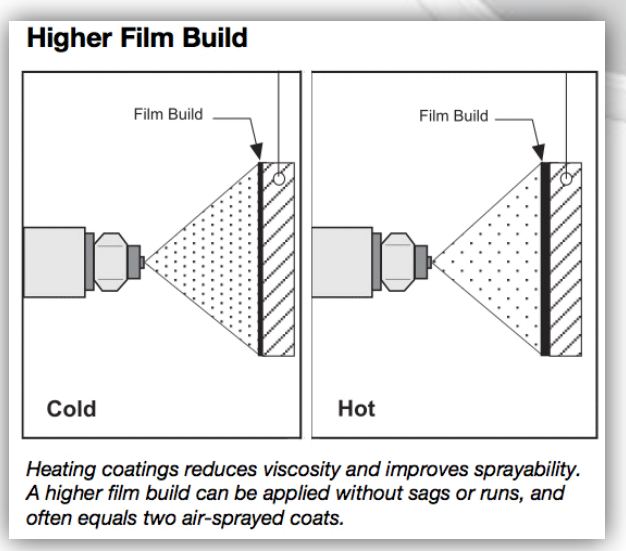
> “From testing, it is clear that the temperature of the paint at the spray gun nozzle has a significant impact on the surface finish, and each layer (basecoats, clear coats, etc.) plays a role in the appearance of the final part. Furthermore, the effects of temperature are both controllable and repeatable, which suggests that we can turn temperature from an adversary in our quest for quality into a tool we can use to improve our process outcome.
>
> Over the course of this experiment, it was determined that an average increase in the first-pass yield of just 5% (a very conservative estimate based on this data), would result in a ROI for a temperature control system of months as opposed to years.” - Paint Temperature Control Solves Finishing Defects. 2013 By Michael R. Bonner VP of Engineering & Technology. Saint Clair Systems, Inc. Washington, MI.
>
> “Prevention is a simple and powerful message of doing things right the first time and adds absolutely nothing to the cost of a product or service. Why? This is because a defect that is never created cannot be missed. By indentifying and eliminating the cause of problems, one can reduce rework, waste, and warranty costs. Hence, creating quality goods and services does not cost money, it saves money. Zero defects is the only acceptable performance standard; and prevention is the actual way in which quality is achieved.” - Nano-Age…How Nanotechnology Changes Our Future. 2010, Professor Mario Pagliaro

The heating of a coating addresses and brings with it the following features and benefits:

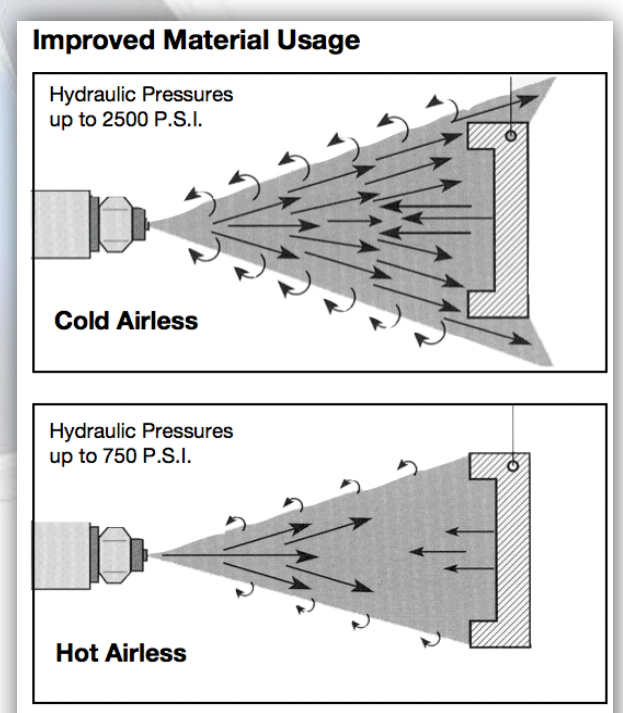
1. Consistent material “thinning” and temperature control of the coating being sprayed, regardless of fluctuating ambient temperatures. This lowers VOC, increases coverage, lowers material requirements, and lowers coating costs.
2. Heating also produces a “softer spray”, allowing for reductions in overspray, material waste, and results in cost savings.
3. A softer spray produces less “fog” and “rebound” because the coating is atomized at a lower pressure, amounting to savings in material, equipment wear and tear, and lowers compressed air and power consumption, dramatically reducing over-spray.
4. Faster “solvent flash” between coats saves time and helps to reduce finishing defects.
5. A higher rate of film build is possible per pass because the heated coating contains solids and much less solvent. This will result in savings in operator and project time with fewer passes needed to achieve the recommended film build.
6. “A conservative higher first-pass yield of 5% results in an ROI for hot spraying systems of months as opposed to years.”



Conventional air spray creates a “cloud” as high-pressure air jets atomize coatings. As coating particles are blown at high speed toward the part, many are dispersed into the air.



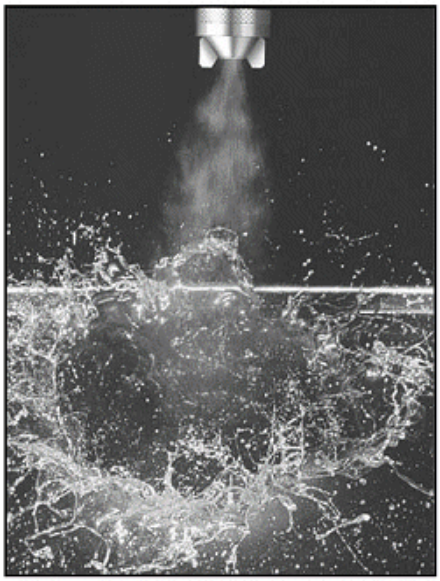
Heating coatings reduces viscosity and improves sprayability. A higher film build can be applied without sags or runs, and often equals two air-sprayed coats.



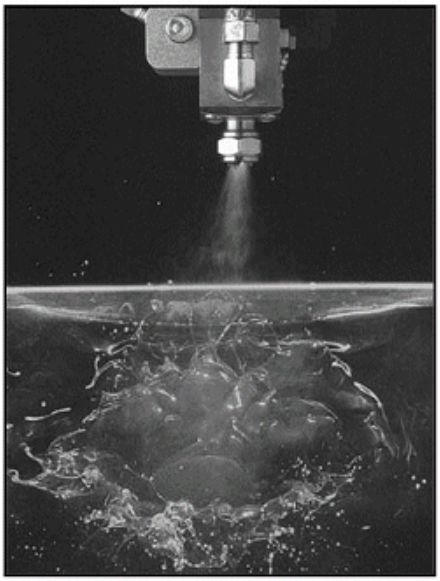
As heat is applied, solvent vapor pressure increases so atomizing pressure can be reduced. Lower pressure results in lower particle velocity and a softer spray. Better coating coverage and less solvents improve material savings.

Characteristics of Spraying Velocity

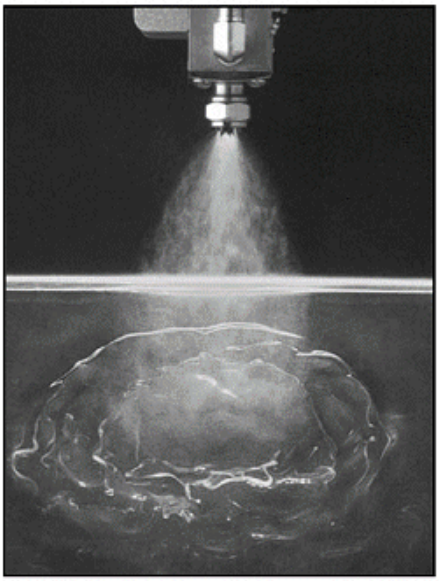
Photographs taken at 1/10,000 of a second reveal the differences between a turbulent spray and a "soft" spray.



Air Spray. *At test pressures of 60 psi, an average of 600 parts of air were used to atomize one part of paint. The large volume of air means excessive turbulence, paint bounce, and overspray.*



Airless. *Hydraulic pressure during test was 1500 psi, but there is no air discharge to carry paint particles long distances from the gun.*



Heated Airless. *Spraying at 600 psi without air produces a soft, direct spray with minimum bounce and overspray.*

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Water & Solvent Based Coatings Technologies

> "Because of their beneficial performance properties and versatility, solvents have played an important role in the formulation of paints and coatings since the dawn of the paint industry. In recent years, regulatory programs designed to reduce air pollution have put increasing pressure on manufacturers to further reduce the volatile organic compound (VOC) and hazardous air pollutant (HAP) content of their formulations. As a result, formulators and users of (industrial) coatings now face significant challenges as they try to respond to their customers' demands for cost-effective, high performance paints and coatings while meeting increasingly stringent regulations. In light of these regulatory pressures, manufacturers now consider alternate formulations and technologies wherever possible.

With the increased attention devoted to alternative technologies, some may assume that solvent systems are being phased out. This is not the case. Despite advances in newer coating technologies, solvent-based coatings continue to be used in most industrial coating applications. First, and most importantly, coating operators must carefully manage worker exposure to ensure safety, regardless of technology type. Second are concerns about odor. Materials used in each of the different technologies have distinctive odors that may be objectionable to some workers or neighbors.

Waterborne Coatings

About 80% of waterborne coatings are used in architectural coatings. However, they also are used in selected industrial applications. Perhaps the most significant advantage of waterborne systems is that they emit relatively small amounts of VOCs and HAPs. With some exceptions, waterborne-coating systems also have low odor and are usually nonflammable. Water has a relatively slow evaporation rate, and more significantly, its evaporation rate varies dramatically with the ambient humidity and temperature. This poses an especially difficult challenge in climates with variable humidity.

The heat capacity and heat of vaporization of water also are high, resulting in significant energy requirements for evaporation. In addition, the surface tension of water is much higher than that of organic solvents, requiring surfactants to wet pigments and substrates adequately. These surfactants can have an adverse effect on gloss and water resistance.

Water also tends to increase corrosion of storage tanks, paint lines, ovens, and other equipment, and thus waterborne coatings require the use of specialized, corrosion resistant equipment. Similarly, flash rusting of mild steel substrates may be a concern with waterborne coatings. In addition, waterborne coatings are more susceptible to freezing under adverse storage and application conditions.

While durability of many waterborne coatings has improved in recent years, it still lags behind that of solvent-based coatings. This can mean that a water-borne coating will not last as long and will need to be applied more frequently, which can increase the actual amount of VOCs being emitted. Finally, although water is used in waterborne formulations, it is not the only ingredient, and therefore, the use of waterborne coatings in industrial applications often generates relatively large amounts of liquid and solid waste that must be treated before disposal.

Solvent-Based Coatings

Solvent-based coatings continue to offer significant performance advantages in most industrial applications. In many ways, solvent-borne coatings have set the standard for flexibility of application and superior finish

qualities. Solvent-based technology is also sometimes the only way to formulate high-quality architectural coatings where superior flow and leveling are required.

Solvent-based paints often have favorable qualities that are essential in many applications. Some qualities are: flexibility and versatility of coating application and dry time; ease of achieving high gloss for good distinctness of image (DOI) for demanding applications; and they tend to be durable, which can mean fewer applications are needed.

In addition to the quality of the final finish, formulators must balance a number of other factors in order to develop high performance coatings for specific applications. When it comes to striking the proper balance, solvent-based coatings generally provide broad flexibility to both formulators and coating applicators. For most coating systems, evaporation rate is a key performance factor. With solvent-based systems, practically any evaporation rate can be achieved simply by adjusting the solvent mixture.

Although formulators of water-based coatings have overcome some of the initial evaporation shortcomings associated with this technology, temperature and humidity still have a much greater impact on water-based systems than they do on solvent-based systems.

As noted earlier, the drawbacks of solvent-based coatings are not related to their performance attributes, but to environmental and other concerns. Since many solvents are VOCs, they are regulated by federal and state governments and special considerations go into their formulation and use in industrial facilities." - Coating Technologies-Formulating to Meet Performance Needs. 2011 American Chemistry Councial.

"Corrosionpedia Explains Waterborne Coating

Meaning

A waterborne coating is an environmentally friendly surface treatment that uses water as a solvent to disperse the resin used to make the coating or paint: Water takes 80% of the solvent used. Its aim is to make the coating or paint easy to apply and also be an eco-friendly product. Waterborne coatings are widely used due to their low VOC (volatile organic compounds) content (less than 3.5 pounds per gallon of water). It can be applied on wood (e.g., furniture) and plastic substrates.

Explanation

This type of coating contains water-soluble resin; hence it completely dissolves in water and other solvents. A waterborne coating contains organic co-solvents since it undergoes poly-condensation or polymerization reactions. It has the following qualities:

- High gloss
- High corrosion protection
- Wetting and stabilization
- Good pigmentation
- Good flow and leveling properties
- Good resistance to heat and abrasion
- Low toxicity and flammability
- Cleans easily with water or water-based solutions

Although it takes longer to dry, it produces an outstanding surface finish and protection. Heating and air movement devices increase the curing time. It can be used in conventional application techniques and by spraying. Waterborne coating is one of the best for use on porous material. It contains binders that can be used in the formulation of epoxy and alkyd resins."

https://www.corrosionpedia.com/definition/2440/waterborne-coating

"Fundamentals of Waterborne Resin Technology

Waterborne coatings are the largest type of coating technology used on a global basis and are expected to continue to grow as a percent of the total coatings market. Growth in large part is due to increased volume in the construction and automotive markets with acrylics being the largest single type of waterborne resin system representing over 80% of the total waterborne market.

Driving forces for the increased use of waterborne coatings include:

- Lower VOC
- Ease of cleanup in most cases
- Decreased fire hazard
- Lower insurance cost
- Lower energy use for baked coatings due to the need for less oven make up air
- The need for decreased levels of petroleum-based materials

As the May, 2014 Prospector article on Flow, Leveling and Viscosity Control in Water-Based Coatings indicates, the two largest classes of waterborne coatings include ***water-reducible*** and ***latex***, with the majority of baked coatings falling in the first category with most of the architectural coatings belonging to the second category. The term ***water-reducible*** is used for resins made in solvent and reduced in water to form a dispersion of resin in water. ***Latex*** resins on the other hand are prepared by emulsion polymerization in water.

Disadvantages for the use of waterborne coatings include:

- High dependence of evaporation rate on relative humidity
- High heat of evaporation for water requires 2260 J/g for water and for example only 373 J/g for 2-butoxyethanol, a commonly used co-solvent
- Nonlinear viscosity reduction curve for coatings using water reducible resins
- High dependence of flow and appearance on relative humidity
- High surface tension of water (poorer wetting) requires the addition of surfactants which in many cases detracts from humidity resistance
- Waterborne coatings are more corrosive than solvent borne coatings and thus require lined containers, plastic or stainless steel to avoid rust
- Waterborne coatings are more prone to popping in baked applications as film formation begins to occur before water evaporates from the film (see Table I)

However, the continued advancement in material science to include innovations in *resin chemistry, surfactants, wetting agents and flow agents* will help enable the continued growth of waterborne coatings.

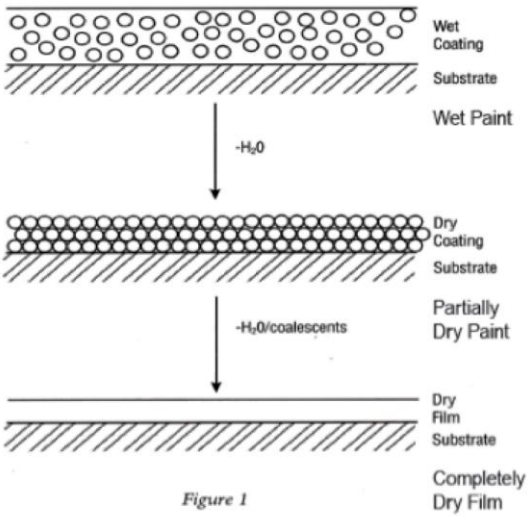

Figure 1

Figure I represents the various stages in drying of a latex based paint system. The **first stage** involves the evaporation of water. The **second stage** includes the continued evaporation of water and co-solvent to the point where the latex particles touch and begin to coalescence to form a film that is partially dried. The **final stage** involves the continued coalescence and cure (in a cross-linked system) to form a cured, dry adherent paint film.

One of the key considerations in the use of waterborne coatings is the increased role that *humidity* in addition to *temperature* plays in the application and cure of these coatings. For example, to provide acceptable application properties, both the temperature and humidity must be carefully controlled as illustrated in Figure II. The effect of humidity on coatings containing water-organic solvent cannot be ignored.

For example, the relative evaporation rate (E) of water at 0 – 5% RH at 25°C is 0.31, but at 100% RH the E is 0. The E of 2-butoxyethanol, a commonly used co-solvent, is 0.077. At low RH, water evaporates more rapidly and thus the ratio of 2-butoxyethanol to water increases; the reverse is true at high humidity.

When waterborne coatings are applied, if humidity is ignored, variation in application properties and appearance will result. For example if the temperature at application year round is 70° – 80° F, dry application (loss of flow) will result in winter months due to low humidity especially in colder climates, and excessive flow will be observed in summer months (high humidity). An example of the latter situation is that at about 65% Relative Humidity/25 °C, a waterborne coating containing 10.6% 2-butoxyethanol of volatiles, the evaporation rate of water and 2-butoxyethanol is equal. This relative humidity is called the *Critical Relative Humidity.*

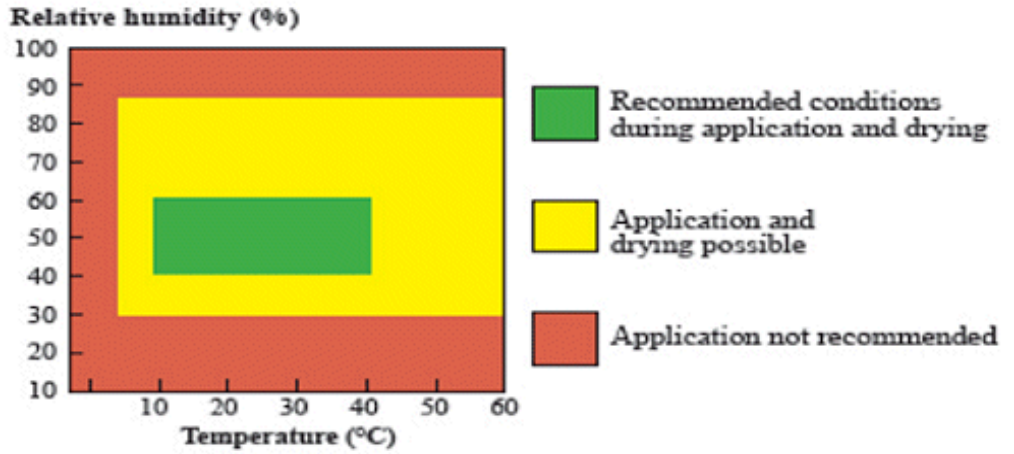

Figure II Application Dependence of Waterborne Coatings on Humidity and Temperature.

Table I illustrates the increased dependence of waterborne coatings on popping at various film thicknesses when compared to solvent born coatings.

Copolymer Tg (°C)	Waterborne Coating	Solvent born Coating
- 28	50	120
- 13	30	>70, <95
- 8	20	>70, <95
14	10	55
32	5	25

Table I Critical Film Thickness for Popping in Microns, Organic Coatings, Wiley-Interscience, 2007, Zeno W. Wicks Jr., Frank N. Jones, S. Peter Pappas, Douglas A. Wicks

Waterborne coatings include a wide variety of resin types such as acrylic, alkyd, urethane, polyester, epoxy, fluoropolymer, waterborne powder as well as curing chemistries including UV cure, aminoplast, urethane, epoxy-polyamide, oxidative and air dry thermoplastic types. As Table II illustrates, particle size and particle architecture (e.g. core shell) also contributes to the ultimate film properties of the coating. In summary, once the unique issues associated with the use of waterborne coatings are fully considered, they offer excellent performance in a wide variety of applications."

Resin Type	Major Characteristic(s)
Latex	Particle size of 5 nm - 10 microns, opaque liquid
Water Reducible	Reduction with water results in irregular viscosity vs. solids relationship
Polyurethane Dispersion (PUD)	- Particle size of 1- 20 microns - Lower Minimum Film Forming temperature in relation to dry film Tg - Lower cosolvent demand
Miniemulsion	- 50 – 500 nm particle size
Microemulsion	- Particle size 10 – 100 nm - Clear liquid
Core-Shell (Low Tg shell with high Tg inner core)	- Reduced blocking - Lower coalescent demand

Table II – Characteristics of Various Water Based Resins

5/8/23, 8:55 AM Fundamentals of Waterborne Resin Technology | Prospector
https://knowledge.ulprospector.com/3069/

Functional Polyurethane Coatings For Protection Of Different Surfaces For Aggressive Environmental Factors

> "Among the urgent problems to be addressed in the field of construction, architecture, preservation of architectural and historical monuments, housing, utilities, transportation, chemical and food industries, there is the creation of new, more efficient, durable, and economical composite materials with improved properties of multifunctional coatings and impregnating materials in order to extend the operating life of new and old buildings and structures [1].

Currently, the stability of materials and structures exposed to harsh environmental factors is defined in terms of two research areas: the chemical and the biological ones. The chemical aspects of material degradation are widely known. They are the abiotic and the anthropogenic factors. The reliability and durability of materials, buildings, facilities, and structures destroyed by micro-organisms is an actual problem of growing importance. According to the recent inventory, the list of micro-organisms that are bio-destructors of polymeric, metallic, and non-metallic (stone, concrete, granite, and wood) materials includes more than 360 species, among which the most aggressive are Aspergillus and Penicilium fungi [2].

In addition, populations of new extremely aggressive bio-destructors have appeared under the influence of extreme factors (including the environmental ones). Addressing the protection of buildings and structures from decay under the influence of destructive environmental factors is possible with the use of polyurethane composites (PCs) as a multifunctional coating and impregnating material. They are created on their basis of innovative protection technologies. The polyurethanes should be considered not only as a class of polymers, but also as a successful and efficient way to create effective polymers with targeted structure and properties [3].

Among the technical and economic advantages of created protective materials, there are the infusion of sustainable operational properties and the extension of maintenance-free service life of metal, wood, brick, and concrete structures and buildings. Excellent resistant qualities of polyurethane composite materials and complete conversion of initial reactants make the use of PCs feasible." - Science and Innovation, 2014. V.10. N0.3.P.26-32.

[1] Lebedev, Ye.V., Savelyev, Yu.V., and Koliada V.M.: Functional Polymers and Construction Composite Materials Based on Them. Construction Materials, Products, and Sanitary Engineering , 42, 76—80 (2011) (In Ukrainian).
[2] Lebedev, Ye.V., and Savelyev, Yu.V.: Polymers Counteracting the Microorganism Attacks. Bulletin of NAS ofUkraine, 10, 16—22 (2008) (in Ukrainian).
[3] Saunders, J.H. and Frisch, K.C. (1968). Chemistry of Polyurethanes. Moscow: Chemistry (Russian translation).

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Environment Canada Regulations for Volatile Organic Compounds (VOCs) in Architectural and Industrial Maintenance Coatings

"Smog is responsible for many serious health effects for Canadians, including thousands of premature deaths, hospital admissions and emergency room visits each year. As gaseous precursors, volatile organic compounds (VOCs) contribute to the formation of particulate matter (PM) and ground-level ozone - the main ingredients of smog. Up to two-thirds of fine particulate matter and almost all ground-level ozone are formed in the atmosphere from gaseous precursors. In order to reduce particulate matter and ground-level ozone, it is therefore necessary to reduce emissions of their precursors, particularly VOCs.

VOC emissions from the Architectural and Industrial Maintenance (AIM) coatings sector result from the use of solvents (and other organic compounds) in both solvent-based and water-based paint. The solvents in paints and coatings are used as a vehicle to transfer the paint to a substrate and are released to the atmosphere by evaporation following application. Due to the highly fragmented and widely distributed nature of painting applications using AIM coatings in small batches, it is usually not feasible to capture and control VOC emissions resulting at the point of use. The best option to reduce VOC emissions from AIM paints is to reformulate products to contain lower levels of VOCs.

Voluntary actions which have been used in the past to encourage VOC reductions from AIM coatings give an unfair advantage to those companies who choose not to participate in the initiatives and continue to market their products without having to put resources towards the research and development necessary to create lower VOC coatings. The regulatory approach provides assurance for purposes of business decision-making that all manufacturers and importers must meet the same requirement for the VOC content of their coatings.

One of the intentions of the regulations is to harmonize the requirements for VOC content in AIM paints with those existing in the US. Clean air is a trans-boundary issue, and as such, efforts must be made on both sides of the border to ensure a reduction in smog precursors such as VOCs. The US has a history of regulatory limits on the VOC content of AIM coatings, and Canadian regulations are needed to harmonize our efforts. The AIM coatings market is highly integrated on a North American basis. Aligning the proposed Canadian regulation with existing measures in the US will facilitate consistency in product requirements in the North American market and allow Canada to benefit from the US experience in implementing VOC emissions reduction strategies."

What Are Architectural Coatings?

Architectural coatings are products such as paints, stains, varnishes, lacquers and other types of coatings applied to traffic surfaces or to a wide variety of stationary structures in residential, commercial, institutional and industrial settings.

The Canadian architectural coatings industry produces coatings for three main segments:

- **General architectural coatings:** coatings sold to painting contractors and to the general public through retail outlets.
- **Industrial maintenance coatings:** high-performance architectural coatings for industrial or professional application to surfaces exposed to extreme conditions.
- **Traffic marking coatings:** used for marking traffic surfaces such as streets and highways, parking lots, airport runways.

Please note Environment Canada is proposing to address VOC emissions from aerosol coatings separately. Please visit their "Aerosol Coatings" page for more details.

What Is the Purpose of these Regulations?

The objective of the Regulations is to protect the environment and the health of Canadians from the effects of air pollution by reducing VOC emissions. VOCs constitute one of the main ingredients in the formation of ground-level ozone, which contributes to the formation of smog. Consumer and commercial use of architectural coatings results in the emission of VOCs by evaporation during the drying process, following application of the coating to a surface.

What Are the Key Elements of these Regulations?

The Regulations set mandatory VOC concentration limits for 53 categories of architectural coatings, including traffic marking coatings.

VOC Limits Canada
- PDF: 1 pages, 42 KB

The following PDF file provides details regarding the concentration limits, which vary between 100 g/L - 800 g/L depending on the category, and are set out in the Schedules of the Regulations:

Volatile Organic Compounds (VOC) Concentration Limits for Architectural Coatings Regulations
- PDF: 32 pages, 443 KB

IMPORTANT NOTE:

Based on the regulations, Nano-Clear® with a VOC content of 150 g/L (grams per Litre), and WB-2K™ with zero VOC and zero HAP, meets and exceeds the regulatory limits under the following categories:

- ✓ Extreme High Durability (800 g/L),
- ✓ Floor Enamel – High Gloss (250 g/L),
- ✓ Floor Coating – Opaque (250 g/L),
- ✓ Industrial Maintenance Coating (340 g/L),
- ✓ Rust Preventative Coating (400 g/L),
- ✓ Coating – Non-Flat (150 g/L), and
- ✓ Coating – High Gloss (250 g/L)

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The Perils of Power Washing Concrete

"Power washing concrete surfaces can cause real problems. Relatively inexpensive high-pressure power washing units are commonly available. Some of those units can deliver water at pressures well in excess of 6,000 pounds per second (psi)! Moreover, it is not just high-pressure water that's the problem. The water exits the nozzle at both a high pressure and a high velocity.

The resulting momentum is great enough to dislodge not only dirt and debris, but also to create flakes, popouts, and even concrete spalls. Even good quality concrete will also experience accelerated wear from high-pressure power washing.

However, there exists another problem that is not so obvious and requires a little bit more thought. Concrete is both porous and permeable. It is porous because it contains millions of microscopic and sub-microscopic voids. Entrained air voids are just one example of the voids within concrete. As concrete hydrates, the water-filled pore space between cement particles will fill up with hydration products thereby decreasing the permeability of the concrete. For good quality concrete, that process takes a matter of days or weeks. For poor quality concrete, that process may never occur.

Therefore, what happens at the microscopic level and what we see at the macroscopic level are directly related: the permeability has a huge impact on what happens to concrete that's power washed. Especially because the pores close to the surface (or lack thereof) are the ones that have the greatest exposure to everything that harms the concrete and provide the greatest protection. High quality concrete with a low water-to-cement ratio (less than 0.45) typically has few capillary pores and is essentially impermeable. Moderate quality concrete with higher water-to-cement ratios (greater than 0.45) contains a much larger fraction of capillary pores.

Close to the surface, this type of pore structure will actually soak up some surface water; similar to a sponge."
Portland Cement Association
http://www.cement.org/for-concrete-books-learning/concrete-technology/concrete-design-production/perils-of-power-washing

When preparing to pressure wash a concrete surface, take the following factors into consideration:

- The quality of the concrete (low quality concrete will absorb and hold water more easily),
- The age of the concrete (newer concrete may not have maximized its bonding process),
- The equipment (psi, nozzles, etc.) and method of pressure washing that will be used, and
- The frequency of cleaning: previous history and future requirements.

Also, when in doubt, be sure to clean a test patch first that is generally out of sight or hidden from view.

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Respiratory Personal Protection Gear/Equipment

The service life of a respiratory cartridge is the period of time for which the cartridge provides adequate protection to the user. After a cartridge has absorbed a particular contaminant to its capacity, the contaminant will begin to pass through the cartridge and enter the face piece of the respirator, a condition commonly referred to as breakthrough.

A cartridge change-out schedule allows the respirator wearer to replace the chemical cartridge or canister before breakthrough occurs, instead of relying on the contaminant's warning properties. An appropriate cartridge change schedule is one that is both convenient and assures that the concentration of the chemical downstream does not exceed the exposure limit.

User senses (odor, taste, irritation, etc.) are not an acceptable means for determining cartridge service life because warning properties rely upon human senses that are not foolproof. The 1987 NIOSH Respirator Decision Logic described the typical wide variation of odor threshold in the general population (greater than two orders of magnitude). Other problems exist: shift in odor threshold due to extended low exposures, shifts due to simple colds and other illnesses, and failure to recognize odor due to distraction in the workplace competing for worker attention. Given the variability among people with respect to detection of odors and differences in measuring odor thresholds, a better practice is to establish cartridge change-out schedules even for chemicals with adequate warning properties.

Rules of Thumb

As part of the overall assessment for determining a change-out schedule, one might look to various "rules of thumb" that have appeared in published literature. Please note that these "rules of thumb" do not work for every chemical in every situation. In particular, these statements do not generally apply to inorganic gases such as sulfur dioxide and hydrogen sulfide.

a. If a chemical's boiling point is greater than 70°C and the concentration is less than 200 ppm you can expect a service life of eight hours at a normal work rate;
b. Service life is inversely proportional to work rate;
c. Reducing concentration by a factor of ten (10) will increase service life by a factor of five (5);
d. Humidity above 85% will reduce service life by 50%;
e. Breakthrough times are diminished from 1 - 10% with each 10°C rise in temperature; and
f. Service life is directly proportional to the amount of carbon in the cartridge.

- Estimating Organic Vapor Cartridge Service Life." 2005 IOH-RS-BR-SR-2005-0005 USAF

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History & Characteristics of Concrete

Concrete is one of mankind's most versatile and universally utilized building materials and has been in use for thousands of years. The word concrete comes from the Latin word "concretus" (meaning compact or condensed).

"The time period during which concrete was first invented depends on how one interprets the term “concrete.” Ancient materials were crude cements made by crushing and burning gypsum or limestone. Lime also refers to crushed, burned limestone. When sand and water were added to these cements, they became mortar, which was a plaster-like material used to adhere stones to each other. Over thousands of years, these materials were improved upon, combined with other materials and, ultimately, morphed into modern concrete." - The History of Concrete, https://www.nachi.org/history-of-concrete.htm

Although the terms concrete and cement are often used interchangeably, it's important to note that they are not the same. Cement is actually a constituent ingredient of concrete. And the proportion of this ingredient, along with the other components added to form concrete, will be the factors that determine the type and quality of concrete product that is produced. Modern concrete, and its production and application, is now a science unto itself. It is often customized to suit the particular needs of a project depending on factors such as strength & durability requirements, geographic location, local climate conditions, usage scenarios, load specifications, timing (of delivery, pour and curing), and of course, economic specifications and/or limitations.

"Concrete is a synthetic construction material made by mixing cement, fine aggregate (usually sand), coarse aggregate (usually gravel or crushed stone), and water in the proper proportions. The product is not concrete unless all four of these ingredients are present.

Constituents of Concrete
The fine and coarse aggregates in a concrete mix are the inert, or inactive, ingredients. Cement and water are the active ingredients. The inert ingredients and the cement are first thoroughly mixed together. As soon as the water is added, a chemical reaction begins between the water and the cement. The reaction, called hydration, causes the concrete to harden. This is an important point. The hardening process occurs through hydration of the cement by the water, not by drying out of the mix. Instead of being dried out, concrete must be kept as moist as possible during the initial hydration process. Drying out causes a drop in water content below that required for satisfactory hydration of the cement. The fact that the hardening process does not result from drying out is clearly shown by the fact that concrete hardens just as well underwater as it does in air." - Concrete Characteristics, http://www.free-ed.net/free-ed/Resources/Trades/carpentry/Building01/default.asp?iNum=0501

Characteristics of Concrete

PROPERTIES	CHARACTERISTICS
Porosity (%) volume of pores/total volume of whole material	Water/cement ratio determines the porosity of hardened cement paste as a given stage of hydration. It generally exceeds 15%.
Water Absorption [(saturation wt. – dry wt.)/dry wt. of material]	Dependent on air voids (1-3% of volume). Moisture causes blotches/streaking after rainfall. Moisture penetration may corrode steel reinforcement in the concrete to form rust stains.
Surface Texture	Smooth to rough depending on aggregates and face moulds used for casting. Textured and profile surfaces mask stain better.
Colour	Wide ranging colours, depending on colour assed to matrix. Coats of paint can also be used to achieve the desired effect.
Resistance to Chemical Attacks	Dependent on quality of concrete. Rainwater dissolves calcium slats in concrete to produce efflorescence and lime staining.
Resistance to Biological Growth	Damp concrete surface traps dirt and promotes biological growth.

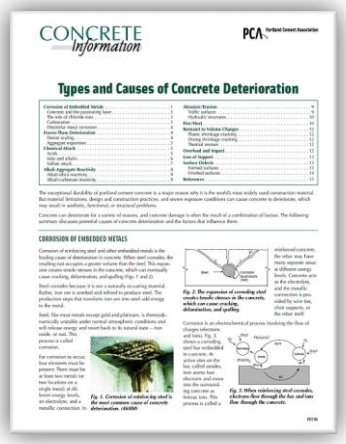
Concrete is an incredibly versatile building material. However, the quality of concrete is dependent on many factors, and over time it can deteriorate for a variety of reasons including, but not limited to:

- Corrosion of embedded metals
- Freeze-thaw cycles
- Chemical attacks
- Alkali-aggregate reactivity
- Abrasion and erosion
- Fire and heat
- Restraint to volume changes
- Overload and impact
- Surface defects
- And more ...

The following PDF file (source: Portland Cement) provides more information on the subject of concrete's limitations, design and construction practices, and conditions that can lead to the deterioration of concrete.

Types and Causes of Concrete Deterioration

- PDF: 16 pages, 834 KB


CONCRETE Information

PCA

Types and Causes of Concrete Deterioration

Cleaning & Maintenance of Concrete

CONDITION OF CONCRETE	CLEANING METHOD
Atmospheric Soiling	Low-pressure water washing (400 to 1000 psi). High pressure water jets should not be used as this may drive the stain further into the concrete. If insufficient, it can be supplemented by the following in order: brushing with a soft brush, a mild soap, a stronger soap, ammonia or vinegar.
Severe Soiling	*Chemical Cleaning* Ammonium hydroxide, sodium hypochlorite or hydrogen peroxide may be used with dilution. The surface should be flushed with water before and after to prevent etching by acidic cleaning agents. Chemicals containing slats may damage concrete due to adverse reactions. *Mechanical Cleaning* Involves power tools such as grinders, buffers, chisels, brushes or steam/flame cleaners. Concrete may be removed along with the stain and result in a roughened or uneven surface. Organic stains that cannot be removed with solvents may be burnt off with flame cleaners. However, the heat may cause part of the concrete surface to scale off.
Biologically Staining	Heavy growth should be removed by brushing with stiff fibre brushes, wooden spatula, scrapers, or a low-pressure water lance. Biocide or non-toxic bio organic cleaner should be applied to inhibit further growth.
Oil Stains	May be removed by applying an emulsifying or degreasing agent. Deep stains should be poulticed with white spirit or trichloroethane. The deposits should be then removed with a hot water pressure lance or with steam.
Efflorescence and Lime Stains	Can be removed by washing with a 5% solution of hydrochloric acid. Alternatively, brushing with a soft compact brushes and sponging the residual powder away will be more effective since excessive wetting with water will initiate further efflorescence formation.

Notes

Assero Coating Technologies

Professional Coating Products

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Revised May 12, 2023