WARNER CUSTOMCOATING

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Leaders in Advanced Finishing Solutions

Outstanding Quality. Customized Solutions. Dependable deliveries.

Uniquely Engineered Coating for Storm Sewers and Culverts

Warner Custom Coating provides an "environmentally friendly" Coating System for Storm Sewers, Culverts, and Structural Steel Components…

This unique solvent free Two Coat System, provides two layers of protection. The base coat Zinc Layer provides outstanding corrosion resistance while being completely sealed from the environment by the top coat Ethylene Acrylic Acid Copolymer which provides superior resistance to Impact, Corrosion, Abrasion and Inorganic Acid or Alkali (diluted). This 10+ mils thick Coating System prevents heavy metals from leaching into the environment and is designed and tested to meet and exceed industry standards.

Physical Properties - Zinc Layer

PROPERTY	TEST METHOD	RESULTS
Flexibility	**ASTM D 523 -Method B**	**1/8” mandrel**
Taber Abrasion CS-10 wheel, 1000 gram load, 1000 cycles	**ASTM D 4060**	**40-60 mg loss**
Impact Resistance - Direct	**ASTM D 2794 - 5/8” indenter**	**160 in.lbs.**
Impact Resistance - Reverse	**ASTM D 2794 - 5/8” indenter**	**160 in.lbs.**
Pencil Hardness - Mar	**ASTM D 3363**	**H-2H**
Pencil Hardness - Gouge	**ASTM D 3363**	**4H-5H**
Crosshatch Adhesion 2 mm cuts	**ASTM D 3359 - Method B**	**5B**
Humidity Resistance* Un-scribed	**ASTM D 2247**	**5000+ hours**
Salt Spray Resistance* Vertical scribe 1/8” undercut	**ASTM B 117**	**3000+ hours**

Physical Properties - Copolymer

PROPERTY	RESULT	PROPERTY	RESULT
Chemistry – Copolymer	Thermal plastic ethylene acrylic acid	Thermal Conductivity, w/Km	0.215
Colour	Black	Thermal Expansion, 10-6/in/in/ deg C	175
60 Deg. Gloss	50+	Tensile Yield, MPa (psi)	8 (1160)
Peak Melting Point, deg F	199	Tensile Strength, MPa (psi)	20 (2900)
Vicat Softening Point, deg F	165	Percent Elongation	610
Relative DSC Crystallinity, %	25.2	Shore D Hardness	54
Service Temperature, deg F	160	Tensile Impact , ft-lbs/in2	234

Physical Testing – Copolymer System

PROPERTY	TEST METHOD	RESULT
Humidity	ASTM D2247-10, X scribe, Air blow off, 4500hrs	Blister rating 10 & Undercut rating 10
Humidity	ASTM D2247-10, un-scribed, 5000hrs	Blister rating 10
Chip Resistance	ASTM D3170-03, 70 +/- psi, Feed rate 7 to 10 sec.	Minimum 6A to 8A rating.
Salt Spray	ASTM B117-11, X scribe, Air blow off 3000hrs	Blister rating 10 & Undercut rating 10
Salt Spray	ASTM B117-11, X routered, Brush off 4000hrs	Corrosion only in routered X with no peel back at X
Cyclic Corrosion	SAE J2334, vertical scribe, scrap, 60 cycles	Max. 6.3 mm Avg. 3.6 mm undercut
Pencil Hardness	ASTM D3363-05, Staedtler Mar Lumograph	Pass 5H gouge
Impact	ASTM D2794-93, Gardner Impact, 4 lb, 5/8" indenter	Ambient -Pass 160in.lbs.(direct)
Impact	ASTM D2794-93, Gardner Impact, 4 lb, 5/8" indenter	Minus 40°C -Pass 140in.lbs.(direct)
Adhesion	ASTM D3359-09, X cut, Method A, Elcometerl 99 Tape	Pass 5A rating
Adhesion	ASTM D4541, Pull adhesion – Glue failure at.	1400 lb/in (9Mpa)
Water Immersion	ASTM D870-09, dionized water, 38+/-2 deg C, 240 hrs	No blistering or other appearance changes
QUV	ASTM G154-06, Cond.4hrs 50°C, UV 8hrs 60°C cycle	DE rating .68 to .84 at 3000 hrs

Physical Testing – Copolymer System

PROPERTY	TEST METHOD	RESULT
Dime Scrape	GM 9506P	Good Adhesion
Thumbnail Hardness	GM 9507P	Marred
Mandrel Bend	ASTM D522-93A, Gardner Rod Mandrels	Passed 1/4" Mandrel
Taber Abrasion	ASTM D4060-10, CS-10, 1000cycles, 1000g load	10.6 to 11.1 mg loss
Taber Abrasion	ASTM D4060-10, CS-17, 1000cycles, 1000g load	8.8 to13 mg loss
Abrasion Humid Blast	LC 21-102, Sand blast, 570g/min., four 43.3 min. C.	Maximum 0.43g or 2micron loss
Cathodic Disbondment	ASTM G8-96 (2010)	Max Disbondment 4.74 cm^2 & 2.47 cm^2
Holidays Test	ASTM A742 / 742M-03, ASTM G62 A	No holidays present
Freeze Thaw Resistance	ASTM A742 / 742M-03, 24 hr cycles, 100 cycles	No spalling, disbonding, or detrimental effect
Microbial Attack	ASTM A742 / 742M-03, ASTM G22 B	No visible effect of bacterial attack
Impact	ASTM A742 / 742M-03, 4.0J on a15.88 mm punch	Ambient -No evidence of cracking
Impact	ASTM A742 / 742M-03, 4.0J on a15.88 mm punch	Minus 40°C -No evidence of cracking
Wheatherability	ASTM A742 / 742M-03, ASTM G23	No cracking, dulling, or blistering.
Thickness of Coating	ASTM A742 / 742M-03 ,ASTM D 1005	Minimum 10 mils or 250 μm per side.

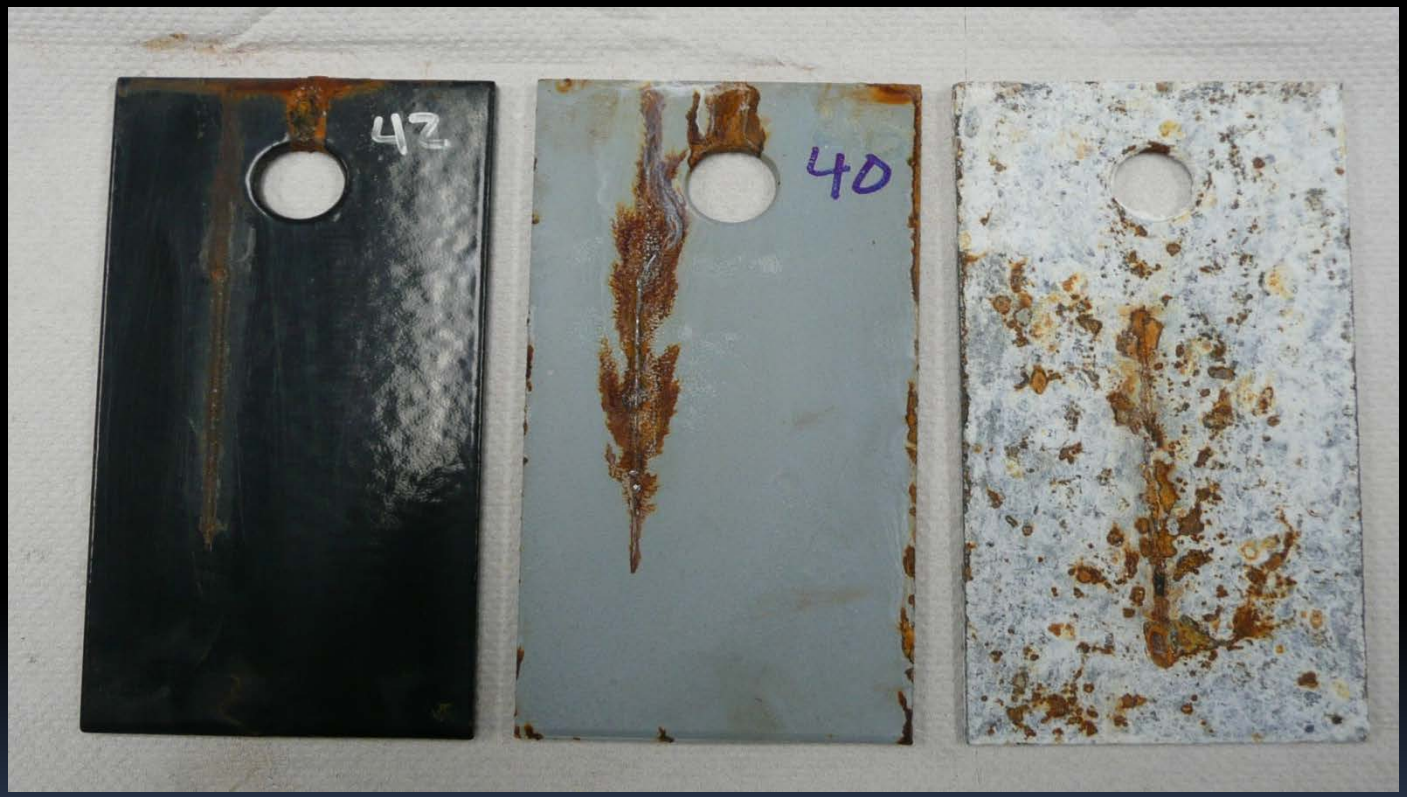
Physical Testing – Copolymer System

PROPERTY	TEST METHOD	RESULT
Chemical Resistance		
Chloroform	ASTM D1308-02 - 24 hrs, ambient	No Change
Methylene Chloride	ASTM D1308-02 - 24 hrs, ambient	No Change
THF	ASTM D1308-02 - 24 hrs, ambient	No Change
Resistance to acids & bases		
Hydrochloric Acid 35%	ASTM D543-60T - 2160 hrs, 73°F	No Change
Nitric Acid 5%	ASTM D543-60T - 2160 hrs, 73°F	No Change
Aluminum Hydroxide	ASTM D543-60T - 2160 hrs, 73°F	No Change
Sodium Hydroxide, 50%	ASTM D543-60T - 2160 hrs, 73°F	No Change
Imperviousness		
Sulfuric Acid 50%	ASTM D543-60T - 2160 hrs, 73°F	No Change
Sodium Hydroxide, 50%	ASTM D543-60T - 2160 hrs, 73°F	No Change
Sodium Chloride Saturated	ASTM D543-60T - 2160 hrs, 73°F	No Change

Salt Spray Test - ASTM B117

Comparable example at 3000 hours

Copolymer System	Copolymer System – Zinc Layer	Galvanized System Only



At 3000 hours this panel shows no signs of blistering nor any signs of delamination.

ASTM D714-87 Rating = 10

ASTM D1654-92 Rating = 10

At 3000 hours this panel shows bleed out of red rust at the scribe, but no signs of blistering nor any signs of delamination.

ASTM D714-87 Rating = 10

ASTM D1654-92 Rating = 10

At 3000 hours this panel shows considerable red rust, blistering and delamination of 16+ mm.

ASTM D714-87 Rating = 2

ASTM D1654-92 Rating = 0

Chemical Resistance - Copolymer

Laboratory tests to determine the attack/resistance of the Ethylene Acrylic Acid Copolymer in a great number of chemicals (or environments) were performed in accordance with ASTM D543-60T. Pure reagents were used to determine effects of fundamental chemicals. An extension of the recommended time from 168 hours to 2160 hours has been used to obtain data in the attached tables. In addition to the specified temperature of 23 deg C, a temperature of 53 deg C was also used. A specimen is immersed under no load, in a gas or liquid, or placed in intimate contact with a solid substance.

Rating System

Subjective rating systems were established for each resin base upon the total weight increase, or loss, and the degree of chemical attack (discolouration, crazing, softening, etc.)

Explanation of Ratings

A – Completely unaffected to very slight clouding or discolouration occurred during test duration.
B – Slight etching, some discolouration and possibly some dimensional changes or weight change.
C – Moderate to considerable change and or softening.

All chemical resistance data in this document is from published literature on Dow EAA Copolymer and is intended as a guide only. The results are based upon laboratory tests and the information is believed to be reliable, but users should not rely upon these results absolutely for specific applications..

Chemical Resistance - Copolymer

ACIDS	23°C	52°C		23°C	52°C
Acetic Acid 10%	A	A	Hydrofluoric Acid 48%	A	A
Boric Acid	A	A	Nitric Acid 5%	A	A
Citric Acid 10%	A	A	Oxalic Acid, saturated	A	A
Formic Acid 100%	A	A	Phosphoric Acid 50%	A	A
Hydrochloric Acid 35%	A	A	Sulfuric Acid 10%	A	A

INORGANIC COMPOUNDS	23°C	52°C		23°C	52°C
Aluminum Chloride	A	A	Magnesium Sulfate	A	A
Aluminum Hydroxide	A	A	Mercuric Chloride	A	A
Barium Chloride	A	A	Potassium Bicarbonate	A	A
Calcium Chloride	A	A	Potassium Chloride	A	A
Calcium Hydroxide	A	A	Potassium Hydroxide	A	A
Calcium Sulfate	A	A	Potassium Nitrate	A	A
Calcium Nitrate, 50%	A	A	Potassium Sulfate	A	A
Caustic Potash	A	A	Silver Nitrate	A	A
Copper Nitrate	A	A	Sodium Chloride	A	A
Ferric Sulfate	A	A	Sodium Hydroxide, 50%	A	A
Ferric Nitrate	A	A	Sodium Nitrate	A	A
Magnesium Chloride	A	A	Sodium Sulfate	A	A
Magnesium Hydroxide	A	A	Zinc Chloride, saturated	A	A
Magnesium Nitrate	A	A	Zinc Sulfate	A	A

Abrasion Resistance of Coating

The three measurable parameters that in combination characterize coating hardness are:

- Abrasion resistance.
- Scratch resistance.
- Indentation under load.

These hardness properties are independent parameters, thus, as in the case of coatings based on EAA Copolymer, it is possible to have a scratch prone coating with superior abrasion resistance. Moreover while hardness is generally considered to be a surface performance quality, actual measurements involves the total coating matrix and not the very surface.

Scratch Resistance

Scratch resistance can be measured manually with lead pencils (such as in ASTM D-3363) or instrumentally with a loaded diamond point. Respectively, scratch hardness is expressed either as the lead hardness that first cause a a visible scratch or as load/width of scratch. Coatings based on EAA Copolymer are usually considered to have poor mar (scratch) resistance.

Indentation Resistance

For indentation resistance, there are four common durometer scales used to cover the range from soft to very hard plastic coatings. The durometer indentation scale are:

- Shore A
- Shore D
- Barcol
- Rockwell M

Coatings based on EEA Copolymer usually have hardness values of between 52-55 (Shore D). In these determinations (such as in ASTM D-785), the depth of the indentation is takes as the hardness reading. Plastic recovery, which is an index of elasticity, does not enter the measurement.

<u>Abrasion Resistance</u>

Abrasion resistance is commonly measured by a loss weight or a change in optical properties after exposure to a loaded abrasive surface for a pre-determined number of cycles or time period (such as in ASTM D-1044 and D-2240). Abrasion hardness can be measured by several different test methods or units.

- Armstrong Abrader
- Taber Abrader
- National Bureau of Standards (NBS) Abrader
- Belt Sander
- Ball Mill

The Taber Abrader is a very popular unit which measures via weight loss and can be fitted with various abrasive surfaces (wheels) to cover a wide range of coarsenesses.

Abrasion and Wear Resistance

Abrasion resistance is often confused with wear resistance which is a non-hardness property. In wear, there is a measurable erosion occurring between mating surfaces as opposed to erosion due to abrasive impact. Although abrasion and wear are different occurrences. They tend to closely correlate. i.e., coatings with good abrasion resistance generally also show good wears resistance.

Avoid Hardness Generalizations

While all three aspects of hardness are important for fully accurate coating characterizations, typically, indentation hardness only (by the “finger-nail test”) is used to describe whether a coating is “hard” or “soft”. This being the tendency, and recognizing property, coating specifiers should focus on the required hardness property for the coating selection and not merely on a generalized description of hard or soft.

Relative Abrasion Performance

The following chart indicates that the EAA Copolymer has outstanding abrasion resistance (as measured by a Taber Abrader), although they are generally characterized as “soft” coatings with low scratch and indentation resistance. Field examples of the excellent abrasion hardness of this coating include: High-Velocity drilling service, Mining Shoots, &Removal difficulty during abrasive grit blasting.

Like nylon resins, the excellent abrasion resistance of EAA based coatings is attributable to relatively high cohesive strength due to intra-molecular and inter-molecular hydrogen bonding.

Abrasion Resistance of Various Materials

Taber Abrasion Weight Loss CS-17 Wheel, mg./1000 cycles

Material	RESULTS
Nylon 12	5.3
Linear Low Density Polyethylene	6.3
Teflon's	7.5 – 20
Ethylene Acrylic Acid Copolymer	8.8
EMAA Ionomer (40% Ns)	10.5
High Density Polyethylene	11.3
Saponifield EVA (90 Melt Index)	12.5
Low Density Polyethylene	13.5
EVA Copolymer (9% VA, 10 Melt Index)	15.6
Polycarbonate	24
Die-Cast Aluminum	25 (1)
Vinyl Floor Tile (Homogeneous)	75 (2)
Mild Carbon Steel	75 – 100 (3)
Rigid PVC	100

Polymeric material were tested as moldings and not as thermal coated specimens. All determinations were made with a Taber Abrader except aluminum, steel, and tile which are expressed as “relative values”

Relative Weight loss: (1) – Belt Sander, (2) – Armstrong Abrader, (3) – Ball Mill.

Source: Plastic Material and Processes, 1982

General Properties and Applications

Performance Properties	Applications
Excellent Toughness / Impact Resistance	Chemical Tank Linings
Excellent Inorganic Acid & alkali (dilute) Resistance	OEM Metal Substrates
Excellent Corrosion Protection	Exterior Industrial Coatings
Excellent Abrasion Resistance	Marine Coatings
Excellent Low Temperature Flexibility	Pipe Coatings
Excellent Weathering Resistance	Bridge Coatings
Excellent Adhesion	Low Temperature Exterior Coatings

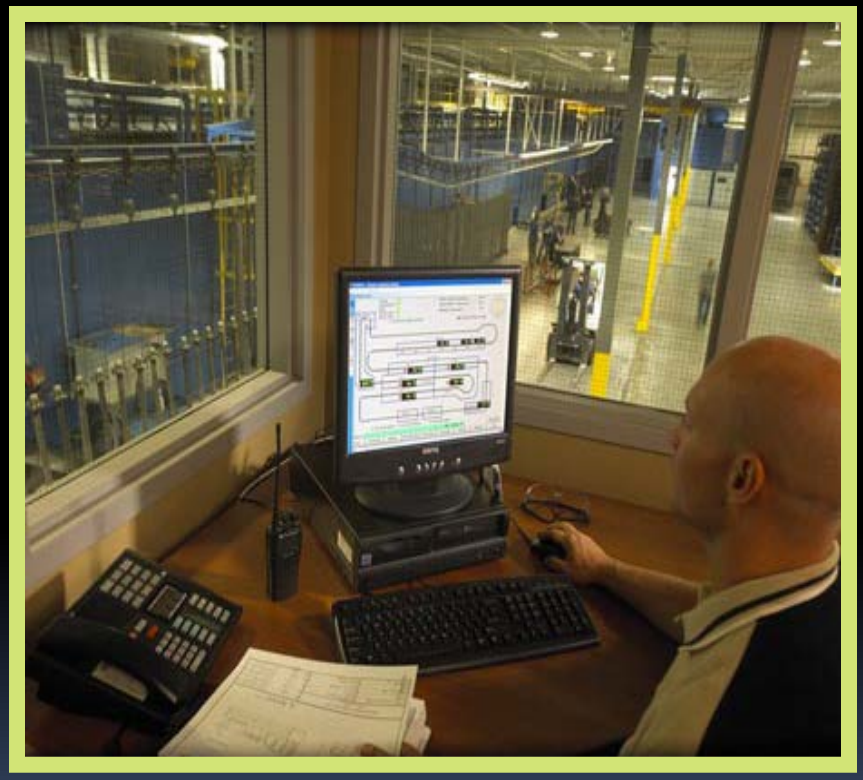
What Makes This Attractive?

- The Copolymer System, extends long-term life of Storm Sewer, and Culvert structures.
- Delivers a strong durable 10 mil barrier between the structure and the environment.
- System is bonded chemically to the substrate, preventing delamination.
- Provides excellent corrosion resistance against diluted acids, salts, and alkalis.
- Offers long-term durability in abrasive environments.
- Displays excellent performance in corrosive environments.
- Adds virtually no weight to the structure.
- Allows for efficient handling, transportation, and installations.
- Economical solution where longer service life is required.
- Ideal for product that is exposed to aggressive environmental conditions.

Application System

Programmable Logic Controls (PLC)

- Our PLC-based system automatically controls and monitors equipment.
- Operators are alerted by alarms if system's performance/product specifications have been compromised in any way.
- In conjunction with the PLC information, Scada Programming allows for trending and retention of historical process data.
- This historical data is paramount to our Continuous Improvement Program - APQP phase as well as troubleshooting any incident that may arise.



Eight-Wheel Post Blast Monorail System

- **Our Eight-Wheel Automated Shot Blasting System provides an aggressive method of removing all surface contaminants including rust and mill scale which are known to be detrimental in the performance of surface coatings.**

Eight-Stage Pretreatment Wash System

- Our robust wash system was designed around strict Automotive & Industry Standards to insure optimal product preparation.
- The Insulated Stainless Steel Wash System is also equipped with energy efficient plate and frame heat exchangers as well as automatic sludge removal to provide premium product preparation.
- The entire wash system is PLC controlled.
- Temperatures, tank levels, pressures, motors and conductivity are monitored every moment of the day.

Two Zone Dry-Off Oven

Offers ultimate flexibility in rapid drying of the substrate while providing the ability to manipulate parts for higher film builds, or out gassing of product prior to cure.

Post Dry-Off Cooling Tunnel

Allows for a forced air cool down to insure product enters the Paint Room at ideal application temperatures.

Application and Environmental Room

- **The Nordson ColorMax and Excel application systems are housed in an enclosed Environmental Room.**
- **Constant humidity and temperature levels are maintained to insure an ideal application environment.**
- **The Programmable I-Control Gun Package allows for reproducible gun recipes and gun control configurations designed to maintain consistent film thickness while reducing rejects and minimizing waste powder.**

Application and Environmental Room

- The Electronic Gun Movers & Triggering Package allows for automatic guns to part profile which not only provides a consistent finish, but improves system efficiencies
- With the ability to roll each booth off-line, Warner has the advantage of performing maintenance & chemistry changes off-line while production continues in another
- This fully integrated approach of the ColorMax System substantially reduces chemistry change downtime and material waste in the applications process.

Three Zone Filtered Oven

Our “Torrid” oven is equipped with a Radiant Zone complete with air curtains to eliminate the potential of cross contamination.

All zones are Filtered and Individually Controlled enabling us to provide our customers with a Class “A” Finish with ideal curing parameters and efficiencies.

The conveyor is equipped with a Sanitary Tray to assist in the delivery of a defect-free, “Class A Finish”.

Post Cure Cooling Tunnel

Lowers part temperature, making the finished product suitable for inspection, handling and packaging.

We've Got What it Takes

- **ISO 9001:2008 certified since 1999.**
- **Meticulous quality control parameters and continual process monitoring.**
- **An ability to meet On-Time Delivery requirements while supplying defect-free product conforming to Customer's specifications.**
- **Coating capabilities, speed and efficiencies that are virtually second-to-none**
- **A strong understanding of the Metal Finishers role in the supply chain.**
- **The ongoing ability to meet and exceed your expectations as a supplier.**
- **Not to mention our extensive and ongoing investment in technology.**

Leaders in Advanced Finishing Solutions

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