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# **PRESERVING DECKS**
# MATERIALS OPTIONS

# Polymer Resins

- Epoxy
- Modified Epoxies
- Methyl Methacrylates
- Polyester
- High Molecular Weight Methacrylates

# Typical Applications

- Wearing surface overlays
- High Friction Surfacing
- Crack and surface sealing

# Selecting the Proper Material

- Compressive strength
- Flexural modulus
- Elongation
- Viscosity
- Temperature limitations
- Cure time
- Required mixing and installation equipment

# Epoxy

Epoxies have been in use in the United States for over 40 years as concrete bridge deck overlays. Over this time there have been many changes to the basic epoxy resins primarily due to problems caused by high modulus materials, UV sensitivity, leaching and environmental issues.

Epoxies resins with low **modulus of elasticity (13 ksi max)** and high **tensile elongation of (30 to 70%)** should be used for polymer overlays.

The **compressive strength** of the polymer overlay system (resin and aggregate) should be between **1 to 5 ksi.**

# Modified Epoxies

Modified epoxies are those materials that incorporate other chemicals in the base epoxy resin to enhance its physical properties. They were first used in the United States for bridge deck overlays approximately 20 years ago. They have similar modulus of elasticity, tensile elongation and compressive strength, as the standard epoxy resins.

The advantages to Epoxy Urethane and Polysulfide Epoxies are that they **maintain their modulus of elasticity and tensile elongation over a wider range of ambient temperatures and are resistant to the detrimental effects of UV rays.**

# Methyl Methacrylates

Methyl Methacrylates have been used in the United States for over 30 years as concrete bridge deck overlays. Original systems had very high compressive strength, high modulus of elasticity and virtually zero elongation. Their rapid cure did not allow broadcast aggregate to be used and surface tyning was not possible. The advantage of the methyl methacrylate systems was their ability to be installed at low temperatures (14°F) and they cured in approximately 1 hour.

Currently available Methyl methacrylate overlays have **low modulus of elasticity (44 ksi), high tensile elongation (150%) and compressive strength of (2.5 ksi).** They have also been changed so that wearing aggregate can be broadcast onto the surface before they cure.

# Polyester

Polyesters have been in use in the United States for over 25 years as concrete bridge deck overlays. This overlay system was developed by Caltrans and has been primarily used in California and Nevada.  These overlays are designed to be installed at approx 1in. thick and use vibrating screeds to finish. HMWM is required as a primer for all polyester overlays.

Current available polyester overlays have **Compressive Strength of (5.0 KSI) and the Neat Resin has a Tensile Strength of (5 KSI max) and Elongation of 35-80%.**

# High Molecular Weight Methacrylate

High Molecular Weight Methacrylates (HMWM) have been used in the United States for over 20 years as concrete crack and surface porosity sealers. These materials are available in **low elongation (5%) and high elongation (30%)** formulations. HMWM is very effective at sealing cracks in horizontal concrete surfaces and can seal cracks with widths as small as ½ mm.

**Cured HMWM can restore concrete up to 75 to 90% of its original strength.** Once HMWM is cured in cracks it permanently seals them from intrusion of moisture unlike some sealers that must be reapplied to maintain performance.

**HMWM should not be considered a wearing surface**, any material remaining on the surface will be quickly be worn away by vehicles.

# Safety and Environment Issues

## Safety

- Do not store materials in extremely high temperatures
- Have copies of manufacturers MSDS on job site
- Review proper mixing procedures
- Supply recommended personal protective equipment

## Environmental

- Read MSDS for any VOC and hazardous chemicals
- Prevent spills or discharge thru joints or drains
- Proper disposal of unused resins and powders
- Proper disposal of empty drums and containers

# Wearing Surface Overlays

Epoxies

Polyesters

Modified Epoxies

Methyl Methacrylate

- Application method (multi-layer/slurry)
- Mixing requirements (special machine)
- Ease of placement and finishing (vibratory screed)
- Temperature limitations
- Curing time

# Crack and Surface Sealing

Epoxies

High Molecular Weight Methacrylates

Methyl Methacrylates

- Application method
- Temperature limitations
- Curing time
- Penetration depth in cracks

# Common Failure Causes

- Existing concrete strength is too low for good polymer bond when concrete is contaminated
- Improper surface preparation
- Poor application procedure
- Loss of broadcast aggregate
- Excessive broadcast aggregate wear
- UV sensitivity which can cause some polymers to become brittle over time
- Modulus of polymer too high to withstand  thermal cycle stresses

# Application Temp and Curing Time

| Polymer Resin | Temp limit | Curing time@70°F |
|---|---|---|
| Epoxy | 50°-100°F | 4 hours |
| Polysulfide Epoxy | 50°-100°F | 4 hours |
| Methyl Methacrylates | 14°-100°F | 1 hour |
| Polyester | 40°-100°F | 4 hours |
| High Molecular Weight Methacrylate | 50°-100°F | 5 hours |

# Application Procedure

| Epoxy | Modified Epoxy | Methyl Methacrylate | Polyester |
|---|---|---|---|
| resin coat | primer coat | primer coat | primer coat |
| agg broadcast | slurry layer | slurry layer | mortar layer |
| resin coat | agg broadcast | agg broadcast | agg broadcast |
| agg broadcast | | seal coat | transverse grooving |

# Proper Polymer Material Selection

- What existing problem needs to be corrected
- Expected life of polymer for proposed installation
- Different polymers systems (meet minimum project requirements)
- Physical properties on polymer compatible with existing structure
- Application method appropriate for specific project
- Application temperatures requirements
- Curing time
- Installation equipment requirements
- Safety and environmental issues
- Future maintenance issues
- Life cycle cost

# Deck Treatment Charts

## Northeast Bridge Preservation Partnership

- Product Name
- Product Supplier and website
- Primary Base Component (MMA, Epoxy, Etc)
- Weather Restrictions
- Deck Preparation
- Set-Up Time
- Patch Material Compatibility
- Deck Age and Condition When Applied
- Expected Service Life
- State DOT Approval
- ASTM/AASHTO (etc) Test Procedures

# Deck Treatment Chart
## Overlay (>1”)

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**Northeast Bridge Preservation Partnership**
**Deck Treatment - Overlay (> 1")**

September 17, 2012

| PRODUCT NAME | PRODUCT SUPPLIER & WEB-SITE | PRIMARY BASE COMPONENT (MMA, EPOXY, etc.) | WEATHER RESTRICTIONS | DECK PREPARATION | SET-UP TIME | PATCH MAT'L COMPATABILITY | DECK AGE & CONDITION WHEN APPLIED | EXPECTED SERVICE LIFE | STATE DOT APPROVAL | ASTM/AASHTO (etc.) TEST PROCEDURES | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| VESLMC<br><br>Very Early Strength Latex Modified Concrete | www.rapidset.com | RS Cement SB Latex | Normal Concrete | Scarified | 3 hours to open | Not Gypsum | New or Repaired | 25-30 years | most | Normal Concrete | |
| PMCC - Polymer Modified Cement Concrete | www.rapidset.com | Low P Cement | Normal Concrete | Scarified | 3 hours to open | Not Gypsum | New or Repaired | 25-30 years | some | Normal Concrete | |
| PPC 1121 | Kwik Bond Polymers. Product data sheet: http://www.kwikbondpolymers.com/product/specsheets/KBP_PDS_PPC1121EC.pdf | polyester resin mixed with aggregates, HMWM primer | Dry | clean surface, shot blast is typical | 2 hour traffic return | no known incompatibility | sound concrete, any age | 30+ years | Placed by special provision/specification in: AK, WA, OR, CA, NV, ID, MT, WY, UT, AZ, CO, NM, MN, MO, FL, PA, DE, NJ, NY, VT. | Meets requirements of AASTHO T34 Guide Specification for Polymer Bridge Deck Overlays, Pre-Mixed Chapter, Polyester binder section. Resin: viscosity <200 cps, tensile strength ASTM D638 >2500 psi, tensile elongation ASTM D638 35% min. Complete system (mixed with aggregates): tensile strength ASTM C307 800 psi, compressive strength ASTM C39 7000 psi, adhesion saturated surface dry >500 psi. | 3/4 in. - 12 in. in single lift |

# Deck Treatment Chart
## Thin Overlay (>3/8” to 1”)

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Northeast Bridge Preservation Partnership
Deck Treatment - Thin Overlay (>3/8" to 1")

September 17, 2012

| PRODUCT NAME | PRODUCT SUPPLIER & WEB-SITE | PRIMARY BASE COMPONENT (MMA, EPOXY, etc.) | WEATHER RESTRICTIONS | DECK PREPARATION | SET-UP TIME | PATCH MAT'L COMPATABILITY | DECK AGE & CONDITION WHEN APPLIED | EXPECTED SERVICE LIFE | STATE DOT APPROVAL | ASTM/AASHTO (etc.) TEST PROCEDURES | THICKNESS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| PPC 1121 | Kwik Bond Polymers. Product data sheet: http://www.kwikbondpolymers.com/product/specsheets/KBP_PDS_PPC1121EC.pdf | polyester resin mixed with aggregates, HMWM primer | Dry | clean surface, shot blast is typical | 2 hour traffic return | no known incompatibility | sound concrete, any age | 30+ years | Placed by special provision/specification in: AK, WA, OR, CA, NV, ID, MT, WY, UT, AZ, CO, NM, MN, MO, FL, PA, DE, NJ, NY, VT. | Meets requirements of AASTHO T34 Guide Specification for Polymer Bridge Deck Overlays, Pre-Mixed Chapter, Polyester binder section. Resin: viscosity <200 cps, tensile strength ASTM D638 >2500 psi, tensile elongation ASTM D638 35% min. Complete system (mixed with aggregates): tensile strength ASTM C307 800 psi, compressive strength ASTM C39 7000 psi, adhesion saturated surface dry >500 psi. | 3/4 in to 12 in in single lift |
| Poly-Carb Mark-163 FLEXOGRID | www.poly-carb.com | Epoxy Urethane | 50 degree F, < 5% Deck Moisture | Shot Blast | 2-4 hrs-temperature dependant/coat | No Magnesium Phosphate | Any age, substrate must be sound | 15+ years | PA, NH, MA, MD, ME, VT, NY, NJ, DE, RI and supplemental specs | | |
| Poly-Carb Mark-163 LT ( low temp) | www.poly-carb.com | Epoxy Urethane | 30 degree F, < 5% Deck Moisture | Shot Blast | 2-4 hrs-temperature dependent/coat | No Magnesium Phosphate | Any age, substrate must be sound | 10+ years | supplemental specs | | |
| Poly-Carb Mark-154 | www.poly-carb.com | Epoxy | 50 degree F, < 5% Deck Moisture | Shot Blast | 1-3 hrs-temperature dependant/coat | No Magnesium Phosphate | Any age, substrate must be sound | 8-10+ years | PA, NY and supplemental specs | | |
| Poly-Carb Mark-155 UREGRID | www.poly-carb.com | Polyurea | 40 degree F, < 5% Deck Moisture | Shot Blast | 2-4 hrs-temperature dependant (multi- | No Magnesium Phosphate | Any age, substrate must be sound | 5+ years | supplemental specs | C836 | |

# Deck Treatment Chart
## Ultra Thin Overlay (<3/8”)

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**Deck Treatment - Ultra Thin Overlay (<3/8")**

September 17, 2012

| PRODUCT NAME | PRODUCT SUPPLIER & WEB-SITE | PRIMARY BASE COMPONENT (MMA, EPOXY, etc.) | WEATHER RESTRICTIONS | DECK PREPARATION | SET-UP TIME | PATCH MAT'L COMPATABILITY | DECK AGE & CONDITION WHEN APPLIED | EXPECTED SERVICE LIFE | STATE DOT APPROVAL | ASTM/AASHTO (etc.) TEST PROCEDURES | THICKNESS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SSI ReDeck | highway@ssicm.com | urethane-epoxy | 60F-85F | shot blast day of | 1st coarse deck | SSI Flexpatch | new concrete deck | 10 years | NYSDOT | | |
| 1/4" -3/8 | www.pipehler.com | 1 to ratio | | intallation | temp -80F -1.5 hr<br><br>2nd coarse deck temp -80F -3 hr | | 28 days, old deck must be in decent shape | | | | |
| PPC MLS | Kwik Bond Polymers. Product data sheet: http://www.kwikbondpolymers.com/product/specsheets/KBP_PDS_PPCmls.pdf | Polyester resin and broadcast aggregate (2 layer) with HMWM primer. 3/8" nominal thickness. | dry surface, 40 degrees F and rising | clean and dry, shot blast is typical | 2 hours per layer from 40 to 90 degrees. | No known incompatibility | Sound concrete, any age. | 10 to 12 years. Longer with high performance aggregates. As with ALL multi layer broom and seed style overlays the service life is a function of aggregate abrasion resistance. | Approved in NV, placed in other states under special provision/specification. | Meets all requirements of AASHTO T34 Guide Specification for Polymer Bridge Deck Overlays, Multi Layer Chapter, Polyester Binder section. Resin: viscosity 500-1000 cps, tensile strength ASTM D638 2500 psi, tensile elongation ASTM D638 >40%. Complete system (with aggregates): compressive strength ASTM C579 >5000 psi, adhesive strength ACI 503R >250 psi, permiability to chloride ion AASHTO T277 <100 coulombs. | 3/4 inch nominal |
| Poly-Carb Mark-163 FLEXOGRID | www.poly-carb.com | Epoxy Urethane | 50 degree F, < 5% Deck Moisture | Shot Blast | 2-4 hrs-temperature dependant/coat | No Magnesium Phosphate | Any age, substrate must be sound | 15+ years | PA, NH, MA, MD, ME, VT, NY, NJ, DE, RI and supplemental specs | | |
| Poly-Carb Mark-163 LT ( low temp) | www.poly-carb.com | Epoxy Urethane | 30 degree F, < 5% Deck Moisture | Shot Blast | 2-4 hrs-temperature dependent/coat | No Magnesium Phosphate | Any age, substrate must be sound | 10+ years | supplemental specs | | |
| Poly-Carb Mark-154 | www.poly-carb.com | Epoxy | 50 degree F, < 5% Deck Moisture | Shot Blast | 1-3 hrs-temperature dependant/coat | No Magnesium Phosphate | Any age, substrate must be sound | 8-10+ years | PA, NY and supplemental specs | | |
| Poly-Carb Mark-155 UREGRID | www.poly-carb.com | Polyurea | 40 degree F, < 5% Deck Moisture | Shot Blast | 2-4 hrs-temperature dependant (multi-system) | No Magnesium Phosphate | Any age, substrate must be sound | 5+ years | supplemental specs | C836 | |
| Poly-Carb SAFETYGRID ( HFS- High Friction Surface) | www.poly-carb.com | Epoxy | 50 degree F, < 5% Deck Moisture | Air or Shot Blast | 1-3 hrs-temperature dependant | No Magnesium Phosphate | Any age, substrate must be sound | 5+ years | supplemental specs | | |
| Traficguard EP35 | BASF Corporation www.buildingsystems.basf.com | Epoxy | 50-100° F; No rain within 12 hours | Mechanical prep to ICRI CSP 6 | 15-25 min pot life; Cure time depenent upon Temp. See Data Guide. | Cementitious patch fully cured; epoxy patch with sand broadcast on surface. | Fully cured concrete; clean; dry; sound | Dependent upon service conditions | ID, LA, MO, NY, NC | ASTM C881, ASTM D695; ASTM D638; ASHTO T277; See Data Guide for more info. | |
| T-48 Slurry | Transpo Industries, www.transpo.com | Epoxy | 50 deg f minimum | Shot blast | 2-9 hours | mag phosphate not reccomended | deck should be sound with no delaminations | 10 - 20 years | IL, NM & TN | ASTM D2849, D1310, D1644, D695, D638, D2240, C109, D790, C307, D638, C1583-04, C331, C666, E274, AASHTO T237, ACI 503R | |
| T-48 Chip seal | Transpo Industries, www.transpo.com | Epoxy | 50 deg f minimum | Shot blast | 2-9 hours | mag phosphate not reccomended | deck should be sound with no delaminations | 10-20 years | SD | ASTM D2849, D1310, D1644, D695, D638, D2240, C109, D790, C307, D638, C1583-04, C331, C666, E274, AASHTO T237, ACI 503R | |
| T-18 | Transpo Industries, www.transpo.com | Methyl Methacrylate | 14 deg F minimum | Shot blast | 1 hour | mag phosphate not reccomended | deck should be sound with no delaminations | 10-20 years | NJ | ASTM D2393, D2849, C881, D1310, D1644, D638, D695, D790, C307, C331, C1583 & D570 | |
| E-Bond 526 | Transpo Industries, www.transpo.com | Epoxy | 50 deg F minimum | Shot blast | 1-3 hours | mag phosphate not reccomended | deck should be sound with no delaminations | 10-20 years | IL, KS, MO, OK, TN & WS | ASTM D2393, C881, D638, C1583-04, C882, C579, D695, D540, AASHTO T277 | |

# Deck Treatment Chart
## Sealers

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**Northeast Bridge Preservation Partnership**
**Deck Treatment - Sealers**

September 17, 2012

| PRODUCT NAME | PRODUCT SUPPLIER & WEB-SITE | PRIMARY BASE COMPONENT (MMA, EPOXY, etc.) | WEATHER RESTRICTIONS | DECK PREPARATION | SET-UP TIME | PATCH MAT'L COMPATABILITY | DECK AGE & CONDITION WHEN APPLIED | EXPECTED SERVICE LIFE | STATE DOT APPROVAL | ASTM/AASHTO (etc.) TEST PROCEDURES |
|---|---|---|---|---|---|---|---|---|---|---|
| KBP 204 | Kwik Bond Polymers www.kwikbondpolymers.com | HMWM (High Molecular Weight Methacrylate) | Dry Surface, 40 degrees F and rising | Clean surface, shot blast is typical | 2 hour traffic return | No known incompatibility | Out of wet cure as a minimum. This is a crack filler and surface penetrant that will do the most good if shrinkage cracks have developed prior to application of the HMWM. | 5 - 10 years | Meets special provision/specification in many states (NY, OH, DE, CA, ID, MT, MN, NV, OK, WY, AZ). Approved list qualified in: MO, NE, NM. | Specific Gravity ASTM D1475 1.06, Viscocity ASTM D2196 <25 cps, Flash Point ASTM D3278 >180 F, Compressive Strength ASTM D695 >2000 psi (2 hr) >3000 psi (24 hr), Tensile Strength ASTM D638 >2000 psi (7 day). More available, I listed what I thought was most important. |
| POLY-CARB MARK-127 (crack sealer) | www.poly-carb.com | Epoxy, < 10% elongation | 50 degree F, <5% Deck Moisture | Shot Blast | 3-4 hr @ 77 F | No Magnesium Phosphate | Any age, substrate must be sound | 3-5+ years (surface); 7-10+ (cracks) | OH | |
| POLY-CARB MARK-135 (crack sealer) | www.poly-carb.com | Epoxy, < 20% elongation | 50 degree F, <5% Deck Moisture | Shot Blast | 4-5 hr @ 77 F | No Magnesium Phosphate | Any age, substrate must be sound | 3-5+ years (surface); 7-10+ (cracks) | OH, PA and NH (supplemental specs) | |
| Enviroseal 40 | BASF Corporation www.buildingsystems.basf.com | Silane | 40°-110° F; No rain or below 40° F for 12 hours after app. | Fully cured; clean; no coatings | Typical dry time is approx 4 hrs at 70° F/50% humidity. High humidity extends dry time. | Cementitious patch mat'l; fully cured; no coating/curing cmpd | Fully Cured; clean; sound; Dry is best, but slightly damp OK | Varies based upon exposure and substrate. 3 years or longer when properly applied | CT, FL, IL, IN, ME, MA, MI, NM, NY, OH, PA, RI, AD, TN, WV, WI | NCHRP 244 Series II-cube test; NCHRP 244 IV-Southern Climate; ASHTO T259 & T260. See Data Guide for more info. |
| Hydrozo 100 | BASF Corporation www.buildingsystems.basf.com | Silane | 40° F or higher; No rain for 4 hours; OK down to 20° F if frost free | Fully cured; clean; No coatings | Typical dry time is approx 4 hrs at 70° F/50% humidity. High humidity extends dry time. | Cementitious patch mat'l; fully cured; no coating/curing cmpd | Fully Cured; clean; sound; Dry is best, but slightly damp OK | Varies based upon exposure and substrate. 5-7 years typ when properly applied | IL, ME, NY, OR, PA, VT | NCHRP 244 Series II-cube test; NCHRP 244 IV-Southern Climate; See Data Guide for more info. |
| Degadeck CSP | BASF Corporation www.buildingsystems.basf.com | MMA | 14°-104° F Substate Temp; Dry conditions | Fully cured; Clean; shotblast, gritblast, or brush-blast | Working time 10-15 min; 45-60 min cure | Cementitious patch mat'l fully cured; or MMA patch mat'l; | Fully Cured; clean; dry | Varies based upon exposure and movement in the substrate | CO, MD, MA, MN, NE, TN, VA | ASTM 638; See Data Guide for more info. |
| Sealate T-70MX30 | Transpo Industries, www.transpo.com | High Molecular Weight Methacrylate (HMWM) | 50 deg F min | shot blast reccomended | 5 hours min | compatable with most all patching materials | any age deck but should be in sound condition with no delaminations | excess of 10 years | ID, ME, MO, MT, NM, OR, TN, VA & WA | ASTM D2395, D1425, D1310, D93, D1644, D638, C3986, D695, D2369, C882, AASHTO T237 |
| Sealate T-70 | Transpo Industries, www.transpo.com | High Molecular Weight Methacrylate (HMWM) | 50 deg F min | shot blast reccomended | 5 hours min | compatable with most all patching materials | any age deck but should be in sound condition with do delaminations | excess of 10 years | AL, CA, FL, MO, NM, OH, RI & WA | ASTM D2395, D1425, D1310, D93, D1644, D638, C3986, D695, D2369, C882, AASHTO T237 |
| T-78 | Transpo Industries, www.transpo.com | Methyl Methacrylate | 40 deg F min | shot blast reccomended | 30 to 60 minutes | compatable with most all patching materials | any age deck but should be in sound condition with no delaminations | excess of 10 years | MN & MO | ASTM D2849, D1310, D1644, D638 & D3986 |

# Advanced Technology Products for Transportation

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