



Florida Department of Transportation

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MEMORANDUM

DATE: February 13, 2008
TO: Specification Review Distribution List
FROM: Duane F. Brautigam, P.E., State Specifications Engineer
SUBJECT: Proposed Specifications Change: 9300000-Materials for Concrete Repair

In accordance with Specification Development Procedures, we are sending you a copy of a proposed new specification change for Materials for Concrete Repair.

This change was proposed by Tom Malerk of the State Materials Office to provide an acceptability method for evaluating products based on the product application.

Please share this proposal with others within your responsibility. Review comments are due within four weeks and should be sent to Mail Station 75 or to my attention via e-mail at SP965DB or duane.brautigam@dot.state.fl.us. Comments received after March 12, 2008 may not be considered. Your input is encouraged.

DFB/dm

Attachment

COMMENTS:

Submitted by:

Phone #:

MATERIALS FOR CONCRETE REPAIR.
(REV 01-09-08)

SECTION 930 (Pages 807 - 812) is deleted and the following substituted:

SECTION 930
MATERIALS FOR CONCRETE REPAIR

930-1 Description.

This Section covers *cementitious* materials used to repair ~~voids in~~ concrete including defects or purposely placed openings in concrete elements. Materials containing organic compounds, such as bitumens and epoxy resin as the principal binder are not included. The requirements for epoxy resin materials ~~is~~ *are* covered in Section 926.

930-2 Product Acceptance on the Project.

930-2.1 Product Acceptance: Use only products listed on the Department's Qualified Products List (QPL). Manufacturers seeking evaluation of products must submit an application in accordance with Section 6 and include independently certified test reports that the material meets the requirements of this Section. ~~The instruction for the maximum water to cementitious material ratio and formulation for two or more component systems will be required when submitting the application for QPL approval.~~ *The application must describe detailed quality control requirements for installation including, but not limited to: maximum water to cementitious material ratio, formulation for two or more component systems special materials and/or equipment, recommendations for cleaning/preparing substrate surfaces, and curing requirements.*

Provide the Engineer certification conforming to the requirements of Section 6 from the manufacturer confirming that the material(s) used meets the requirements of this Section and is the appropriate product for the intended use.

When specified in the Contract Documents, furnish a report of test results from an independent laboratory on samples taken from material shipped. Ensure the test was performed within 45 days prior to the shipping date of the material.

930-2.2 Material Supply, Storage, and Marking: The material shall be pre-proportioned including aggregate. Deliver products in original, unopened containers with manufacturer's name, date of manufacture, expiration date, product identification label and batch numbers. Store the material in an elevated dry and weather protected enclosure in full compliance with the manufacturer's recommendations. Material must be used within manufacturer's recommended shelf life.

The material from which the containers are made shall have water vapor transmission not greater than 2,048 lb/ft² in 24 hours as determined in accordance with Procedure B of ASTM E 96.

All containers shall be marked with the following information:

- (a) LOT identification number and material expiration date
- (b) Directions for use shall include but are not limited to the following:

(1) The type and kind of adhesive recommended (if any) to bond fresh repair material to the concrete or mortar being repaired.

(2) The recommended amount of resin, other liquid component, or both, to be mixed with the package contents.

(3) The recommended length of mixing time or sequence of mixing and resting times in minutes.

(c) Date the material was packaged.

(d) The yield in cubic feet or yield in ft²/in thickness when mixed with the recommended amount of liquid.

(e) The net ~~weight~~-*mass* in each container. (The contents of any container shall not vary by more than 2% from the ~~weight~~-*mass* stated in markings. The average ~~weight~~-*mass* of filled containers in a LOT shall be not less than the ~~weight~~-*mass* stated in the markings.)

(f) Instructions for the maximum and minimum water (or solutions) to cementitious material ratio.

(g) Define the approximate working time.

930-2.3 Sampling, Mixing, and Additional Testing: A LOT is the packaged repair material normally placed on a pallet. A unit sample is a single container or package of material randomly selected from the LOT. Mix and install the material(s) in accordance with the manufacturer's recommendations. Manufacturers will be required to provide field representation upon request by the Engineer. The Department reserves the right to conduct further field testing ~~if desired~~ *on any approved material*-~~approved~~.

930-2.4 Rejection: All broken containers will be rejected. Material that fails to meet any of the requirements of this Specification will be rejected. Report all materials failing to meet this specification and state the reason(s) for rejection in writing to the Engineer and the producer or supplier. Material in local storage in the hands of a vendor for more than six months after testing will be retested before use, except for the scaling resistance test and length change immersed in sulfate solution test for Magnesium Ammonium Phosphate Concrete. Retested material will be rejected if it fails to conform to any of the requirements of this Specification.

930-2.5 Chemical Requirements: The material shall not contain total chlorides or other corrosive ingredients in excess of 0.40 lb/yd³ of the hardened concrete when used in reinforced and prestressed structures. Chloride determination shall be made in accordance with FM 5-516.

930-2.6 Laboratory Specimen Preparation.

930-2.6.1 Concrete: *Packaged, dry concrete material shall contain aggregate of which more than 5% by ~~weight~~-mass of the total mixture is retained on a 3/8 inch sieve. This material can be used for repairing concrete with a depth up to six inches. Any depth larger than this shall be repaired with Portland cement concrete meeting the requirements of Section 346.*

Mechanically mix the packaged, dry concrete material with water and/or mixing liquid. Prepare and test three test specimens for each age of all of the hardened tests and each level of mixing temperature in accordance with ASTM C 31.

(a) The sample of packaged dry material shall be any combination of whole packages yielding not less than 0.667 ft³ [~~0.0188 m³~~] of hardened material.

(b) Use only water, other liquid component or both based on the manufacturer's recommendation. Measure the amount of liquid needed based on the quantity per bag stated in the instructions for use.

(c) Place the sample in the mixing machine and add the required amount of liquid. Start mixing immediately and continue mixing for the length of time indicated in the directions for use.

(d) When performing the slump test, schedule work so the test will be completed in 15 ± 1/2 minutes after mixing the liquid with the rapidly hardening materials.

(e) Mold the required number of specimens using additional samples as may be necessary, mixing in accordance with (a) through (d).

Use 4" by 8" cylinders to mold specimens where nominal aggregate size is smaller than ~~one~~ one inch.

930-2.6.2 Mortar: Packaged, dry mortar material may contain aggregate of which less than 5% by mass of the total mixture is retained on a 3/8 inch sieve. These materials may not be extended by the addition of aggregate in the field. This material can be used for repairing concrete with a depth up to six inches. Any depth larger than this shall be repaired with Portland cement concrete meeting the requirements of Section 346.

Mechanically mix the packaged, dry mortar material with mixing liquid. Prepare and test three test specimens for each age of all of the hardened tests and each level of mixing temperature in accordance with ASTM C 109.

(a) The sample obtained from the packaged dry material shall weigh 6.6 ± 0.05 lbs and shall be representatively obtained from a whole package in accordance with FM 1-T 248.

(b) Base the quantity of water, or other liquid component, or both added during mixing on the quantity per unit of weight stated in the directions for use.

(c) When performing the flow test, schedule work so the test will be completed in $15 \pm 1/2$ minutes after mixing the liquid with the rapidly hardening materials.

(d) Mold the required number of specimens using additional samples as necessary mixing in accordance with (a) through (c).

930-2.6.3 Temperature: In those cases where the manufacturer has indicated in the package markings, or elsewhere, that the packaged repair material can be mixed and applied at temperatures that lie beyond the range of 55°F to 85°F, the product must be tested at the extreme of those temperatures. Specimens shall be mixed, molded and cured during the first three hours within $\pm 2^\circ\text{F}$ of the extreme temperature(s) stated by the manufacturer in the package markings.

930-2.6.4 Length Change: Make and cure the test specimens in accordance with ASTM C 157, except omit the curing period in Section 10.3; however both 11.1.1 and 11.1.2 shall apply for 28 day curing period. The average length change of the test specimens for each preparation temperature and for each storage condition after 28 days shall meet the requirements as shown below.

930-2.6.5 Time of Setting: Initial time of set for concrete materials will be tested in accordance with ASTM C 403. Initial time of set for mortar materials will be tested in accordance with ASTM C 191.

930-2.6.6 Manifestly Faulty Specimens: Visually examine each group of specimens representing a given test or a given age of test, including tests of freshly mixed concrete, before or during the test, or both, whichever is appropriate. Discard any specimen found to be manifestly faulty by such examination without testing. Visually examine all specimens representing a given test at a given age after testing, and should any specimen be found to be manifestly faulty the test results thereof shall be disregarded. Should more than one specimen representing a given test at a given age be found manifestly faulty either before or after testing, the entire test shall be disregarded and repeated. The test result reported shall be the average of the individual test results of the specimens tested or, in the event that one specimen or one result has been discarded, it shall be the average of the test results of the remaining specimens.

930-3 Materials for Repair of Predominately Horizontal Surfaces. Cementitious Concrete or Mortar Materials for Rapid Repairs.

930-3.1 General: Packaged, dry concrete material shall contain aggregate of which more than 5% by weight of the total mixture is retained on a 3/8 inch sieve.

————— Packaged, dry mortar material may contain aggregate of which less than 5% by weight of the total mixture is retained on a 3/8 inch sieve. These materials may not be extended by the addition of aggregate in the field.

————— Aqueous solutions compounds and aqueous emulsions or dispersions compounds may be used to replace some or all of the required mixing water. These liquids must be furnished as components of the packaged materials. *This material is intended to be used to repair concrete where the area to be treated will be on a horizontal surface. Examples of the type of locations for these materials are bridge decks, Portland cement concrete pavements and other locations required by the Contract Documents. Follow the manufacturer's recommendations for preparing the surfaces and for mixing, placing, and curing the concrete unless otherwise directed in the Contract Documents*

930-3.2 Classification: The materials to be considered as alternates *under this classification* shall meet the following requirements:

930-3.2.1 Rapid Hardening: Moderate compressive strength for repairing concrete with an original *in-place* compressive strength less than or equal to 4,000 psi.

930-3.2.2 Very Rapid Hardening: High compressive strength for repairing concrete with an original *in-place* compressive strength greater than 4,000 psi.

930-3.3 Physical Properties: The repair material shall meet or exceed the specified physical properties stated in Table 1 as determined by the following *specified* standard test methods.

Table 1 Physical Properties			
Requirement	Rapid Hardening	Very Rapid Hardening	Test Method
Minimum Compressive Strength			
3 hours, psi	500	2,000	ASTM C 39 or ASTM C 109
24 hours, psi	2,000	4,000	
7 day, psi	4,000	6,000	
28 day, psi	The strength at 28 days shall not be less than the strength at seven days.		
Maximum Length Change (at 28 days)			
Allowable increase in water cured, based on length at one day, %	+0.15	+0.15	ASTM C 157 ASTM C 157 ASTM C 157
Allowable decrease in air cured, based on length at one day, %	-0.15	-0.15	
Allowable difference between increase in water and decrease in air determination, %	0.20	0.20	
Minimum Consistency			
Slump (Concrete), inches	3	3	ASTM C 143
Flow (Mortar), %	100	80	ASTM C 1437
Time of Setting			

Table 1 Physical Properties			
Requirement	Rapid Hardening	Very Rapid Hardening	Test Method
Initial Set, minutes	30 to 60	10 to 29	ASTM C 191 or ASTM C 266
Bond Strength by Slant Shear, psi [MPa]			
24 hours	400 [2.76]	400 [2.76]	
7 days			

Table 1 - Physical Properties of Repair Materials for Horizontal Surfaces			
Requirement	Test Method	Rapid Hardening	Very Rapid Hardening
Minimum Compressive Strength, psi [MPa]			
3 hours	ASTM C 39* or ASTM C 109*	500 [3.45]	2,000 [13.79]
24 hours		2,000 [13.79]	4,000 [27.58]
7 days		4,000 [27.58]	6,000 [41.37]
28 days		Greater than or equal to strength at 7 days.	
Maximum Length Change (at 28 days), %			
Allowable expansion in water cured compared to length at one day	ASTM C 157	0.12	0.12
Allowable shrinkage in air cured compared to length at one day		-0.12	-0.12
Allowable difference between increase in water and decrease in air		0.2	0.2
Minimum Slump (Concrete), inches [mm]	ASTM C 143	3 [75]	3 [75]
Minimum Flow (Mortar), %	ASTM C 1437	100	80
Time of Setting (Initial), minutes	ASTM C 191* or ASTM C 403*	30 to 60	10 to 29
Coefficient of Thermal Expansion, in/in/°F	ASTM C 531	5.0 x 10 ⁻⁶ to 9.0 x 10 ⁻⁶	5.0 x 10 ⁻⁶ to 9.0 x 10 ⁻⁶
Minimum Bond Strength by Slant Shear, psi [MPa]			
24 hours	ASTM C 882	400 [2.76]	400 [2.76]
7 days		Greater than or equal to strength at 24 hours.	
* as applicable			

930-3.4 Specimen Preparation:

930-3.4.1 Concrete: Mechanically mix the packaged, dry concrete material with water and/or mixing liquid. Prepare and test three test specimens for each age of test and each

level of mixing temperature in accordance with ASTM C 31. The average strength of the test specimens for each age of test and each preparation temperature shall be not less than that prescribed in Table 1.

_____ (a) The sample of packaged dry material shall be any combination of whole packages yielding not less than $2/3 \text{ ft}^3$ of hardened material.

_____ (b) Base the quantity of water, other liquid component, or both added to the sample on the quantity per bag stated in the instructions for use.

_____ (c) Place the sample in the mixing machine and add the required amount of liquid. Start mixing immediately and continue mixing for the length of time indicated in the directions for use.

_____ (d) When performing the slump test, schedule work so the test will be completed in $5 \pm 1/2$ minute after the mixing liquid is added to the very rapid hardening materials or $15 \pm 1/2$ minute after mixing the liquid with the rapid hardening materials.

_____ (e) Mold the required number of specimens using additional samples as may be necessary, mixing in accordance with (a) through (d). Do not use the mixtures for molding test specimens when the slump test is less than that specified in Table 1.

_____ Where the nominal maximum particle size is not greater than 1 inch the use of 4 inch x 8 inch cylindrical molds is required. *Samples shall be prepared in accordance with 930-2.6.1 except schedule work that work shall be scheduled so the test for flow will be completed in $5 \pm 1/2$ minutes after the start of mixing liquid with the very rapid hardened materials or $15 \pm 1/2$ minutes after mixing the liquid with the rapid hardening materials. The temperature, length change, and time of set shall be performed in accordance with 930-2.6.3 through 930-2.6.5.*

930-3.4.2 Mortar: Mechanically mix packaged, dry mortar material with mixing liquid. Prepare and test three test specimens for each age of test and each level of mixing temperature in accordance with ASTM C 109. The average strength of the test specimens for each age of test and each preparation temperature shall be not less than that prescribed in Table 1.

_____ (a) The sample obtained from the packaged dry material shall weigh $6.6 \pm 0.05 \text{ lb}$ and shall be representatively obtained from a whole package in accordance with FM 1 T 248.

_____ (b) Base the quantity of water, or other liquid component, or both added during mixing on the quantity per unit of weight stated in the directions for use.

_____ (c) When performing the flow test, schedule work so the test will be completed in $5 \pm 1/2$ minute after the start of mixing liquid with the very rapid hardened materials or $15 \pm 1/2$ minute after mixing the liquid with the rapid hardening materials.

_____ (d) Mold the required number of specimens using additional samples as necessary mixing in accordance with (a) through (c). Do not use the mixtures for molding test specimens when the flow is less than that specified in Table 1.

_____ **930-3.4.3 Temperature:** In those cases where the manufacturer has indicated in the package markings, or elsewhere, that the packaged repair material can be mixed and applied at temperatures that lie beyond the range of 55°F to 85°F , the product must meet the requirements of Table 1. Specimens shall be mixed, molded and cured during the first three hours within $\pm 2^\circ\text{F}$ of the extreme temperature(s) stated by the manufacturer in the package markings.

_____ **930-3.4.4 Length Change:** Make and cure the test specimens in accordance with ASTM C 157, except omit the curing period in Section 10.3; however both 11.1.1 and 11.1.2 shall apply for 28 day curing period. The average length change of the test specimens for each preparation temperature and for each storage condition after 28 days shall meet the requirements

shown in Table 1. *Samples shall be prepared in accordance with 930-2.6.2 except ~~schedule work~~ that work shall be scheduled so the test for flow will be completed in $5 \pm \frac{1}{2}$ minutes after the start of mixing liquid with the very rapid hardened materials or $15 \pm \frac{1}{2}$ minutes after mixing the liquid with the rapid hardening materials. The temperature, length change, and time of set shall be performed in accordance with 930-2.6.3 through 930-2.6.5.*

930-3.4.5 Manifestly Faulty Specimens: Treat manifestly faulty specimens in accordance with ASTM C 494 Section 15.2.Requirement	Rapid Hardening	Test Method
3 hours	500 [3.45]	ASTM C 39 or ASTM C 109
24 hours	2,000 [13.79]	
7 days	4,000 [27.58]	
28 days	This strength shall not be less than the strength at seven days.	
Allowable expansion in water cured compared to length at one day	+0.12	ASTM C 157
Allowable shrinkage in air cured compared to length at one day	-0.12	
Allowable difference between increase in water and decrease in air	0.20	
Slump (Concrete), inches [mm]	3	ASTM C 143
Flow (Mortar), %	100	ASTM C 1437
Time of Setting (Initial), minutes	30 to 60	ASTM C 191 or ASTM C 403
Coefficient of Thermal Expansion, in/in/°F	5.0×10^{-6} to 9.0×10^{-6}	ASTM C 531
Bond Strength by Slant Shear, psi [MPa]		
24 hours	400 [2.76]	ASTM C 882

930-4 Materials for Repair of Predominately Vertical Surfaces.

930-4.1 General: *This material is intended to be used to repair concrete where the area exposed in the field to be treated will be on a vertical surface. If an element has both horizontal and vertical surfaces, then the repair used will be for vertical surfaces. If it is not apparent which material is to be used, the vertical application will prevail. Examples of the type of locations for these materials are columns, caps, beams, piles, incidental concrete products, drainage structures and other locations required by the Contract Documents. Follow the manufacturer's recommendations for preparing the surfaces and for mixing, placing and curing the concrete.*

930-4.2 Physical Properties: *The repair material shall meet or exceed the physical properties stated in Table 2 as determined by the specified test methods.*

<i>Table 2 - Physical Properties of Repair Materials for Vertical Surfaces*</i>		
<i>Requirement</i>	<i>Test Method</i>	<i>Test Value</i>
<i>Minimum Compressive Strength, psi [MPa]</i>		
<i>24 hours</i>	<i>ASTM C 39** or ASTM C 109**</i>	<i>2,000 [13.79]</i>
<i>7 days</i>		<i>5,000 [34.47]</i>
<i>28 days</i>		<i>Greater than or equal to strength at 7 days</i>
<i>Maximum Length Change (at 28 days), %</i>		
<i>Allowable expansion in water cured compared to length at one day</i>	<i>ASTM C 157</i>	<i>0.12</i>
<i>Allowable shrinkage in air cured compared to length at one day</i>		<i>-0.08</i>
<i>Allowable difference between increase in water and decrease in air</i>		<i>0.2</i>
<i>Maximum Slump (Concrete), inches [mm]</i>	<i>ASTM C 143</i>	<i>3-[75] ***</i>
<i>Maximum Flow (Mortar), %</i>	<i>ASTM C 1437</i>	<i>100</i>
<i>Time of Setting (Initial), minutes</i>	<i>ASTM C 191** or ASTM C 403**</i>	<i>10 to 60</i>
<i>Coefficient of Thermal Expansion, in/in/°F</i>	<i>ASTM C 531</i>	<i>5.0 x 10⁻⁶ to 9.0 x 10⁻⁶</i>
<i>Minimum Bond Strength by Slant Shear, psi, [MPa]</i>		
<i>24 hours</i>	<i>ASTM C 882</i>	<i>750 [5.17]</i>
<i>7 days</i>		<i>Greater than or equal to strength at 24 hours.</i>
<i>Minimum Flexural Strength, psi [MPa]</i>	<i>ASTM C 580</i>	<i>750 [5.17]</i>
<i>Maximum Absorption (Mortar at 7 days), %</i>	<i>ASTM C 413</i>	<i>4</i>
<i>Minimum Surface Resistivity (Concrete at 28 days), KOhm-cm</i>	<i>FM 5-578</i>	<i>22</i>
<i>* use cement based materials modified with polymers and silica fume for extremely aggressive environments</i>		
<i>**as applicable</i>		
<i>***for pump and pour applications, the slump can be adjusted according to the contract documents</i>		

930-4.3 Specimen Requirements:

930-4.3.1 Concrete: Samples shall be prepared in accordance with 930-2.6.1, 930-2.6.3 through 930-2.6.5.

930-4.3.2 Mortar: Samples shall be prepared in accordance with 930-2.6.2 through 930-2.6.5.

930-4.5 ~~Magnesium Ammonium Phosphate Concrete (MAPC)~~ Material for Repair of Concrete in High Stress Concentration Areas.

930-45.1 General: ~~MAPC is intended to be used to repair block-outs and holes in post-tensioned boxes and girders and other locations required by the Contract Documents. Follow the~~

manufacturers recommendations for preparing the surfaces and for mixing, placing and curing the concrete. This material is intended to be used to repair block-outs and holes in post-tensioned elements, load bearing area of a beam, and other locations required by the Contract Documents. Follow the manufacturer's recommendations for preparing the surfaces and for mixing, placing and curing the concrete. This material shall be a magnesium ammonium phosphate based concrete (MAPC).

930-45.2 Physical Properties: The MAPC material shall meet or exceed the specified physical properties stated in Table 2-3 as determined by the following *specified* standard test methods.

Table 2 Physical Properties		
Requirement	Test Value	Test Method
Minimum Compressive Strength at 28 days, psi	8,500 psi	ASTM C 109*
Minimum Flexural Strength at 28 days, psi	600 psi	ASTM C 348*
Minimum Slant Shear Bond at 14 days, psi	2,500 psi	ASTM C 882*
Time of Setting		
Initial Set, minutes, minimum time	15	ASTM C 266***
Sealing Resistance	No scaling	ASTM C 672
Maximum Length Change		
Wet Cure at 28 days, %	0.03	ASTM C 157 ASTM C 596
Dry Cure at 28 days, %	0.03	
Sulfate Resistance after 52 week of immersion, %	0.1	ASTM C 1012
Maximum Chloride Absorption at 21 days, %	1.5	NCHRP T-244**
* Modified test methods for air curing instead of moist curing.		
** Use cube specimens meeting the requirements of ASTM C 109.		
*** Specimen shall be tested at a minimum of 95 °F		

Table 3 - Physical Properties of Repair Material in High Load Areas		
Requirement	Test Method	Test Value
Minimum Compressive Strength (at 28 days), psi {MPa}	ASTM C 109	8,500 {58.60}
Minimum Flexural Strength (at 28 days), psi {MPa}	ASTM C 348	600 {4.14}
Minimum Slant Shear Bond (at 14 days), psi {MPa}	ASTM C 882	2,500 {17.24}
Time of Setting (Initial), minutes	ASTM C 191	15 to 60
Maximum Scaling Resistance	ASTM C 672	No scaling
Maximum Length Change (at 28 days), %		
Allowable expansion in water cured compared to length at one day	ASTM C 157	0.03
Allowable shrinkage in air cured compared to length at one day		-0.03
Maximum Expansion due to Sulfate Resistance (after 52 week of immersion), %	ASTM C 1012	0.1

Maximum Chloride Absorption at 21 days, %	NCHRP 12-19A*	1.5
* Use cube specimens meeting the requirements of ASTM C 109.		

930-5.3 Specimen Requirements:

930-5.3.1 Mortar: Samples shall be prepared in accordance with 930-2.6.2 and 930-2.6.4.

930-5.3.2 Curing of Compressive Strength, Flexural Strength and Slant Shear Bond Specimens: The test methods for compressive strength (ASTM C 109), flexural strength (ASTM C 348), and Slant Shear Bond (ASTM C 882) shall be modified so that the specimens are air cured instead of moist cured. All of these samples shall be air cured ~~up unto~~ until the time of testing.

930-5.3.3 Time of Setting: Initial time of set for MAPC will be tested in accordance with ASTM C 191. The initial time of set shall be tested at a minimum of 95°F ~~±35 °C~~.

930-5-6 Packaged, Thermosetting Polymer Material For Concrete Repair.

930-56.1 General: This ~~Section~~ *material* covers packaged, thermosetting, polymer ~~material~~ *modified hydraulic cement* for rapid repairs to hardened ~~portland~~ *Portland* cement concrete pavement and structures. Only low odor materials, such as styrene diluted polyester resin, will be considered *permitted*.

If the area is being used for vehicular traffic, the repair material shall have a minimum compressive strength of 2,200 psi prior to opening to traffic or as noted in the plans.

930-56.2 Classification: The materials to be considered *permitted* as alternates shall meet the following requirements:

930-56.2.1 Type 1 Polymer: Moderate compressive strength for repairing concrete with an original compressive strength less than 4,500 psi.

930-56.2.2 Type 2 Polymer: Low modulus with a compressive strength less than 2,500 psi for repairing low quality and or moving concrete (across working cracks).

930-56.3 Physical Properties: The repair material shall meet or exceed the ~~specified~~ physical properties stated in Table ~~3-4~~ as determined by the ~~following~~ *specified* standard test methods.

Table 3 Physical Properties			
Requirement	Type 1 Polymer	Type 2 Polymer	Test Method
Minimum Compressive Strength			
3 hours, psi	1,500	800	ASTM C 579
24 hours, psi	3,500	1,500	
7 day, psi	4,500	2,000	
28 day, psi	The strength at 28 days shall not be less than the strength at seven days.		
Working Time	12 to 20 minutes	12 to 20 minutes	
Minimum Strength (at 7 days)			
PCC Bond, psi	3,500	2,000	ASTM C 882
Flexural, psi	1,800	800	ASTM C 580
Tensile, psi	900	400	ASTM C 307
Maximum Shrinkage, %	0.03	0.03	ASTM C 531
Maximum Expansion, per °F	0.000012	0.000012	ASTM C 531
<i>Table 4 - Physical Properties of Packaged, Thermosetting Polymer Materials</i>			

Table 3 Physical Properties			
Requirement	Type 1 Polymer	Type 2 Polymer	Test Method
Minimum Compressive Strength			
<i>Requirement</i>	<i>Test Method</i>	<i>Type 1 Polymer</i>	<i>Type 2 Polymer</i>
<i>Minimum Compressive Strength, psi [MPa]</i>			
3 hours	ASTM C 579	1,500 [10.34]	800 [5.52]
24 hours		3,500 [24.13]	1,500 [10.34]
7 days		4,500 [31.03]	2,000 [13.79]
28 days		Greater than or equal to 7 days	
Time of Setting (Initial), minutes	ASTM C 191	12 to 20 minutes	12 to 20 minutes
Minimum Slant Shear Bond (at 7 days), psi	ASTM C 882	3,500	2,000
Minimum Flexural Strength (at 7 days), psi	ASTM C 580	1,800	800
Minimum Tensile Strength (at 7 days), psi	ASTM C 307	900	400
Maximum Shrinkage, %	ASTM C 531	0.03	0.03
Maximum Expansion, per °F	ASTM C 531	0.000012	0.000012
Maximum Absorption (Mortar at 7 days), %	ASTM C 413	4	4
Minimum Surface Resistivity (Concrete at 28 days), KOhm-cm	FM 5-578	22	22

930-6.4 Specimen Requirements:

930-6.4.1 Mortar: Samples shall be prepared in accordance with 930-2.6.2, 930-2.6.3 and 930-2.6.5

930-6.4.2 Mixing: The catalyst, resin and aggregate blend shall be provided by the manufacturer and approved by the Department.

If the area is being used for vehicular traffic, the repair material shall have a minimum compressive strength of 2,200 psi prior to opening to traffic or as noted in the plans.

930-56.45 Constructability: Furnish to the Engineer for approval shop drawing as may be required to complete repairs in compliance with the design shown in the plans and the manufacturer's recommended repair system.

3 hours	500 [3.45]	2,000 [13.79]	ASTM C 39 or ASTM C 109
24 hours	2,000 [13.79]	4,000 [27.58]	
7 days	4,000 [27.58]	6,000 [41.37]	
28 days	This strength shall not be less than the strength at seven days.		

930-7 Special Fillers.

930-7.1 General: *This material is intended to be used as filler material and for rapid repairs to pile jacket structures and other locations specified in the Plans when no design mix concrete is available or a special filler is specified in the Contract Documents. Follow the requirements of Section 457 for preparing the surfaces, placing, testing and curing the concrete. Mix the material in accordance with the manufacturer's recommendations.*

930-7.2 Classification: *The materials to be considered under this classification shall meet the following requirements:*

930-7.2.1 Cathodic Protection (CP) Filler: *Provide cementitious based materials with a minimum cement content of 900 pounds of cement per cubic yard of mix. Material formulation must not contain fly ash, slag, silica fume or other mineral admixtures which may produce increased electrical resistance. The material shall not contain any chlorides or substances corrosive to metals.*

930-7.2.2 Non-Cathodic Protection (Non-CP) Filler: *Provide cementitious based materials with a minimum cement content of 900 pounds of cement per cubic yard of mix. The material shall not contain any chlorides or substances corrosive to metals.*

930-7.2.3 Extended Materials: *Where concrete filler materials are specified, approved mortar materials may be extended using 89 gradation aggregates from a certified FDOT approved source.*

930-7.3 Physical Properties: *The repair material shall meet or exceed the physical properties stated in Table 5 as determined by the specified standard test methods. Extended and non-extended materials shall meet the minimum requirements.*

<i>Table 5 - Physical Properties of Special Fillers</i>			
<i>Requirement</i>	<i>Test Method</i>	<i>Cathodic Protection</i>	<i>Non-Cathodic Protection</i>
<i>Minimum Compressive Strength, psi [MPa]</i>			
<i>24 hours</i>	<i>ASTM C 39* or ASTM C 109*</i>	<i>1,500 {10.34}</i>	<i>1,500 {10.34}</i>
<i>7 days</i>		<i>4,000 {27.58}</i>	<i>4,000 {27.58}</i>
<i>28 days</i>		<i>5,000 {34.47}</i>	<i>5,000 {34.47}</i>
<i>Maximum Length Change (at 28 days), %</i>			
<i>Allowable expansion in water cured compared to length at one day</i>	<i>ASTM C 157</i>	<i>0.12</i>	<i>0.12</i>
<i>Allowable shrinkage in air cured compared to length at one day</i>		<i>-0.12</i>	<i>-0.12</i>
<i>Allowable difference between increase in water and decrease in air</i>		<i>0.2</i>	<i>0.2</i>
<i>Slump (Concrete), inches[mm]</i>	<i>ASTM C 191* or ASTM C 403*</i>	<i>8 {200}</i>	<i>8 {200}</i>
<i>Time of Setting (Initial), minutes</i>	<i>ASTM C 191* or ASTM C 403*</i>	<i>30 to 90</i>	<i>30 to 90</i>
<i>Minimum Bond Strength by Slant Shear (at 7 days), psi [MPa]</i>	<i>ASTM C 882</i>	<i>750 {5.17}</i>	<i>750 {5.17}</i>
<i>Minimum Flexural Strength (at 7 days), psi [MPa]</i>	<i>ASTM C 580</i>	<i>750 {5.17}</i>	<i>750 {5.17}</i>
<i>Minimum Tensile Strength (at 7 days), psi [MPa]</i>	<i>ASTM C 307</i>	<i>200 {1.38}</i>	<i>200 {1.38}</i>
<i>Surface Resistivity (at 28 days), KOhm-cm</i>	<i>FM 5-578</i>	<i>15 or less</i>	<i>22 or greater</i>
<i>*as applicable</i>			

930-7.4 Specimen Requirements:

930-7.4.1 Concrete: Samples shall be prepared in accordance with 930-2.6.1, 930-2.6.3 through 930-2.6.5.

930-7.4.2 Mortar: Samples shall be prepared in accordance with 930-2.6.2 through 930-2.6.5.

930-7.5 Constructability: Furnish to the Engineer for approval shop drawing as may be required to complete repairs in compliance with the design shown in the plans and the manufacturer's recommended repair system.