930 MATERIALS FOR CONCRETE REPAIR (REV 6-29-20) (FA 7-1-20) (1-21)

ARTICLE 930-1 is deleted and the following substituted:

930-1 Description.

This Section covers cementitious materials used to repair concrete including defects or purposely placed openings in concrete elements. Materials containing organic compounds, such as bitumen and epoxy resin as the principal binder are not included. The requirements for epoxy resin materials are covered in Section 926. Any depth larger than the manufacturer's recommendation for the specific material shall be repaired with portland cement concrete meeting the requirements of Section 346.

SUBARTICLE 930-2.2 is deleted and the following substituted:

930-2.2 Material Supply, Storage, and Marking: The material shall be preproportioned including aggregate. Deliver products in original, unopened containers with manufacturer's name, date of manufacture, and clearly marked with all information described below. 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 100 g/m^2 in 24 hours as determined in accordance with Procedure B of ASTM E96.

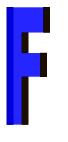
All containers shall be marked with the following information:

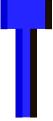
- 1. LOT identification number and material expiration date
- 2. Directions for use shall include but are not limited to the following:
- a. The type and kind of adhesive recommended (if any) to bond fresh repair material to the concrete or mortar being repaired.
- b. The recommended amount of resin, other liquid component, or both, to be mixed with the package contents.
- c. The recommended length of mixing time or sequence of mixing and resting times in minutes.
 - 3. Date the material was packaged.
- 4. The yield in cubic feet or yield in ft²/in. thickness when mixed with the recommended amount of liquid.
- 5. The net weight in each container. The contents of any container shall not vary by more than 2% from the weight stated in the declarations. The average weight of filled containers in a LOT shall be not less than the individual weight stated in the declarations.
- 6. Instructions for the maximum and minimum water (or solutions) to cementitious material ratio.
 - 7. State the approximate working time.











SUBARTICLE 930-4.3 is deleted and the following substituted:

930-4.3 Physical Properties: The repair material shall meet or exceed the physical properties stated in Table 930-1 as determined by the specified test methods.

Table 930-1 - Physical Properties of Repair Materials for Horizontal Surfaces				
Requirement	Test Method	Rapid	Very Rapid	
Requirement	Test Method	Hardening	Hardening	
Minimum Compressive Strength, psi				
3 hours	ASTM C39* or ASTM C109*	N/A	2,000	
24 hours		2,000	4,000	
7 days		4,000	6,000	
28 days		Greater than or equal to strength at 7 days.		
Maximum	Length Change, %			
Allowable expansion at 28 days when water cured compared to length at one	ASTM C157** ASTM C143***	0.12	0.12	
Allowable shrinkage at 28 days when air cured compared to length at one day		-0.12	-0.12	
Allowable difference between increase in water and decrease in air		0.20	0.20	
Minimum Slump (Concrete), inches		3	3	
Minimum Flow (Mortar), %	ASTM C1437***	100	80	
Time of Setting (Initial), minutes	ASTM C191* or ASTM C403*	Minimum 30	10 to 29	
Coefficient of Thermal Expansion, in/in/°F	ASTM C531* or AASHTO T336	3.0x 10 ⁻⁶ to 9.0 x 10 ⁻⁶	3.0 x 10 ⁻⁶ to 9.0 x 10 ⁻⁶	
Minimum Bond S	trength by Slant Sh	iear, psi		
24 hours		400	450	
7 days	FM 5-587		an or equal to at 24 hours.	
Maximum Allowable Total Chlorides lb/yd ³	FM 5-516	0.40		
* as applicable				

^{*} as applicable

^{**} 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.

^{***} Testing for flow/slump will be completed in 15 plus or minus 1/2 minute after the start of mixing liquid with the rapid hardening materials or 5 plus or minus 1/2 minute after mixing the liquid with the very rapid hardening materials.

SUBARTICLE 930-5.3 is deleted and the following substituted:

930-5.3 Physical Properties: The repair material shall meet or exceed the physical properties stated in Table 930-2 as determined by the specified test methods.

Table 930-2 - Physical Properties of Repair Materials for Vertical Surfaces*				
Requirement	Test Method	High	Ultra-high	
		Performance	Performance	
Minimum Compressive Strength, psi				
24 hours	ASTM C39** or ASTM C109**	1,000	2,000	
7 days		N/A	5,000	
28 days		5,000	Greater than or equal to strength at 7 days	
Maximo	um Length Change,	%		
Allowable expansion at 28 days when water cured compared to length at one day	ASTM C157**	0.12	0.12	
Allowable shrinkage at 28 days when air cured compared to length at one day		-0.08	-0.08	
Maximum Slump (Concrete), inches	ASTM C143	3****	3****	
Maximum Flow (Mortar), %	ASTM C1437	100****	100****	
Time of Setting (Initial), minutes	ASTM C191** or ASTM C403**	10 to 180****	10 to 180****	
Coefficient of Thermal Expansion, in/in/°F	ASTM C531*** or AASHTO T336**	3.0 x 10 ⁻⁶ to 9.0 x 10 ⁻⁶		
Minimum Bono	d Strength by Slant	Shear, psi,		
24 hours		450	750	
7 days	FM 5-587	750.	750	
Minimum Flexural Strength (at 7 days), psi	ASTM C580	500	700	
Maximum Absorption (Mortar at 7 days), %	ASTM C413	4	4	
Minimum Surface Resistivity (Concrete at 28 days), kohm-cm	AASHTO T358	N/A	22	
Maximum Allowable Total Chlorides lb/yd ³	FM 5-516	0.40		

Table 930-2 - Physical Properties of Repair Materials for Vertical Surfaces*			
Requirement	Test Method	High	Ultra-high
	Test Method	Performance	Performance

^{*} Use cement-based materials modified with polymers and silica fume for extremely aggressive environments

SUBARTICLE 930-6.2 is deleted and the following substituted:

930-6.2 Physical Properties: The MAPC and MPPC materials shall meet or exceed physical properties stated in Table 930-3 as determined by the specified standard test methods.

Table 930-3 - Physical Properties of Repair Material in High Stress Areas			
Requirement	Test Method	Test Value	
Minimum Compressive Strength (at 28 days), psi	ASTM C109*	8,500	
Minimum Flexural Strength (at 28 days), psi	ASTM C348*	600	
Minimum Slant Shear Bond (at 14 days), psi	FM 5-587*	2,500	
Time of Setting (Initial), minutes	ASTM C191**	15 to 60	
Maximum Scaling Resistance	ASTM C672	No scaling	
Maximum Length Change, %			
Allowable expansion at 28 days when water cured compared to length at one day	A CITY & C.1 5 Tababa	0.03	
Allowable shrinkage at 28 days when air cured compared to length at one day	ASTM C157***	-0.03	
Maximum Allowable Total Chlorides lb/yd ³	FM 5-516	0.40	

^{*} The test methods for compressive strength (ASTM C109), flexural strength (ASTM C348), and Slant Shear Bond (FM 5-587) shall be modified so that the specimens are air cured instead of moist cured. All of these samples shall be air cured until the time of testing.

SUBARTICLE 930-7.1 is deleted and the following substituted:

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. Meet the requirements of the contract documents for preparing the surfaces, placing, sampling, testing, and curing the concrete. Mix the material in accordance with the manufacturer's recommendations.

^{**} Make and cure the test specimens in accordance with ASTM C157, 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.
*** As applicable

^{****} For pump and pour applications, the maximum flow, slump and time of setting can be adjusted according to the manufacturer's recommendation.

^{**} Initial time of set for MAPC or MPPC will be tested in accordance with ASTM C191 with the following modification. The initial time of set shall be tested at 95° plus or minus 5°F.

^{***} 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.

SUBARTICLE 930-7.3 is deleted and the following substituted:

930-7.3 Physical Properties: The repair material shall meet or exceed the physical properties stated in Table 930-4 as determined by the specified standard test methods. If extended, materials shall meet the minimum requirements of Table 930-4.

	Cathodic Protection	Non- Cathodic			
		Protection			
	Minimum Compressive Strength, psi				
ASTM C39* or	1,500	2,000			
ASTM C109*	5,000	5,000			
ength Change, %					
ASTM C157**	0.12	0.12			
	-0.12	-0.12			
	0.20	0.20			
ASTM C143	7-9	7-9			
ASTM C1437	100	100			
ASTM C191* or ASTM C403*	200 to 400	200 to 400			
FM 5-587	450	450			
ASTM C580	700	700			
ASTM C307	200	200			
AASHTO T358	15 or less	22 or greater			
FM 5-516	0.4	40			
	ASTM C39* or ASTM C109* ength Change, % ASTM C157** ASTM C143 ASTM C1437 ASTM C191* or ASTM C403* FM 5-587 ASTM C580 ASTM C307 AASHTO T358	ASTM C39* or ASTM C109* 5,000 ength Change, % O.12 ASTM C157** O.20 ASTM C143 7-9 ASTM C1437 100 ASTM C191* or ASTM C403* FM 5-587 450 ASTM C580 700 ASTM C307 200 AASHTO T358 15 or less			

^{*} as applicable

^{**} Make and cure the test specimens in accordance with ASTM C157, 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.