

EXPECTED IMPLEMENTATION JULY 2020

932 NONMETALLIC ACCESSORY MATERIALS FOR CONCRETE PAVEMENT AND CONCRETE STRUCTURES (REV 12-3-19) (FA 1-22-20) (7-20)

SUBARTICLE 932-3.1 is deleted and the following substituted:

932-3 Fiber Reinforced Polymer (FRP) Reinforcing Bars.

932-3.1 General: Obtain FRP reinforcing bars from producers currently on the Department's Production Facility Listing. Producers seeking inclusion on the list shall meet the requirements of Section 105.

Use only solid, round, thermoset glass fiber reinforced polymer (GFRP) or carbon fiber reinforced polymer (CFRP) reinforcing bars. Bars shall be manufactured using pultrusion, variations of pultrusion, or other suitable processes noted in the producer's Quality Control Plan, subject to the approval of the State Materials Office (SMO). For GFRP, use only bars manufactured using vinyl ester resin systems and glass fibers classified as E-CR or R that meet the requirements of ASTM D578.

SUBARTICLE 932-3.3 is deleted and the following substituted:

932-3.3 Material Requirements: Producers shall submit to the State Materials Office, a test report of the physical and mechanical property requirements in Table 3-2 and Table 3-3 as applicable for the types and sizes of FRP reinforcing produced. Qualification testing shall be conducted by an independent laboratory approved by the Department for performing the FRP test methods.

Three production LOTS shall be randomly sampled at the production facility by a designee of the State Materials Office. The minimum number of specimens per production LOT shall be as indicated in Table 3-2 and Table 3-3. The coefficient of variation (COV) for each test result shall be less than 6%. Outliers shall be subject to further investigation per ASTM E178. If the COV exceeds 6%, the number of test specimens per production LOT may be doubled, a maximum of two times, to meet the COV requirement. Otherwise, the results shall be rejected. A production LOT is defined as a LOT of FRP reinforcing produced from start to finish with the same constituent materials used in the same proportions without changing any production parameter, such as cure temperature or line speed.

Property	Test Method	Requirement	Specimens per LOT
Fiber Mass Fraction	ASTM D2584 or ASTM D3171	$\geq 70\%$	5 ⁿ
Short-Term Moisture Absorption	ASTM D570, Procedure 7.1; 24 hours immersion at 122°F	$\leq 0.25\%$	5 ^m

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Property	Test Method	Requirement	Specimens per LOT
Long-Term Moisture Absorption	ASTM D570, Procedure 7.4; immersion to full saturation at 122°F	≤1.0%	5 ^m
Glass Transition Temperature (T _g)	ASTM D7028 (DMA) or ASTM E1356 (DSC; T _m)/ASTM D3418 (DSC; T _{mg})	≥230°F ≥212°F	3 ^m
Total Enthalpy of Polymerization (Resin)	ASTM E2160	Identify the resin system used for each bar size and report the average value of three replicates for each system	--
Degree of Cure	ASTM E2160	≥95% of Total polymerization enthalpy	3 ⁿ
Measured Cross-Sectional Area	ASTM D7205	Within the range listed in Table 3-1	10 ⁿ
Guaranteed Tensile Load ^a		≥ Value listed in Table 3-1	
Tensile Modulus		≥6,500 ksi for GFRP ≥18,000 ksi for CRFP	
Alkali Resistance with Load	ASTM D7705; Procedure B, set sustained load to 30% of value in Table 3-1; 3 months test duration, followed by tensile strength per ASTM D7205	≥ 70% Tensile strength retention	5 ^m
Transverse Shear Strength	ASTM D7617	>22 ksi	5 ⁿ
Bond Strength to Concrete, Block Pull-Out	ACI 440.3R, Method B.3 or ASTM D7913	>1.1 ksi	5 ^m

a – Guaranteed tensile load shall be equal to the average test result from all three lots minus three standard deviations.
n – Tests shall be conducted for all bar sizes produced.
m – Tests shall be conducted for the smallest, median, and largest bar size produced.

SUBARTICLE 932-3.4 is deleted and the following substituted:

932-3.4 Material Acceptance: Submit to the Engineer a certificate of analysis for each production LOT from the producer of the FRP reinforcing bars, confirming compliance with the requirements of this Section.

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932-3.4.1 Sampling: The Engineer will select a minimum of six straight bars with minimum lengths of 7 feet each and a minimum of five bent bars from each shipment, representing a random production LOT, per bar size of FRP reinforcing for testing in accordance with Table 3-4. Testing shall be conducted, at the Contractor's expense, by a Department approved independent laboratory. Each test shall be replicated a minimum of three times per sample. Submit the test results to the Engineer for review and approval prior to installation.

Property	Test Method	Requirement	Test Required for Straight Bar	Test Required for Bent Bar
Fiber Mass Fraction	ASTM D2584 or ASTM D3171	$\geq 70\%$	Yes	Yes – bent portion ^b
Short-Term Moisture Absorption	ASTM D570, Procedure 7.1; 24 hours immersion at 122°F	$\leq 0.25\%$	Yes	Yes – bent portion ^b
Glass Transition Temperature	ASTM D7028 (DMA) or ASTM E1356 (DSC; T_m)/ ASTM D3418 (DSC; T_{mg})	$\geq 230^\circ\text{F}$ $\geq 212^\circ\text{F}$	Yes	Yes – bent portion ^b
Degree of Cure	ASTM E2160	$\geq 95\%$ of Total polymerization enthalpy	Yes	Yes – bent portion ^b
Measured Cross-sectional Area	ASTM D7205	Within the range listed in Table 3-1	Yes	Yes – straight portion
Guaranteed Tensile Load ^a		\geq Value listed in Table 3-1	Yes	No
Tensile Modulus		$\geq 6,500$ ksi for GFRP $\geq 18,000$ ksi for CFRP	Yes	No

a – Guaranteed tensile load shall be equal to the average test result from all three lots minus three standard deviations.
b – Bent portion specimens shall be extracted from a central location within a 90° bend.

932-4 FRP Spirals for Concrete Piling.

FRP Spirals for reinforcing in concrete piling shall be CFRP conforming to the requirements of Section 933.