973 STRUCTURAL PLASTICS.
(REV 5-11-09) (FA 6-10-09) (1-10)

SECTION 973 (Pages 939-944) is deleted and the following substituted:

SECTION 973
STRUCTURAL PLASTICS

973-1 Description.

This work covers structural plastic (SP) components including fiberglass structurally reinforced composite piles (CP), fiberglass structurally reinforced composite lumber (SCL) and smaller dimensional fiberglass fiber reinforced composite lumber (FFRCL).

973-2 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.

In accordance with Section 6, provide manufacturer's certification that the material meets the requirements of this section.

973-3 Materials.

Use polyethylene made from recycled post consumer or post industrial thermoplastics. Mix the plastic with appropriate colorants, UV inhibitors, hindered amine light stabilizers and antioxidants so that the resulting product meets the material property requirements specified in Tables 1 and 2. Structural Plastic must not corrode, rot, warp, splinter or crack. The skin must be smooth and black in color unless otherwise specified in the Contract Documents. Skin is the surface material exposed to the atmosphere. Core is the material that surrounds and bonds to the fiberglass reinforcing rods. The use of separate materials for skin and core is at the discretion of each manufacturer; however, if a single material is used, that material must meet the requirements for both skin and core.

Manufacture Structural Plastic as one continuous piece with no joints or splices to the dimensions and tolerances in accordance with Table 3. Interior voids shall not exceed 3/4 inch in diameter. Structural Plastic shall be free of twist and curvature.

Reinforce 10"x10" fiberglass structurally reinforced composite lumber for use in heavy duty and medium duty fender systems with a minimum of four 1 1/2 inch fiberglass reinforcing rods placed in the corners of the section. Reinforce 10"x10" fiberglass structurally reinforced composite lumber for use in light duty fender systems with a minimum of four 1 inch fiberglass reinforcing rods placed in the corners of the section. Reinforce 16" O.D. Components including fiberglass structurally reinforced composite piles for use in heavy duty fender systems with a minimum of sixteen 1 1/2 inch fiberglass reinforcing rods. Reinforce 16" O.D. Components including fiberglass structurally reinforced composite piles for use in medium duty fender systems with a minimum of sixteen 1 inch fiberglass reinforcing rods.

Reinforcing rods must be continuous and offer a minimum flexural strength of 70.0 ksi when tested in accordance with ASTM D 4476 and a minimum compressive strength of 40.0 ksi when tested in accordance with ASTM D 695. Steel reinforcing rods are not permitted.

Reject any sections of structural plastic containing cracks or splits. Also, inspect the ends of the reinforcing rods and reject any sections containing reinforcing rods with voids or cracks.

Add a minimum of 15% (by weight) chopped fiberglass reinforcement to the polyethylene used for fiberglass structurally reinforced composite lumber, a minimum of 5% (by weight) chopped fiberglass reinforcement for components including fiberglass structurally reinforced composite piles and a minimum of 15% (by weight) chopped fiberglass reinforcement for smaller dimensional fiberglass fiber reinforced composite lumber. The fiberglass reinforcement may be reduced when other means of controlling cracking are specified with test results which show long term cracking is nonexistent.

Fiberglass structurally reinforced composite lumber must meet the minimum structural properties listed in Tables 4A and 4B.

Smaller dimensional fiberglass fiber reinforced composite lumber must meet the minimum physical properties listed in Table 5.

Components including fiberglass structurally reinforced composite piles must meet the structural properties listed in Tables 6A and 6B.

Table 1
Plastic Material Properties- CP and SCL

Density	ASTM D792	Skin	55-63 pcf
Density	ASTM D792	Core	48 – 56 pcf
Water Absorption	ASTM D570	Skin	2 hrs:<1.0% weight increase 24 hrs:<3.0% weight increase
Brittleness	ASTM D746	Skin	Brittleness temperature to be less than -40 deg. C
Impact Resistance	ASTM D256 Method A (Izod)	Skin	Greater than 0.55 ft-lbs/in
Hardness	ASTM D2240	Skin	44-75 (Shore D)
Ultraviolet	ASTM D4329 UVA	Skin	500 hours<10% change in Shore D Durometer Hardness
Abrasion	ASTM D4060	Skin	Weight Loss: <0.02 ozCycles=10,000 Wheel=CS17 Load-2.2 lb
Chemical Resistance	ASTM D756	Skin/Core Sea Water Gasoline No. 2 Diesel	 <1.5% weight increase < 9.5% weight increase <6.0% weight increase
Tensile Properties	ASTM D638	Core	Minimum 2200 psi at break
Compressive Modulus	ASTM D695	Core	Minimum 40 ksi
Static Coefficient of Friction	ASTM D1894	Skin	Maximum 0.25, wet
Nail Pull-Out	ASTM D 6117	Skin/Core	Minimum 60 lb

Table 2
Plastic Material Properties FFRCL

Density	ASTM D 792	50-65 pcf

Table 2 Plastic Material Properties FFRCL		
Impact Resistance	ASTM D256 Method A (Izod)	Greater than 2.0 ft-lbs/in
Hardness	ASTM D2240	44-75 (Shore D)
Ultraviolet	ASTM D4329 (UVA)	500 hours <10% change in Shore D Durometer Hardness
Abrasion	ASTM D4060	Weight Loss: <0.02 oz Cycles = 10,000 Wheel = CS17 Load -2.2 lb
Chemical Resistance	ASTM D756 Sea Water Gasoline No. 2 Diesel	 <1.5% weight increase <7.5% weight increase <6.0% weight increase
Tensile Properties	ASTM D638	Minimum 3000 psi at break
Static Coeffecient of Friction	ASTM D2394	Minimum 0..25, wet or dry
Nail Pull-Out	ASTM D 6117	Minimum 250 lb
Screw Withdrawal	ASTM D6117	Minimum 400 lb

Table 3 Dimensions and Tolerances		
Structural Plastic	Dimension	Tolerance
Length	Per order (80 ft Maximum)	0/+6 inch
Width – SCL Width – FFRCL	See Contract Plans	±1/2 inch ±1/4 inch
Height – SCL Width – FFRCL	See Contract Plans	±1/2 inch ±1/4 inch
Diameter – CP	See Contract Plans	±1/2 inch
Corner Radius – SCL Corner Radius – FFRCL	1 1/2 inch 1/4 inch	±1/2 inch ±1/16 inch
Skin Thickness	3/16 inch minimum	n/a
Distance from outer surface to center rebar elements (SCL)	2 inches	±1/4 inch
Distance from outer surface to center rebar elements (CP)	1 3/8 inches	±1/4 inch
Straightness (gap, bend or inside while lying on a flat surface)		<1 1/2 inches per 10 feet

Table 4A Structural Properties for Heavy Duty and Medium Duty SCL	
Member Size	10 inches x 10 inches
Modulus of Elasticity as derived below	521 ksi
Stiffness, E.I.	4.05E+08 lb-inch^2
Yield Stress in Bending	5.8 ksi

Weight	30-37 lb/ft

Table 4B Structural Properties for Light Duty SCL	
Member Size	10 inches x 10 inches
Modulus of Elasticity as derived below	307 ksi
Stiffness, E.I.	2.39E+08 lb-inch^2
Yield Stress in Bending	3.4ksi
Weight	28-35 lb/ft

Table 5 Properties for FFRCL	
Modulus of Elasticity ASTM D 6109	306,000 psi
Flexural Strength ASTM D 6109	2,500 psi
Compressive Strength ASTM D 6108	2200 psi
Compressive Strength Perpendicular to grain ASTM D 6108	700 psi

Table 6A Structural Properties for Heavy Duty CP	
Member Size	16 inch O.D.
Modulus of Elasticity as derived below	1,146 ksi
Stiffness, E.I.	3.69E+09 lb-inch^2
Yield Stress in Bending	9.1 ksi
Weight	68-83 lb/ft

Table 6B Structural Properties for Medium Duty CP	
Member Size	16 inch O.D.
Modulus of Elasticity as derived below	622 ksi
Stiffness, E.I.	2.0E+09 lb-inch^2
Yield Stress in Bending	4.9 ksi
Weight	61-74 lb/ft

The following bending test is required to determine the structural properties listed in Tables 4A, 4B, 6A and 6B. The values stated in these tables are the required minimums.

Determine the modulus of elasticity and yield stress for CP and SCL using the following test. The test specimens shall be full size and of manufacturers standard commercial type. Test the specimens using a three point bend test with the applied load at the center of a simply supported span. The distance between supports shall be 16 times the depth of the specimen with an overhang distance beyond each support equal to 10% of the span length. The loading nose and supports shall have cylindrical surfaces for the SCL tests. In order to minimize excessive indentation at the nose and support locations the radius of the nose and supports shall be at least 0.5”. The loading nose and supports for the CP tests shall be a saddle of same diameter as the

pile and subtending an angle of 15 degrees and bearing length of 2". The loading shall be applied such that the deflection rate at the load location equals 2 inches/minute +- 10%.

Yield stress shall be evaluated at maximum P or at P for 1% strain whichever is less. In the event a specimen will neither break nor show true yield point at outer fiber strains up to 3%, the yield stress shall be evaluated using the load P at 1% strain.

Yield stress Fy = (P*L)/(4*S)
Where:
P = Load as stated above
L = Span length
S = Section modulus of gross section

Stiffness EI = (P'*L^3)/(48*delta)
Where:
P' = Load that is ½ P yield
L = Span length
delta = Deflection at the location of load corresponding to P'

Modulus of Elasticity E = EI/Ig
Where:
EI = calculated from load deflection curve above
Ig = gross moment of inertia