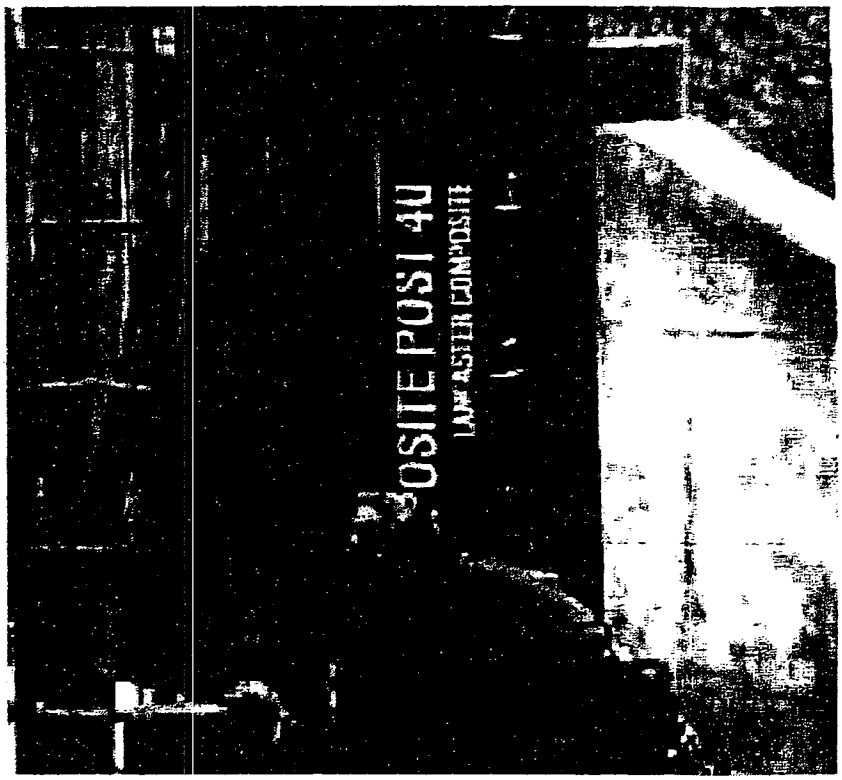
SUPPORTING INFORMATION FOR PROPOSAL NO. 19

COMPOSITE POST 40

MARINE PILING & STRUCTURALS



LANCASTER COMPOSITE, INC.
design engineers/manufacturers of Composite Posts

1000 Houston Street, P.O. Box 247, Columbia, PA 17512-0247
tel 717-684-4440 fax 717-684-4445

COMPOSITE POST 40™

There is an ever increasing demand for piling made of materials that exhibit more beneficial characteristics than have been traditionally available. Lancaster Composite, Lancaster, PA has responded to this need with the introduction of the Composite Post 40™ product line.

Composite Post 40™ delivers the bending strength of sch. 40 steel with the flexural stiffness of wood. Where strength, energy absorption, durability and a positive environmental impact are required, Composite Post 40™ is the choice.

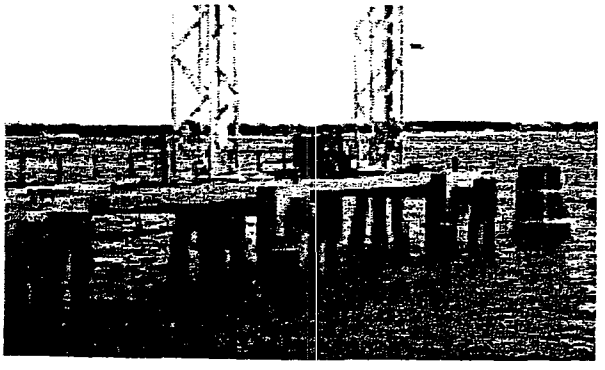
A truly superior product must meet the standard performance demands and deliver with affordable cost. Composite Post 40™ accomplishes this with innovative design efficiency. Composite Post 40™ incorporates space age technology and advanced materials to build the most cost effective concrete piling available.

DESIGN

Composite Post 40 marine piles consist of a Fiber Reinforced Polymer (FRP) shell which acts compositely with a high strength concrete core. Structural behavior of the piles in flexure and tension primarily utilize the capacity of the FRP shell. In compression and shear, however, the concrete core is the primary structural element. Tests have indicated that proper concrete mix designs and production methods can produce sufficient bond of the FRP shell and concrete core for the piles to act compositely. Further the FRP shell protects the concrete core from damage while providing external reinforcement. The concrete core provides dimensional stabilty of the FRP shell, enabling the shell to develop its full flexural capacity without crimping or local buckling. Together they produce a superior product having the best capability of both materials.

FULL SYSTEMS DESIGN

STRUCTURAL PILES FOR PIERS, DOCKS, WHARFS, BOARDWALKS & SEAWALLS; FENDERING, DOLPHIN CLUSTERS, MONOPILES; NAVIGATIONAL AIDS; FOUNDATION PILES, COLUMNS.



MARINE PILING MATERIALS: advantages/disadvantages

Materials	Advantages	Disadvantages
Wood	• standard in industry • marine structure designs using wood are common • inexpensive initially	• rots • subject to marine borers, termites, worms, etc.; severe damage can occur very quickly • increasingly regulated due to toxic chemicals • Hazmat: increasing costs to safely install and dispose due to toxic chemicals • only 10-15 year life cycle • increasing, critical shortage of uniform long-lengths....leading to high prices • unreliable design loads
Aluminum	• corrosive resistant, though surface decay must be taken into account; best use is in freshwater only	• very expensive • electrolysis can corrode surface quickly • most alloys are very much effected by salt metallic finish is undesirable
Steel	• reliable strength • marine structure designs using steel are common	• rust/corrosion is a BIG problem • maintenance is extremely labor intensive rehab work is very expensive
Concrete	• reliable strength • lower price than steel • marine structure designs using concrete are common	• cracks and spalls due to exposure to corrosive factors (salt, water) • quality control is a major problem • particularly poor performance in freeze/thaw environment • corrosion mitigation measures costly and of limited effectiveness • potential to crack during handling and driving • contains metal cabling or cages that rust • not off-the-shelf, stocked item subject to attack by concrete borers in certain loads
Composites	• cannot rot, rust, or corrode • not subject to marine borers and ship worm damage • uniform piles available in any length, in any quantity • easy to handle and drive • electromagnetically invisible • not hazmat • low/no maintenance • color available • low price and life-cycle cost • greatly extended service life • reliable design loads • off-the-shelf product with established standard performance	• engineers unfamiliar with material • perceived as "new" material

BENEFITS OF COMPOSITE POST 40

STRENGTH	Equal to/or greater than the strength of Sch. 40 Steel pipe of the same diameter.
DEFLECTION / MEMORY	Beneficial property where the post/pile deflects three times as far as steel before failure and then returns to its original position.
CORROSION RESISTANCE	Cannot not rust, rot or spall. Not subject to marine borer damage. More durable than stainless steel. Withstands harsh environments (low temperatures, freeze/thaw, salt, harsh chemicals, etc.)
STANDARD SIZES	6", 8", 10", 12", 14", 16" OD's. Continuous lengths up to 115 feet. (Monopiles & columns up to 8' OD available.)
DRIVABLE	Easily driven in solid soils by conventional means (diesel hammers). "Handles and drives like a steel pipe pile." (PDA's available)
HANDLING / STORAGE	Use conventional equipment & procedures.
SKIN FRICTION	Overwrap of glass roving wrapped into the lower section of the FRP tube during manufacture create surface ridges, resulting in exceptional skin friction.
CONNECTIONS	CP40 can be drilled. Use traditional methods for system connections (bolting, collaring, etc.).
COMPATIBLE	Materials with matching service lives available: plastic lumber, stainless steel, etc.
U.V. PROTECTION	Two part system: marine-grade coatings shield the FRP shell from U.V. exposure; U.V. inhibitors in the shell's resin matrix preclude any U.V. degradation.
COLOR	The FRP tube is pigmented throughout, providing permanent color: Black & Brown. Custom colors available.
NON-TOXIC	Materials comply with all local & federal environmental regulations. No leaching of harmful chemicals associated with wood piling or heavy metals into surrounding waters. Pile is cleanfill and will not harm the ecosystem in which it is placed.
RECYCLED MATERIAL	Recycled materials can be incorporated in the solid core.
NON-CONDUCTIVE	Impervious to anodic/cathodic corrosion. Ideal for electromagnetically sensitive installations.
QUALITY CONTROL	FRP shell manufactured with ISO 9001 accreditation; CP40 precast procedures according to PSI/PCI MNL 116-85.
PRE-CAST	Produced near installation site or at our facilities. QC handled during fabrication, prior to acceptance & installation. Uniform material with predictable performance.
AVAILABILITY	Available worldwide from plants in Texas, Georgia, Holland, Saudi Arabia, Singapore & Indonesia. Call to verify current lead times.
COST	Competitive with traditional materials of similar strength, corrosion resistance, and service life.

ULTIMATE DESIGN VALUES

BENDING MOMENT COMPOSITE POST 40

PILE DIAMETER (inches)	SECTION MODULUS (in^3)	BENDING STRENGTH (in-kips)
6 (6.625)	15	340
8 (8.625)	31	680
10 (10.750)	62	1210
12 (12.750)	102	2002
14 (14.000)	150	2947
16 (16.000)	223	4387

AXIAL STRENGTH COMPOSITE POST 40

PILE DIAMETER (inches)	LENGTH (feet)	AXIAL STRENGTH (kips)
6 (6.625)	12'	397
	24'	99
	36'	44
	P_C	192
8 (8.625)	12'	1127
	24'	282
	36'	125
	P_C	325
10 (10.750)	12'	2752
	24'	688
	36'	306
	P_C	510
12 (12.750)	12'	5384
	24'	1346
	36'	599
	P_C	713
14 (14.000)	12'	9052
	24'	2263
	36'	1006
	P_C	925
16 (16.000)	12'	15442
	24'	3860
	36'	1717
	P_C	1209

NOTE: See enclosed specification for strength reduction factors and other design considerations.

DESIGN VALUES

PHYSICAL PROPERTIES
COMPOSITE POST 40 *

Bending Stress (psi)	25,000
Bending Modulus (psi)	2.8×10^6
Compressive Stress (psi)	25,000
Compressive Modulus (psi)	2.8×10^6
Shear Stress (psi)	8,000
Water Absorption (%)	0.07
Strain (%)	0.90
Density (lbs./ft^3)	145

MATERIAL PERFORMANCE
COMPOSITE POST 40 *

	12.75" O.D.	14.44" O.D.	16.50" O.D.
Bending Stress (psi)	25,000	25,000	25,000
Modulus of Elasticity (psi)	2.8×10^6	2.8×10^6	2.8×10^6
Moment of Inertia (in^4)	845	1,413	2,411
Stiffness (EI) - (lbs in^2)	2.36×10^9	3.95×10^9	6.75×10^9
Max Load - 20 Foot Beam (ultimate, lbs)	40,000	58,900	87,600
Max Load - 10 Foot Beam (ultimate, lbs)	80,000	117,800	175,300
Displacement (ultimate, inches to failure)			
20 foot	13.2	7.9	6.2
10 foot	3.5	2.1	1.6

* All values above reflect appropriate safety factors

By Jan Stapleman, Managing Editor

PILE ON THE ABUSE

The U.S. Navy calls composite piles into service in the harsh Gulf of Mexico environment.

Engineering challenge: Design non-magnetic piles for a Navy degaussing pier in the Gulf of Mexico that will meet the Navy's strength requirements, stand up to extreme salinity and other harsh marine conditions with minimum maintenance and provide a cost-effective alternative to traditional materials.

Design solution: Pre-cast, internally stressed composite piles fashioned from E-glass/epoxy filament wound tubes with an expanding cementitious core. Proprietary longitudinal/circumferential wrap ratio addresses bending stress and containment.

When the Navy designed its EMR Facility Pier at Ingleside, Texas (near Corpus Christi), it was looking for a few good piles. Unlike steel, these piles would have to stand up to extreme salinity in the Gulf of Mexico. Unlike wood, they would have to retain their integrity at water level (the "splash zone") where they would be alternately submerged and exposed. And since this would be a degaussing pier, designed to demagnetize ships' hulls making them less vulnerable to underwater mines, the piles would have to be non-magnetic — another requirement excluding traditional steel.

When the Navy drew up its plans for the pier, it specified concrete piling with stainless steel pre-stressing tendons — a non-corrosive and non-magnetic, but costly, alternative to regular steel.

Robert Greene, president of Lancaster Composite Inc. (Columbia, Pa.) had a better idea. He approached the Navy about trying out Lancaster's pre-cast, internally stressed composite piles. Greene provided test data showing the composite piles surpassed the performance characteristics of the materials originally specified by the Navy and pointed out that his product would cost a third less as well. The pier's designers decided to try out the Lancaster product for a portion of the pier. When the pier was built, 95 of the total 260 piles were of Lancaster's composite design — E-glass/epoxy filament wound tubes with an expanding cementitious core.

Installed in July of 1997, the 95 piles range in length from 42 to 73 ft and include four different structural applications: walkway batter piles (14-inch outer diameter), vertical and batter piles at the header pier (14-inch and 16-inch outer diameters), approach dolphin (a cluster of piles located at a pier's corner, 12.7-inch outer diameter) and fender piles (16-inch outer diameter).

When Lancaster began producing marine piles in 1993, the company applied what it had learned over the previous five years of manufacturing posts and poles of all sizes. According to Greene, the design of Lancaster's posts, poles and piles evolved through several fabrication processes, including pultrusion, filament winding and hybrid processes incorporating both. The progeny of that evolution is the Composite Post 40 Marine Structure — the basic design used for piles in the Ingleside project.

Greene says although Navy specifications required an axial load-bearing capacity of 50 tons, Lancaster's 14-inch-diameter piles tested at 225 tons — as determined by pile-driving analysis particular to the soils at the Ingleside site. The 14-inch piles demonstrated a 61.2 psi section modulus and a bending strength of more than 2,900 inch-kips, which is equal to Schedule 40 steel of the same outside diameter. (See accompanying table for additional performance values for Composite Post 40 piles of various diameters.)

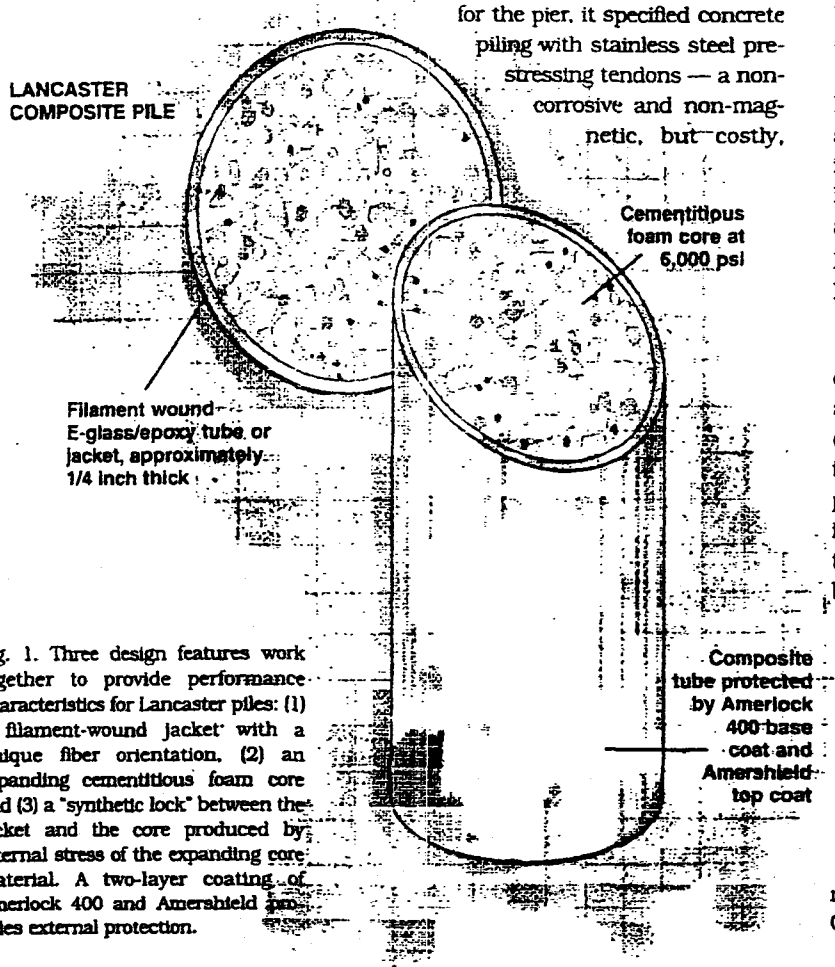


Fig. 1. Three design features work together to provide performance characteristics for Lancaster piles: (1) a filament-wound jacket with a unique fiber orientation, (2) an expanding cementitious foam core and (3) a "synthetic lock" between the jacket and the core produced by internal stress of the expanding core material. A two-layer coating of Amerlock 400 and Amershield provides external protection.

Flexural properties, referred to as "memory," allow the Lancaster piles to deflect more than twice as far as steel and still return to their original position (15° compared to 6° with Schedule 40 steel). This makes them especially suitable as fender piles; flexure tests showed the piles exhibited both the deflection and ultimate moment necessary to withstand berthing loads applied by most vessels.

Greene says three design features work together to provide the piles' performance characteristics: (1) a filament-wound jacket with a unique fiber orientation and an integral ridge at the bottom to provide soil friction, (2) an expanding cementitious foam core and (3) a "synthetic lock" between the jacket and the core produced by the internal stress of the expanding core material.

IT'S A WRAP

Greene took his design for a filament-wound fiberglass tube to Ameron International Fiberglass Pipe Group (Houston) because of that company's versatility in tailoring its filament winding processes to customers' needs. Greene's need was for a tube with greater longitudinal strength than would be required for an ordinary pipe — to hold up to bending stress — and for sufficient circumferential strength to provide containment. Although he won't disclose the proprietary wrap ratio for his fiberglass tubes, Greene says the emphasis is on longitudinal wraps, whereas most filament-wound pipe has a higher ratio of circumferential wraps. He worked with Ameron's Engineering Manager Joie Folkers to perfect the filament winding process for the Lancaster piles.

The process employs standard E-glass from either Owens Corning (Toledo, Ohio) or PPG Industries Inc. (Pittsburgh) packaged in especially long lengths wound on 3-inch spools. The resin is Epon 828 epoxy from Shell Chemical Co. (Houston) or DER 331 epoxy from Dow Chemical (Midland, Mich.).

The Ameron manufacturing equipment is uniquely suited to the construction of these fiberglass jackets, because it is capable of producing cylinders in continuous lengths — in this case to the length desired for even the longest Lancaster pile. As each cylinder is generated, it is rotated on the mandrel while the machine spirals from front to back, providing a fiber orientation which is very close to, but not exactly, circumferential and longitudinal.

Pipe Diameter (inches)	Section Modulus	CP40 - Bending Strength (in-kips)
6 (6.625)	8.50	340
8 (8.625)	16.81	680
10 (10.750)	29.90	1210
12 (12.750)	47.10	2002
14 (14.450)	61.2	2947
16 (16.520)	91.5	4387

Fig. 2. Performance values for the Composite Post 40 Marine Structure. (Source: Lancaster Composite Inc.)

Circumferential wraps are oriented at about 85-88°, and longitudinal wraps are skewed at a slight angle to balance the structure and reduce torsion.

Ameron's process wraps alternating layers, first in a circumferential direction and then in a longitudinal orientation, continuing this process from alternating directions until the required number of layers are wrapped, producing a wall thickness of up to 1/2 inch. Winding the cylinder in a "+" pattern, rather than an "X" pattern, produces higher stiffness in both circumferential and longitudinal directions than would be possible in a typical, reciprocally wound tubular shape. The fiberglass jackets are wound under controlled tension to prevent any loose or wavy glass fibers in the wall of the pile.

To provide soil friction, a 3/8-inch-high ridge of fiberglass bulk roving (Fiber Glass Industries Inc., Amsterdam, N.Y.) is wound onto the bottom 30 ft of each pile at approximately 1-inch intervals. This profile is created integral to the cylinder winding process, with the same angle as the circumferential wraps.

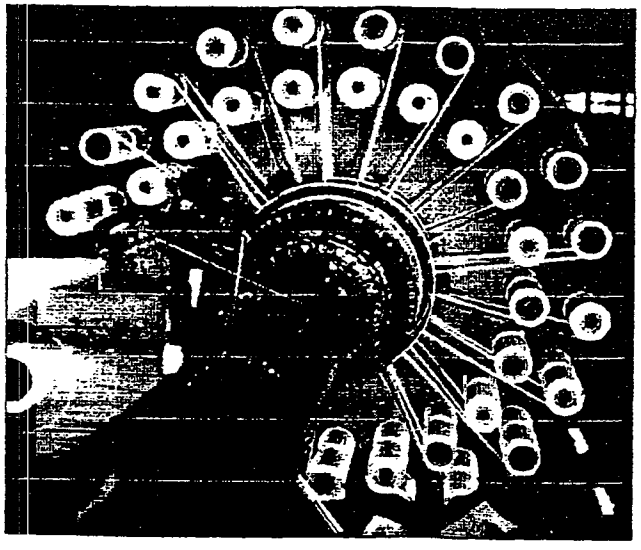


Fig. 3. This filament winding machine at Ameron International Fiberglass Pipe Group is uniquely suited to the construction of the fiberglass jackets because it is capable of producing cylinders in continuous lengths. It easily accommodates the longest lengths required for Lancaster piles and can produce even longer tubes. (Source: Ameron International Fiberglass Pipe Group)

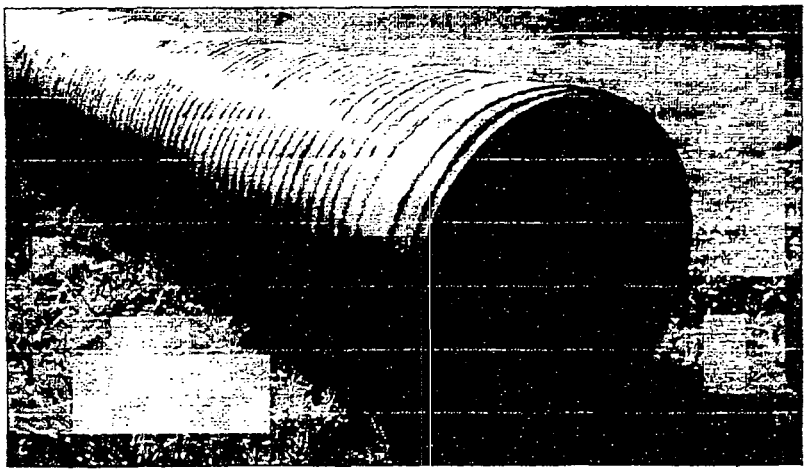


Fig. 4. The empty fiberglass jackets are shipped to a casting yard near the installation site to be filled with a cementitious foam core. Notice the 3/8-inch-high ridge of fiberglass bulk roving which is wound onto the bottom 30 ft of each pile to provide soil friction. (Source: Ameron International Fiberglass Pipe Group)

After the winding is completed, a two-layer coating consisting of a high-performance epoxy base coat of Amerlock 400 and a high-build polyurethane top coat of Amershield provides external protection. Both products are supplied by a sister company, Ameron International Protective Coatings Group (Brea, Calif.).

STRENGTH AT THE CORE

Before filling, Lancaster's fiberglass tubes were shipped to a casting yard at Live Oak Materials, only a couple of miles from the pier construction site. There, under the watchful eyes of Lancaster quality control agents, a cementitious foam was air blown at high pressure into the fiberglass jacket, creating a rigid 6,000 psi core. This core mix was formulated by Lancaster chemists and features a standard low water/cement ratio and solid state expansion agent.

Fender piles for the Ingleside pier incorporate six continuous lengths of fiberglass rebar produced by Marshall Industries Composites Inc. (Jacksonville, Fla. — see story in May/June 1995 issue of CT, pg. 15), configured in a circle concentric with the outside diameter, and running the entire length of the piles. Vertical and batter piles, both 14-inch and 16-inch diameters, incorporate four shorter lengths of stainless steel rebar which extend out of the top of the pile for the purpose of tying into the pile cap. Dolphin piles include no rebar.

Fig. 5. The completed Lancaster piles are installed at the Navy's EMR Facility Pier at Ingleside, Texas. (Source: Lancaster Composite Inc.)

According to Greene, filling the piles at a site near the final installation site is essential for cost-effective production. He estimates savings of at least 15 percent over what it would have cost to truck the piles already filled.

STRENGTH THROUGH INTERNAL STRESS

Greene calls the solid state expansion agent the most important component of the core, adding that it is critical to the overall strength of the pile. Internal stress is an integral part of the design, he says, providing a "synthetic lock," or pressure fit, between the jacket and the core. Rather than shrinking as it hardens as with most concrete, the core expands slightly and hardens to a permanent, positive stress — about 35 psi — against the inside wall of the jacket. This internal stress puts the fiberglass in tension and the concrete in compression, essentially producing a chemically pre-stressed concrete within the pile, and ultimately increasing strength.

Ameron's Folkers says it is the way the design elements work together that produces the piles' strength. "The fiberglass is oriented exactly in the direction of the stress and takes advantage of the strength of the concrete," he says. "There is a synergy between the jacket and the concrete that improves the properties of each."

STACKING UP THE BENEFITS

Although Lancaster's piles have a higher initial price than regular steel or concrete, they are half the cost of stainless steel, a particular value in corrosive, marine environments. Greene reiterates an advantage well-known to those in the composites business: the Lancaster piles provide an extended low/no maintenance service life, so they have a greater life-cycle value than traditional materials. Although they are warranted for 15 years, Greene expects his composite piles to provide at least 75-plus years of useful life. In contrast, timber piles that are exposed to the ebb and flow of tides and the ravages of timber borers may have to be replaced as often as every 18-24 months. "Our piles never rot, rust or decay," Greene says.

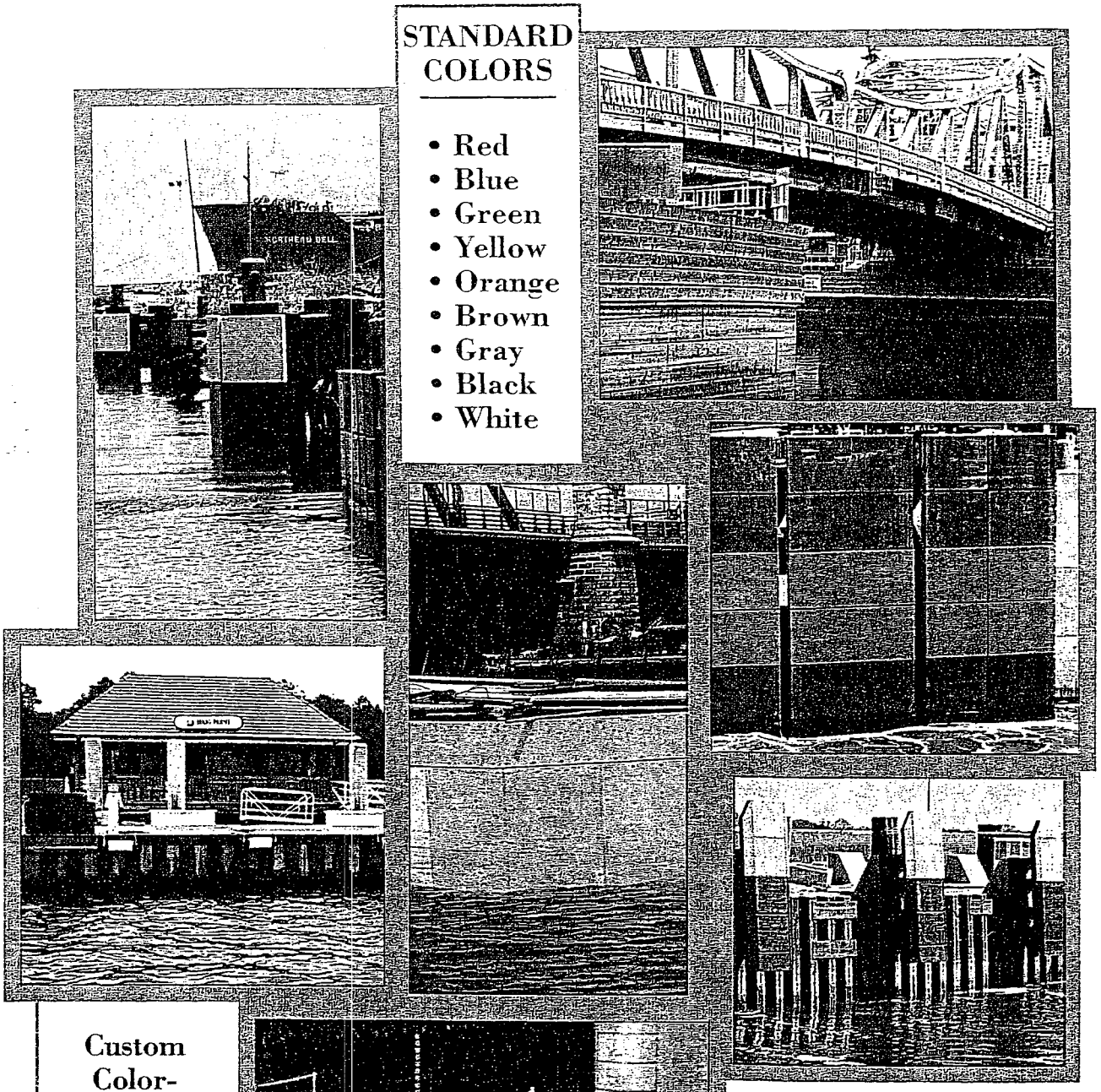
SUPPORTING INFORMATION FOR PROPOSAL NO. 43

ULTRA POLY

Ultra Poly Advantages

Easy to Reach ➢	800-872-8469 Phone: 253-272-1217 Fax: 253-272-1457 Website: http://www.ultrapoly.com Email: sales@ultrapoly.com
Technical Capabilities ➢	Read prints, make drawings, do take-offs, convert metric to inches, language assistance in Spanish, French, German.
Formulations ➢	Virgin, ASTM 4020 grade, 1/8" - 7", molecular weight 3,100,000, repro, unlimited color choices and blend ratios. Best Wear: AR, colors, UV orange, cross-linked, lubricant filled, combines everything you need in one formulation.
Sheet Size Choices ➢	See reverse side or call our office. Unlimited sheet sizes up to 60" x 144", and 48" x 120" depending on press. Sheets manufactured to size offer great savings to you for your customers.
Fabrication ➢	Cut, drill, chamfer, counterbore, bevel, bend, and form. Call us for special requirements.
Special ➢	Fiberglass backed, non-skid, and insert molding.
Fire Retardant ➢	Compliant with Naval CID A•A•590001.
MSHA ➢	Mine Safety & Health Association approved (IC-193) for underground use.
Extrusions ➢	Rod, angle, channel, flight tang, mill chain guard to chain size, board and king coils-in many sizes.

Ultra Poly Has a Colorful Past...



STANDARD COLORS

- Red
- Blue
- Green
- Yellow
- Orange
- Brown
- Gray
- Black
- White

Custom Color-Matching available

...Ultra Poly Can Color Your Future!

ULTRAPOLY

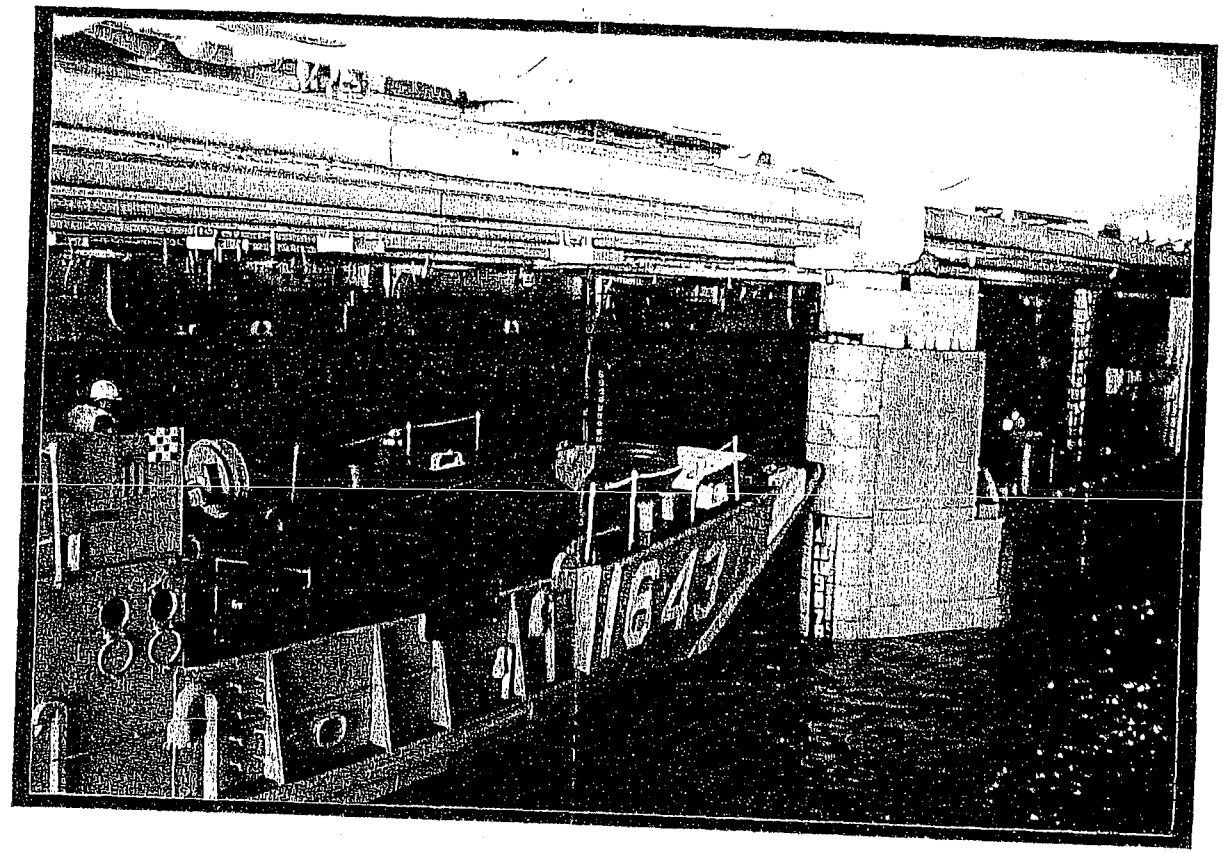
1-800-USA-UHMW
1-800-872-8469

S102 3/96

Gatorpoly:

GATORPOLY has seen extensive service on United States Navy ships since 1987. The initial installation on the USS Tarawa was a direct result of Navy Personnel observing Ultra Poly® products in service on docks around the country.

The evolution of the GATORPOLY included extensive formulating and testing to improve flammability resistance, impact resistance, and smoke density. As we improve our products for a sailor-safe environment, it is important to us to retain the physical properties that make UHMW unique.



GATORPOLY Physical Properties

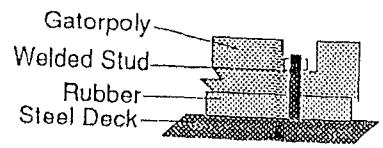
Flame Spread	E162	23.7
Smoke Generation Smoke Density (Dm, max specific optical density, corrected)	E662 (flaming/non flaming)	25/157
Coefficient of Friction	D1894	0.106-0.092
Impact Resistance	D256	no break
Water Absorption	D570	0
Resilience	ASTM 2832	25

TEST:
4000 lb. vehicle impacting sheets of Gatorpoly at 30 mph. at 15 degree impact angle, the Ultra Poly is virtually unaffected by the 5,000,000 in./lbs. impact..

REQUIREMENT:
No breaking, only scratches allowed in the sheet's surface. Deflection not to exceed 2".

COMPOSITION:
Gatorpoly is a custom sandwich product consisting of layers of UV stabilized UHMW and marine grade rubber combined to offer a combination of impact resistance and low friction.

STUD MOUNT:



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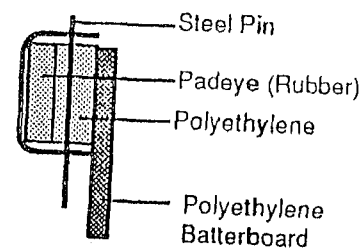
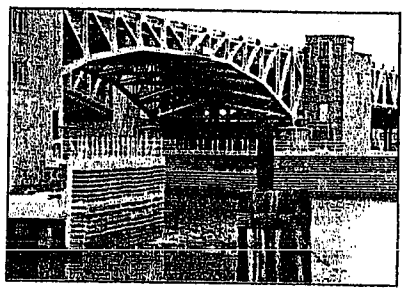




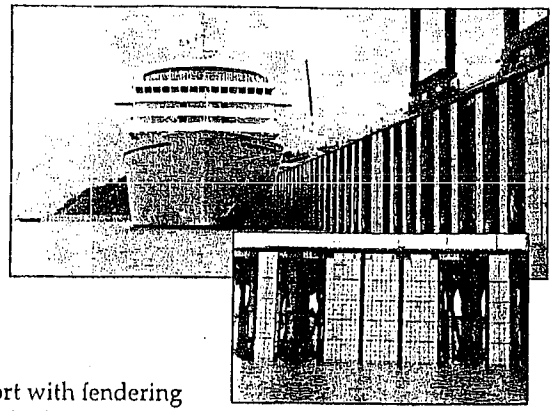
Duwamish Bridges

How do you stop a 2,700-ton barge loaded with 7,500 tons of freight from ramming into a bridge?

Atkinson Construction, the bridge contractor, and consultant Ben C. Gerwick designed a new fender system that uses slabs of reinforced concrete strips faced with a six-inch-wide, one-inch-thick band of Ultra Poly's UV Stabilized Ultra High Molecular Weight Polyethylene in a unique T-bar extrusion. This is the first UHMW shape manufactured by Ultra Poly that will be cast directly into reinforced concrete.

Estimates are that $650,000 was saved by using this new design for the First Avenue South Bridge project. The new bridge configuration will eliminate head-on car collisions which have ocurred frequently on the busy two-way span. The entire project is expected to be finished in early 1998.

Port of Anchorage



The Port of Anchorage, an agency of the Municipality of Anchorage, provides a vital link connecting our 49th state to the continental United States and other worldwide locations. In September of 1995, the Port of Anchorage celebrated their "Fender-Fest," a grand opening which marked the official completion of the Port's $7 million facilities upgrate.

Svedala Trellex supplied the Port with fendering systems, which help to prevent costly damage to the dock by today's larger vessels. Attached to these fendering systems is Ultra Poly's UHMW. This dock is believed to be the single largest UHMW-PE application for marine port fendering. Over 38,000 square feet of High Visibility Yellow and black UHMW-PE were used in this job which totals almost 600,000 pounds of UHMW-PE product.

This new fendering system is expected to reduce annual maintenance costs to the Port by $200,000.

Ultra Poly's UHMW-PE (Ultra High Molecular Weight Polyethylene) fendering can meet all of your requirements and still save you money!

ULTRAPOLY

1-800-872-8469

253-272-1217 • 253-272-1457 (Fax)

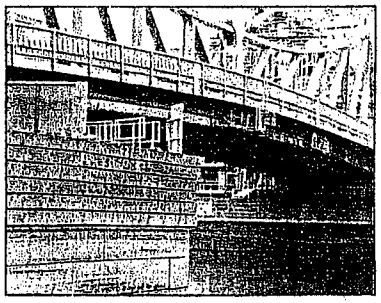
2926 South Steele Street • Tacoma, WA 98409

County of Alameda Department of Transportation

In December of 1991, Ultra Poly provided fendering to the County of Alameda, Department of Transportation. The fendering was installed on the Fruitvale, Park and High Street drawbridges, all narrow entry waterways.

Mr. Yogosh Goel, a Civil Engineer for the County of Alameda, reported that since the Ultra Poly material was installed, they have had no maintenance requirements and no material replacement. The use of Ultra Poly eliminates the erosion of wood fendering due to the chemically active marine environment and vessel impact.

The use of Ultra Poly's fendering has allowed the County of Alameda to realize considerable annual savings.



Ultra Fend®:

Miter Gate Protection

Ultra Fend® is made of virgin, ultra high molecular weight (UHMW) polyethylene, crosslinked and UV stabilized. A sheet of Ultra Fend® bolted or bonded to a fender front creates an unbreakable, low friction shield which protects surfaces from impact and abrasion. Hulls hit and slide freely along Ultra Fend's tough, slick face. No grabbing, dragging, or tearing.

Ultra fend® can be designed into the construction of new fendering structures, enduring continuous impact and rubbing, prolonged ultra violet light exposure, wide temperature variations, salt and chemical contact.

Ultra Fend® fendering for Miter Gates is available in custom colors, sizes, and formulations. The physical properties will vary slightly, depending on the grade.

ULTRAPOLY

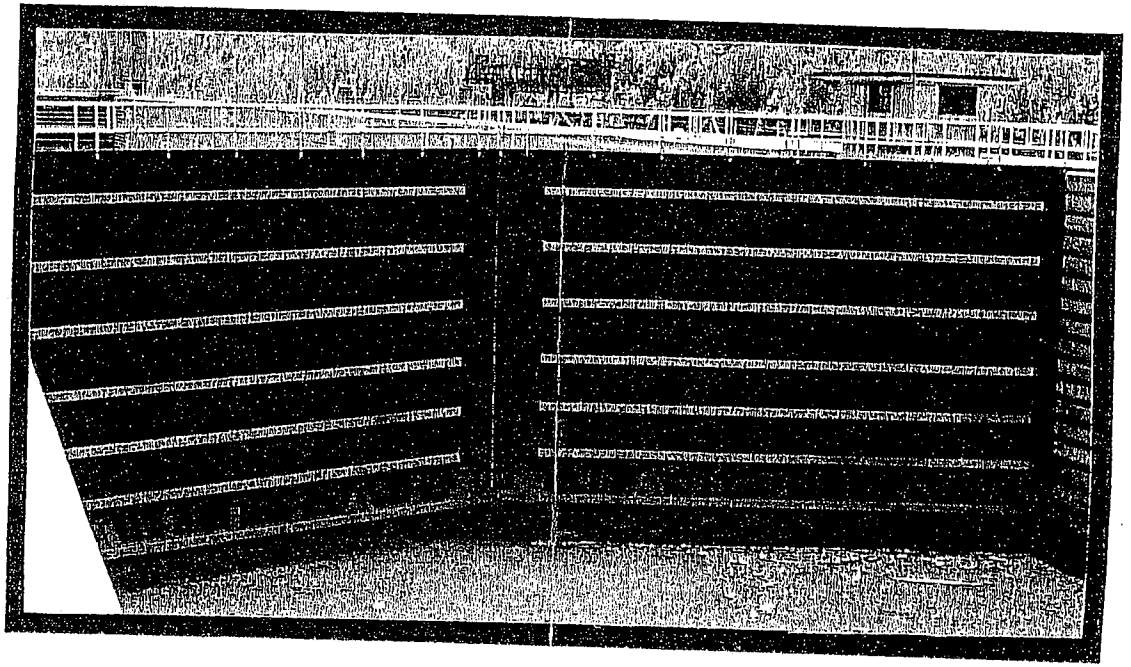
TM105 Manufacturers of High-Impact UHMW

In 1988, Ultra Poly, Inc., contacted the Army Corp of Engineers in Portland, Oregon, about testing Ultra Fend® on the Willamette Lock Gate. Barges were constantly tearing up the wood gate. It being of historical significance, the Willamette Lock Officials were skeptical of plastic and what it would do to the aesthetics of the lock. However, given the continuous cost of repairs, the Corp. decided to do one side of the gate as an experiment. Our Ultra Fend® is still mounted to the lock gate.

Ultra Poly's attitude towards placement of UHMW-PE on locks throughout the United States waterways is that it's just a matter of time. The Army Corp. of Engineers in Pittsburgh, Pennsylvania, have to be given the credit for taking Miter Gate protection one step into the future. Gray's Landing is the second major lock supplied with Ultra Fend® Hi Viz Yellow UV Stabilized UHMW-PE, Point Marion, Pennsylvania being the first.

We labeled parts to insure that fenders were used correctly. Holes were drilled on 12 inch centers, staggered from side-to-side, with two holes on each end. Edges were beveled to keep boat and barge traffic from catching an edge. While lengths of each part varied because of gate design, the standard width of Ultra Fend® was 8 inches, with a thickness of 5 inches. The rubber had a standard thickness of 3 inches, and an identical width.

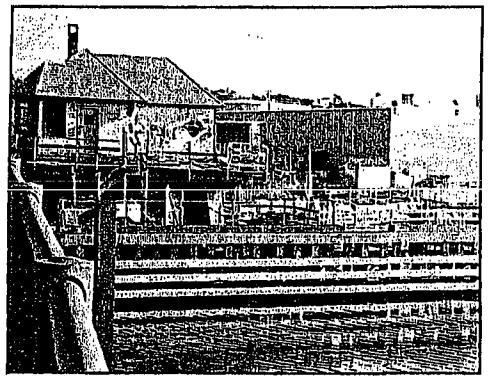
Each gate was supplied tight tolerance rubber-backed Ultra Fend® installed horizontally on steel gates. Ultra Poly, Inc. fabricated the Ultra Fend® with holes and bevels insuring that the rubber would match up for easy installation.



Gray's Landing Locks

Ultra Fend

The results speak for themselves



Chelsea River Bridge

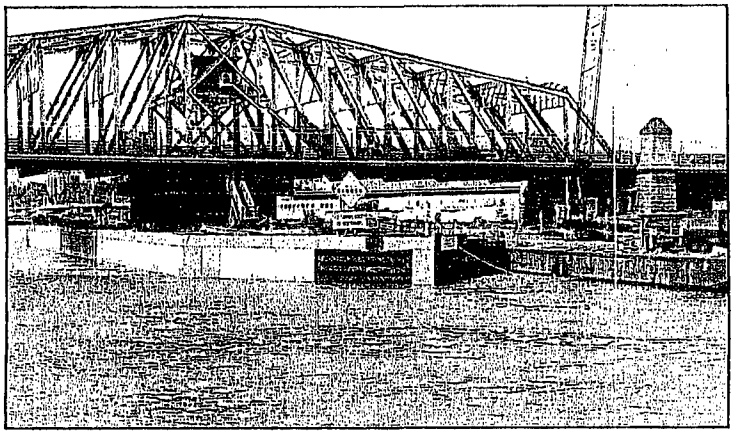
- No Maintenance
- Fast, easy installation
- Marine life resistant
- Abrasion resistant
- No chemical agents are released into the water

ULTRAPOLY

1-800-872-8469

253-272-1217 • 253-272-1457 (Fax)

2926 South Steele Street
Tacoma, WA 98409

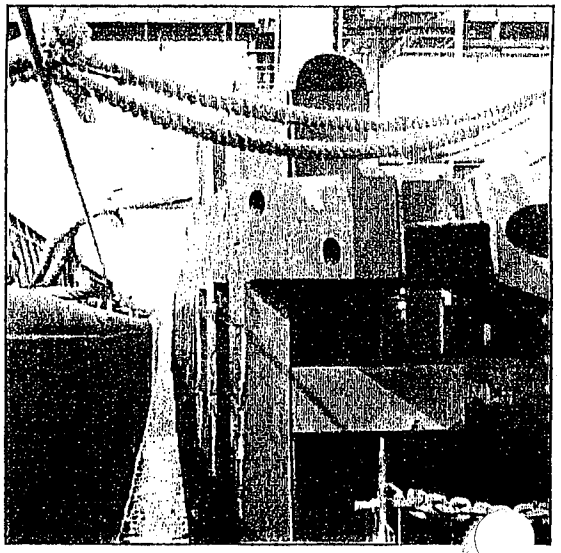


145th St. Bridge New York, New York

Mr. Jarda Nehybka, an engineer with Massand, Inc. reports no maintenance costs nor repair costs since Ultra Poly fendering was installed. He indicates that Ultra Poly is more economical, easier and safer to install using power tools, and eliminates marine borers from pollution in the Harlem River. Because of the unique Ultra Poly sheeting properties and lower friction, the fender system was able to be designed as a light structural system with significant savings on material, handling, labor and rentals. Also, there was no need for heavy galvanized metal sheets at tips and shoulders. The Ultra Poly fendering was installed on the 145th St. Bridge over the Harlem River. Fender systems in New York have been known for high fire hazard. Ultra Poly added fire retardant to the material to eliminate the fire hazard as well as toxic smoke. In order to provide high visibility to limit vessel collisions, the fendering material was produced in orange. The water level beige color was designed as a tough fender product in a non-intrusive color.

Baltimore Gas & Electric

BG&E also reported that they have had no maintenance, nor material replacement since Ultra Poly's fendering material was installed in October of 1992. Previously, large numbers of 6' x 12' oak timbers needed repair or replacement annually. Every year that Ultra Poly's fendering lasts without maintenance, repair and downtime costs, means dramatic maintenance savings and significantly reduces the upfront installation costs.



ULTRA POLY
Marine Products

Ultra Poly, Inc.
2926 So. Steele Street
Tacoma, WA 98409

1-800-872-8469
206-272-1217
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Ultra Fend AR

Description	Property	Test Method	Unit	Value
Ultra High Molecular Weight Polyethylene crosslinked virgin grade, averaging 3.1 - 6 million molecular weight, in full compliance with ASTM 4020-81 standards. Fully UV Stabilized formulations are available in black or colors. Contact us for standard or custom color requirements.	Specific Gravity	ASTM D792	g/cm^3	.93-.94
	Tensile, Ultimate	ASTM D638	psi	5600-6100
	Elongation at Break	ASTM D638	percent	350-390
	Flexural Modulus	ASTM D790	PSI (1,000s)	110-130
	Thermal Expansion	ASTM D648	in/in/°F	$5.5x10^{-5}$
	Hardness R	ASTM D785	--	64-69
	Abrasion	Sand Slurry	--	-7 (best)
	Izod Impact	ASTM D256	ft.lbs./notch	No break
	Izod Impact (Modified w/double notch)	ASTM D256A	ft.lbs./notch	20-26
	Coefficient of Friction (vs. Steel)	ASTM D1894	--	.11-.20

Ultra Fend

Description	Property	Test Method	Unit	Value
Ultra High Molecular Weight Polyethylene averaging 3.1 - 6 million molecular weight, in full compliance with ASTM 4020-81 standards. Fully UV Stabilized formulations are available in black or colors. Contact us for standard or custom color requirements.	Specific Gravity	ASTM D792	g/cm^3	.935-.945
	Tensile, Ultimate	ASTM D638	psi	6300-6900
	Elongation at Break	ASTM D638	percent	400-450
	Flexural Modulus	ASTM D790	PSI (1,000s)	110-130
	Thermal Expansion	ASTM D648	in/in/°F	$9.0x10^{-5}$
	Hardness R	ASTM D785	--	63-68
	Abrasion	Sand Slurry	--	16 (good)
	Izod Impact	ASTM D256	ft.lbs./notch	No break
	Izod Impact (Modified w/double notch)	ASTM D256A	ft.lbs./notch	23-29
	Coefficient of Friction (vs. Steel)	ASTM D1894	--	.11-.20

Poly Fend

Description	Property	Test Method	Unit	Value
Ultra High Molecular Weight Polyethylene, mechanical blend of virgin UHMW resin & ground UHMW chips, averaging 3.1 - 6 million molecular weight, in full compliance with ASTM 4020-81 standards. Fully UV Stabilized formulations are available in black or colors. Contact us for standard or custom color requirements.	Specific Gravity	ASTM D792	g/cm^3	.94-.955
	Tensile, Ultimate	ASTM D638	psi	4200-5100
	Elongation at Break	ASTM D638	percent	300-350
	Flexural Modulus	ASTM D790	PSI (1,000s)	102-120
	Thermal Expansion	ASTM D648	in/in/°F	$9.0x10^{-5}$
	Hardness R	ASTM D785	--	65-70
	Abrasion	Sand Slurry	--	14 (good)
	Izod Impact	ASTM D256	ft.lbs./notch	No break
	Izod Impact (Modified w/double notch)	ASTM D256A	ft.lbs./notch	18-24
	Coefficient of Friction (vs. Steel)	ASTM D1894	--	.11-.20

Standard Sheet Sizes

Weight in pounds*

Thickness	Per Sq. Ft.	48 x 96	48 x 120	59 x 120	59 x 144
			40 SF	50 SF	60 SF
1/4"	1.25		50	63	
3/8"	1.88		75	94	
1/2"	2.5		100	125	
5/8"	3.12		125	157	
3/4"	3.75		150	188	
7/8"	4.37		175	218	
1"	5		200	250	
1-1/4"	6.25		250	313	
1-1/2"	7.5		300	375	450
1-3/4"	8.75		350	438	525
2"	10	320	400	500	600
2-1/4"	11.25	360	450		
2-1/2"	12.5	400	500		
2-3/4"	13.75	440	550		
3"	15	480	600		
3-1/4"	16.25	520	650		
3-1/2"	17.5	560	700		
3-3/4"	18.75	600	750		
4"	20	640	800		
4-1/4"	21.25	680	850		
4-1/2"	22.5	720	900		
4-3/4"	23.75	760			
5"	25	800			
5-1/4"	26.25	840			
5-1/2"	27.5	880			
5-3/4"	28.75	920			
6"	30	960			

Standard Tolerances: Thickness = +/-10%
Width and Length = +1/2" / 1/4"

Special tolerances: May be available at extra cost

Colors: Minimums and set-up charges may be required depending on color.

*Standard sheet sizes and thicknesses are available only in those where weights provided above. Ultra Poly has many custom sheet sizes available in metric or under/over size sheet sizes not listed. Please call for availability and pricing.

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