Natatec® Containment Systems

Information and Technical Data

The Ultimate Barrier...

For when it can't leak!

Natare Corporation
5905 West 74th Street • Indianapolis, IN 46278 • USA
(800) 336-8828 • (317) 290-8828 • FAX (317) 290-9998
www.natare.com • natare@natare.com

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Natare Corporation is one of the most respected suppliers of equipment, systems and services for commercial and public swimming pools, water features and aquatic recreation in the United States and around the world.

Natare offers a comprehensive selection of equipment and systems, in combination with consulting, engineering and technical services. Whether it's design, construction, renovation or operation, Natare is part of state-of-the-art aquatic facilities around the globe.

The following information is a collection of topics pertaining to Natatec® PVC Containment Lining Systems. These documents include product support information as well as typical specifications and drawings.

We invite all inquiries concerning aquatic or water feature development, planning, construction or renovation. Additional information can be found on-line at **www.natare.com** or you may contact us at **(800) 336-8828**.

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All information contained in this booklet, as well as typical specifications and information on other Natare products and systems, is available by download from www.natare.com, available by e-mail at natare@natare.com, or on a CD upon request: (800) 336-8828.

Natatec is the name for a selection of impervious linings used in a wide range of environmental, containment and specialty waterproofing. Their uses include primary and secondary containment for many different uses including decorative and display waters, recreational waters, wastewater and other liquids that may be chemically aggressive.

Available as an engineered system in single ply and reinforced thicknesses, Natatec is a total solution for waterproofing or water containment when it simply cannot leak.

Natatec PVC environmental, containment and specialty waterproofing systems provide years of leak-free service to ponds, fountains, landscape applications, reflecting pools or any other application where containment and absolute waterproofing is required.

Natare offers custom engineered solutions as well as standard sizes of lining systems. Rigorous testing ensures compliance with applicable ASTM, ANSI, Military and regulatory standards.

Natatec Linings are custom engineered solutions for general containment and environmental uses (ponds, lagoons, landscaping, dikes, levies, irrigation, industrial water storage, etc); fish and aquatic applications (fish ponds, fish tank linings, raceway and fish ladders, decorative pond and landscape linings); potable water storage (filtration tanks, water treatment, waste storage cisterns, reservoirs, aquariums, etc.); and petroleum containment (fuel storage, fuel tank under-liners, dike and berm liners, oil exploration pit liners, emergency spill containment, airport deicing facility liners, etc.)

Standard Natatec PVC Lining Systems

Natatec® PVC lining systems offer-engineered solutions for virtually any waterproofing or containment applications. Wide selections of standard PVC linings are available.

Natatec GP -

General Purpose Containment and Environmental Lining. Natatec GP is PVC lining specially formulated for use as a general containment membrane. Natatec GP is the ideal general purpose containment or environmental membrane.

Natatec GP is available in a 20, 30, 40 and 60-mil thickness, both in single ply and fabric reinforced. Natatec GP is typically used for pond and lagoon linings, landscaping, dike and levy liners, waterproofing, construction, waste water storage, irrigation, industrial water storage, recreational waterproofing

Natatec FA –

Fish and Aquatic Grade Lining. Natatec FA is PVC lining specially formulated for use in aquaculture, including applications such as fish rearing, aquatic cultivation and aquatic environments where prolonged contact with marine and aquatic life occurs.

Highly flexible, easily fabricated and UV resistant, Natatec FA is the ideal aquatic environmental lining. Natatec FA is available in a 20, 30 and 40-mil thicknesses (.020, .030, .040-inch/.51, .76, 1.02-mm) in single ply construction.

Other thicknesses and reinforced construction is also available. Natatec FA is typically used for fish pond and lagoon linings, fish tank linings, raceways and fish ladders, decorative pond linings and landscape applications.

Natatec PW –

Potable Water Storage Lining. Natatec PW is a heavy duty, flexible PVC material with a tough inner core of polyester supporting scrim specially formulated for use in potable water storage applications and meets EPA standards for drinking water storage.

Natatec PW is a durable, high damage-resistant lining material. A wide variety of installation techniques are available to provide maximum design flexibility and lining integrity. Natatec PW is available in a 40 and 60-mil fabric reinforced thicknesses. Natatec PW is typically used for potable water storage tanks, filtration tanks, water treatment plants, water storage cisterns, reservoirs, fish hatcheries and aquariums.

Natatec OR –

Petroleum Resistant Lining. Natatec OR is a heavy duty, flexible PVC material with a tough inner core of polyester supporting scrim specially formulated for short term containment and storage of oils, certain process fluids and petroleum-based products.

Natatec OR is a durable, high damage-resistant lining material. A wide variety of installation techniques are available to provide maximum design flexibility and lining integrity. Natatec OR is available in a 40 and 60-mil fabric reinforced thicknesses.

Natatec OR is typically used for fuel storage facilities, fuel tank under-liners, tank liners, dike and berm liners, oil exploration pit liners and mud pit liners, emergency spill containment, equipment wash-down areas, vehicle marshaling yards, airport deicing facility liner, area runoff and retention lagoon liners.

PVC Geomembrane Durability

It is widely believed by some within the geosynthetic community that PVC geomembranes degrade after installation. While it is true that PVC may degrade when in contact with some chemicals, the same holds true for other geomembranes such as polyethylene.

There is no perfect geomembrane in terms of chemical compatibility. For example, neither PVC nor polyethylene is compatible with benzene; however, urethane geomembranes are available for retaining this chemical.

PVC resins by themselves are hard, brittle compounds due to the strong attraction bonds between hydrogen and chlorine atoms of adjacent polymer chains, resulting in secondary bonding between the polymer chains. In order to facilitate the processing of geomembranes, plasticizers are added to the resin to increase low temperature properties, elongation and flexibility.

Plasticizers are clear, organic liquids that improve process ability and provide the physical properties associated with PVC geomembranes. These compounds fall into two categories based on their compatibility with the resin; primary plasticizers, those that have a high degree of compatibility with the PVC resin matrix, and secondary plasticizers, which are used in some markets other than geomembranes to lower the overall cost.

There are many different types of primary plasticizers used in PVC, of which phthalates are the most common in PVC geomembrane production because they provide the geomembrane with the best balance of properties.

Typical PVC geomembranes contain 30 to 35 percent plasticizers per weight. Plasticizers on the surface of the geomembrane are subject to migration out of the product. The plasticizers within the sheet that are secondarily bonded to the PVC chains require encouragement to migrate.

The plasticizer loss is a function of plasticizer type, temperature, sheet thickness, environmental conditions, and exposure time. The worst case for plasticizer loss is when there is a large gradient of organic compounds between the geomembrane and the surrounding environment. Here the gradient must have sufficient energy to overcome the Vander Waals bonding of the ester group of the compound, allowing the linear group to separate the chains and provide migration paths between the chains.

As the percentage of plasticizer is reduced, secondary bonding between the polymer chains increases, “locking in” the remaining plasticizers. Studies by the U.S. Bureau of Reclamation on 10-mil PVC geomembranes used in canal linings show that 54 percent of the initial plasticizer content remained after 19 years of service. In this application, the organic gradient was very high due to running water within the canals minimizing organic concentrations from the geomembrane surface. Even with a 46 percent reduction in plasticizer, the geomembrane still met the original design specifications.

Case studies of geomembranes under actual conditions contain some of the most important information that can be gathered to determine long-term performance. Opportunities to evaluate the performance of the geomembrane under these conditions are limited because of the expense of excavating the geomembrane and the fear of disturbing the geomembrane in an attempt to obtain a sample.

This leaves only limited opportunities to investigate the durability, such as when sites are being expanded or require modification. To increase the number of case studies the PVC Geomembrane Institute (PGI) has initiated a research project with the Minnesota Department of Natural Resources.

The main objective of the project is to investigate the long-term (30 year) durability of PVC geomembranes and seams. Samples of different PVC geomembranes and seams are being obtained annually from a double lined settling basin that contains mine drainage. Since this project is in the second of the 30-year duration, other case histories were sought to provide an insight to the long-term durability of PVC geomembranes.

PVC Geomembrane Durability

The following paragraphs describe such a case history.

In 1993 a golf course pond was being enlarged and the existing PVC geomembrane was excavated in the process. The site was at the Lake of the North Golf Course located in the northern part of the lower peninsula of Michigan. According to Jerry Matthews, the golf course architect who originally designed the project, the PVC geomembrane was installed in the summer of l968. The material, a 10-mil PVC geomembrane, was originally covered by twelve inches of sand. Approximately six to eight inches of silt had accumulated over the sand during the 25-year period from 1968 to 1993.

The climate is harsh with winter temperatures falling well below 0° F and summer temperatures rising to above 90° F. Also based upon some other previous studies of plasticizer extraction, rainwater may be more severe than a typical municipal landfill leachate. This phenomenon is due to the fact that there is a larger gradient for plasticizer migration in water than leachate, due to the lack of organic compounds in the water.

Lastly, this geomembrane was only 10 mil thick. Changes to a PVC geomembrane will occur more quickly with this gauge than the thicker gauges, 20- to 40-mils that are typically used on projects today. For all of these reasons, this site provided some meaningful information relating to the long-term performance of PVC geomembranes.

Samples were taken to evaluate the physical properties of the parent material and the factory and field seams. In 1968, all seams were made using a chemical fusion weld. Physical testing according to NSF Standard 54 for PVC geomembranes was conducted, along with chemical analysis of the film.

The specific tests that were conducted included thickness, specific gravity, tensile, elongation, 100% modulus, and tear resistance. Peel and shear tests were conducted on both the factory and field seams. There were several things that are immediately apparent from this data.

The physical properties still exceed the requirement of NSF Standard 54 – 83 even after 25 years. In fact they exceed the NSF 54 Standard by a large margin. There was no deterioration of the seams by the peel and shear values in either the field or factory seams. All of the peel tests on the factory and field seams resulted in a film-tearing bond.

The analytical tests confirm that the formulation of this PVC geomembrane has changed very little over the 25-year period. Existing PVC geomembrane formulas have about 30% plasticizer, versus the 27.8% found in this geomembrane. (An unexposed sample of the geomembrane was not available for comparative purposes so the remaining plasticizer content was compared to the formulation of a current geomembrane, i.e., 30% plasticizer.)

It may be concluded that the geomembrane had reached a steady state with the surrounding harsh environment and it was not losing any additional plasticizer. The samples themselves were still very flexible with no sign of deterioration or cracking of the surface. There appeared to be no physical signs that would indicate that the geomembrane had not functioned as designed for the 25 years it was in service.

This study only adds to the growing amount of information that suggests PVC geomembranes are a viable choice for a wide range of applications. The fact that they do contain plasticizer is not the problem that some people would believe, but gives the geomembrane the flexibility that is important in geosynthetic design, installation and long-term service.

Natatec GP - General Purpose Containment and Environmental Lining

Description

Natatec GP is PVC lining specially formulated for use as a general containment liner. Natatec GP is the ideal general purpose containment or environmental lining. Natatec GP is available in a 20, 30, 40 and 60-mil thickness (.020, .030, .040, .060-inch/.51, .76, 1.02, 1.52-mm) in single ply construction and 30, 40, and 60-mil (.030, .040, .060-inch/.76, 1.02, 1.52-mm) in fabric reinforced construction.

Application and uses

Natatec GP is typically used for pond and lagoon linings, landscaping, dike and levy liners, waterproofing, construction, waste water storage, irrigation, industrial water storage, recreational waterproofing

Advantages

Highly flexible, easily fabricated and UV-resistant. Excellent weathering. Quick installation. Absolutely waterproof. Chemically resistant. Economical and cost efficient with large panel sizes. PVC formulations allow positive heat-welded seams.

Colors

Typically black with other colors available.

Property	Test Value 20-mil Single Ply	Test Value 30-mil Single Ply	Test Value 40-mil Single Ply	Test Value 60-mil Single Ply	Test Method
Thickness	20-mil (.020-inch/.51-mm)	30-mil (.030-inch/.76-mm)	40-mil (.040-inch/1.00-mm)	60-mil (.060-inch/1.50-mm)	ASTM D1593
Specific gravity	1.23 g/cc	1.23 g/cc	1.23 g/cc	1.21 g/cc	ASTM D792
Break Strength	MD 56 lbs/in – XD 53 lbs/in	MD 81 lbs/in – XD 80 lbs/in	MD 108 lbs/in – XD 104 lbs/in	MD 160 lbs/in – XD 155 lbs/in	ASTM D882/method A
Elongation at Break	MD 530% - XD 560%	MD 560% - XD 590%	MD 570% - XD 600%	MD 590% - XD 620%	ASTM D882/method A
Modulus at 100%	MD 21% - XD 21 %	MD 32% - XD 31 %	MD 41% - XD 40 %	MD 60% - XD 60 %	ASTM D882/method A
Tear Resistant	MD 8 lbs/in - XD 8 lbs/in	MD 10 lbs/in - XD 10 lbs/in	MD 12 lbs/in - XD 12 lbs/in	MD 18 lbs/in - XD 18 lbs/in	ASTM D1004, Die C
Low Temperature Resistance	-28C	-31C	-31C	-31C	ASTM D1790
Dimensional Stability	MD 2.5 – XD 2.5	MD 2.0 – XD 2.0	MD 2.0 – XD 2.0	MD 2.0 – XD 2.0	ASTM D1204
Water Extraction	0.15	0.10	0.10	0.10	ASTM D3083
Volatile Loss	0.80	0.60	0.60	0.60	ASTM D1203 (A)
Resistance to Soil Burial	Pass	Pass	Pass	Pass	ASTM D3083
Breaking Factor	5%	5%	5%	5%	ASTM D3083
Elongation at Break	20%	20%	20%	20%	ASTM D3083
100% Modulus	20%	20%	20%	20%	ASTM D3083
Water Vapor Transmission	5.0 x 10-9 cm/sec (max)	5.0 x 10-9 cm/sec (max)	5.0 x 10-9 cm/sec (max)	5.0 x 10-9 cm/sec (max)	ASTM D814
Hydrostatic Resistance	65 lbs/in2	93 lbs/in2	120 lbs/in2	180 lbs/in2	ASTM D751 (A)
Peel Strength	12.5 lbs/in (min)	15 lbs/in (min)	15 lbs/in (min)	15 lbs/in (min)	ASTM D413
Shear Strength	38.4 lbs/in (min)	58.4 lbs/in (min)	77.6 lbs/in (min)	116 lbs/in (min)	ASTM D413

Natatec GP (Reinforced) - General Purpose Containment and Environmental Lining

Description

Natatec GP is a PVC liner specially formulated for use as a general containment lining. Natatec GP is the ideal general purpose containment or environmental lining. Natatec GP is available in a 20, 30, 40 and 60-mil thickness (.020, .030, .040, .060-inch/.51, .76, 1.02, 1.52-mm) in single ply construction and 30, 40, and 60-mil (.030, .040, .060-inch/.76, 1.02, 1.52-mm) in fabric reinforced construction.

Application and uses

Natatec GP is typically used for pond and lagoon linings, landscaping, dike and levy liners, waterproofing, construction, waste water storage, irrigation, industrial water storage, recreational waterproofing.

Advantages

Highly flexible, easily fabricated and UV-resistant. Excellent weathering. Quick installation. Absolutely waterproof. Chemically resistant. Economical and cost efficient with large panel sizes. PVC formulations allow positive heat-welded seams.

Colors

Typically black with other colors available.

Property	Test Value 30-mil	Test Value 40-mil	Test Value 60-mil	Test Method
Thickness	30-mil (.030-inch/.76-mm)	40-mil (.040-inch/1.00-mm)	60-mil (.060-inch/1.50-mm)	ASTM D1593
Weight	27 ± 2 oz/sy – 0.9 kg/sm	36 ± 3 oz/sy – 1.2 kg/sm	54 ± 4 oz/sy – 1.8 kg/sm	ASTM
Fabric Type (polyester)	9 x 9 x 1000 denier	9 x 9 x 1000 denier	9 x 9 x 1000 denier	Weft Inserted Warp Knit
Break Strength	MD 263 lbs/in – XD 244 lbs/in	MD 271 lbs/in – XD 252 lbs/in	MD 280 lbs/in – XD 260 lbs/in	ASTM D751/method A
Ply Adhesion	17.5 lbs/in	20 lbs/in	20 lbs/in	ASTM D413
Tear Resistant	122 lbs/in	126 lbs/in	130 lbs/in	ASTM D751 Tongue Tear
Low Temperature	-35 C	-35 C	-35 C	ASTM D2136
Dimensional Stability	2% (max.)	2% (max.)	2% (max.)	ASTM D1204 1hr @ 100C
Water Extraction	2% (max.)	2% (max.)	2% (max.)	ASTM D3083 7 days
Volatile Loss	0.6%	0.6%	0.5%	ASTM D1203 24 @ 70C
Resistance to Soil Burial	Pass	Pass	Pass	ASTM D3083 % loss
Breaking Factor	5%	5%	5%	ASTM D3083 % loss
Hydrostatic Resistance	450 lbs/in2	480 lbs/in2	500 lbs/in2	ASTM D751 (A)
Bonded Seam Strength	190 lbs	196 lbs	202 lbs	ASTM D751 Mod. A NSF54
Peel adhesion	14 lbs/in	16 lbs/in	16 lbs/in	ASTM D413
Weatherometer (QUV)	Pass	Pass	Pass	ASTM G53
Chemical Resistance	Pass	Pass	Pass	ASTM D543 Proc.1

**R in the test value field denotes reinforced material*

Natatec FA – Fish and Aquatic Grade Lining

Description

Natatec FA is PVC lining specially formulated for use in aquaculture, including applications such as fish rearing, aquatic cultivation and aquatic environments where prolonged contact with marine and aquatic life occurs. Highly flexible, easily fabricated and UV resistant. Natatec FA is the ideal aquatic environmental lining. Natatec FA is available in a 20, 30 and 40-mil thicknesses (.020, .030, .040-inch/.51, .76, 1.02-mm) in single ply construction and 30, 40, and 60-mil (.030, .040, .060-inch/.76, 1.02, 1.52-mm) in fabric reinforced construction.

Application and uses

Natatec FA is typically used for fish pond and lagoon linings, fish tank linings, raceways and fish ladders, decorative pond linings and landscape applications.

Advantages

Highly flexible, easily fabricated and UV-resistant. Excellent weathering. Quick installation. Absolutely waterproof. Chemically resistant. Economical and cost efficient with large panel sizes. PVC formulations allow positive heat-welded seams.

Colors

Typically black with other colors available.

Property	Test Value 20-mil Single Ply	Test Value 30-mil Single Ply	Test Value 40-mil Single Ply	Test Method
Thickness	20-mil (.020-inch/0.51mm)	30-mil (.030-inch/0.76mm)	40-mil (.040-inch/1.00mm)	ASTM D1593
Specific gravity	1.23 g/cc	1.23 g/cc	1.21 g/cc	ASTM D792 method A
Break Strength	MD 56 lbs/in – XD 53 lbs/in	MD 81 lbs/in - XD 80 lbs/in	MD 108 lbs/in - XD 104 lbs/in	ASTM D882 method A
Elongation at Break	MD 530% - XD 560%	MD 560% - XD 590%	MD 570% - XD 600%	ASTM D882 method A
Modulus at 100%	MD 21% - XD 21 %	MD 32% - XD 31 %	MD 41% - XD 40 %	ASTM D882 method A
Tear Resistant	MD 8 lbs/in - XD 8 lbs/in	MD 10 lbs/in - XD 10 lbs/in	MD 12 lbs/in - XD 12 lbs/in	ASTM D1004, Die C
Low Temperature Resistance	-28C	-31C	-31C	ASTM D1790
Dimensional Stability	MD 2.5 – XD 2.5	MD 2.5 – XD 2.5	MD 2.0 – XD 2.0	ASTM D1204
Water Extraction	0.15	0.10	0.10	ASTM D3083
Volatile Loss	0.80	0.60	0.60	ASTM D1203 (A)
Water Vapor Transmission	5.0 x 10-9 cm/sec (max)	5.0 x 10-9 cm/sec (max)	5.0 x 10-9 cm/sec (max)	ASTM D814
Hydrostatic Resistance	65 lbs/in2	95 lbs/in2	120 lbs/in2	ASTM D751 (A)
Peel Strength	12.5 lbs/in (min)	15 lbs/in (min)	15 lbs/in (min)	ASTM D413
Shear Strength	38.4 lbs/in (min)	58.4 lbs/in (min)	77.6 lbs/in (min)	ASTM D413
Toxicity – Acute & Chronic (Ceridaphnia Dubia)	LC-50 > 100%	LC-50 > 100%	LC-50 > 100%	EPA/600/4-90/027F EPA/600/4-91/002

Natatec FA (Reinforced) – Fish and Aquatic Grade Lining

Description

Natatec FA is PVC lining specially formulated for use in aquaculture, including applications such as fish rearing, aquatic cultivation and aquatic environments where prolonged contact with marine and aquatic life occurs. Highly flexible, easily fabricated and UV resistant. Natatec FA is the ideal aquatic environmental lining. Natatec FA is available in a 20, 30 and 40-mil thicknesses (.020, .030, .040-inch/.51, .76, 1.02-mm) in single ply construction and 30, 40, and 60-mil (.030, .040, .060-inch/.76, 1.02, 1.52-mm) in fabric reinforced construction.

Application and uses

Natatec FA is typically used for fish pond and lagoon linings, fish tank linings, raceways and fish ladders, decorative pond linings and landscape applications.

Advantages

Highly flexible, easily fabricated and UV-resistant. Excellent weathering. Quick installation. Absolutely waterproof. Chemically resistant. Economical and cost efficient with large panel sizes. PVC formulations allow positive heat-welded seams.

Colors

Typically black with other colors available.

Property	Test Value 30R-mil	Test Value 40R-mil	Test Value 60R-mil	Test Method
Thickness	30-mil (.030-inch/.76-mm)	40-mil (.040-inch/1.00-mm)	60-mil (.060-inch/1.50-mm)	ASTM D1593
Weight	27 ± 2 oz/sy – 0.9 kg/sm	36 ± 3 oz/sy – 1.2 kg/sm	54 ± 4 oz/sy – 1.8 kg/sm	ASTM
Fabric Type (polyester)	9 x 9 x 1000 denier	9 x 9 x 1000 denier	9 x 9 x 1000 denier	Weft Inserted Warp Knit
Break Strength	MD 263 lbs/in – XD 244 lbs/in	MD 271 lbs/in – XD 252 lbs/in	MD 280 lbs/in – XD 260 lbs/in	ASTM D751/method A
Ply Adhesion	17.5 lbs/in	20 lbs/in	20 lbs/in	ASTM D413
Tear Resistance	122 lbs/in	126 lbs/in	130 lbs/in	ASTM D751 Tongue Tear
Low Temperature	-35 C	-35 C	-35 C	ASTM D2136
Dimensional Stability	2% (max.)	2% (max.)	2% (max.)	ASTM D1204 1hr @100C
Water Extraction	2% (max.)	2% (max.)	2% (max.)	ASTM D3083 7 days
Volatile Loss	0.6%	0.6%	0.5%	ASTM D1203 24 @70C
Resistance to Soil Burial	Pass	Pass	Pass	ASTM D3083 % loss
Breaking Factor	5%	5%	5%	ASTM D3083 % loss
Hydrostatic Resistance	450 psi	480 psi	500 psi	ASTM D751 (A)
Bonded Seam Strength	190 lbs	196 lbs	202 lbs	ASTM D751 Mod.A NSF54
Peel adhesion	14 lbs/in	16 lbs/in	16 lbs/in	ASTM D413
Weatherometer (QUV)	Pass	Pass	Pass	ASTM G53 2000 hrs
Chemical Resistance	Pass	Pass	Pass	ASTM D543 Proc. 1

**R in the test value field denotes reinforced material*

Natatec PW – Potable Water Storage Lining

Description

Natatec PW is a heavy duty, flexible PVC material with a tough inner core of polyester supporting scrim specially formulated for use as a potable water storage application and meets EPA standards for drinking water storage. Natatec PW is a durable, high damage-resistant lining material. A wide variety of installation techniques are available to provide maximum design flexibility and lining integrity. Natatec PW is available in a 20, 30, 40 and 60-mil thickness (.020, .030, .040, .060-inch/.51, .76, 1.02, 1.52-mm) in single ply construction and 30, 40, and 60-mil (.030, .040, .060-inch/.76, 1.02, 1.52-mm) in fabric reinforced construction.

Application and uses

Natatec PW is typically used for potable water storage tanks, filtration tanks, water treatment plants, water storage cisterns, reservoirs, fish hatcheries and aquariums.

Advantages

Highly flexible, easily fabricated and UV-resistant. Excellent weathering. Quick installation. Absolutely waterproof. Chemically resistant. Economical and cost efficient with large panel sizes. PVC formulations allow positive heat-welded seams. Reinforced construction. Does not support bacteria growth.

Colors

Typically royal blue or white with other colors available.

Property	Test Value 20-mil Single Ply	Test Value 30-mil Single Ply	Test Value 40-mil Single Ply	Test Value 60-mil Single Ply	Test Method
Thickness	20-mil (.020-inch/.51-mm)	30-mil (.030-inch/.76-mm)	40-mil (.040-inch/1.00-mm)	60-mil (.060-inch/1.50-mm)	ASTM D1593
Specific gravity	1.23 g/cc	1.23 g/cc	1.23 g/cc	1.21 g/cc	ASTM D792
Break Strength	MD 52 lbs/in – XD 50 lbs/in	MD 74 lbs/in –XD 70 lbs/in	MD 99 lbs/in – XD 96 lbs/in	MD 2500 lbs/in – XD 2400 lbs/in	ASTM D882/method A
Elongation at Break	MD 520% - XD 550%	MD 550% - XD 590%	MD 540% - XD 630%	MD 500% - XD 500%	ASTM D882/method A
Modulus at 100%	MD 19% - XD 17 %	MD 28% - XD 27 %	MD 35% - XD 34 %	MD 700% PSI - XD 700 % PSI	ASTM D882/method A
Tear Resistant	MD 8 lbs/in - XD 8 lbs/in	MD 10 lbs/in - XD 10 lbs/in	MD 12 lbs/in - XD 12 lbs/in	MD 16 lbs/in - XD 16 lbs/in	ASTM D1004, Die C
Low Temperature Resistance	-24C	-26C	-29C	-29C	ASTM D1790
Dimensional Stability	MD 2.5 – XD 2.5	MD 2.5 – XD 2.5	MD 2.0 – XD 2.0	MD 1.5 – XD 1.5	ASTM D1204
Water Extraction	0.15	0.10	0.10	0.10	ASTM D3083
Volatile Loss	0.80	0.60	0.60	0.60	ASTM D1203 (A)
Water Vapor Transmission	5.0 x 10^{-9} cm/sec (max)	5.0 x 10^{-9} cm/sec (max)	5.0 x 10^{-9} cm/sec (max)	5.0 x 10^{-9} cm/sec (max)	ASTM D814
Hydrostatic Resistance	65 lbs/in2	93 lbs/in2	120 lbs/in2	180 lbs/in2	ASTM D751 (A)
Peel Strength	12.5 lbs/in (min)	15 lbs/in (min)	15 lbs/in (min)	Not Available	ASTM D413
Shear Strength	38.4 lbs/in (min)	58.4 lbs/in (min)	77.6 lbs/in (min)	Not Available	ASTM D413

Natatec PW – Potable Water Storage Lining

Description

Natatec PW is a heavy duty, flexible PVC material with a tough inner core of polyester supporting scrim specially formulated for use as a potable water storage application and meets EPA standards for drinking water storage. Natatec PW is a durable, high damage-resistant lining material. A wide variety of installation techniques are available to provide maximum design flexibility and lining integrity. Natatec PW is available in a 20, 30, 40 and 60-mil thickness (.020, .030, .040, .060-inch/.51, .76, 1.02, 1.52-mm) in single ply construction and 30, 40, and 60-mil (.030, .040, .060-inch/.76, 1.02, 1.52-mm) in fabric reinforced construction.

Application and uses

Natatec PW is typically used for potable water storage tanks, filtration tanks, water treatment plants, water storage cisterns, reservoirs, fish hatcheries and aquariums.

Advantages

Highly flexible, easily fabricated and UV-resistant. Excellent weathering. Quick installation. Absolutely waterproof. Chemically resistant. Economical and cost efficient with large panel sizes. PVC formulations allow positive heat-welded seams. Reinforced construction. Does not support bacteria growth.

Colors

Typically royal blue or white with other colors available.

Property	Test Value 30R-mil	Test Value 40R-mil	Test Value 60R-mil	Test Method
Thickness	30-mil (.030-inch/.76-mm)	40-mil (.040-inch/1.00-mm)	60-mil (.060-inch/1.50-mm)	ASTM D1593
Weight	27 ± 2 oz/sy – 0.9 kg/sm	36 ± 3 oz/sy – 1.2 kg/sm	54 ± 4 oz/sy – 1.8 kg/sm	ASTM
Fabric Type (polyester)	9 x 9 x 1000 denier	9 x 9 x 1000 denier	9 x 9 x 1000 denier	Weft Inserted Warp Knit
Break Strength	MD 263 lbs/in – XD 244 lbs/in	MD 271 lbs/in – XD 252 lbs/in	MD 280 lbs/in – XD 260 lbs/in	ASTM D751/method A
Ply Adhesion	17.5 lbs/in	20 lbs/in	20 lbs/in	ASTM D413
Tear Resistance	122 lbs/in	126 lbs/in	130 lbs/in	ASTM D751 Tongue Tear
Low Temperature	-35 C	-35 C	-35 C	ASTM D2136
Dimensional Stability	2% (max.)	2% (max.)	2% (max.)	ASTM D1204 1hr @100C
Water Extraction	2% (max.)	2% (max.)	2% (max.)	ASTM D3083 7 days
Volatile Loss	0.6%	0.6%	0.5%	ASTM D1203 24 @70C
Resistance to Soil Burial	Pass	Pass	Pass	ASTM D3083 % loss
Breaking Factor	5%	5%	5%	ASTM D3083 % loss
Hydrostatic Resistance	450 psi	480 psi	500 psi	ASTM D751 (A)
Bonded Seam Strength	190 lbs	196 lbs	202 lbs	ASTM D751 Mod.A NSF54
Peel adhesion	14 lbs/in	16 lbs/in	16 lbs/in	ASTM D413
Weatherometer (QUV)	Pass	Pass	Pass	ASTM G53 2000 hrs
Chemical Resistance	Pass	Pass	Pass	ASTM D543 Proc. 1

**R in the test value field denotes reinforced material*

Natatec OR – Petroleum Resistant Lining

Description

Natatec OR is a heavy duty, flexible PVC material with a tough inner core of polyester supporting scrim specially formulated for short term containment and storage of oils, certain process fluids and petroleum-based products. Natatec OR is a durable, high damage-resistant lining material. A wide variety of installation techniques are available to provide maximum design flexibility and lining integrity. Natatec OR is available in 20, 30-mil thickness (.020, .030,-inch/.51, .76-mm) in single ply construction and 30, 40, and 60-mil thickness (.030, .040, .060-inch/.76, 1.02, 1.52-mm) in fabric reinforced construction.

Application and uses

Natatec OR is typically used for fuel storage facilities, fuel tank underliners, tank liners, dike and berm liners, oil exploration pit liners and mud pit liners, emergency spill containment, equipment wash down areas, vehicle marshaling yards, airport deicing facility liner, area runoff and retention lagoon liners.

Advantages

Highly flexible, easily fabricated and UV-resistant. Excellent weathering. Quick installation. Absolutely waterproof. Highly resistant to tearing. Chemically resistant. Economical and cost efficient with large panel sizes. PVC formulations allow positive heat-welded seams. Reinforced construction. Does not support bacteria growth.

Colors

Typically royal blue or white with other colors available.

Property	Test Value 20-mil Single Ply	Test Value 30-mil Single Ply	Test Method
Thickness	20-mil (.020-inch/.51mm)	30-mil (.030-inch/.76mm)	ASTM D1593
Specific gravity	1.21 g/cc	1.21 g/cc	ASTM D792
Break Strength	MD 52 lbs/in – XD 48 lbs/in	MD 78 lbs/in – XD 72 lbs/in	ASTM D882/method A
Elongation at Break	MD 400% - XD 400%	MD 490% - XD 490%	ASTM D882/method A
Modulus at 100%	MD 23% - XD 231 %	MD 35% - XD 34 %	ASTM D882/method A
Tear Resistant	MD 8 lbs/in - XD 7 lbs/in	MD 10 lbs/in - XD 9 lbs/in	ASTM D1004, Die C
Low Temperature Resistance	-35C	-35C	ASTM D1790
Dimensional Stability	MD 2.5 – XD 2.5	MD 2.0 – XD 2.0	ASTM D1204
Water Extraction	0.15	0.10	ASTM D3083
Volatile Loss	0.80	0.60	ASTM D1203 (A)
Breaking Factor	5%	5%	ASTM D3083
Elongation at Break	20%	20%	ASTM D3083
100% Modulus	20%	20%	ASTM D3083
Water Vapor Transmission	5.0 x 10^{-9} cm/sec (max)	5.0 x 10^{-9} cm/sec (max)	ASTM D814
Hydrostatic Resistance	65 psi	98 psi	ASTM D751 (A)
Peel Strength	12.5 lbs/in (min)	15 lbs/in (min)	ASTM D413
Shear Strength	38.4 lbs/in (min)	58.4 lbs/in (min)	ASTM D413

Natatec OR (Reinforced) - Petroleum Resistant Lining

Description

Natatec OR is a heavy duty, flexible PVC material with a tough inner core of polyester supporting scrim specially formulated for short term containment and storage of oils, certain process fluids and petroleum-based products. Natatec OR is a durable, high damage-resistant lining material. A wide variety of installation techniques are available to provide maximum design flexibility and lining integrity. Natatec OR is available in 20, 30-mil thickness (.020, .030,-inch/.51, .76-mm) in single ply construction and 30, 40, and 60-mil thickness (.030, .040, .060-inch/.76, 1.02, 1.52-mm) in fabric reinforced construction.

Application and uses

Natatec OR is typically used for fuel storage facilities, fuel tank underliners, tank liners, dike and berm liners, oil exploration pit liners and mud pit liners, emergency spill containment, equipment wash down areas, vehicle marshaling yards, airport deicing facility liner, area runoff and retention lagoon liners.

Advantages

Highly flexible, easily fabricated and UV-resistant. Excellent weathering. Quick installation. Absolutely waterproof. Highly resistant to tearing. Chemically resistant. Economical and cost efficient with large panel sizes. PVC formulations allow positive heat-welded seams. Reinforced construction. Does not support bacteria growth.

Colors

Typically royal blue or white with other colors available.

Property	Test Value 30R-mil	Test Value 40R-mil	Test Value 60R-mil	Test Method
Thickness	30-mil (.030-inch/.76-mm)	40-mil (.040-inch/1.00-mm)	60-mil (.060-inch/1.50-mm)	ASTM D1593
Weight	27 ± 2 oz/sy – 0.9 kg/sm	36 ± 3 oz/sy – 1.2 kg/sm	54 ± 4 oz/sy – 1.8 kg/sm	ASTM
Fabric Type (polyester)	9 x 9 x 1000 denier	9 x 9 x 1000 denier	9 x 9 x 1000 denier	Weft Inserted Warp Knit
Break Strength	MD 263 lbs/in – XD 244 lbs/in	MD 271 lbs/in – XD 252 lbs/in	MD 280 lbs/in – XD 260 lbs/in	ASTM D751/method A
Ply Adhesion	17.5 lbs/in	20 lbs/in	20 lbs/in	ASTM D413
Tear Resistance	122 lbs/in	126 lbs/in	130 lbs/in	ASTM D751 Tongue Tear
Low Temperature	-35 C	-35 C	-35 C	ASTM D2136
Dimensional Stability	2% (max.)	2% (max.)	2% (max.)	ASTM D1204 1hr @100C
Water Extraction	2% (max.)	2% (max.)	2% (max.)	ASTM D3083 7 days
Volatile Loss	0.6%	0.6%	0.5%	ASTM D1203 24 @70C
Resistance to Soil Burial	Pass	Pass	Pass	ASTM D3083 % loss
Breaking Factor	5%	5%	5%	ASTM D3083 % loss
Hydrostatic Resistance	450 psi	480 psi	500 psi	ASTM D751 (A)
Bonded Seam Strength	190 lbs	196 lbs	202 lbs	ASTM D751 Mod.A NSF54
Peel adhesion	14 lbs/in	16 lbs/in	16 lbs/in	ASTM D413
Weatherometer (QUV)	Pass	Pass	Pass	ASTM G53 2000 hrs
Chemical Resistance	Pass	Pass	Pass	ASTM D543 Proc. 1

**R in the test value field denotes reinforced material*

Natatec Polyester Fleece Separator

Description

Natatec polyester fleece is an 11-ounce, 150-mil (.150-inch/3.81-mm) 100% polyester, certified needle free geotextile material that is utilized as a separating layer between Natatec PVC lining systems. Natatec polyester is extremely resistant to rot or moisture degradation and provides an excellent barrier between the PVC liner and the substrate.

Application and uses

Natatec polyester fleece is typically used beneath PVC lining systems as protection from debris. Natatec fleece is also used above a PVC lining in certain applications to provide additional protection from debris or damage. The open structure of the polyester fleece also allows a pathway for water or gas migration.

Advantages

Highly flexible, easily fabricated and UV-resistant. Excellent weathering, Quick installation. Highly resistant to tearing. Chemically resistant. Economical and cost efficient with large panel sizes. Natatec polyester fleece separator is be resistant to freeze, thaw, moisture, soil-chemical and physical properties. All Natatec fleece separators are certified and guaranteed to be free of foreign materials, which could potentially be damaging to the liner.

Colors

Typically gray.

Standard Sizes:

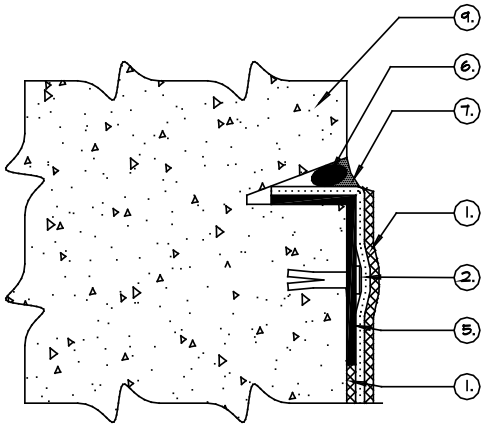
Typically rolls ranging from 7.5 to 15-ft (2.28 m to 4.75 m) wide by up to 300 lf long (91.44 m)

Representative Technical Values

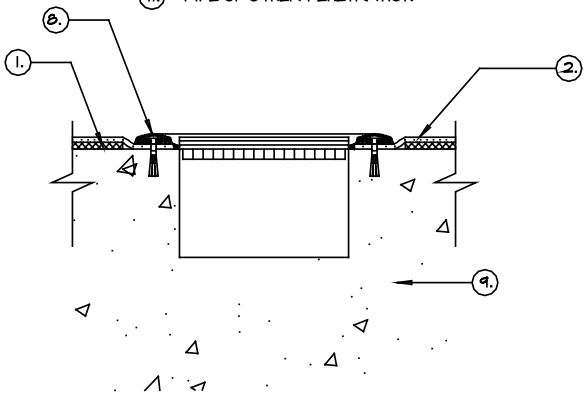
Property	Test Value	Test Method
Weight	10.5 oz./sq. yd.	ASTM D 3776
Thickness	150 mil	ASTM D 1777
Grab Strength	390/330 lbs.	ASTM D 4632
Grab Elongation	75/85%	ASTM D 463
Trapezoid Tear Strength	135/120 lbs	ASTM D 4533
Puncture Resistance	155 lbs.	ASTM D3787
Mullen Burst Strength	550 psi	ASTM D 3786
Water Flow Rate	100 gpm/ft	ASTM D 3776
Permeability	0.52 cm/sec	ASTM D 1777

Typical Waterproofing Details

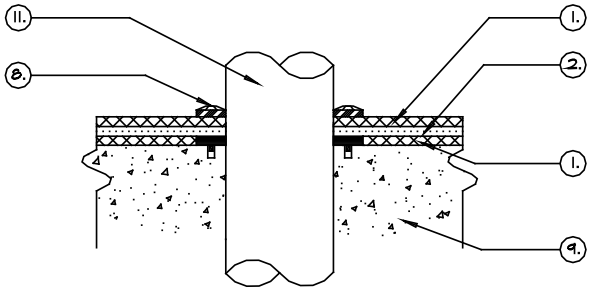
1. 150 mil. NONWOVEN POLYESTER GEOTEXTILE (PUNCTURE RESISTANT 155 lbs., ASTM D3787)
2. FABRIC REINFORCED (3 PLY) PVC OR SINGLE PLY PVC with FUSE WELDED SEAMS (SEE PROJECT DETAILS FOR SPECIFIC LINING SYSTEM)
3. MEMBRANE WATERPROOFING SYSTEM
4. OVERLAP WATERPROOFING SYSTEM 3" ON FOOTING
5. PVC COATED ANGLE with FASTENER
6. BACKER ROD
7. SEALANT JOINT
8. PVC COMPRESSION FLANGE with REQ'D. FASTENER
9. CONCRETE
10. EARTH
11. PIPE or OTHER PENETRATION



TYPICAL REGLET DETAIL (IF REQUIRED)
(NOT TO SCALE)



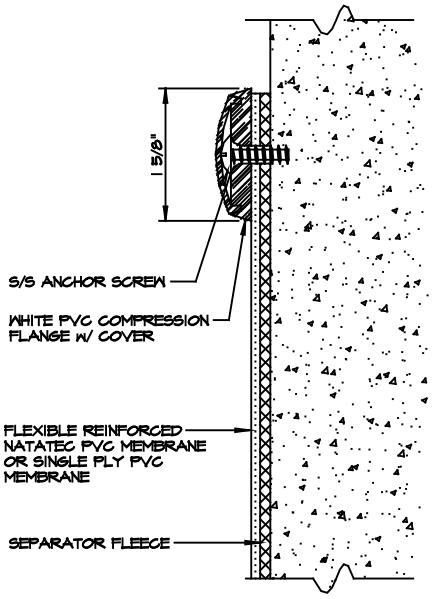
TYPICAL DRAIN DETAIL
(NOT TO SCALE)



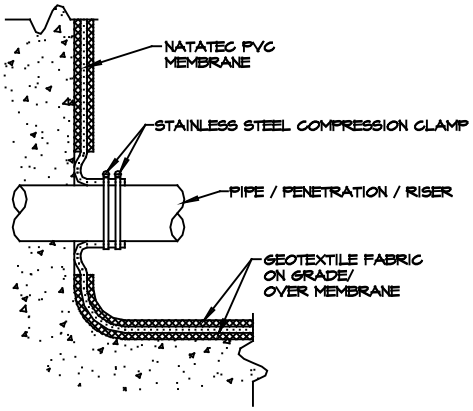
TYPICAL \ FLANGED PENETRATION DETAIL
(NOT TO SCALE)

NOTE:
DETAILS SHOWN EXAGGERATED FOR CLARITY.

Typical Waterproofing Details



MEMBRANE TERMINATION DETAIL
(NOT TO SCALE)



TYPICAL PENETRATION DETAIL
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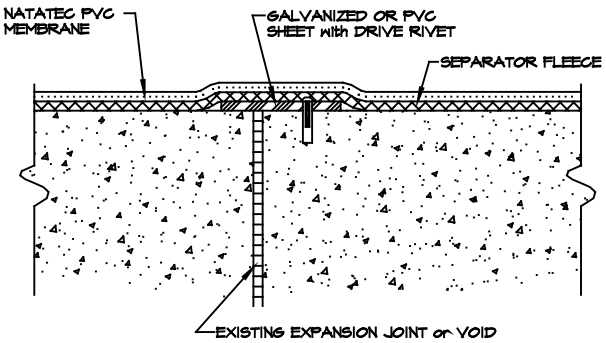
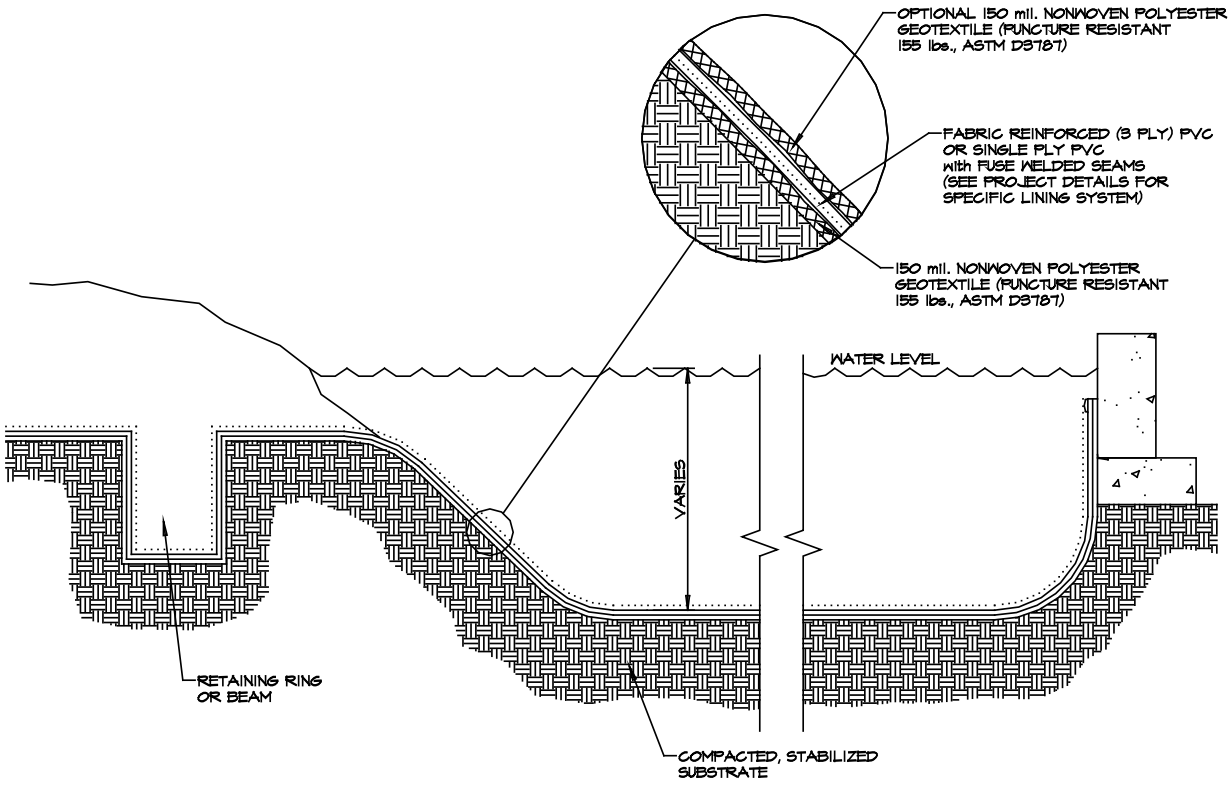


TYPICAL EXPANSION JOINT / VOID DETAIL
(NOT TO SCALE)

NOTE:
DETAILS SHOWN EXAGGERATED FOR CLARITY.

Typical Details

Typical Waterproofing Details



NOTE:
DETAILS SHOWN EXAGGERATED FOR CLARITY.

Statement of Extended Warranty
Natatec® PVC Containment Liner Systems

(installed by Natare Corporation or authorized installer)

NATARE CORPORATION ("Natare") hereby provides to _____ ("Owner") the warranties contained herein, or on exhibit on hereto, regarding the Liner System sold by Natare and installed at _____ ("site"):

Natare WARRANTS that, for a period of one (1) year, the system or products are made from new materials, free from defects, and made in a workmanlike manner in accordance only with Natare shop drawings, submittals or technical information.

Natare further WARRANTS that, for a period of ten (10) years ("the warranty period") commencing upon the completion of the installation as established by the Natatec Systems Warranty Application, the Liner shall: not peel, flake, crack, tear or delaminate; and retain its integrity as a watertight membrane.

In the event that during the warranty period the Liner System shall peel, flake, crack, tear, delaminate, or fail as a watertight liner, Natare agrees that it shall, as soon as practical after receipt of written notice from the owner, and at its option, either: repair or replace the defective materials; or refund to the Owner the portion of the purchase price attributable to the defective materials.

Specifically exempted form these warranties are claims arising from: abuse or other conditions exceeding normal use; improper or incorrect operation, or maintenance; or any use of the product other than the particular use for which the product was intended; and structural or earth movements; or acts of God.

In no event shall Natare be liable for any consequential damage, loss, or expense arising in connection with the use or inability to use the Liner System for any purpose whatsoever. The warranty described herein is provided solely with regard to the Liner System purchased from Natare and upon payment in full to Natare for any and all charges related to the Liner System. Goods or equipment not manufactured by Natare are covered only by the standard warranty of the manufacturer, though sold or operated with Natare' goods or equipment. Natare represents only that work or labor performed by Natare has been performed in a reasonable and workmanlike manner. Should any repair be required within one year for defective workmanship by Natare, Natare will undertake the required repair, and such repair, or cost thereof, shall be exclusive entitlement of the owner for any defective workmanship. Any claims against Natare must be made promptly in detail and in writing. All Natare warranties and other duties with respect to material, equipment, systems, or services furnished by Natare shall be conclusively presumed to have been satisfied one day after the expiration of the warranty period as set forth herein:

Specifically exempted from these warranties are claims arising from: abuse or other conditions deviating from normal use or contrary to Natare Care and Maintenance Instructions or in violation; improper, incorrect or incomplete installation, operation, or maintenance; or any use of the product or system other than the particular use for which the product or system was intended; structural or earth movement, or acts of God.

In no event shall Natare Corporation be liable for any consequential or other damages whatsoever, direct or indirect, except as expressly agreed to by Natare in writing. There are no other warranties or guaranties, expressed or implied, given by Natare or its agents except those provided herein.

NATARE
CORPORATION
5905 West 74th Street
Indianapolis, IN 46278
(317) 290-8828

EFFECTIVE DATE OF WARRANTY _____

SIGNED BY _____

Natare Corporation
5905 West 74th Street • Indianapolis, IN 46278 • USA
(800) 336-8828 • (317) 290-8828 • FAX (317) 290-9998
www.natare.com • natare@natare.com