

## TURTLE GLASS

What is commonly referred to throughout the glass industry as “turtle glass” is, in short, glass with a Visible Light Transmittance of 45% or less in the wavelengths associated with the visible spectrum, (400 to 700 nanometers).

In undeveloped coastal environments hatchling sea turtles are guided to move toward the water by the light of the moon. In developed environments it is known that artificial lighting will confuse the hatchlings and cause them to travel away from the water where they will likely perish. To improve the chances of hatchling survival, in March, 1993, the “Model Lighting Ordinance for Marine Turtle Protection” was adopted by the Department of National Resources in Florida and the regulation includes the 45% VLT requirement. In the time since, dozens of gulf state municipalities and local governments up the Atlantic seaboard have recognized the need to adopt or have already adopted the “turtle law”, or similar legislation. Such regulations are aimed toward the protection of marine turtles from adverse impacts including artificial beach front lighting.

In addition to glass, other requirements within the ordinance include restrictions on artificial lighting, coastal construction activities, motorized vehicle operation, and campfires within line-of-sight of the beach. The issue can be complex, as studies have shown that certain lighting, such as low-pressure sodium vapor lamps are not seen by the turtles. The turtle’s

sight is primarily affected in the 380 – 500 nanometer range.

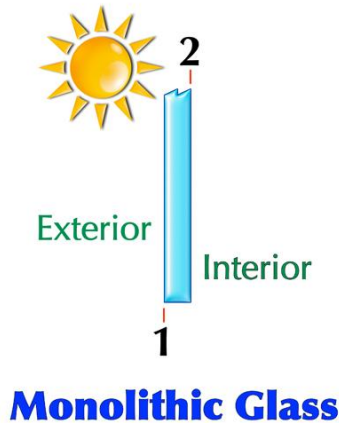
When designing or updating a building for a coastline area, the responsible design professional will consider all applicable building codes as well as the energy performance and the aesthetic appearance of the glass. This will include but not be limited to the required solar performance of the glass, the Hurricane Impact requirements and the Turtle Protection requirements.

The tables below show a few examples of Vitro (formerly PPG Industry) products in common glass constructions that will meet or exceed the requirements of the marine protection ordinance. Given the large number of glass products on the market today combined with the many different possible fabricated glass constructions, the design possibilities that meet the turtle code requirement are for all intensive purposes infinite. Many other Vitro products not listed here will also meet the code. If the center of glass VLT of the desired construction is 45% or less then that design meets the Turtle Code. Please visit <http://www.vitroglazings.com/> and utilize Vitro’s Glass Performance Calculator to determine if the specific glass construction you desire meets the Turtle Code. You can link directly to the calculator at: <http://www.ppg.com/ideascape/glass/tools/> Or contact your Vitro representative for further information and product availability.

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Table one shows monolithic Vitro glass products that meet or exceed the Turtle Code. Using the products shown here in any other typical architectural glass construction such as an Insulating Glass Unit, (IGU), or laminated or hurricane glass constructions, with any other glass type will result in a product that also meets the Turtle Code requirements. Thicker monolithic glass of the same substrate as shown below will have a lower VLT and will also meet the turtle code.

The VLT listed in table one is for Monolithic Glass as shown here:



Note: The VLT for Solarcool coated monolithic glass is the same for the coating installed towards the interior or towards the exterior. Vistacool coatings are not to be installed towards the exterior.

Table 1: Select Vitro Monolithic Glass Products with Visible Light Transmittance of Less Than 45%	
PRODUCT	VISIBLE LIGHT TRANSMITTANCE
Uncoated Monolithic Glass	
1/8" Graylite II	24%
1/4" Graylite II	9%
1/4" Pacifica	42%
1/4" Solargray	44%
5/16" Solarbronze	43%
Coated Monolithic Glass	
<b>Solarcool Coating on</b>	
3/16" Azuria	27%
1/4" Azuria	26%
1/4" Pacifica	16%
1/4" Solarbronze	21%
1/4" Solargray	17%
1/4" Solarblue	21%
1/4" Solexia	30%
1/4" Graylite II	3%
1/4" Optigray	24%
<b>Vistacool Coating on</b>	
1/4" Pacifica	32%
1/4" Solargray	34%

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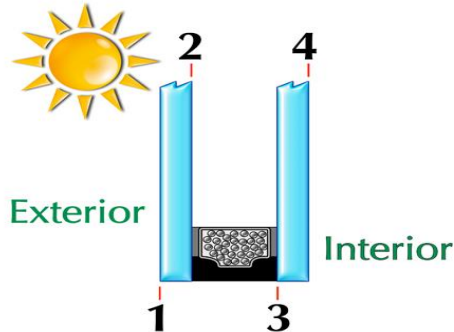


Table 2 shows a few examples of Vitro products used in an IG unit that will meet or exceed the VLT requirements of the marine protection ordinance. Many other Vitro products not listed here will also meet the code. Vitro’s on-line Glass Performance Calculator can be used to determine if the specific glass construction you desire meets the Turtle Code.

### Insulating Glass IG Unit

**Table 2: Popular Insulating Glass Units with Visible Light Transmittance of Less Than 45%**

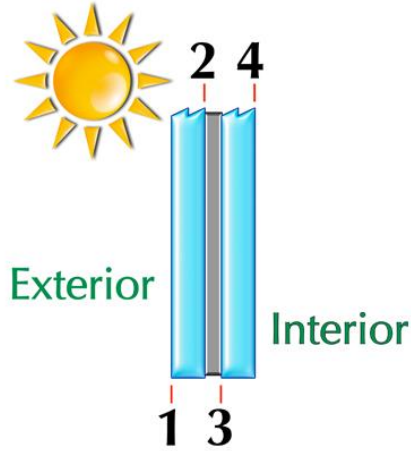
Typical residential IGU’s with glass thickness as shown:

Outdoor Lite	Indoor Lite	Visible Light Transmittance
1/8” Solargray	1/8” Solarban 70XL (3) Clear	43%
1/8” Solarban 60 (2) Solargray	1/8” Solexia	45%
1/8” Solarban 60 (2) Solargray	1/8” Solargray	33%
3/16” Solargray	3/16” Clear	45%

Typical commercial IGU’s with two 1/4-inch, (6mm) lites

Outdoor Lite	Indoor Lite	Visible Light Transmittance
Pacifica	Clear	38%
Solargray	Clear	40%
Graylite II	Clear	8%
Solarbronze	Sungate 500 (3) Clear	44%
Pacifica	Sungate 500 (3) Clear	35%
Pacifica	Sungate 400 (3) Clear	37%
Solarban 60 (2) SolarBlue	Clear	44%
Solarban 60 (2) SolarBronze	Clear	42%
Solarban 67 (2) Optigray	Clear	38%
Pacifica	Solarban 60 (3) Clear	34%
Solarban 70XL (2) Solarblue	Clear	40%
Solarban 70XL (2) Solarbronze	Clear	38%
Solargray	Solarban 70XL (3) Starphire	32%
Graylite II	Solarban 70XL (3) Starphire	7%
Solarban z50 (2) OPTIBLUE	Optiblue	37%
Solexia	Solarban z50 (3) OptiBlue	44%
Pacifica	Solarban z50 (3) OptiBlue	25%
Solarban R100 (2) Starphire	Starphire	44%
Solarban R100 (2) Atlantica	Clear	32%
Solarban R100 (2) Optigray	Clear	29%
Vistacool (2) Solargray	Clear	31%
Vistacool (2) Azuria	Sungate 500 (3) Clear	44%
Solarcool (2) Azuria	Clear	23%
Solarcool (2) Graylite II	Clear	3%

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### Laminated Glass

Table 3 shows a few examples of Vitro products used in a monolithic laminated glass construction that will meet or exceed the VLT requirements of the marine protection ordinance. Many other Vitro products not listed here will also meet the code.

Note: Vitro MSVD Sungate and Solarban coated glass must be laminated by an approved Certified Laminator Program member in good standing for a valid warranty to be offered.

**Table 3: Select Laminated Glass Combinations with Visible Light Transmittance of Less Than 45% All configurations using 0.060" Clear PVB**

Outdoor Lite	Indoor Lite	Visible Light Transmittance
1/8" Graylite II	1/8" Clear	23%
1/8" Graylite II	1/8" Solarban 60(3) Clear	20%
1/8" Solargray	1/8" Solarban 70XL (3) Clear	40%
1/8" Solarban 60 (2) Solargray	1/8" Solargray	33%
3/16" Solarban 60 (2) Clear	3/16" Solargray	41%
3/16" Solarban 70XL (2)	3/16" Solarbronze	39%
1/4" Solargray	1/4" Clear	43%
1/4" Solarbronze	1/4" Solarban 60(3) Clear	43%
1/4" Solarban 60 (2) Solargray	1/4" Clear	36%
1/4" Solarban z50 Optiblue	1/4" Azuria	40%
1/4" Solarban 70XL(2)	1/4" Pacifica	29%
1/4" Graylite II	1/4" Clear	9%
1/4" SOLARGRAY	1/4" SUNGATE 500 (3)	41%
1/4" SOLARCOOL (2) AZURIA	1/4" Clear	30%

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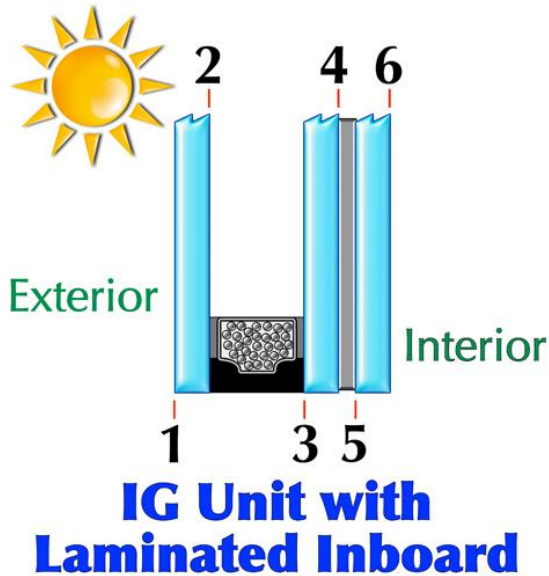


Table 4 shows a few examples of Vitro products used in an IGU with inboard laminated glass construction that will meet or exceed the VLT requirements of the marine protection ordinance. The laminate in this case is constructed with a standard PVB interlayer.

Many other Vitro products not listed here will also meet the code. Vitro's on-line Glass Performance Calculator can be used to determine if the specific glass construction you desire meets the Turtle Code.

**Table 4: Select Laminated Insulating Glass Unit Combinations with Visible Light Transmittance of Less Than 45%. All configurations using 0.090" Clear PVB**

Outdoor Lite	Lami Lite 1	Lami Lite 2	Visible Light Transmittance
1/8" Solargray	1/8" Solarban 70XL(2) Clear	1/8" Clear	37%
1/8" Solarbronze	1/8" Solarban 70XL(2) Clear	1/8" Clear	41%
3/16" Solargray	1/8" Clear	1/8" Clear	45%
3/16" Solargray	1/8" Sungate 500(2) Clear	1/8" Clear	42%
1/4" Solarban 60 Solargray	1/8" Clear	1/8" Clear	35%
1/4" Solarban z50 Optiblue	1/8" Azuria	1/8" Clear	43%
1/4" Azuria	1/8" Solarban 70XL(2) Clear	1/8" Clear	42%

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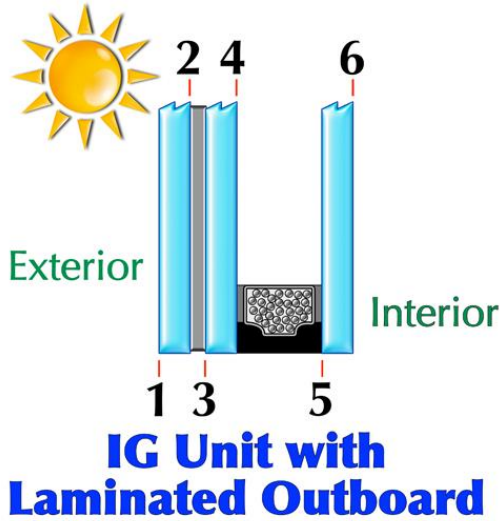


Table 5 shows a few examples of Vitro products used in an IGU with outboard laminated glass construction that will meet or exceed the VLT requirements of the marine protection ordinance. Note that the laminate in this case is constructed with the Pleotint® Sunlight Responsive interlayer.

Many other Vitro products not listed here will also meet the code. Vitro’s on-line Glass Performance Calculator can be used to determine if the specific glass construction you desire meets the Turtle Code.

**Table 5: Thermochromic Pleotint® Sunlight Responsive Laminated Insulating Glass Unit Combinations with Visible Light Transmittance of Less Than 45%.**

Lami Lite 1	Lami Lite 2	Inboard Lite	Visible Light Transmittance ← continuously variable →
¼” Azuria	3/16” Clear	¼” Solarban 60 (5) Clear	43% ↔ 10%
¼” Optiblue	3/16” Clear	¼” Solarban 60 (5) Clear	40% ↔ 9%
¼” Solargray	3/16” Clear	¼” Solarban 60 (5) Clear	28% ↔ 6%
¼” Solarbronze	3/16” Clear	¼” Solarban 60 (5) Clear	33% ↔ 7%

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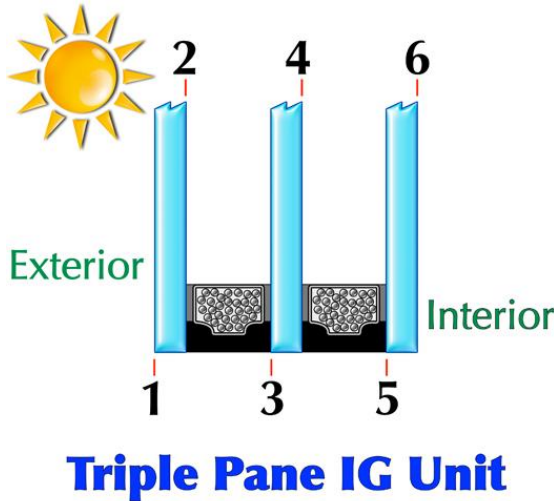


Table 6 shows a few examples of Vitro products used in a Triple Pane IGU construction that will meet or exceed the VLT requirements of the marine protection ordinance. Many other Vitro products not listed here will also meet the code.

Vitro's on-line Glass Performance Calculator can be used to determine if the specific glass construction you desire meets the Turtle Code.

**Table 6: Triple Pane Insulating Glass Units with Visible Light Transmittance of Less Than 45%**

Outdoor Lite	Center Lite	Indoor Lite	Visible Light Transmittance
Typical residential IGU's with glass thickness as shown:			
1/8" Solarbronze	1/8" Solarban 70XL (3) Clear	1/8" Clear	43%
1/8" Solarban 60 (2) Solargray	1/8" Clear	1/8" Clear	44%
1/8" Azuria	1/8" Solarban 70XL (3) Clear	1/8" Azuria	42%
Typical commercial IGU's with three 1/4-inch, (6mm) lites			
Outdoor Lite	Center Lite	Indoor Lite	Visible Light Transmittance
1/4" Solarblue	1/4" Clear	1/4" Clear	44%
1/4" Azuria	1/4" Solarban 70XL (3) Starphire	1/4" Clear	44%
1/4" Solarban z50 Optiblue	1/4" Clear	1/4" Azuria	35%

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HISTORY TABLE		
ITEM	DATE	DESCRIPTION
Original Publication	June 1994	Turtle Glass presented in ISAAC program
Transferred to Internet	4/29/02	Turtle Glass – updated products
Revision #1	Jan 2012	Added link to Vitro calculator, text on fabricated glass constructions, and tables 2-6
Revision #2	May 2014	Optigray combinations added.
Revision #3	2016-10-04	Updated to Vitro Logo and format

This document is intended to inform and assist the reader in the application, use, and maintenance of Vitro Flat Glass products. Actual performance and results can vary depending on the circumstances. **Vitro makes no warranty or guarantee as to the results to be obtained from the use of all or any portion of the information provided herein, and hereby disclaims any liability for personal injury, property damage, product insufficiency, or any other damages of any kind or nature arising from the reader's use of the information contained herein.**