Turtle Glass

What is commonly referred to throughout the glass industry as "turtle glass" is, in short, glass with a Visible Light Transmittance (VLT) 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 on the following pages show a few examples of Vitro 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 intents and 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.

The reader should also note that field applied window tint films or coatings are not included in any of the tables. The use of such field applied materials is not recommended by Vitro and the application of such materials will void

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any and all applicable Vitro glass and coating warranties. Refer to Vitro Technical Document TD-139, *Field Application of Materials to Glass* for more details.

Please visit http://www.vitroglazings.com/ and utilize Vitro's Glass Construct tool to determine if the specific glass construction you desire meets the Turtle Code. You can link directly to the Construct tool at: http://construct.vitroglazings.com/ or contact your Vitro representative for further information and product availability.

Table 1 on the following page 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.

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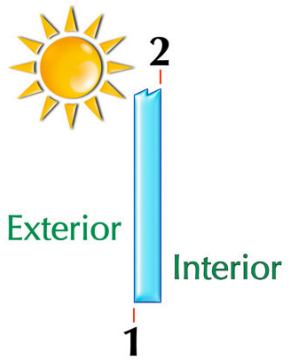
The VLT listed in table one is for Monolithic Glass as shown here:



Monolithic Glass

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	
Solarcool® Coating on	
3/16” Azuria®	27%
1/4" Azuria	26%
1/4" Pacifica	16%
1/4" Solarbronze	21%
1/4" Solargray	17%
1/4" Solarblue®	21%
Vistacool® Coating on	
1/4" Pacifica	32%

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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.

Table 2: Popular Insulating Glass Units with Visible Light Transmittance of ≤ 45%.

Typical residential IGU's with glass thickness as shown:		
Outdoor Lite	**Indoor Lite**	**Visible Light Transmittance**
1/8" Solargray	1/8" Solarban® 70 (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 ¼-inch, (6mm) lites		
Outdoor Lite	**Indoor Lite**	**Visible Light Transmittance**
Pacifica	Clear	38%
Solargray	Clear	40%
Graylite II	Clear	8%
Solarbronze	Solarban 60 (3) Clear	42%
Optigray®	Solarban 90 (3) Clear	36%
Solarban 60 (2) Solarblue	Clear	45%
Solarban 60 (2) Solarbronze	Clear	42%
Solarban 67 (2) Optigray	Clear	38%
Pacifica	Solarban 60 (3) Clear	34%
Solarban 70 (2) Solarblue	Clear	41%
Solarban 70 (2) Solarbronze	Clear	39%
Solargray	Solarban 70 (3)	32%
Graylite II	Solarban 70 (3)	7%
Solarban z50 (2) Optiblue®	Optiblue	37%
Solexia	Solarban z50 (3) Optiblue	44%
Solarban R77 (2) Solargray	Clear	23%
Solarban R100 (2) Starphire®	Starphire	44%
Solarban R100 (2) Atlantica®	Clear	31%
Solarban R100 (2) Optigray	Clear	29%
Vistacool (2) Azuria	Solarban 60 (3) Clear	42%
Solarcool (2) Azuria	Clear	24%
Solarcool (2) Pacifica	Clear	15%
Solarcool (2) Solargray	Clear	16%
Solarcool (2) Solargray	Solarban 60 (3) Clear	14%

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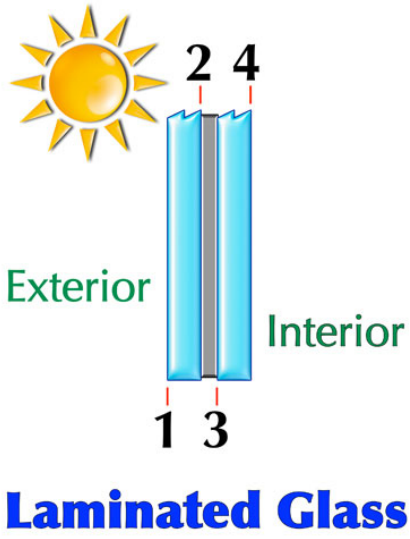

Table 3 shows a few examples of Vitro products used in a monolithic laminated glass construction that will meet or exceed the VLT requirements of the marine protection ordinance. Many other Vitro products not listed here will also meet the code.

Note: Vitro MSVD Sungate and Solarban coated glass must be laminated by an approved Vitro 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 ≤ 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 70 (3) Clear	41%
1/8" Solarban 60 (2) Solargray	1/8" Solargray	33%
3/16" Solarban 60 (2) Clear	3/16" Solargray	41%
3/16" Solarban 70 (2)	3/16" Solarbronze	39%
¼" Solargray	¼" Clear	43%
¼" Solarbronze	¼" Solarban 60(3) Clear	43%
¼" Solarban 60 (2) Solargray	¼" Clear	36%
¼" Solarban z50 (2) Optiblue	¼" Optiblue	38%
¼" Solarban 70 (2)	¼" Pacifica	29%
¼" Solarban 90 (2) Clear	¼" Clear	45%
¼" Graylite II	¼" Clear	9%
¼" Solargray	¼" Solarban 60 (3) Clear	36%
¼" Solarcool (2) Azuria	¼" Clear	30%
¼" Solarcool (2) Pacifica	¼" Solarban 70(3)	13%
¼" Solarcool (2) Solargray	¼" Solarban 70(3)	14%

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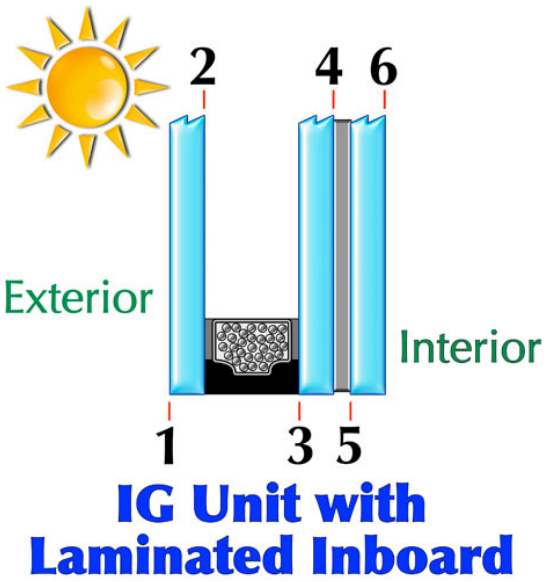

Table 4 shows a few examples of Vitro products used in an IGU with inboard laminated glass construction that will meet or exceed the VLT requirements of the marine protection ordinance. The laminate in this case is constructed with a standard PVB interlayer.

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 ≤ 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 70 (4) Clear	1/8" Clear	37%
1/8" Solarbronze	1/8" Solarban 70 (4) Clear	1/8" Clear	41%
1/8" Solargray	1/8" Solarban 60 (4) Clear	1/8" Clear	45%
3/16" Solargray	1/8" Clear	1/8" Clear	45%
3/16" Solargray	1/8" Solarban 60(4) Clear	1/8" Clear	37%
¼" Solarban 60 (2) Solargray	1/8" Clear	1/8" Clear	35%
¼" Solarban z50 (2) Optiblue	1/8" Azuria	1/8" Clear	43%
¼" Solarban 90 (2) Optiblue	1/8" Clear	1/8" Clear	37%
¼" Azuria	1/8" Solarban 70 (4) Clear	1/8" Clear	42%
¼" Graylite II	1/8" Clear	1/8" Clear	8%
¼" Solarcool (2) Pacifica	1/8" Clear	1/8" Clear	15%
¼" Solarcool (2) Solargray	1/8" Clear	1/8" Clear	13%

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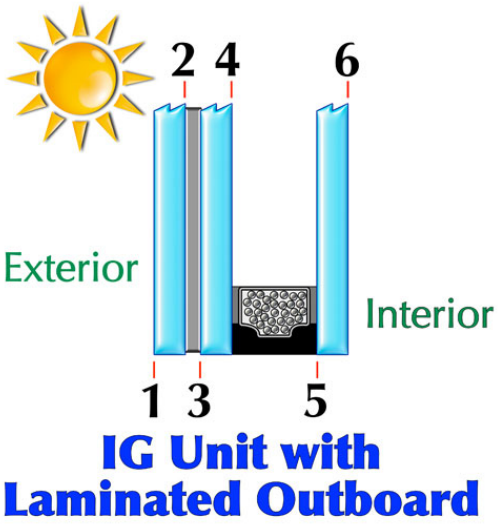

Table 5 shows a few examples of Vitro products used in an IGU with outboard laminated glass construction that will meet or exceed the VLT requirements of the marine protection ordinance. The laminate in this case is constructed with a standard PVB interlayer.

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 5: Select Laminated Insulating Glass Unit Combinations with Visible Light Transmittance of ≤ 45%. All configurations using 0.090" Clear PVB

Lami Lite 1	Lami Lite 2	Inboard Lite	Visible Light Transmittance
¼" Azuria	¼" Clear	¼" Solarban 90 (5) Clear	38%
1/8" Graylite II	1/8" Clear	¼" Solarban 60 (5) Clear	18%
¼" Graylite II	¼" Clear	¼" Solarban 60 (5) Clear	7%
¼" Optiblue	¼" Solarban 70 (4)	¼" Clear	44%
¼" Solargray	¼" Clear	¼" Solarban 60 (5) Clear	34%
¼" Solarbronze	¼" Clear	¼" Solarban 60 (5) Clear	41%
¼" Solarcool (2) Solarblue	¼" Clear	¼" Solarban 90 (5) Clear	15%

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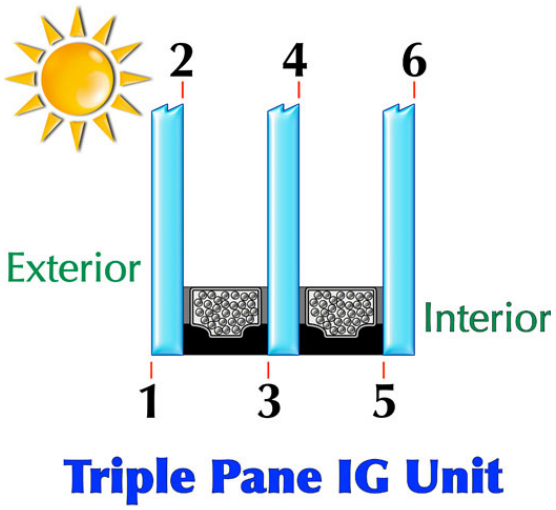

Table 6 shows a few examples of Vitro products used in a Triple Pane IGU construction that will meet or exceed the VLT requirements of the marine protection ordinance. Many other Vitro products not listed here will also meet the code.

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 ≤ 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 70 (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 70 (3) Clear	1/8" Azuria	42%
1/8" Graylite II	1/8" Solarban 70 (3) Clear	1/8" Clear	15%
Typical commercial IGU's with three ¼-inch, (6mm) lites			
Outdoor Lite	**Center Lite**	**Indoor Lite**	**Visible Light Transmittance**
¼" Solarblue	¼" Clear	¼" Clear	45%
¼" Azuria	¼" Solarban 70 (3)	¼" Clear	45%
¼" Solarban z50 (2) Optiblue	¼" Clear	¼" Azuria	35%
¼" Graylite II	¼" Clear	¼" Clear	7%
¼" Solarcool (2) Pacifica	¼" Clear	¼" Clear	13%

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HISTORY TABLE		
ITEM	DATE	DESCRIPTION
Original Publication	06/01/1994	Turtle Glass presented in ISAAC program
Transferred to Internet	4/29/02	Turtle Glass – updated products
Revision #1	1/01/2012	Added link to Vitro calculator, text on fabricated glass constructions, and tables 2-6
Revision #2	05/01/2014	Optigray combinations added.
Revision #3	10/04/2016	Updated to Vitro Logo and format
Revision #4	1/25/2019	Updated the Vitro Logo and format
Revision #5	7/19/2021	Added disclaimer regarding use of field applied materials to glass and updated the link to the Vitro Construct tool, updated charts to eliminate discontinued products and added new compliant combinations.