Solexx™

TECHNICAL GUIDE

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Solexx Technical Guide

By Adapt8, Inc.

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Introduction

Production costs are the number one concern for growers, with energy costs being the largest. In addition to managing energy costs, growers must consider plant health, worker health, and costs of repeatedly covering structures as well as risks associated with weather events.

Solexx™, a strong, shatter-proof greenhouse covering, protects crops from harsh weather conditions. The insulated covering reduces labor, heating and cooling costs, plant stress and condensation. The diffuse, full spectrum light spurs lush, compact growth, decreasing time to market. Solexx, a high-density polyethylene (HDPE) material, incorporates UV inhibitor throughout the material for long-lasting sun protection that will not scratch or wear off. Because Solexx is flexible, it is a perfect choice for new construction or recovering an existing greenhouse or hoop house. Solexx is the only insulated covering alternative to film for covering a hoop house, and is an excellent choice for replacing polycarbonate, fiberglass or glass.

I.1. Solexx Products

Physical Dimensions		
3.5mm Rolls		**3.5mm Panels**
Width	**Length (2 sizes)**	**Width xx Length (2 sizes)**
49.5 in*, 125.73 cm	400 ft., 121.92 m	49.5 x 99 in, 125.73 x 251.46 cm
49.5 in, 125.73 cm	900 ft., 274.32 m	49.5 x 146 in, 125.73 x 370.84 cm
5mm Rolls		**5mm Panels**
Width	**Length (4 sizes)**	**Width x Length (2 sizes)**
50.5 in*, 128.27 cm	300 ft., 91.44 m	49.5 x 99 in, 125.73 x 251.46 cm
50.5 in, 128.27 cm	600 ft., 182.88 m	49.5 x 146 in, 125.73 x 370.84 cm
65.0 in, 165.10 cm	300 ft., 91.44 m	
77.5 in, 196.85 cm	300 ft., 91.44 m	

*Custom lengths available

Table 1

Physical Properties	ASTM Test	Value	
		3.5mm	**5mm**
Weight	N/A	0.16 lbs./sf (0.78 kg/m^2)	0.24 lbs./sf (1.17 kg/m^2)
Density	D792	58.08 lb./ft^3 (0.9304 g/cc)	58.39 lb./ft^3 (0.9353 g/cc)
Specific Gravity	D792	58.08 lb./ft^3 (0.9304 g/cc)	58.39 lb./ft^3 (0.9353 g/cc)

Table 2

II. Energy Savings

II.1. Insulation Measurements

Standardized procedures in the building and construction industry, determine the relative energy efficiency of most building products. Insulation, measured in terms of R-Value and U-Factor, quantify a material's resistance to heat transfer. R-Value (R) measures heat retention while U-Factor (U) measures heat loss. The values are inverse where $U = \frac{1}{R}$. A lower U-value represents less heat loss over a given area under standardized conditions. (Table 4)

II.2 Solexx construction: R-Value and U-Value

The general design of Solexx facilitates improved heat retention. The twin-walled material increases the energy efficiency by increasing the number of surfaces through which heat must transfer before it reaches the outside. Heat transfer occurs when air is passed from one atom to another atom. Trapped air has fewer atoms and reduces the heat lost to the cell walls. The result of the trapped air is known as insulation because the movement is slower. The key is to trap air in the flutes. Simply adding airspace between two layers is not enough to significantly show heat loss, so larger flutes do not proportionally increase insulation. Larger air chambers create convection and air movement inside the trapped space decreasing the insulation properties.

II.3 Solexx 3.5mm material vs. 5mm

Solexx Paneling is available in 3.5mm and 5mm thicknesses. While both provide superior insulation, Solexx 5mm has a higher R-value and lower U-value and is the product recommended for covering commercial greenhouses for the best heat retention on the market.

Insulation Values of Solexx

Solexx	3.5mm	5mm	3.5mm	5mm
R-Value	2.10 (US)	2.30 (US)	0.366 (SI)	0.409 (SI)
U-Value	0.48 (US)	0.43 (US)	2.73 (SI)	2.44 (SI)

United States (US): R-Value (US) = *(ft^2 x °F x hr) / Btu* U-Value (US) = *Btu / (hr x ft^2 x °F)*

Système Internationale (SI): R-Value (SI) = *(m^2 x °K) / W* U-Value (SI) = *W / (m^2 x °K)*

Table 3

II.4 Comparison of Solexx to Double Polyethylene Film

Solexx greenhouse covering lasts three to four times as long as polyethylene film, assuming the film does not tear. Solexx requires no energy input to maximize the R-Value, unlike double polyethylene necessitating a full-time blower. The R-Value of 5mm Solexx is 2.30, compared with 1.70 for 6mm Double Polyethylene Film, when fully inflated. Not only is Solexx 35% better at resisting heat loss, it does not lose effectiveness in storms or with loss of power (without power, blown poly loses its insulation value).

The U-value refers to the heat loss rate. If 5mm Solexx is 0.43 compared with 0.59 for 6mm Double Polyethylene Film, then 6mm Double Polyethylene Film loses heat almost 40% faster than Solexx. Greater insulation increases heating efficiency and reduces the total amount of time requiring heat. Unheated structures covered with Solexx have a more consistent temperature and better protection from frost earlier in the season, so crops are ready for market earlier. Improved plant health occurs with fewer temperature fluctuations and a more uniform growing environment.

II.5 R-Value and U-Values of Common Greenhouse Coverings

Heat Loss Comparison

Greenhouse Covering	R-Value (US)	U-Value (US)	R-Value (SI)	U-Value (SI)
5.0 mm Solexx*	2.30	0.43	0.409	2.44
3.5 mm Solexx*	2.10	0.48	0.366	2.73
8.0 mm Triple Wall Polycarbonate	2.00	0.50	0.352	2.84
Double Pane Window	2.00	0.50	0.352	2.84
10.0 mm Twin Wall Polycarbonate	1.89	0.53	0.332	3.01
6.0 mil Double Polyethylene Film**	1.70	0.59	0.298	3.35
8.0 mm Twin Wall Polycarbonate	1.60	0.63	0.279	3.58
6.0 mm Twin Wall Polycarbonate	1.54	0.65	0.271	3.69
5.0 mm Double Polyethylene Film**	1.50	0.67	0.263	3.80
4.0 mm Twin Wall Polycarbonate	1.43	0.70	0.251	3.97
3.0 mm Single Pane Glass	0.95	1.05	0.157	5.96
Corrugated Polycarbonate	0.88	1.14	0.154	6.47
6.0 mil Single Polyethylene Film	0.83	1.20	0.146	6.81
Corrugated Fiberglass	0.64	1.56	0.112	8.86

* With caulked flutes, independent laboratory results

*** Requires constant inflation to maintain R-Value***

United States (US): R-Value (US) = $(ft^2 \times °F \times hr) / Btu$ U-Value (US) = $Btu / (hr \times ft^2 \times °F)$

Système Internationale (SI): R-Value (SI) = $(m^2 \times °K) / W$ U-Value (SI) = $W / (m^2 \times °K)$

Table 4

II.6 Comparison of Solexx to Double-Wall Polycarbonate

Two specific features account for the superior energy efficiency of Solexx over polycarbonate. The first feature is the thermal permeability of HDPE verses other greenhouse coverings. Heat transfers more slowly through

HDPE than other coverings, so Solexx holds in the heat longer. The second feature is that Solexx and Silicone caulk used to seal the flutes have a similar coefficient of expansion. Caulking the flutes of Solexx creates a dead air space. This means the silicone will continue to seal as the material changes temperature, both as the greenhouse covering heats and cools. The lack of air movement in the panel flutes translates directly to a greater insulation. Silicone does not seal polycarbonate flutes because they expand and contract at different rates. This is especially true in cooler temperatures. Polycarbonate is usually sealed with an aluminum tape, which often fails to create a lasting seal. Additionally, the highly thermal conductive aluminum tape increases the rapidity of air flow within the flutes resulting in heat loss.

II.7 Determine Energy Savings with Virtual Grower

Several years ago, the USDA-ARS created Virtual Grower, an energy consumption simulation software program. With the Virtual Grower program, growers perform an energy audit of an existing facility or new construction. The software allows comparison between a variety of scenarios to determine the best energy conservation options and areas of greatest savings. Solexx is the only greenhouse covering named by brand in the software. For more information on Virtual Grower, please go to the USDA website. Adapt8 will gladly run comparisons using the software and your specific data if you prefer.

II.8 Solexx ROI

The chart below shows the Return on Investment of covering a greenhouse structure with Solexx 5mm. Over the warrantied lifespan, Solexx saves an estimated $79,580 on greenhouse heating. That is a saving of $4,945 each year. Experience shows the ROI is usually between 1.5 to 4 years depending on energy costs and growing conditions.

The following example compares yearly heating costs between existing Double Polyethylene Film, and 5mm Solexx. This example is for a single Kalamazoo, Michigan greenhouse heated between January 1 and May 31 to a constant temperature of 68°F, with no energy curtain. The data compiled from the USDA Virtual Grower Software uses a Nov 2021 price for propane of $2.20 per gallon. We chose an annually maintained 6+ year old unit heater with power ventilation as our heating source. The data is based on historical averages and does not reflect increased heating costs from a Polar Vortex.

Greenhouse 100' long 30' wide 6' side height 13' roof height	**Annual Heating Cost** *with Double Polyethylene Film*	**Annual Heating Cost** *with Solexx 5mm*	**Annual Dollars saved** *with Solexx 5mm*	**Cost to Cover the 30'x100'** Greenhouse *with Solexx 5mm*	**Return on Investment** *(not including freight)*
3,000 sq. ft.	$12,903	$7,958	$4,945	$14,796	2.99 yrs.

Table 5

II.9 Energy Rebates and Incentives

Many states and provinces, in addition to the US and Canadian federal governments, offer a collection of loans, rebates, and other incentives, to encourage energy conservation in greenhouse construction. Including these financial incentives in an ROI analysis further reduces the payback period. In some cases, the project pays for itself in only one growing season. For more information on these rebates and incentives, please contact your Adapt8 representative at 877-476-5399.

III. Light

It is impossible to talk about attributes of greenhouse coverings without addressing light. Light, a fundamental component of photosynthesis, is critically important in plant production. Light in a greenhouse significantly affects plant growth and crop readiness. Plants require enough light to photosynthesize, but too much light creates excess heat. When light strikes an object, the light waves interact with the surface of the material. The effects vary depending on the properties of the covering medium. Greenhouse crops require three light dimensions: light duration, light quantity, and light quality. A greenhouse covering significantly impacts light quantity and light quality. Light duration refers to daylight length, so the choice of covering does not affect this requirement. The following section describes types of light and light quality.

Solexx Optical Properties

Optical Properties	ASTM Test	Value	
		3.5mm	5mm
Light Transmittance	D1003	75-80%	75-80%
Light Diffusion Percent	D1003	98.4%	100.0%
Solar Reflectance	E903	22.2%	21.1%
Shading Coefficient	E903	0.804	0.764
Solar Heat Gain Coefficient	E903	0.699	0.665
Yellow Index	E313	10.032	12.853

Table 6

III.1 Light Transmission

Light transmission is the passage of electromagnetic radiation through a medium. Light transmission refers to the quantity of light passing through a given material. Light reacts with the medium in one of three ways: it passes through the material, the material reflects the light, or the material absorbs the light. Light, not reflected or absorbed, results in visible light transmitted through the material. The following equation demonstrates light transmission into the greenhouse:

Light Transmission in a Greenhouse = Total Light – (Light Absorbed by Greenhouse Covering + Light Reflected by Greenhouse Covering)

Transmission values indicate the percentage of photons falling upon a surface, in a given time, compared to the photons reaching the other side of the material.

It is often difficult to compare different greenhouse covering options for light transmission, since many companies quote a number, but do not tell you where the number came from. Typically companies use a hand light transmission meter, which often gives a much higher rating, rather than the official ASTM test used for Solexx in this guide.

III.2 Diffuse Light

Transmitted light may transmit directly through a material, or scatter. Scattered light, called diffuse light, may be partially or fully diffuse.

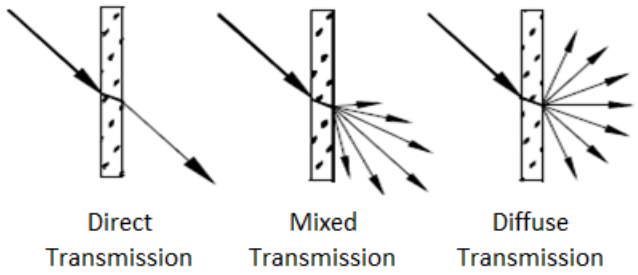
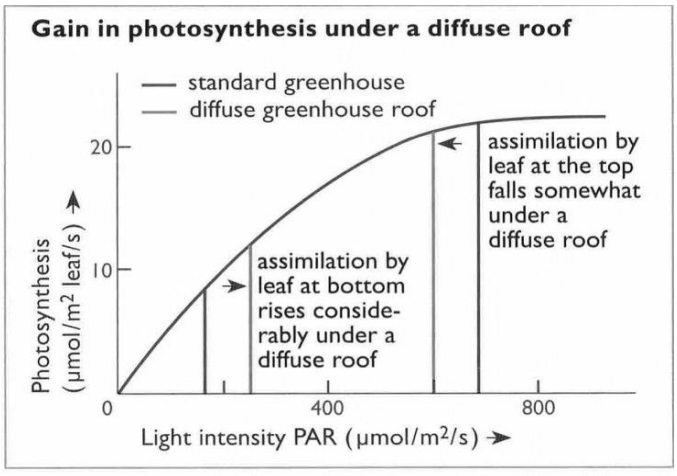


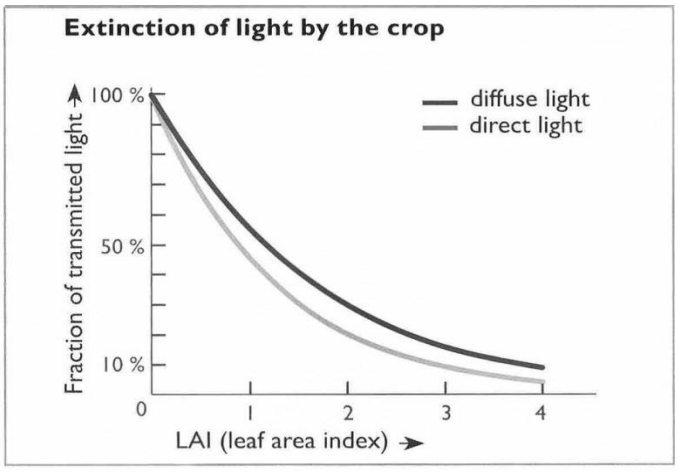
Figure 1

Light diffusion refers to scattered light rays. Unlike direct light, diffuse light bends around corners leaving no shadows. Direct light consists of focused beams of light, thus, is more intense than diffuse light and transmits more heat. Direct beams of light do not bend around corners. In a greenhouse, the more diffuse the light, the greater the light coverage because the scattered rays reach more surface areas (leaves, stems and fruits deeper in the canopy). The benefits of diffuse light were recently discussed in the January 2015 issue of In Greenhouse Magazine. The article shows an increase in photosynthesis (Figure 2) and greater light penetration (Figure 3) with diffused light vs. direct light.



With diffuse light a leaf at the top of the crop receives less light while a leaf at the bottom gets more. The net result is more photosynthesis. The leaf at the top is quite close to its light saturation point, while the leaf at the bottom clearly can produce more assimilates with more light.

Figure 2



The light becomes more subdued as it penetrates deeper into a crop as it is absorbed by the leaves (indicated here by the rising leaf area index, LAI). Diffuse light is less quickly extinguished than direct light.

Figure 3

While the human eye is more sensitive to direct light, a bright cloudy day nicely illustrates the power of diffuse light. High cloud cover results in bright light, even though the clouds obscure the light source, the sun. As sunlight hits the clouds, the rays scatter in every direction, covering a wide area despite having a single point

of origin. Photographers often choose overcast days for their work because the light illuminates the subject without casting shadows or glare. In plant production, this translates to faster, healthier growth.

Plants benefit from diffuse light because all available light reaches the entire plant, not just the upper canopy. More leaf penetration results in more photosynthesis and faster growth—by as much as 25%, delivering crops to market in three quarters of the time. Diffuse light also produces fewer culls which translates into a healthier bottom line.

http://www.ballpublishing.com/GrowerTalks/ViewArticle.aspx?articleid=20729

http://www.greenhousegrower.com/structures-equipment/equipment/diffuse-lighting-offers-multiple-benefits/

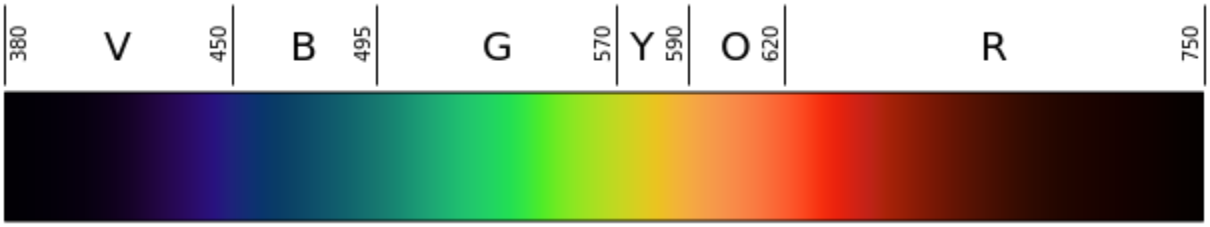
III.3 The Relationship between Light Transmission and Diffuse Light

When choosing a greenhouse covering it is important to look at the total usable light. High light transmission but low diffusion results in "leggy" plants because the light reaches only the upper canopy. The greenhouse is also more likely to overheat, and there is a greater chance of leaf burn. Solexx's total usable light means less plant stretch and less stress. The proper balance of transmission and diffusion improves growth and reduces plant stress.

III.4 Light Quality/PAR

The visible spectrum of light is roughly 400 to 800 Nanometers, or nm. Nanometers refer to the length of particle movement for each color. Light with less than 400 nm is Ultraviolet light, while greater than 800 nm in infrared. The human eye is most tuned to 555 nm, meaning colors on the green spectrum appear brighter to us than other colors in the spectrum. Wavelengths outside the visible spectrum still create radiant energy and impact plant growth, however, photosynthetically active radiation (PAR light), refers to visible light between 400 and 780 nm (see Figure 4 and 5).

Figure 4



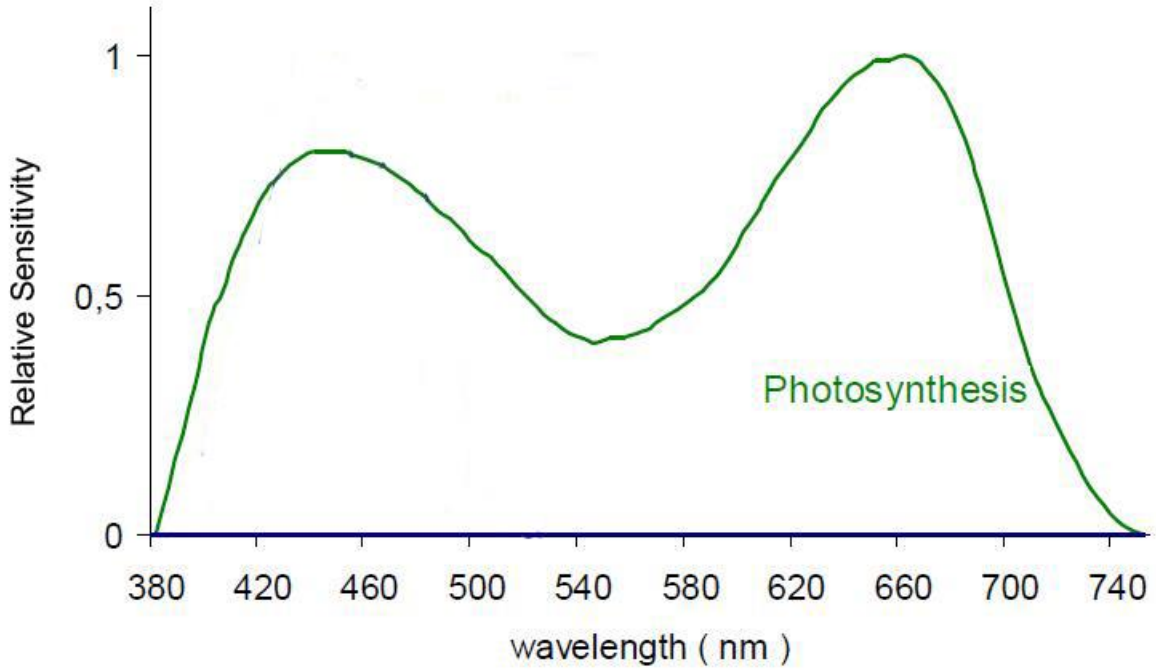


Figure 5

Full spectral light results in optimal photosynthesis. The optimal growing range is the same as the visual spectrum; however, plants do not use the green spectrum for photosynthesis as the leaves reflect it, rather than absorb the light. (See Figure 6 below for the full spectral graph of Solexx Transmittance)

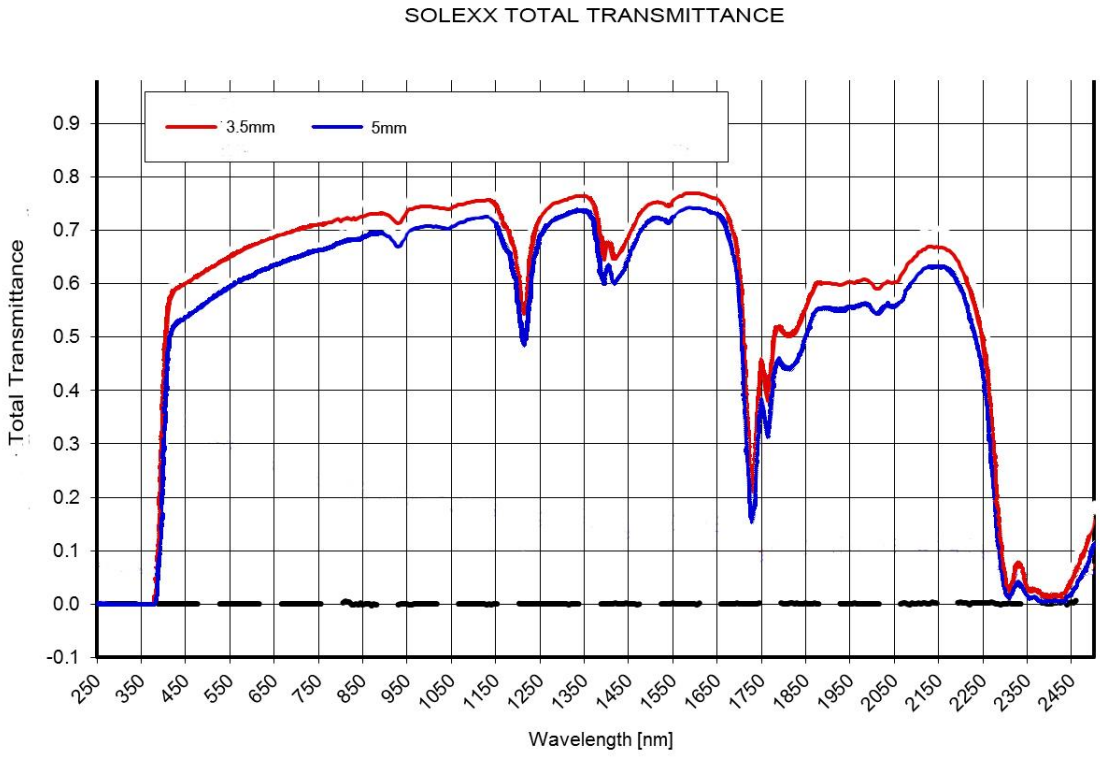


Figure 6

Solexx transmits, the entire visible spectrum, but blocks light on both the Ultra-violet and Infra-red ranges. Just as ultraviolet light causes DNA damage in humans, it is harmful to plants as well. While Solexx allows the entire visible light spectrum to pass through, it blocks ultraviolet rays that harm plant growth. Plants do not benefit from large quantities of UV light. A covering that reduces the UV light within a greenhouse improves growth by maximizing photosynthesis and minimizing UV damage. "Generalized plant damage", from UV-B rays, impairs cellular division and linear growth. This damage occurs between 280 nm and 331 nm.

Light transmitted through Solexx produces full spectrum light. In figure 6, the x axis (horizontal) represents the light spectrum from 250 to 2500 nm, while the y axis (vertical) represents the total percent transmittance. The red and blue lines show the total transmittance over the light spectrum. The baseline appears as 0.0 on the y axis. The red line represents the results of two samples of 3.5mm Solexx and the blue lines represents two samples of 5 mm Solexx. Due to its twin walled construction and since Solexx is installed vertically (V) and horizontally (H), Solexx was tested in both directions with no significant difference in performance. The total transmittance was very high for the photosynthetically active radiation range in both the 3.5 mm and 5 mm Solexx. In the ultraviolet range, both thicknesses block out all UV below the 380 nm level due to the UV inhibitor in the Solexx. A small divergence in performance occurs for Solexx in the infrared light range, with the 5mm thickness having a slightly lower transmittance than the 3.5mm Solexx. This difference has no impact on plant performance.

III.6 Addition of UV Inhibitor

UV additives protect Solexx greenhouse coverings from UV degradation. The UV additives, mixed with the resin in the extrusion process, ensure even distribution throughout the material. Unlike polycarbonate, the UV protection in Solexx is not just a surface coating. Solexx's UV protection will not scratch, flake, wash, or burn off. There is no need for special care. Bleach will not harm the surface of Solexx so it can be easily disinfected without creating *Bisphenol A* (*BPA*) off-gassing (as with polycarbonate).

III.7 Additional Optical Properties

Solexx's solar **heat gain coefficient** can be interpreted as the percent of solar radiation that enters the greenhouse and increases the greenhouse temperature. Relative to its thickness, Solexx lets in a minimal amount of solar radiate heat. (Table 6)

The **yellow index** is used as a reference with zero being the ideal white. In reality you need to compare samples of similar thickness, gloss, texture and translucency to evaluate yellow index performance of several greenhouse coverings. Positive values indicate the sample will be more yellow and negative values indicate the sample will be bluer when exposed to natural light. The low positive values for the two Solexx samples indicate Solexx will stay very close to the ideal white when exposed to outdoor light conditions. (Table 6)

IV. Performance

IV.1 Chemical Resistance, Compatibility and Cleaning

Keeping both sides of the Solexx paneling surface clean enables Solexx to perform at optimal levels. Unlike other greenhouse coverings, Solexx paneling is inert and can be safely cleaned with most greenhouse disinfectant chemicals. We suggest you test any new chemicals on a scrap piece of Solexx before you spray a finished greenhouse. Solexx is BPA free. Materials with BPA's can produce off gassing that can harm your plants. Solexx is safe for people and for plants.

Contact us for a complete MSDS sheet.

IV. 2 Durability

Based on over 25 years' experience, Solexx should last around twelve to fifteen years before requiring full or partial replacement. The lifespan varies based on specific location and conditions. Shade cloth use during summer months will reduce total UV exposure and extend the life of the Solexx. Typically, the top portion of the roof shows wear sooner than other surfaces due to prolonged sun exposure versus other sections of the greenhouse. Proper installation will also contribute to an extended durability. For more complete installation suggestions, see our website for a copy of the Solexx Installation Guide.

IV.3 Snow Load

The design of the greenhouse frame determines a greenhouse's snow load capability; however, Solexx reduces the risk of collapse in snow and ice. Solexx has a smooth surface that easily sheds snow as it falls reducing the stress on the greenhouse frame. Solexx does not stretch from the weight of snow. Polyethylene film will stretch as snow accumulates and heavy pockets of snow will start to accumulate. The disproportionate weight can easily damage a greenhouse frame. Solexx provides a smooth surface and does not stretch so snow slides off the roof and heavy snow remaining on the roof will not accumulate unevenly.

IV.4 Wind Performance

Solexx covered structures passed field tests in high wind areas across the country. Solexx performs extremely well in high wind conditions. Since Solexx does not float between metal channels like polycarbonate, it cannot blow out of the channels and create a pathway for air to enter and further damage the structure. Unlike polyethylene film, Solexx will not rip or tear in wind. Unlike glass, Solexx does not shatter. **It is always important to tie down your structure and keep strong wind from getting under it.**

IV.5 Condensation Control

Condensation occurs when warm heated air contacts a cool surface. The more insulation a greenhouse covering provides, the less temperature difference exists to create the condensation. Solexx lessens or reduces condensation formation with its higher R factor. Droplets form from condensation on film due to the high surface tension unless treated with a surfactant. Solexx panels do not require the use of surfactants because the flutes in the paneling create a slight ribbed surface and break the surface tension. Excess moisture does not collect on the interior of the roof because the flutes channel the droplets away from the roof.

IV.6 Insects and Weed Management

A greenhouse covered with Solexx requires few cuts since the panels are continuous and can be bent around a corner (bend over 90°). This feature not only makes Solexx easy to install, it tightly covers the greenhouse. Fewer openings mean less opportunity for pests and weed seeds to enter the greenhouse.

IV.7 Color Constancy

ASTM test results confirm what we have found in the field, Solexx does not yellow with age like polycarbonates typically do. The results are close to zero, meaning Solexx stays true to its original color. Since Solexx does not discolor, light transmission does not diminish or change with age. Greenhouses covered with Solexx continue to perform. (Table 6, Yellow Index)

IV.8 Mold and Algae Resistance

Mold and mildew cannot adhere to the walls of Solexx because the walls are too smooth. As fiberglass ages, its fibers shorten. With polycarbonate, the surface scratches over time. These rough surfaces allow mold and mildew to stick as the material ages. Solexx does not have fibers and does not scratch, so this is not a risk or characteristic of the material.

V. General information

V.1 Warranty

Solexx 10 Year Limited UV Warranty

Adapt8, Inc. warrants Solexx Greenhouse Panels and Rolls against ultraviolet (UV) degradation for a period of 10 years. This warranty is made in lieu of all other warranties, express, implied, or statutory, including any implied warranty of merchantability or fitness for particular purpose.

A full copy of the warranty is available on our website.

V.2 Building Code Compliance

Solexx is fully compliant for use in any type of greenhouse project. Both the strength of the material and its performance in a battery of fire, ignition and smoke tests confirm the product conforms and excels in its compliance to a variety of building codes.

V.3 Smoke and Fire Performance

Solexx has performed well in a variety of ASTM tests for smoke and flammability. In smoke tests, Solexx was found to create a clear nontoxic smoke when it was burned. In additional ASTM smoke density testing, Solexx received a very good rating for smoke density visibility. In separate flammability testing, Solexx received a CC2 rating, meaning it burned less than 2.5 inches per minute and received the slow burning HB flame resistance rating. These classifications allow Solexx to be extensively used in a variety of building projects without restrictions. (Table 7)

Fire, Ignition, Smoke Properties	ASTM Test	Value 5mm
Flammability Rating	D635	HB
International Building Code	D635	Class CC2
Flash Ignition Temperature	D1929	675°F
Smoke Density (%)	D2843	4.5%

Table 7

VI. Technical Definitions

Compressive Strength of a material is the force per unit area that it can withstand in compression. This is in contrast to the more commonly measured tensile strength.

Density is the degree of compactness of a substance. Mass/volume unit.

Flammability Rating is the measure of the material's ability to support combustion.

Flash Ignition Temperature is the lowest temperature at which a material can vaporize to form an ignitable mixture in air.

Flexural Modulus is defined as a material's ability to resist deformation under load.

Flexural Strength at Yield is the maximum tensile stress value that can be sustain before the specimen becomes deformed but does not break.

Heat deflection temperature is a measure of a polymer's ability to bear a given load at elevated temperatures. The value obtained for a specific polymer grade will depend on the base resin and on the presence of reinforcing agents.

Light Diffusion is the process where light passes through a material without being absorbed and then undergoes repeated scattering events that change the direction of the light.

Light Transmission is light that has traveled through a medium without being absorbed or scattered.

R-Value is the capacity of an insulating material to resist heat flow. The higher the R-value, the greater the insulating power.

Shading Coefficient is the amount of solar heat that comes through a surface. Until the development of the Solar Heat Gain Coefficient, the Shading Coefficient was the standard measurement for the transfer of heat.

Smoke Density The amount of smoke given off by the burning material compared to the amount of smoke given off by the burning of a standard material.

Solar Heat Gain Coefficient is defined as that fraction of incident solar radiation that enters the greenhouse through the greenhouse covering as heat gain.

Solar Reflectance is the amount of solar energy that is reflected off a surface and does not pass through the surface

Specific Gravity is the ratio of the density of a substance to the density of a standard, usually water for a liquid or solid.

Tensile Modulus of Elasticity is the mathematical description of an object or substance's tendency to be deformed elastically (non-permanently) when a force is applied to it.

Tensile Strength at Break is the tensile stress at the moment at which a substance tears.

Tensile Strength at Yield is the stress at which a material begins to deform plastically. Prior to the yield point the material will deform elastically and will return to its original shape when the applied stress is removed. Once the yield point is passed, some fraction of the deformation will be permanent and non-reversible.

U-Factor refers to Unit Heat Loss Rate and is defined as the rate at which thermal energy is conducted through unit area. The lower the U-Factor the better the product will insulate. U-Factor is equal to 1/R-value.

VICAT Softening Temperature is the temperature at which a flat-ended needle penetrates the specimen to the depth of 1 mm under a specific load. The temperature reflects the point of softening to be expected when a material is used in an elevated temperature application.

Yellow Index is a number calculated from spectrophotometric data that describes the change in color of a test sample from clear or white toward yellow. This test is most commonly used to evaluate color changes in a material caused by real or simulated outdoor exposure.

Appendix

A.1 Thermal Properties

Thermal Properties	ASTM Test	Value	
		3.5mm	5mm
Heat Deflection Temperature @66psi	D696	113°F(45°C)	118°F(48°C)
VICAT Softening Temperature (2.2 lb.)	C177	139°F(59°C)	145°F(63°C)
Coefficient of Linear Thermal Expansion*	D696	5.3H x 10^{-5} in/in/°F (13.56 cm/cm/°C)	Same as 3.5

Table 8

A.2 Mechanical Properties

Mechanical Properties	ASTM Test	Value	
		3.5mm	5mm
Tensile Strength at Yield (0.4 in/min)	D638	603 psi (4,157 kPa)	766 psi (5,281 kPa)
Tensile Strength at Break (0.4 in/min)	D638	63 psi (434 kPa)	78 psi (537 kPa)
Tensile Modulus of Elasticity	D638	21,660 psi (149,340 kPa)	25,909 psi (178,636 kPa)
Flexural Modulus	D790	58,168 psi (401,054 kPa)	66,862 psi (460,997 kPa)
Flexural Strength at Yield	D790	679 psi (4,681 kPa)	844 psi (5,819 kPa)
Compressive Strength	D695	32 psi (220 kPa)	43 psi (296 kPa)
Longitudinal Bending Radius	N/A	2ft (0.6m)	2ft (0.6m)
Brittle Temperature*	D746	-103°F (-75°C)	-103°F (-75°C)

**Test results for polyethylene raw material used to manufacture Solexx*

Table 9

A.3 Shipping

Solexx is available in rolls and panels, however, most customers take advantage of reduced freight costs by purchasing Solexx in a roll.

Solexx Thickness	Solexx Width	Roll Length	Pallet Size	Average Pallet Weight
3.5 mm Solexx XP	49.5 in	400 ft.	34x34x56 in	360 lbs. (163 kg)
3.5 mm Solexx XP	49.5 in	900 ft.	48x48x56 in	740 lbs. (336 kg)
5.0 mm Solexx Pro	50.5 in	300 ft.	34x34x56 in	400 lbs. (182 kg)
5.0 mm Solexx Pro	50.5 in	600 ft.	48x48x56 in	705 lbs. (320 kg)
5.0 mm Solexx Pro	65.0 in	300 ft.	32x32x70 in	466 lbs. (212 kg)
5.0 mm Solexx Pro	77.5 in	300 ft.	32x32x84 in	540 lbs. (245 kg)

Table 10 (Refer to Table 1 for Metric equivalents in Solexx width and roll length)