SUNPIPE® Performance Test

At **Monodraught** we pride ourselves on the quality of our engineering. Because of this, we design our systems very carefully in accordance with the message we want to convey:

- Performance
- Innovation
- Sustainability
- Reliability

Many manufacturers of tubular skylights make vague and ambiguous claims asserting to be the “brightest” or “most efficient” system on the market whilst providing limited information tailored to support these assertions.

Monodraught have always been dedicated to the integrity of the SUNPIPE brand and subsequently base our design decisions around providing the best possible solution for our clients and customers from every possible aspect.

As such, we firmly believe that SUNPIPE is demonstrably the best balance of outright performance, durability and longevity on the market today.

To quantify this, we subjected one of our SUNPIPE Natural Daylight systems to both a Light Transmittance Test and an Accelerated Ageing Test against one of our leading competitors to compare the systems.

The aim of the test was to observe how the materials in each system perform over the life cycle of the product in a simulated outdoor environment, rather that quoting figures from a manufacturer specification sheet under laboratory conditions.

We believe that testing systems in this manner gives customers a far more informed understanding of the science behind these products and shows them exactly that they are putting on their roofs and how the systems will function over time.

Real Science vs Marketing Science

In the tubular skylight industry clients are often presented with hypothetical theories asserting figures that claim superior performance.

The most prominent of these alleges that the **reflectance of the tube material is a direct representation of the lighting performance of the system**, which is often displayed as the efficiency of the system.

Further, light redirecting technology is often promoted without measurable data detailing how these technologies perform in a real world environment.

What Monodraught have attempted to quantify in our comparative testing is why

SUNPIPE should be your only logical choice of tubular skylight.

What did we Test?

In a sentence, we tested how the performance of the dome and tube material is sustained over time.

SUNPIPE uses SUPER SILVER® mirror finish Aluminium for our tubing rather than a polymer laminate that can be found in other products.

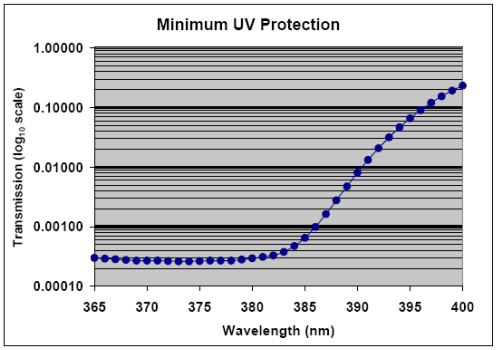
We avoid using polymer laminates because the high performances they promise quickly deteriorate over time and can lead to further problems within the pipe. Specifically, polymer laminate films are susceptible to longer UV wavelengths that are particularly difficult to filter.

Furthermore, whilst the initial performance figures of polymer films can be enticing at first, even when kept in sterile laboratory conditions the actual sustained performance from these materials is the same as Super Silver Aluminium in the long term.

We choose to believe that our customers would prefer a system which delivers its performance consistently throughout the entirety of its product life, not just a matter of months.

Laminated Polymer Film Frailty

Below is a graph taken from the specification sheet of a prominent manufacturer of laminated polymer films:



Transmission data obtained using a Shimadzu model UV2401 PC UV/Vis Spectrophotometer.

"The film must be protected from UV solar radiation. The following chart and data table show the Minimum UV Protection for a TDD's protective dome or window needed for the Warranty" (disclaimer note on specification sheet).

SUNPIPE has a 98% total reflectance value, but a competitor claims a value of over 99%. Surely that means more light will be reflected? Doesn't it?

This is true in the same way that a cheetah may initially be faster than a horse over the first part of a long distance race.
The trouble is, the cheetah cannot maintain its speed for very long and will quickly lose its performance and be overtaken by the horse.

Your SUNPIPE is designed to last for decades, not mere months!

We chose not to use a fragile tubing material which has a fractionally higher reflectance for a very short period of time before it starts to degrade; rather we opt for a material which delivers its performance consistently throughout the duration of its lifespan.

Specular Reflectance and Total Reflectance

Specular reflectance refers to the mirror-like reflection of light from a surface, in which light from a single incoming direction is reflected into a single outgoing reflection.

Light reflecting materials are most often marketed using values of Total Reflection, which takes into account both specular and diffuse reflection of light.

The Test

Samples of materials used in the dome and tube parts of both Monodraught and a leading competitor's product were sent to BRE's research facility in Watford.

These samples would be tested to determine their specular reflectance and light transmittance for the tube and dome samples respectively.

They would then be placed in an accelerated ageing chamber to simulate the effects of the natural environment on the samples and removed periodically to be retested to determine the effects.

Results

Tube Sample Specular Reflectance

Inner light pipe sample	Reflectance before ageing (%)	Reflectance after 1000 hours artifical ageing (%)	Reflectance after 2000 hours artifical ageing (%)	Reflectance after 3000 hours artifical ageing (%)	Reflectance after 4000 hours artifical ageing (%)
Monodraught sample 1 (aged behind Monodraught acrylic dome sample)	93.5%	93.2%	93.2%	93.4%	92.8%
Monodraught sample 2	93.6%	92.5%	91.4%	91.5%	90.8%
Monodraught sample 3 (aged behind Monodraught polycarbonate dome sample)	93.3%	93.5%	92.8%	93.0%	93.3%
Monodraught sample 4	92.9%	92.2%	91.5%	91.0%	91.1%
Solatube 1 (aged behind leading competitor polycarbonate dome sample)	98.4%	98.3%	97.9%	97.5%	97.6%
Solatube sample 2	98.7%	94.6%	87.6%	66.0%	16.0%
Solatube sample 3	98.8%	94.7%	86.3%	57.0%	13.9%
Solatube sample 4	98.8%	94.6%	86.9%	67.6%	21.0%

**1000 hours is broadly equivalent to one year of UV exposure in the natural environment*

Clear Dome Sample Light Transmittance

Dome sample	Transmittance before ageing (%)	Transmittance after 1000 hours artifical ageing (%)	Transmittance after 2000 hours artifical ageing (%)	Transmittance after 3000 hours artifical ageing (%)	Transmittance after 4000 hours artifical ageing (%)	Reseacher Observation
Monodraught Acrylic	87.6%	87.2%	87.4%	87.1%	86.6%	Clear
Monodraught Polycarbonate	86.6%	85.5%	83.5%	81.8%	79.6%	Slight discolouration
Solatube Polycarbonate	83.5%	80.6%	78.2%	77.1%	75.1%	Severe yellowing

**For Clear Dome Sample Tests, clear sections were cut from each dome to determine the materials transmittance. This meant that dome redirecting technology did not interfere with results.*

Full dome Transmittance

Dome sample	Transmittance (%)
Monodraught Acrylic	90.2%
Monodraught Polycarbonate	85.4%
Solatube Polycarbonate	74.2%

**For Full Dome Transmittance tests, each dome was placed, unmodified, over an opening sized to suit the diameter of the pipe it would accommodate. This means all dome redirecting technology is accounted for in the test.*

Results Summary

Reflectance

The specular reflectance tests confirm our hypothesis of polymer laminate films susceptibility to direct UV damage.

Over a simulated 4 year period, the unprotected polymer laminate tube samples lost between 77.8% and 84.9% in specular reflection.

Conversely, the unprotected Monodraught samples experienced a maximum drop in performance of only 2.8%.

The Monodraught samples behind Acrylic and Polycarbonate dome samples had performance drops of 0.7% and 0% respectively, with the polymer laminate film suffering a 0.8% drop in performance when protected by a sample of leading competitor's polycarbonate dome.

Light Transmittance

Monodraught's acrylic dome had the highest initial transmittance of 87.6%, and suffered a 1% drop in performance – within the boundaries of experimental error.

Leading competitor's Polycarbonate dome sample had the lowest initial transmittance of 83.5% and the highest drop in performance of 8.4%.

Full dome Transmittance Test

Monodraught's Acrylic Diamond Dome had the highest transmittance of 90.2%.

Leading competitor's Polycarbonate dome had the lowest transmittance of 74.2%.

Conclusions

Specular Reflectance

The specular reflectance of the polymer laminated film dropped dramatically when exposed to UV radiation. This is consistent with both our hypothesis and also the warning on the specification sheet from the polymer laminate manufacturer.

The Monodraught Super Silver Aluminium only experienced a very minor change in reflectance when exposed to direct UV light and negligible performance drop when covered by both Acrylic and Polycarbonate.

The polymer laminate film experienced only minor performance drop when covered by polycarbonate, as expected (polycarbonate provides very competent protection against UV)

Light Transmission

The Light Transmittance of Monodraught's Acrylic Dome sample experienced only minute difference on light transmittance, within the boundaries of experimental error.

The Monodraught Polycarbonate dome sample experienced a 7.0% drop in light transmittance after 4000 hours of testing.

The Solatube Polycarbonate dome sample experienced an 8.4% drop in performance, and had the lowest initial transmittance measurement. Both polycarbonate samples were observed to have yellowed in colour, the Solatube sample more so than Monodraught. The acrylic dome sample was still clear.

Full Dome Light Transmittance

The three domes from which the samples were taken were also tested, unmodified in anyway, for their light transmittance. This is to clarify what effect the light redirecting technology in each dome affected the total light transmittance.

Monodraught's Acrylic dome had the highest light transmittance, 90.2%, and Solatube's dome had the lowest, only 74.2%. It is therefore possible that the Solatube Dome construction actually has an adverse effect on light.

Full test results are available on Monodraught's website:
www.monodraught.com

Ramifications

The tests show that polymer film laminates are susceptible to larger drops in performance if they are not shielded from UV rays.

From the information provided from one prominent manufacturer's specification sheet, the film absorbs the most damage from longer UV wave lengths (>365nm). Indeed stated on the same sheet is that if the laminate is not shielded by approved materials then the performance warranty is void.

Polycarbonate is regarded as the best clear plastic UV shield available, often used in the manufacture of "100% UV protected sunglasses". However, polycarbonate itself suffers from significant UV damage as a result of this property. Polycarbonate also has a lower initial light transmittance over acrylic and acrylic does not filter out UV wave lengths above 300nm.

In summary, if a polymer laminate is used in a tubular skylight without being properly shielded from UV light it will suffer a large drop in performance. However, if it is protected by polycarbonate, the polycarbonate material will also lose performance and discolour.

It is worth noting that the polycarbonate used in the manufacture of both domes is advertised as "UV Stabilised Polycarbonate".

Neither the Monodraught Acrylic dome nor the Super Silver Aluminium used in SUNPIPE experienced significant performance decreases. Further, the Super Silver sample covered by the acrylic had such a low performance decrease that it fell within the boundaries of experimental error.

Put simply, your SUNPIPE system will still be performing in Year 5 just as it was at the date of purchase!