

# Properties and Performance of Rear Screen Materials

Stewart AeroGlas 100 vs. Da Lite DA 100 WA

Tests Performed by Brawn Consulting LLC

One area of the audio visual industry that requires further study involves published specifications of products and how these specifications relate to the products as delivered and their actual performance in systems integration. The two areas of concern in our current studies involves video projectors and projection screens. For this analysis we began by purchasing samples of 10 of the most popular screens on the market and performed a technical evaluation of each one in terms of materials, construction, specifications, performance as delivered, gain, half gain, contrast, and color uniformity. We began by taking two of those screens, the Stewart Aeroglas 100 and the Da Lite DA 100 to see how independently purchased samples would perform versus their published specifications.

## **STRUCTURAL DIFFERENCES**

The two products in comparison, while similar in functionality, are completely different in structure as well as construction. The key difference lies in the material and method of construction. The Da Lite DA 100 is manufactured from a cast acrylic substrate, 1/4" in thickness. The Stewart product, Aeroglas 100, as the name implies, is constructed from a glass substrate, in this case, 1/4" in thickness. The Da Lite product is a single sheet of cast acrylic, with a diffusion layer applied to achieve the screen properties, allowing it to be lighter in weight, but as in most acrylic materials it carries a few significant caveats to be considered.

All screen companies that use large acrylic substrates purchase them from a single source supplier who is one of the few manufacturers of acrylic sheets that possess the required dimensions and image performance characteristics. The acrylic sheets from this supplier often contain a number of waves and visible artifacts that stem from the manufacturing process. These undesirable visual characteristics present in the acrylic can be remedied through a heat treatment process, but this treatment adds additional production time and cost, to an acrylic screen. Also, this heat treatment process does significantly change the structure of the acrylic, causing it to no longer be able to support its own weight or maintain flatness. Think in terms of steel that is not heat treated properly. To correct for this, large acrylic screens must be installed into a specific frame structure that supports the weight and allows the screen to be hung. An additional frame system is required to correct for screen flexing and keep the screen flat. These additional steps are not required with a glass substrate, as the clear float optical grade glass that is used does not contain any optical aberrations or waves, and the more rigid structure of the glass can support itself, requiring less mounting hardware.

As we know, we cannot break the laws of physics and acrylic by its very nature is hydroscopic, or water absorbing. It will, over time, absorb moisture from the surrounding air, even in a dry climate. This will produce the undesirable effect of visible changes to the screen properties, caused by noticeable warping or sagging of the acrylic material. Acrylic also exhibits a higher temperature sensitivity than glass. Acrylic demonstrates a much larger expansion coefficient than glass, approximately 8 times the level of expansion. For example, a 30° F increase in temperature would cause a 36 foot long acrylic sheet to expand by one half inch. Glass would only expand by 1/16 of an inch under the same temperature increase. Consider this from the perspective of a projected image and the resultant effect on the focus and visual acuity of the sourced material. Also, acrylic is much less thermally conductive than glass, acting more as an insulator than

a conductor. This can cause problems with bending or warping due to temperature differences. Take for example, an 8 foot span of acrylic substrate. If an air temperature difference made the acrylic 9° hotter on one surface, the temperature difference would cause the screen to bend outward nearly 1 inch in the center, causing a horizontal cylindrical shape. The same conditions for glass would create a lesser temperature difference, by nearly a factor of 5, causing a deflection of only 1/16 of an inch at center of the span.

While the acrylic is “rigid”, it is still by its nature a semi flexible material, allowing it to be bent or curved into custom shapes which depending upon the application can be useful. This also means that acrylic screens can be subject to a “flutter” effect where the screen can move slightly under atmospheric pressure differences in front and behind the screen material. In addition, the acrylic material is not rated as a construction material, and does not rate under safety or building codes as a certified building component. It is not capable of supporting its own weight, let alone any additional structure. This must be borne by the mounting system. This means that care must be taken to ensure that any structure with a screen of sufficient size must be reinforced to meet code standards. Also, acrylic materials can be highly flammable, and must be protected from high heat, as they are subject to melting and becoming slightly cloudy as they cool down and heat up. Finally, the screen's diffusion coating, which is the material that allows it to hold an image, is coated onto the front surface of the acrylic substrate. This can make it prone to damage, from environmental or human factors, either through impact or scratching. This sort of damage may be able to be repaired, but only in a very limited manner and typically this sort of damage can only be solved by replacing or recoating the entire screen surface.

The Stewart Aeroglas, being constructed from glass substrates, is inherently more stable. It carries a higher weight than a comparable acrylic screen, and is slightly more fragile to install, requiring more careful handling, but it's stronger construction means it is more flexible in terms of applications as a building material, and thus can be built as part of a structure with less concern of compromise to the structural integrity. Aeroglas is a laminated screen, with a diffusion fabric applied to the front of a glass substrate. This gives it greater structural strength, and allows it to tolerate higher temperatures without damage. Also, glass is not hydroscopic, so it can withstand higher levels of moisture, or longer periods of time, without degradation. Glass also provides an enhanced sound blocking effect, helping to isolate projector or projection room fan noise from the viewer.

Reflectivity must also be taken into account. The Da Lite acrylic screen presents with a more satin or matte type finish on its surface, and as such, also has the effect of diffusing glare from ambient light on the screen surface. Aeroglas, being a laminated fabric over glass, presents a very similar reflectivity profile. However, the two screen coatings differ in repair capability. The Da Lite diffusion material is applied directly to the acrylic substrate as a coating. This means that the coating, if scratched, cannot be repaired easily. It would have to be removed from the substrate through an abrasive process, and reapplied, assuming the substrate was not damaged. The Aeroglas applied fabric coating could potentially be removed if damaged, and due to glass' inherent hardness and durability, be replaced if need be, and cost permitted.

## PERFORMANCE DIFFERENCES

Both screen materials in question are specified to achieve similar on screen images, from the factory. However, there are distinct differences in the screens which can result in a different experience in actual use.

### Screen Color:

The DA 100 is specified as a “neutral gray” screen. Meaning that it's screen surface is light grey in color. This is an attempt to take advantage of the properties of gray screen technology, which enhances screen contrast through controlling light output and absorbing ambient light. However, the grey tint must be kept light, as gray screens will reduce the angle of view, making the half gain angle narrower, which can cause banding when used in edge blending applications. Such light or neutral gray tints are intended as a compromise between the traditional white screens, and grey screen technology, hence the “wide angle” nomenclature in the product name.

Stewart Aeroglas is a “white” screen surface, but not a true Lambertian diffuser in a purely scientific sense. It provides a half gain of 60 degrees whereas a true matte white surface has no half gain angle and would be considered is a perfect diffuser. The Stewart Aeroglas had a noticeably wider half gain angle than the samples of the Da Lite DA100 in our tests.

### Screen Gain and Half Gain Angle:

Gain is the other significant difference between the two compared and tested screen materials. The DA 100 screen material is rated as a 1.0 gain screen. However, in testing of two different samples, purchased from authorized dealers representing several screen manufacturers, the results were quite different, not only from the manufacturer specification, but also from each other. The initial tests showed the screen produced an actual gain of 1.43, 43% higher than the stated specification. An additional test showed on a second, separate screen, showed a gain of 0.99, lower than the specification. In addition, the difference in gain produced a reduction in viewing angle. The screen is specified as a “wide angle” diffusion material, with a stated half gain angle of 52 degrees. However, the higher gain in the initial tests rendered an actual half gain result of 35 degrees. This shows a variance that could pose a problem if the viewing or seating area is designed based on the viewing angle produced by the manufacturers specified gain. Also, the inconsistency between samples means it could be difficult to predict what variance could be in each screen received from the manufacturer. We should note that the variation in published specifications is not unique to these samples and is an issue we found with several screen manufacturers. This directly relates to manufacturing “runs” of various projection screen models. The Aeroglas screen, is specified as a 1.0 gain screen, with a half gain angle of 60 degrees. The tests showed an actual consistent result of 0.97 gain, and a half gain of 60 degrees. While the gain is slightly lower than the manufacturers specification, it was consistent in two samples, and did not affect the half gain angle.

### Screen Bloom:

An additional noted property of the two screens was a “bloom” effect surrounding bright images on dark backgrounds. This is an expected screen property, but the difference in result was worthy of note. The DA

100 diffusion material provided a much more noticeable “bloom” than the Aeroglas using the same Display-Mate test patterns and images. This is something that should be evaluated before using any screen material, as the more noticeable “bloom” could potentially degrade image quality at closer viewing positions, or on larger screen installations.

#### Testing Procedures:

The tests were conducted in a near black cave environment with less than one foot candle of ambient light in the lab and no ambient light measurable on the screen materials themselves. A single chip DLP Projectiondesign projector, equipped with a wide angle optic, was used for all testing with the projector calibrated to ISF-C specifications at a color temperature of 6500 Kelvin. Calibration was done using a Sencore OTC 1000 non contact tri-stimulus colorimeter. Test patterns were supplied from a Sencore VP403C video test generator. The tests were repeated several times to insure accuracy of measurements.

#### Conclusion:

We found the Stewart Aeroglas 100 in general closer their advertised specification and more consistent in both samples we tested. Our conclusion is that a glass substrate has a significant advantage in terms of structural integrity, optical clarity, and reparability versus large acrylic panels. We found weight and complexity of installation with large glass substrates issues to be considered but offset by the strengths and long term viability and total cost of ownership of glass versus acrylic in most applications. Uniformity and contrast were acceptable with each screen exceeding the SMPTE standard 85% for uniformity. Finally, the excessive “bloom” on the DA 100 and the lack of consistency in half gain angles on the samples tested should be considered in the final selection process.

