

Making High Quality Glass with the Osprey® by LiteSentry. Meeting the Spec - When a Zebra Board Just Isn't Enough.

The Case for Online Inspection

"If we hadn't had the LiteSentry Osprey® system up we would have shipped bad glass for weeks before we noticed the problem at our next scheduled maintenance." This was heard shortly after installing our first high speed online measurement system on a high speed tempering line.

Warped glass can cause a myriad of problems including the "fun house mirror" effect, delamination of laminated products, and mechanical failures. Glass warp can be a problem in residential, commercial, and solar applications. Reliability issues may not be evident until months or even years after the product is installed and exposed to extended thermal cycling. Whether an appearance or reliability issue, it is always a problem that the customer will not accept.

Iridescence is frequently visible when glass reflects the polarized light off blue skies or water. In these situations, light that would naturally pass through the glass rotates, causing shimmering patterns where glass stress is high and reflected, and dark patterns where stress is low and transmitted. Top two parts exhibit heat stain or white haze.

Although few admit it, there is an unspoken fear of what you will discover if you inspect your product too closely. That's like driving with your eyes closed because you don't want to see the curves in the road. We can all agree, never drive with your eyes closed! With the right measurement tools you will always make a better product.

The benefits of measuring and controlling product quality is a no brainer. When you have a quality program with all your parts inspected and archived, complaints arising are virtually eliminated. In the rare case of quality disagreements you can certify compliance with the specification and provide measurements for the parts in question. In short - you will have pride and confidence in the product you are selling.

Types of Quality Defects

Glass tempering and heat-strengthening involves heating and controlled cooling of the product to set up an internal stress gradient. This process always causes some distortion and anisotropy. Historically manufacturers claimed that these were inherent characteristics of all heat-treated product and therefore not a defect. That has changed! Customers are now much more discerning and demanding with regard to product quality. Due to advances in tempering equipment and online monitoring, higher quality products have become the norm and customers now specify distortion/flatness, and anisotropy limits. While it was once sufficient to monitor and control only gross levels of roller-wave distortion and ignore anisotropy, it has now become critical to measure and control all types of distortion and anisotropy.

In the Beginning: The Zebra Board and Offline Gauges Measurements

The Zebra board is a board with a series of black and white stripes at a 45 degree angle and low upfront cost. With a trained eye, and enough time, highly objectionable glass warp can be detected. However, subtle distortion such as edge lift will often be missed and it does not provide a quantifiable result. With no quantified measurement, no traceability or accountability, the Zebra Board is a very costly tool in the long term.

Depth gauges with either rollers or a flat bottom have been developed to measure glass warp down a single line. These measurements were slow and prone to poor human repeatability. Automatic gauges with motors and trolleys have been devised to overcome the human repeatability problem, but have proven to be overly cumbersome in practice.

The First Generation: Online Rollwave Inspection

The first generation of online flatness measurement began in the 1990's with the introduction of a 100% online rollwave inspection system measurement in discrete one-dimensional strips. Although these first generation systems were a great leap in technology they still limited their measurements to rollwave, gross distortion in one dimension only - the market demanded more

The Second Generation: Online Multi-Dimensional Distortion/Flatness Inspection

The market was in need of a system that was capable of measuring arbitrary distortion in all dimensions and sets of customizable production specifications based on product type.

In 2003, LiteSentry introduced the Osprey® 3D Flatness/Distortion measurement system. This was another giant leap forward. By introducing revolutionary and proprietary technology, the Osprey® 3D was able to measure true optical measurement in lens power (diopters), not just discrete one dimensional strips to meet this market demand.

The Next Generation: Anisotropy and Online Multi-Dimensional Distortion/Flatness Inspection

Introduced in 2017 in partnership with Stress Photonics, the Osprey® 7 Complete was a major breakthrough offering online inspection and visualization of anisotropy, distortion and flatness of each glass sheet. Since no correlation can be drawn from anisotropy to predicting distortion measurements, or vice versa, both of these phenomena needed be measured. The Osprey® 7 Complete created a paradigm shift in tempering by measuring all types of iridescence, white haze, average residual stress, and ALL types distortion, not just roller wave or edge kink.

In 2019 LiteSentry introduced TemperQC to integrate LiteSentry Systems and 3rd party equipment into a unified Tempering Quality Control system. By fully controlling the process, top glass fabricators can produce higher quality glass at lower cost by closing the loop.

Putting it All Together

A quality program is essential to ensure that production meets specification. With real-time 100% inspection systems problems are exposed immediately and can be addressed before production time is wasted, or worse, bad product is shipped. Any of the methods discussed in

this article are a good start in understanding and controlling product quality, but only 100% online inspection ensures that all production meets customer specifications before it goes out the door. Nothing matches the confidence provided by the ability to retrieve quality measurements of every part manufactured.

Other Resources

Revised ASTM Standards November 2011-
<http://www.usgnn.com/newsASTM20111118.htm>

About the Author

Eric Hegstrom is the Director of Technology for LiteSentry LLC (litesentry.com) and has developed Quality Control Software and Hardware for more than 25 years.