



Birds & Glass

Researchers estimate that hundreds of millions of birds are killed each year in North America due to collisions with glass on buildings, making bird window strikes one of the largest avian fatality threats.

It is the reflective and transparent characteristics of glass that create the danger for birds, as they cannot see glass. They fly to sky and landscape reflected by or on the other side of a window or railing and hit the glass. To prevent these collisions, glass must somehow be made visible to birds.

Many organizations, such as American Bird Conservancy, FLAP and Audubon chapters, work to create awareness of this issue and urge manufacturers to develop bird-friendly glazing solutions. Across North America, many cities and states now encourage, and sometimes legislate, bird-friendly design through published standards and guidelines.

ORNILUX Bird Protection Glass

As the leader in innovative bird-friendly



glass solutions, Arnold Glas began the ORNILUX journey starting in 2000 when the Nature-Inspired idea of a transparent bird-friendly glass

utilizing the UV technology was first conceived.

History

The history of ORNILUX has roots in Biomimicry Design Theory; a discipline that studies nature's best ideas and then imitates these designs and processes to solve human problems.

The Inspiration

The inspiration for ORNILUX glass came from connecting the knowledge

that birds see light in the ultra-violet spectrum, and a proposed theory of how some spider species use UV reflective strands of silk in their webs. One idea was that birds would see the web and be able to avoid a collision, thus preserving the spider's ability to capture prey.



The Development

Given that the human eye does not perceive UV light, the challenge for Arnold Glas became to develop a UV reflective, but transparent glass that works on the same proposed principle as a spider's web. This would offer a unique and innovative solution to the prevention of bird window collisions, balancing visibility to birds and transparency to us.



Research & Testing

The initial testing of ORNILUX was conducted in Germany. Ongoing testing of new configurations continues with American Bird Conservancy at a flight tunnel test facility located at the Carnegie Museum Powdermill Nature Reserve in Rector, PA. Additional tests are conducted at a flight tunnel facility in Rybachy, Russia.

The Method

Birds are released inside a dark 30' flight tunnel with a side-by-side, clear-glass (invisible to birds) control pane and a test pane at the far end. Natural light is reflected on to the front surface of the glass by mirrors mounted to each side of the tunnel.* Birds are attracted to light and try to fly out through one of the pieces of glass; a net keeps



them from injury. The 'tunnel score' is the percentage of birds tested that fly towards the clear glass, instead of the pattern. A minimum of 80-100 birds is tested per sample.

*See notes in Results section; point #4 regarding the use of mirrors to test UV reflective patterns.



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Tested Products

ORNILUX insulated and laminated units with varying pane and spacer bar thicknesses, and low-E and solar control coatings have been tested in the flight tunnel. Results are analyzed

to understand which configurations offer statistically significant collision deterrence solutions compared to clear glass. A minimum of 60% of flights must fly to the control.

Results

ORNILUX units have achieved tunnel scores in the range of 61 – 77. The following ORNILUX types have been tested.

| Appearance | Product | Transmission | | | Reflectance | | | U-Value | | Relative Heat Gain BTU/(h*ft²) | Shading Coefficient | Solar Heat Gain Coefficient | Light to Solar Gain (LSG) | Tunnel Score (% to control) |
|---|-----------------|-----------------|----------------|----------------|---------------------|--------------------|--------------------|----------------------|----------------------|--------------------------------|---------------------|-----------------------------|---------------------------|-----------------------------|
| | | Visible Light % | Ultra-violet % | Solar Energy % | Visible Light Out % | Visible Light In % | Solar Energy Out % | Winter Btu/(h ft² F) | Summer Btu/(h ft² F) | | | | | |
| Insulating Glass with low-E: (ORNILUX Mikado on surface #2 / Arcon low-E on surface #3) | | | | | | | | | | | | | | |
| 4mm / 16mm Argon / 8.76mm lam | | | | | | | | | | | | | | |
| Neutral | Adv. N33 | 76 | 0 | 47 | 17 | 18 | 32 | 0.30 | 0.20 | 133 | 65 | 57 | 1.30 | 73 |
| 10mm / 12mm Argon / 8.76mm lam | | | | | | | | | | | | | | |
| Neutral | Adv. N33 | 74 | 0 | 44 | 17 | 18 | 25 | 0.2 | 0.2 | 124 | 61 | 53 | 1.40 | 64 |
| 8mm / 16mm Argon / 12.76mm lam | | | | | | | | | | | | | | |
| Neutral | Adv. N33 | 73 | 0 | 42 | 17 | 17 | 27 | 0.2 | 0.2 | 126 | 62 | 54 | 1.40 | 63 |
| 6mm / 10mm Argon / 8.76mm lam | | | | | | | | | | | | | | |
| Neutral | Uno N10 | 66 | 0 | 35 | 24 | 25 | 39 | 0.2 | 0.2 | 105 | 51 | 44 | 1.50 | 74 |
| Insulating Glass with solar control: (Arcon solar control on surface #2 / ORNILUX Mikado on surface #3) | | | | | | | | | | | | | | |
| 6mm / 16mm Argon / 8.76mm lam | | | | | | | | | | | | | | |
| Light Blue | Scandic | 50 | 0 | 20 | 18 | 17 | 37 | 0.2 | 0.2 | 58 | 28 | 24 | 2.10 | 77 |
| 6mm / 24mm Argon / 8.76mm lam | | | | | | | | | | | | | | |
| Light Blue | Scandic | 50 | 0 | 20 | 18 | 17 | 37 | 0.3 | 0.2 | 59 | 28 | 25 | 2.00 | 63 |
| 8mm / 16mm Argon / 12.76mm lam | | | | | | | | | | | | | | |
| Light Blue | Scandic | 49 | 0 | 19 | 18 | 17 | 34 | 0.2 | 0.2 | 58 | 28 | 24 | 2.00 | 70 |
| 6mm / 10mm Argon / 8.76mm lam | | | | | | | | | | | | | | |
| Neutral | Polaris | 62 | 0 | 27 | 14 | 17 | 33 | 0.2 | 0.2 | 78 | 37 | 33 | 1.90 | 66 |
| Triple Insulating Glass with low-E: (Arcon ORNILUX Mikado on surface #2 / Arcon low-E on surfaces #3 & 5) | | | | | | | | | | | | | | |
| 4mm / 14mm Argon / 4mm / 14mm / 8.76mm lam | | | | | | | | | | | | | | |
| Neutral | Adv. N33 triple | 68 | 0 | 37 | 21 | 22 | 37 | 0.1 | 0.1 | 111 | 55 | 47 | 1.40 | 61 |
| Triple Insulating Glass with solar control: (Arcon solar control on surface #2 / ORNILUX Mikado on surface #3 / Arcon low-E on surface #5) | | | | | | | | | | | | | | |
| 6mm / 12mm Argon / 12.76mm lam / 12mm Argon / 6mm | | | | | | | | | | | | | | |
| Light Blue | Scandic triple | 44 | 0 | 17 | 20 | 22 | 38 | 0.1 | 0.1 | 50 | 24 | 21 | 2.10 | 69 |
| 6mm / 14mm Argon / 6mm / 14mm Argon / 8.76mm lam | | | | | | | | | | | | | | |
| Light Blue | Scandic triple | 45 | 0 | 17 | 20 | 22 | 38 | 0.1 | 0.1 | 51 | 25 | 21 | 2.10 | 62 |
| Triple Laminated Glass (ORNILUX Mikado on surfaces #2 & 5) | | | | | | | | | | | | | | |
| 36mm lam made of 12mm (0.76mm PVB) / 12mm (0.76mm PVB) / 12mm | | | | | | | | | | | | | | |
| Clear | mono 36mm | 76 | 0 | 45 | 10 | 10 | 7 | 0.8 | 0.8 | 152 | 71 | 61 | 1.2 | 68 |
| 12mm lam made of 4mm (0.76mm PVB) / 4mm (0.76mm PVB) / 4mm | | | | | | | | | | | | | | |
| Clear | mono 12mm | 84 | 0 | 65 | 11 | 11 | 8 | 0.9 | 0.9 | 180 | 84 | 73 | 1.1 | 62 |



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Conclusions

Based on results, it can be stated that varying factors of pane and spacer bar thicknesses, as well as additional energy efficiency coatings may affect the performance of ORNILUX for collision deterrence. More research on this topic is required.

Based on tunnel testing to date as well as feedback from actual installations,

ORNILUX has demonstrated to be an effective solution to mitigate bird collisions with glass on buildings, especially in areas where transparency is the top priority.

It is the goal of Arnold Glas to provide the highest performing bird-friendly glass, balancing visibility to birds, transparency to the human eye and energy efficiency. Ongoing testing and development of ORNILUX is a high priority.

While flight tunnel testing is critical to the development and comparison of bird-friendly glass treatments because of its controlled environment, so too is real-world data from actual installations where factors such as changing light, weather conditions and bird behavior come into play. Feedback from clients who have installed ORNILUX indicates that it is performing well for collision mitigation.

Project Descriptions

The first generation of ORNILUX was released in Europe in 2006. The coating had a vertically striped pattern. The next generation of our bird protection glass, ORNILUX Mikado was released in 2009 and has been available in North America since 2010.



Center for Global Conservation, Bronx Zoo / New York / USA / 2008
ORNILUX SB1 / approx. 1,076 sq ft

LEED Gold project completed by FXFWLE Architects. Several different bird-friendly design techniques were implemented on this building, including a corner conference room glazed on two sides with ORNILUX SB1. An ongoing monitoring program has reported: *“The portions where we used it (ORNILUX) have been very successful; there have been no bird kills. The portions where we didn’t use it have been dramatically different.”*

- Architect



Photo: Brenda Liu Photography; Architect: PUBLIC Architecture + Communication

Centennial Beach Cafe / Delta, B.C. / Canada / 2012

ORNILUX Mikado / approx. 480 sq ft

The new Centennial Beach cafe building at Boundary Bay Regional Park in Delta, B.C. sits at the water’s edge of the Bay, a key stopping point for migratory birds en route via the Pacific Flyway and a world famous birding location. Large window expanses facing the water and requiring a high level of transparency to preserve visitors’ views were glazed with ORNILUX insulated units. *“Bird-friendly” is one of many green-building strategies incorporated into the design.*

- Metro Vancouver Project Manager



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Education Building, Tracy Aviary / Salt Lake City, UT / USA / 2011

ORNILUX Mikado / approx. 86 sq ft

ORNILUX was chosen as one of 3 bird-friendly strategies for this new Education Center building. A section of glazing adjacent to a pond and trees was identified as a high-risk collisions

area and decided upon for the ORNILUX units. A key intent was a means of showing visitors

another option for bird-safe windows. A monitoring program is in place to track the performance of the bird-friendly strategies.



"In the 4 months the building has been

occupied there have been 2 strikes on the building, but none at the ORNILUX location. The pattern is virtually impossible to notice from the inside looking out. Outside, you have to look up close and at an angle to see the pattern."

- Tim Brown, Aviary Director



Polar Bear Exhibit, Hellabrunn Zoo / Munich / Germany / 2010

ORNILUX Mikado Laminate / approx. 5,134 sq ft

Munich's Hellabrunn Zoo is dedicated to the long term welfare of its animals. The zoo is located in the Isarauen Nature Reserve and because of the many wild Kingfisher birds inhabiting this area and a history of collisions, the subject of bird strike protection played a major role in the architectural design and construction of the new polar bear enclosure. Previous attempts to mitigate strikes with the use of hawk silhouettes, bamboo plants and adhesive applications proved ineffective and blocked visitors' views into the animal habitats.

"The big advantage is in what people don't see: no glass coating. Visitors can't see (the ORNILUX), but hopefully birds will. We've also tested the glass by our Pelican House, and to put it bluntly, not a single Kingfisher has collided with the glass."

- Andreas Knieriem, Zoo Director

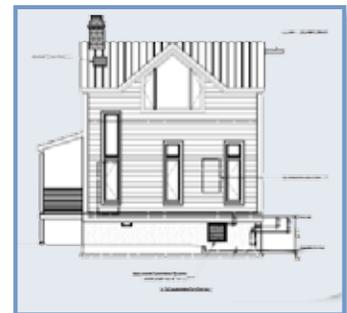
Private Residence / San Francisco area / USA / 2011

ORNILUX Mikado / approx. 270 sq ft

Having previous experience with bird collisions, when the homeowner decided to build a new home they chose to glaze all windows with ORNILUX.

"I've heard from my clients that the glass has been very successful in preventing bird collisions, and it has no effect whatsoever on the perception of clear vision to the outside."

- Pete Retondo, Architect





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Building Association, Garden City Wandsbek / Hamburg / Germany / 2009

ORNILUX Mikado / approx. 2,800 sq ft

The glazed atrium of this design presented the challenge of balancing thermal insulation, aesthetics and, given the location in the center of a wildlife area, protection for area birds. As a result, ORNILUX with the solar control coating Solarlux Scandic 52/27 was chosen. Completed in 2009, the building not only achieves a high thermal efficiency, but the collision prevention properties of ORNILUX are performing well.

"With pleasure we want to confirm once more the positive experience with Bird Protection Glass at our office building: ... Today, after 2 years of business operations at the new office building, we still are happy like on the first day... And the



best is: no single bird has hit our facade so far! We think that the Bird Protection Glass is a very reasonable development, which we

hope, will be used much more often in the future."

- Christine Stehr, Board of Directors,
Residential Construction Assoc.



Indoor Swimming Pool / Plauen / Germany / 2007

ORNILUX SB1 / approx. 4,300 sq ft

This was the first and one of the largest ORNILUX projects to date. The facade of this indoor swimming pool was glazed with Bird Protection Glass as it offered a solution to two key design objectives; preserving the views to the Weiße Elster River and the historic city center, and protecting the local bird populations from

collisions with the large, glass facade.



Glass Replacement Projects

Visitor Center, John Heinz National Wildlife Refuge / Philadelphia, PA / USA / 2011

ORNILUX Mikado Scandic / approx. 72 sq ft

A large facade of the Visitor Center was problematic for bird collisions, and although budget did not allow for the entire facade to be replaced, 5 panes close to the ground and reflective of surrounding vegetation were identified for replacement. This was completed as part of a window collisions education display for visitors





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Private Residence / NY State / USA / 2011

ORNILUX Mikado / approx. 195 sq ft



For this project, the homeowner retrofitted one window in 2009 with first generation ORNILUX SB1 as a trial to see its effectiveness in preventing window collisions. Pleased with its performance, in early 2011 the homeowner retrofitted a second window with ORNILUX Mikado.

"The newer window is incredible, as you can't see the Mikado pattern. The client had questioned whether or not

we had replaced the window. That's how good it is."

-Property Management Company

Exhibit Door, Philadelphia Zoo / Philadelphia, PA / USA / 2011

ORNILUX Mikado / approx. 31 sq ft

As part of the Zoo's collisions monitoring program and efforts to treat problematic areas of glass, ORNILUX was chosen to replace existing glass on an entrance door to one of the animal exhibits that caused many collisions each year. The ORNILUX was installed approx Nov. 2011 and monitoring efforts for 2012 report that no collisions have been noted.



Additional North America Projects

- **University of Massachusetts, Science Building**, Amherst, MA, 2012, ORNILUX Mikado, 2,800 sq ft
- **Santa Monica Pier Restaurant**, Santa Monica, CA, 2012, ORNILUX Mikado laminated, 472 sq ft
- **Visitor Center, U.S. Fish & Wildlife Blackwater Refuge**, Cambridge, MD, USA, 2011, ORNILUX Mikado, 1,270 sq ft
- **Environment Canada, Pacific Wildlife Research Centre**, Delta, B.C., Canada, 2012, ORNILUX Mikado, 840 sq ft
- **North Carolina Zoo**, Polar Bear Exhibit, Asheboro, NC, 2012, ORNILUX Mikado laminated, 560 sq ft
- **Kalamazoo Nature Center Preschool**, Kalamazoo, MI, 2013, ORNILUX Mikado, 1,000 sq ft
- **Jacksonville Zoo**, Jacksonville, FL, 2013, ORNILUX Mikado laminated, 300 sq ft
- Additionally many residential ORNILUX applications (private houses, conservatories)

Additional Europe Projects

- **Mountain Railway Aineck**, Austria, 2009, ORNILUX Mikado, 2,260 sq ft
- **Mountain Railway Saalbach-Hinterglemm**, Austria, 2009, ORNILUX Mikado, 2,950 sq ft
- **Mountain Railway Hinterbündt**, Austria, 2009, ORNILUX Mikado, 592 sq ft
- **Non-profit Building Society GWG**, Ingolstadt, Germany, ORNILUX Mikado, 592 sq ft
- **Uni Workshop Luruper Chausee**, Hamburg, Germany, ORNILUX Mikado, 592 sq ft
- **Feldbauer, Starnberg**, 2009, ORNILUX Mikado, 590 sq ft
- **Environmental Center**, Karwendel, Austria, 2008, ORNILUX SB1, 1,076 sq ft
- **Bird Capture Station of State Alliance for Bird Protection**, Regenstauf, Germany, 2008, ORNILUX SB1, 860 sq ft
- **Max Planck Institute**, Seewiesen, Germany, 2007, ORNILUX SB1, 270 sq ft

Commercial

ORNILUX is supplied as an energy-efficient insulated units with a low-E or solar control coating, and as triple laminated glass for outdoor applications such as glass guardrails, windscreens or walls. It can be produced as Float or tempered safety glass.

Awards & Recognition



About Arnold Glas

Headquartered in Remshalden, Arnold Glas is one of Germany's largest and most innovative glass producers. With our 11 production locations, own coating facilities and float works, we are a full-line supplier for architectural and decorative glass.

We established a direct presence in North America in 2010, but have been known for innovation in the glass industry in Europe since 1959.

We enjoy taking a fresh look at things and see opportunity in every challenge. We invest where others wait. Our bird protection glass ORNILUX is what brought us to North America, and is only one of the examples of our commitment to solving problems through innovation.