

## **The Tunnel Test: Standard Test Method for Rating Bird Collision Threat Levels of Glazing Materials**

Birds are essential features of healthy ecosystems, providing critical services, for example, by consuming insects and regenerating habitat, while also having cultural significance and making environments healthier for people. Bird mortality from collisions with glass on buildings is a serious conservation concern, with a minimum estimate of over 300 million killed each year across the United States alone. Bird-friendly design strategies often make use of glass, window film and other materials that birds will avoid but these vary in effectiveness. In order to comply with a growing number of legal mandates and guidelines, the testing method described here has been developed to quantify levels of effectiveness. Testing takes place during spring and fall migration seasons, to ensure sufficient test subjects. Netting and handling specimens is strictly regulated by Federal and State laws and may only be done by properly accredited individuals. For this reason, it is advisable to locate testing facilities at existing bird banding stations.

This is a standard test method using live birds (primarily seasonal migrants) and a binomial choice protocol to provide quantitative ‘bird-friendly’ ratings of glazing materials used for building façades (e.g. curtain wall, shop front, windows), architectural elements (e.g. connection corridors, balustrades) and free-standing glazing (e.g. transparent noise reduction walls).

Glazing materials may be monolithic, laminated, filmed, coated, fritted and insulating glass units. Manually applied films must be tested as an assembly including a glass substrate equal to the Control Specimen.

Glazing materials or films evaluated through this test methodology can be used in new and retrofit building construction.

Safety of glazing or installation, glass strength, impact strength and structural capacity, sound control, solar performance, optical distortion and the evaluation thereof, and other sustainability characteristics are not within the scope of the standard

Mockups are recommended as a method to evaluate visual acceptability of Test Specimen.

Units—The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

*This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

## **Summary of Test Method**

This standard outlines the method of evaluating glazing materials through use of birds’ response to visual signals, to provide comparative ratings of deterrence to impact. A

specially designed tunnel is used in this test. Live birds, handled by qualified personnel are released to fly through a trapezoidal shaped tunnel toward two naturally lit openings. The narrow, entry end of the tunnel supports the monitoring equipment and contains the opening for placing the birds inside. The birds are released and tracked by video as they fly towards the natural light. The birds are prevented from impacting the glass by the Safety Net. The bird path is recorded. This process is repeated for the requisite number of times and the Material Threat Factor of a material is calculated from the resulting Tunnel Score.

Tunnel – a rotatable trapezoidal tunnel, 720 cm long, 125 cm high, 42.5 cm at the ‘release port end’, 102 cm wide at the ‘specimen end’ constructed of plywood and particle board over a steel frame with a flat or peaked roof depending upon climate conditions at the test facility, see figure 1. The inside is completely lined with 1.83m wide, black polyester ‘Plush Felt Fabric’, capable of blocking light. The felt is stapled to the roof, floor and walls. The entry port end is solid plywood with openings for viewing and Test Subject release and flight...

Entry Port; A 25 cm x 40 cm square hole, centered 40 cm below the roof, is curtained with black fabric, to block light. At the center of the curtain, a fabric tube, 8 cm in diameter x 30 cm is inset, to permit placement of birds into the tunnel. A 1.5 cm diameter port for a video camera is located 30 cm below the roof, with an additional port for operator viewing 20 cm to the left. A 12x12 cm shelf supports the camera, and a 25 x 25cm shelf for a notebook computer or data sheet is located in a convenient place).

Safety Net;

At the Specimen end, the tunnel is open. The safety net is mounted flush with the end of the tunnel.

Tunnel rotation;

The tunnel is mounted on two parallel hollow metal beams, 910 cm in length. The beams are flush with the entry port end of the tunnel and project beyond at the other end. Cross beams are attached to support the glass holder, mirrors and background (figure X). The beams are attached to a rotational axis/pivot mechanism. The pivot mechanism must be capable of supporting the weight of the tunnel structure, including maintenance loads, and specimens and -allow uninhibited rotation by hand with horizontally applied force of 4.0 lb. (18 N) or less. The height of the tunnel floor above the ground is approximately 25 cm (to enable comfortable use by operators).

Specimen Mounting Apparatus -- a mechanism capable of holding two panels, the Test Specimen and the Control Specimen, side by side. The mounting apparatus comprises a vertically stable structure, painted flat black that is capable of holding the specimens (standard size 1000 x 500 mm) side by side with no more than 50 mm ( $\pm 5$  mm) separation between the two specimens at the center. Specimens are set into the structure with a border of 1.5 cm to allow screen door holders, clamps, clips or other mechanisms to secure their position. The structure is mounted on the tunnel support beams, with the bottom of the specimens at the same level as the floor of the tunnel and is positioned 400 mm ( $\pm 5$  mm) away from the net.

Mirrors and sun shade- (need size) are mounted vertically at the sides of the tunnel to reflect ambient light equally onto the front surfaces of the specimen and control glass and allowing some natural light to fall on the back surfaces.

Computer (optional) or data sheet: any with worksheet software capability. Data sheet available on request.

Video Camera –any capable of clearly capturing the flight of the bird and the tunnel components, mounted at the operator end

Net flasher (Vibration sensor) – details [this is explained in ‘definitions’]<http://www.learningaboutelectronics.com/Articles/Vibration-detector-circuit.php>

Sampling – 80 trials per material are run to account for environmental variation and species mix.

#### Test Specimens

Clear Glass Control Specimen– A clear 6.3 mm monolithic fully tempered glass control must be used with each test.

Test Specimen - glazing material to be evaluated. Variation of the color, pattern or marking within the test specimen is to be tested.

Specimen dimensions – each specimen shall be 50 cm wide by 100 cm mm high. The thickness varies depending upon the construction and is limited only the configuration of the mounting mechanism.

Tunnel is oriented on its rotational base so that the sun, or estimated position of the sun if cloudy, is directly behind the operator at the narrow end of the tunnel.

A section of Safety Net is mounted on a frame and placed between the entry port and the mounting mechanism for the glazing specimens. This netting is virtually invisible to the birds and prevents them from impacting the specimens. After a flight, a door in the side of the tunnel is opened to release the bird

Specimens are mounted so that they are 40 cm away from the Safety Net.

The Background Panel is mounted 76.0 mm beyond the samples to reduce back-lighting

Trials using two clear glass control specimens mounted side by side are run prior to testing. Equal numbers of flights to the left and right indicate that the tunnel itself is not influencing the choice of flight path made by the birds.

Control patterns 0.25 10 V and black horizontal shall be tested once per year to ensure no year to year differences are seen.

Specimens and mirrors must be free of condensation.

Specimens must be cleaned before each set of trials, and at any time during the testing should they become soiled.

All flight videos are reviewed, using frame by frame analysis when necessary to determine flight destination to the control side or to the specimen side. If the path is toward the side, floor or ceiling of the tunnel this is recorded as well.

Tunnel score (TS) = The percentage of birds that flew toward the control specimen for all flights. “No Fly” trials are eliminated from the count. TS ranges from 50 to 100.

Interpretation of TS - The TS ranges from 50 (birds fly randomly to the left or right, indicating no effect from the material being tested) to 100 (all birds fly to the control specimen). The 'effectiveness' of a material at reducing collisions ranges from 0 (no effect) to 99 and must be measured by monitoring collisions at an installation site before and after a material is installed. The TS therefore correlates with effectiveness but is not equivalent to effectiveness. A given material might vary in effectiveness from site to site, depending on site specific variables. The threat factor for a material is 100 minus the TS.