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Bundesverband Flachglas

Bird-friendly construction with glass

Requirements and recommendations

This Bulletin was produced by: Working group "Vogelschutz" at
Bundesverband Flachglas e. V.,
With the cooperation of: "Verband Fenster und Fassade VFF"
(German Window and Façade Association)

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1. About this Bulletin

Glass in building provides architectural freedom, a view out to nature, and the daylight illumination that human beings require to stay physically and mentally healthy. In addition, today's glass surfaces are energy-efficient because they combine excellent thermal insulation with free gains of natural solar energy – something that only glass as a material can do.

But glass surfaces can also be a risk factor for birds. Collision with glass façades is one of the human-induced causes of bird deaths. There are many different parameters affecting when and why birds collide with glass surfaces, e.g. transparency, reflection and the size of the glass as well as the environment and its reflection in the glass, but also the behaviour of different bird species.

In practice, the actual total number of collisions with glass cannot be determined by monitoring (counting mortalities). Existing estimates are based on variables such as the number of buildings, the area of installed glass, etc. and are therefore not reliable. Irrespective of this, however, the topic is of great practical relevance.

This Bulletin shows which product solutions and possible measures are available for windows and façades to prevent a high risk of bird strikes on glass. It also aims to make designers, planners and building owners more aware of their responsibility for holistic design and planning. In addition, the Bulletin describes the criteria applied by authorities to assess the need for bird protection measures in specific construction projects. It explains how the effectiveness of glass products is assessed in practice and what needs to be considered when interpreting test results.

2. Explanation of terms and definitions

ABC	American Bird Conservancy (ABC) is a not-for-profit member organisation dedicated to conserving wild birds and their habitats throughout the Americas. Among other things, it operates a flight tunnel in cooperation with PARC.
Species under special protection	All European bird species are considered specially protected in accordance with Section 7, (2), No. 13 of the Federal Nature Conservation Act.
Biological Station Hohenau-Ringelsdorf	Operator of the flight tunnel in Hohenau-Ringelsdorf for choice tests of glass products to prevent birds from striking glazed surfaces.
Flight tunnel	Facility to test the effectiveness of markings on glass panes for bird protection. Birds always exit a dark space in the direction of bright openings. This is used in choice tests for ensuring test efficiency and standardising the flight conditions towards the pane. The marked test pane and a clear (unmarked) reference pane are placed in front of the tunnel and exposed to daylight. A net in front of the panes prevents birds from actually striking them.
LAG VSW	Länderarbeitsgemeinschaft der Vogelschutzwarten (Working Group of German State Bird Conservancies): A body used by the state ornithological institutes and the federal and state authorities responsible for bird protection to exchange information. Publisher of the scheme introduced for assessing the risk of bird collisions with glass.
ONR 191040	Introduced non-normative Austrian standard "Vogelschutzglas — Prüfung der Wirksamkeit" (Bird protection glass — effectiveness testing). Describes tests on non-reflective transparency in the flight tunnel. The ONR applies to free-standing glass panes (e.g. transparent noise barriers) and transparent glass structures (e.g. connecting corridors), not to windows.
ONR test	Flight-tunnel-supported choice test with non-reflective transparency, to be distinguished from the WIN test. Applicable to applications such as noise barriers, spandrel glass, etc.
PARC	Powdermill Avian Research Center (PARC) operates, among other things, a flight tunnel in cooperation with ABC.
Powdermill	Location of ABC / PARC flight tunnel
Significantly increased mortality risk	Legal term If this risk is present, there is a violation of the general prohibition of killing under Section 44 BNatSchG. (Federal Nature Conservation Act). To assess when this is the case, the LAG VSW assessment scheme is generally used.
Bird strike	Collision of a bird with an object, here with a glass pane.
Bird protection glass / Bird-friendly glass	Glass that prevents birds from colliding with the glass surface with a specific probability. ONR 191040 defines bird protection glass as "transparent glass and other transparent materials (e.g. PMMA) that are made recognisable to birds by certain methods (e.g. markings) in order to minimise collisions". As the standard has not been introduced, there is no binding definition.
Choice test	Traditional experiment in behavioural biology. The birds fly towards two different panes and choose whether to fly towards the clear (unmarked) reference pane or the marked test pane. The more often the birds fly towards the reference pane, the clearer the deterring effect of the marking.
WIN test	Flight-tunnel supported choice test including reflections (weakly illuminated pane background); to be distinguished from the ONR test. The WIN method (from window) is used in Hohenau to test panes for window and façade applications.

3. Transparency and reflection

Birds collide with glass panes for two main reasons: Either because they recognise an attractive target behind the glass, which they head for, or because the (natural) surroundings are reflected in the glass and the birds want to fly towards them.

The risk of a collision due to transparency tends to increase with corner glazing or if a second window on the back panel suggests the possibility of flying through. It also increases with illumination behind the glass in the evening hours. In addition, night-time lighting of large buildings in particular can also be a source of danger to birds.

The risk of collision due to reflection generally increases with increasing external reflectance and if targets that are attractive to birds are reflected.

When evaluating the effectiveness of bird protection glass (see Section 7), it is important to differentiate between the effectiveness of transparency or reflection.

4. Requirements for preventing bird collisions and risk assessment

Key importance attaches to the ban on killing and injuring species under Section 44 of the Federal Nature Conservation Act "Regulations for specially protected and certain other animal and plant species". Paragraph 1 No. 1 reads as follows: "It is prohibited to hunt, catch, injure or kill wild animals of specially protected species or to remove their developmental forms from nature, or to damage or destroy them (...)."

Species under special protection include all bird species naturally occurring in Europe. Section 44 of the Federal Nature Conservation Act (BNatschG) is "non-negotiable", i.e: The general prohibition on killing formulated there must be taken into account as a matter of principle and may not be violated for the sake of other goals. According to general case law, intent does not matter: even accepting the risk is a violation of the general prohibition on killing – not in the case of the death of single individuals, but when there is "a significantly increased risk of mortality".

The problem here is that, in the case of bird strikes, there is no official standard or legally valid threshold in Germany as to when this "significantly increased risk of mortality" is present. Decisions will therefore continue to be made on a case-by-case basis. The responsible authority for the expert assessment is the relevant nature conservation authority.

The nature conservation authority can order the inclusion of suitable preventive measures against bird strikes even before construction starts. It will then use the following factors to assess whether a planned building or building component with glass poses a risk to the bird population:

- Which bird species exist locally and in what population size?
- How many green structures are there in the surrounding area?
- Are there any protected areas in the vicinity that would be endangered by a building?
- The factors evaluated include size, transparency, reflection and arrangement of the glass panes, illumination and exposure of the building.

An assessment procedure for estimating the risk of bird collisions with glass panes has been established by the "Working Group of German State Bird Conservancies" in their decision 21/01 "Prevention of bird losses at glass panes – assessment of the bird-glass collision risk". It is often used by nature conservation authorities for a rough initial assessment of the bird collision risk with the glass surfaces of a planned building. According to this assessment procedure, there is generally no significantly increased bird mortality risk for bird collisions with (smaller) residential buildings For "free-standing glass or mirror walls", (including "bus shelters/passenger shelters at stops, noise barriers, glazed walkways and windbreaks, as well as corner glazing on buildings and mirror façades",), the bird mortality risk is assessed to be only significantly increased. Between these two are "larger buildings", for which a significantly increased bird mortality risk is assumed at an average of more than four birds per 100 m of façade or external wall length per year.

In addition, the Working Group of German State Bird Conservancies provides a points system for assessing the risk (Länderarbeitsgemeinschaft der Vogelschutzwarten: Decision 21/ 01: "Prevention of bird losses at glass panes – assessment of the bird-glass collision risk." Augsburg 2021).

In order to ensure compliance with nature conservation requirements, the competent authority has the power to act and issue orders in accordance with Section 3 (2) BNatSchG. The authority may intervene if a violation of Section 44 (1) No. 1 of the Federal Nature Conservation Act (BNatSchG) has already occurred (i.e. after the building has been erected) or is imminent as a real threat.

Even if a permit has already been granted, the authority can still intervene, provided its order does not provide for a "substantial change to the building structure". In practice, this can lead to relatively far-reaching retrofitting obligations, because, for example, the subsequent application of printed films to the glazing will not be considered a significant change in this meaning – although it can of course, be complex and expensive. Additional measures may result in a separate entitlement to compensation.

Hessian Nature Conservation Act 2023
(Hessisches Naturschutzgesetz)

In June 2023, a new law for the protection of nature and care of landscapes (Hessian Nature Conservation Act – HeNatG) came into force in Hesse. Section 37 governs "Species protection in buildings, prevention of bird strikes on glass surfaces".
It is therefore likely that, as a result, the use of bird protection glass with verified effectiveness (see Section 7) will be increasingly required in Hesse. At the time of going to press for this Bulletin, there are still no administrative regulations for the implementation of the law in practice by the regulatory authorities.

5. Design and planning process

In practice, it cannot be assumed (at least not in all German federal states) that the various approval procedures will establish mandatory measures to prevent or minimise bird strikes. The parties involved should assess in advance whether preventive measures are necessary.

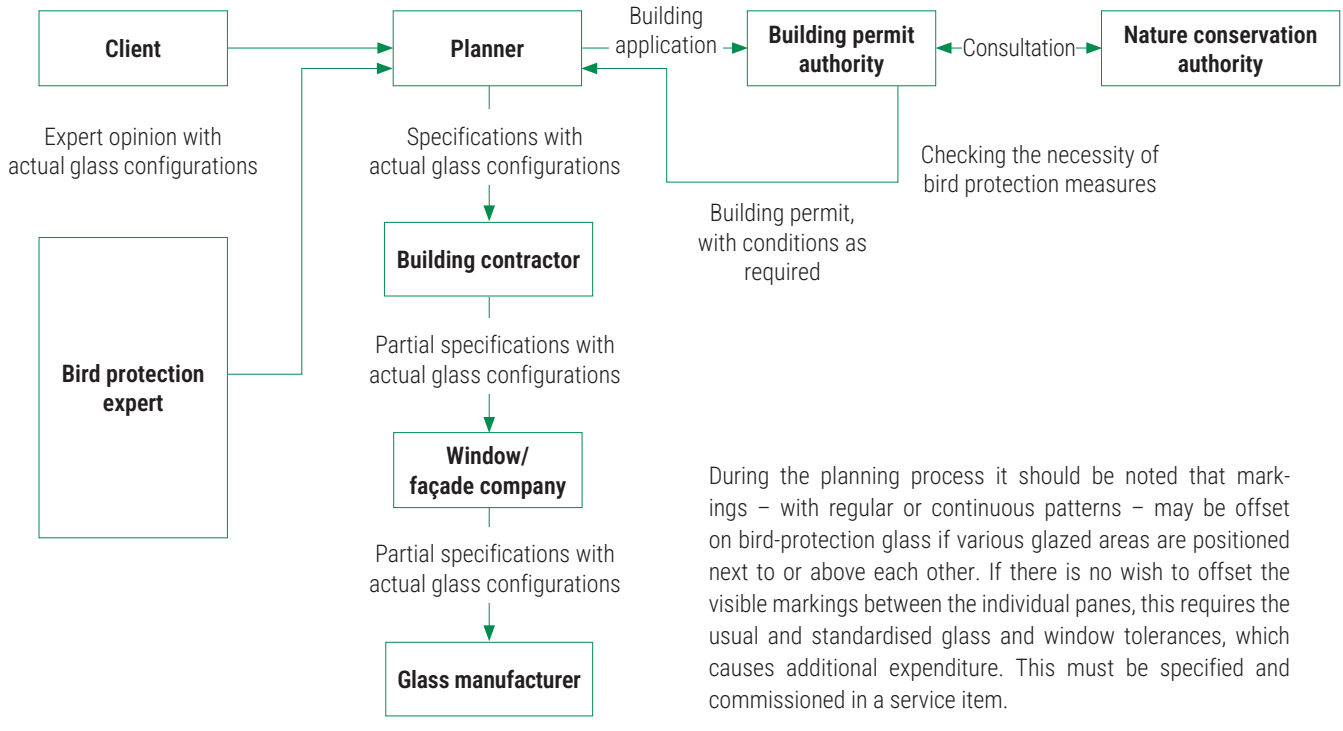
The above assessment scheme of the "Länderarbeitsgemeinschaft der Vogelschutzwarten" ((Working Group of German State Bird Conservancies) is an established tool for risk assessment and is regularly used by the authorities for a preliminary assessment. However, it does not replace the necessary assessment of all the factors relevant to the individual local context. A meaningful statement on the actual risk potential of the future building and the necessary preventive measures requires a more detailed analysis of the environmental and building parameters of the individual façade sections.

New build or refurbishment measures should take bird protection into account right from the planning stage. The earlier that potentially hazardous elements are identified and low-risk alternatives considered, the fewer conflicts will arise. The most important contacts are always the local nature conservation authority in conjunction with the building permit authority.

Planners and nature conservation authorities should work closely together. Planners can deal appropriately with the relevant local building and environmental regulations and mediate between the client and the authorities. They must ensure that no subsequent changes to the building will be required, so saving costs and time.

The tender must include a service item for the necessary bird protection measures. The details required, such as installation situation (transparency or reflection are crucial) and environmental conditions must be specified so that a suitable glass product can be supplied.

Example of planning flow chart



During the planning process it should be noted that markings – with regular or continuous patterns – may be offset on bird-protection glass if various glazed areas are positioned next to or above each other. If there is no wish to offset the visible markings between the individual panes, this requires the usual and standardised glass and window tolerances, which causes additional expenditure. This must be specified and commissioned in a service item.

6. Measures for bird protection

6.1. Bird protection glass

Glass manufacturers and fabricators offer many solutions for making glass surfaces visible to birds. The member companies of the Bundesverband Flachglas are continuously developing new and innovative products for this purpose.

In general, verification of the effectiveness must always be provided (see Section 7), and must be valid for the specific case.

The general principle of the products is to make the transparent or reflective glass surfaces visible to the birds by means of markings. Markings can be applied by e.g., printing, laser marking, coating with transparent but visible patterns, etching or sandblasting. Markings can be applied to the glass itself or to films that are inserted into laminated glass or applied to the glass (including subsequently). Cast glass such as patterned or channel shaped glass can also prevent bird collisions thanks to their rolled or patterned surfaces.

Subsequent application of bird protection patterns using films:

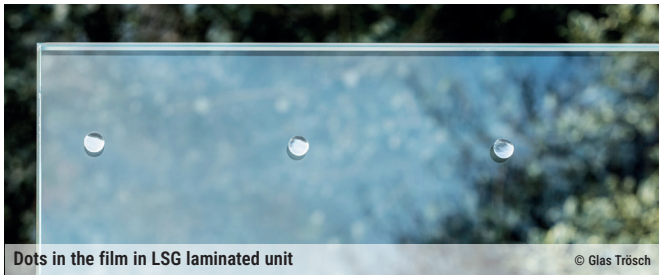
The subsequent application of films is more complex and expensive than taking bird protection glass into account right from the planning stage.

In addition, the use of films may have a negative effect on the durability and optical quality compared with glass without films, especially as films must always be applied to the outside of the glazing so that the effectiveness of the markings is not impaired by the reflection of the glass pane.

Care must be taken when applying (dark) patterns to glass. Differences in absorption may produce thermal stresses within the glass surface which may cause normal (untoughened) float glass to crack. The risk of thermally induced glass breakage can be assessed at the planning stage.

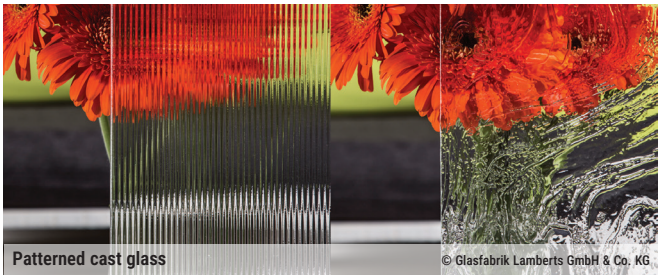
When applying films to thermally toughened glass (thermally toughened safety glass, TSG), it should be noted that in the event of breakage, the splinter-binding effect may eliminate the glass's safety function. Slab-like glass fragments may fall down and cause serious injuries.

The aim is to go beyond conventional, visible markings and use markings that are subjectively perceived by humans as minimal visual impairment but are recognized by birds as obstacles. UV signatures on glass are created with patterns of UV-reflecting and UV-absorbing elements in special coatings. They are largely invisible to humans, but certain bird species can still see them in the UV range.



Dots in the film in LSG laminated unit © Glas Trösch

UV coating © ISOLAR



Patterned cast glass © Glasfabrik Lamberts GmbH & Co. KG

Pattern, screen print © Studio Harmony - stock.adobe.com

Channel glass © Glasfabrik Lamberts GmbH & Co. KG

Manufacturers and research institutes are also working on other types of marking that are as unobtrusive and as transparent as possible.

In addition to potential visual impairments, the use of glass products to prevent bird collisions with glass surfaces must also take into account possible conflicts with other performance characteristics of the glass, such as the view from inside to outside, the supply of natural daylight to indoor spaces and visual comfort. It is up to the planners to clarify, on a case-by-case basis, whether additional desired functions such as sound insulation, solar control, solar shading, safety/security features etc. are available in combination with tested bird protection properties.

The costs of the additional properties of these glazing systems must be taken into account during planning.

Based on the tests conducted (see Section 7), certain trends can be derived as to which properties the markings should have in order to be efficient as bird protection glass.

Experience from tests:

- The effectiveness of patterns does not correlate with the degree of coverage. There are patterns that have been tested as highly effective with an extremely low degree of coverage.
- High-contrast markings are more effective.
- Beyond a certain threshold, overly fine markings tend to be ineffective.
- The influence of marking colours on effectiveness has not been sufficiently researched.
- If the markings are applied to the exterior (level 1) of the glazing, they are less likely to be impaired by reflections.

From this, however, it should not be concluded that the presence of generally favourable properties ensures the effective operation of the relevant glazing as a bird protection glass. This must always be checked for the specific product.

6.2. Other measures

In addition to the measures described above using bird protection glass, effective bird protection can also be achieved by structural measures. There is a great variety of architectural options that significantly affect the character of a building.

In order to implement structural measures for bird protection, planners must consider these aspects early in the design and planning stage and develop concepts that are in conformity with the requirements. There is no generally applicable structural measure to achieve adequate bird protection.

Examples of possible structural measures for bird protection:

- Glazed façade surfaces with front-mounted fixed or movable structured planes (pilaster strips, perforated sheets, ornaments, grids, nets, vertical or horizontal (large) slats, etc.)
- Green façades with dense growth
- External blind systems in front of glass surfaces
- Textile solar shading systems in front of glazed areas
- Translucent membrane façades (textile) in front of glazed façade areas
- Opaque areas (panels) with materials with patterned surfaces
- Opaque areas (panels) with materials with non-reflecting or low-reflecting surfaces
- Downward tilting or rotating glazed areas

The applicable structural measures, in particular combinations with other bird protection measures, must be adapted to the specific application.

7. Evaluation of the effectiveness of bird protection glass

The term "bird protection glass" is not legally defined or protected. There is no official standard for bird protection glass in Germany or the EU. The most realistic method for measuring effectiveness would, of course, be to record it in the field. However, there is no cost-effective, automated method for recording bird collisions with buildings; monitoring is only carried out in individual cases for exposed structures. Since influencing parameters vary greatly, an analysis of individual buildings is of only minor general relevance.

"Flight tunnel tests" have therefore become an established test method for comparative evaluation. For these tests, birds are caught with nets in large areas (as part of scientific bird ringing) and their behaviour is observed in small test areas. This drastically increases event density and simplifies documentation. The test panes are exposed to daylight. Daylight-adapted birds are placed in a seven metre long tunnel which they want to exit immediately in the direction of the light. The birds have the option to exit by flying either towards an unmarked reference pane, which they do not recognise as an obstacle, or a marked pane, whose visibility is to be tested. The birds are protected by a special net before a collision occurs, ensuring that they will not be harmed. Flight tunnels enable a certain degree of control and standardisation of the flight towards the panes. The influence of the solar altitude is minimised by mounting the tunnel on a pivot to allow tracking of the entire testing facility, and to ensure symmetrical light incidence. The percentage of birds that fly towards the test or the reference panes is used as a measure of the effectiveness of the test pane.

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These flight tunnel tests are conducted by independent institutes. The important institutes for the market are the Biologische Station Hohenau-Ringelsdorf / Wiener Umweltanwaltschaft and the American Bird Conservancy / Powdermill Aviation Research Center (USA).
The tests in Hohenau-Ringelsdorf are based on the Austrian standard ONR 191040. However, its supervisory working group has been disbanded, which is the reason why the standard was withdrawn (ONR tests; there "WIN tests" are also conducted there).
In a study for the Bundesverband Flachglas, the Fraunhofer ISE compared the details of the test conditions in the two flight tunnels and established the following comparative table:*


Flight tunnel © Biologische Station Hohenau-Ringelsdorf

	Biologische Station Hohenau-Ringelsdorf		**ABC Powdermill**
Test focus	**Reflection (WIN test)**	**Visual transparency**	**Visual transparency**
Angle of pane to flight direction	125°	90°	90°
Reflection on obstacle	Yes, (with solar radiation the light distribution across the mirrors is uniform; with diffuse radiation it decreases downwards/towards the inside, of course)	Yes	No
View of the sky	Reflection	Yes	No
View of	Dense and homogeneous, natural ruderal vegetation with white canvas, sky in the upper part	Dense and homogeneous, natural ruderal vegetation, sky in the upper part	Blue and white speckled vinyl banner
View of attractive interior	No	No	No
Test runs for test pane as to whether there is influence on the right or left installation sides	Yes	Yes	Yes
Random installation of test pane on left or right side	Yes	Yes	Yes
Change for arranging test panes	After 3 individual tests	After 3 individual tests	After 12 individual tests
Balanced installation of test pane on left and right	Yes	Yes	Yes
Low lighting conditions in the tunnel	Yes	Yes	Yes
Influence of illumination situation (diffuse light/sun)	Yes	Yes	No
Measurement of global radiation	Yes, quantitatively recorded	Yes, quantitatively recorded	Acc. to test report: no but qualitatively recorded
Distinction global radiation > / < 400 W/m²	Yes	Yes	not specified

* Ensslen, Frank; Kuhn, Tilmann; Kroyer, Thomas, Fraunhofer-Institut für Solare Energiesysteme ISE, Freiburg:Bericht (report) EEB3-FE-2105-E02: Vogelschutzglas – Erfahrungen aus derzeitigen Flugtunnel-Versuchen bzw. Monitoring-Daten im Freiland, im Auftrag des Bundesverband Flachglas e. V. (Bird protection glass - Experiences from current flight tunnel tests and monitoring data in the field, commissioned by the Bundesverband Flachglas e. V., June 2022)

	Biologische Station Hohenau-Ringelsdorf		**ABC Powdermill**
Test focus	**Reflection (WIN test)**	**Visual transparency**	**Visual transparency**
High UV irradiation (sunshine)	Different light conditions and solar altitudes; at least 1/3 of the tests with direct solar radiation (without clouds in front of the sun); at least half of the tests with maximum 35° solar altitude	Different light conditions and solar altitudes; at least 1/3 of the tests with direct solar radiation (without clouds in front of the sun); at least half of the tests with maximum 35° solar altitude	not specified
Shadow cast on test panes (i.e. sym. light incidence, no direct sunlight on test panes)	No, pivoted test facility, follows solar altitudes	No, pivoted test facility, follows solar altitudes	No, pivoted test facility, follows solar altitudes
Intensity of light reflected to the outside	1-5 % of daylight	Not applicable	Not applicable
Measurement of light intensity of pane background	Yes	Yes	No, qualitatively
Simulation of bright partial areas inside	Yes (white canvas)	Not applicable	Not applicable
Simulation of dark partial areas inside (weakly lit cabin)	Yes (area outside of white canvas)	Not applicable	Not applicable
Time of day of test	> 70 % until 12:00 h	> 70 % until 12:00 h	not specified
Test months	July, August, September	July, August, September	April, May to August
Test bird species	Wild birds of mixed species: at least 90 % songbirds from at least 4 families, trapped between spring and autumn; bird species frequently involved in bird collisions	Wild birds of mixed species: at least 90 % songbirds from at least 4 families, trapped between spring and autumn; bird species frequently involved in bird collisions	not specified
Daylight-adapted birds	Yes	Yes	Yes
Eliminating birds which do not fly directly to the light openings	Yes	Yes	Yes
Random sample of flights	> 80	> 80	> 80
Video documentation	Yes	Yes	Yes
Camouflage netting	Yes	Yes	Yes

Bird-friendly construction with glass

Evaluation of results

Transparency versus reflection

A distinction must be made between the two situations when assessing the effectiveness of bird protection glass (see Section 3) In the tests at Hohenau-Ringelsdorf, both application situations are tested separately (ONR and WIN tests), while at Powdermill, so far only transparency is currently tested (a method for reflection testing is also being developed in the USA). The transparency tests apply to locations with a bright background such as noise barriers or glass balustrades, while the reflection tests apply to locations with a weakly illuminated background such as windows and façades. The test report must therefore describe the tested applications in detail.

Statistical evaluation of the flight data

For the tests > 80 flights of wild birds with a mixed species composition were evaluated in both institutions.

When comparing the results, a distinction must be made between the proportion of the flights to the test or reference pane and the "effectiveness" in percent of the tested glazing. If 50 % of the birds fly towards one pane and 50 % towards the other (a perfect random distribution), the effectiveness is not 50 %, but zero.

Evaluation method:

- **Biological Station Hohenau-Ringelsdorf**

Flights: The percentage of birds that fly towards the bird protection glass in the test.

Hohenau-Ringelsdorf rates a flight rate of a maximum of 10 % as "**highly effective**".

- **ABC Powdermill**

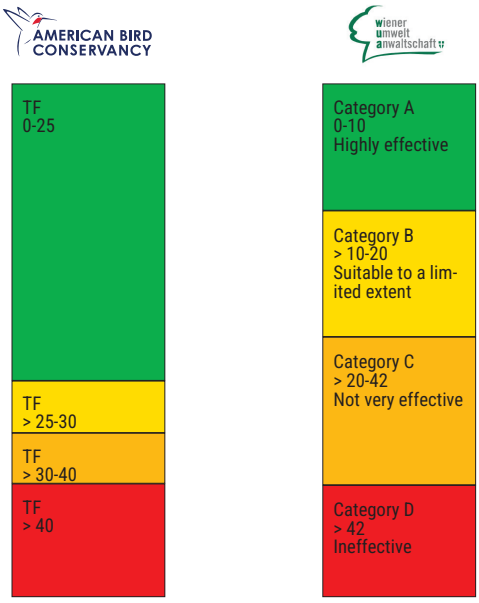
Threat Factor TF: The percentage of birds that fly towards the bird protection glass during the test.

A threat factor of max. 30 is rated by Powdermill as "**passed / bird friendly**".

TF 0 ≙ 100 % effectiveness

TF 50 ≙ 0 % effectiveness

The rating of both testing institutes is based on percentage of flights. This does not require 100 % effectiveness. The evaluation criteria are as follows:



Comparison of the evaluation criteria in Hohenau-Ringelsdorf and Powdermill

Additional information on testing bird protection glass

- As pointed out, the term "bird protection glass" is neither legally defined nor protected, the measurement of its effectiveness is not standardised and the test conditions in the two testing facilities differ. The test results given in the test reports can therefore only be compared to a very limited extent.
- Nature conservation organisations in Germany advocate for strict requirements to be fulfilled by the test results (Category A according to Hohenau-Ringelsdorf). In contrast, Powdermill classifies results of significantly lower effectiveness as "bird-friendly". Stakeholders in the USA argue that lower requirements will promote the acceptance of bird protection glass, resulting in an increase in the distribution of bird protection glass and therefore improve bird protection.
- The results of flight-tunnel-based choice tests cannot be readily applied in practice. A correlation between the test result and the bird protection effectiveness of a real object cannot be established and depends on numerous parameters, so that the tests primarily provide a ranking of the effectiveness of various tested products and only offer indicative values for effectiveness in practice.
- As mentioned, reflections tend to increase the risk. Numerical values for external reflectance have been the subject of controversial debate in the past. There is now a consensus among experts that bird collisions cannot be reliably reduced only by keeping below specific threshold values for reflectance.
- Testing capacities are limited because Hohenau-Ringelsdorf is the only operating testing facility in Europe and testing is limited due to the seasons.

- To designate and market a product as bird protection glass, it is not sufficient that certain design features of the glass have been verified as being generally effective against bird strikes by testing on other products (see box in Section 6). Evaluation of effectiveness requires testing and verification that the result are valid for the specific product.
- It is therefore also not permissible to market entire product ranges of similar glass as bird protection glass if only individual products have actually been tested.
- The American Bird Conservancy has made proposals for rating the effectiveness of glass according to the presence of certain design characteristics (see bibliography in Section 8), but these are not adequate for the classification as bird protection glass in Germany.

8. Literature

American Bird Conservancy (2023): "About the ABC Rating System"
https://abcbirds.org/glass-collisions/research-testing/

Bund für Umwelt und Naturschutz Deutschland BUND NRW e.V (publisher): "Vogelschlag an Glas – Das Problem und was Sie dagegen tun können" Düsseldorf, Germany (Bird-glass collisions - The problem and what you can do about it).
https://www.bund-nrw.de/publikationen/detail/publication/broschuere-vogelschlag-an-glas-das-problem-und-was-sie-dagegen-tun-koennen/.

BUND NRW e.V: "Flugtunneltest und die Norm ONR 191040" (Flight tunnel test and the ONR 191040 standard)
https://www.bund-nrw.de/themen/vogelschlag-an-glas/loesungen/flugtunnel-norm-onr-191040/

Ensslen, Frank; Kuhn, Tilmann; Kroyer, Thomas, Fraunhofer-Institut für Solare Energiesysteme ISE, Freiburg: Bericht (report) EEB3-FE-2105-E01: Vogelschutzglas – Ist-Analyse von bestehenden Zusammenhängen, Randbedingungen und relevanten Einflussgrößen für die Kollision von Vögeln auf Glasfassaden, (Bird protection glass - Analysis of existing relationships, boundary conditions and relevant influencing parameters for the collision of birds with glass façades, commissioned by the Bundesverband Flachglas e. V., June 2021
https://www.bundesverband-flachglas.de/downloads

Ensslen, Frank; Kuhn, Tilmann; Kroyer, Thomas, Fraunhofer-Institut für Solare Energiesysteme ISE, Freiburg:Bericht (report) EEB3-FE-2105-E02: Vogelschutzglas – Erfahrungen aus derzeitigen Flugtunnel-Versuchen bzw. Monitoring-Daten im Freiland, im Auftrag des Bundesverband Flachglas e. V.(Bird protection glass - Experiences from current flight tunnel tests and monitoring data in the field, commissioned by the Bundesverband Flachglas e. V., June 2022)
https://www.bundesverband-flachglas.de/downloads

Förster, Judith; BUND für Umwelt und Naturschutz Deutschland (Publisher) (October 2019). "Vogelschlag an Glas: Über 18 Millionen oder 100 Millionen? Was stimmt?" (Bird-glass collisions: over 18 million or 100 million? What is correct?)
https://www.bund-nrw.de/meldungen/detail/news/vogelschlag-an-glas-ueber-18-millionen-oder-100-millionen-was-stimmt/

Grünfelder, K. 2011: Vogelanprall an Glasflächen – eine Übersicht zum Stand von Wissenschaft und Technik.(Bird strikes on glass surfaces– an overview of the state of the art in science and technology). Published by Salzburger Umweltanwaltschaft, Salzburg. 21 pp.
https://docplayer.org/25430813-Vogelanprall-glasflaechen.html
https://www.lua-sbg.at/themen/artenschutz/vogelanprall-an-glasflaechen/Vogelanprall an Glasflächen

Huggins, Benedikt; Schlacke, Sabine, 2019: "Schutz von Arten vor Glas und Licht. Rechtliche Anforderungen und Gestaltungsmöglichkeiten (Band 18)". (Protection of species from glass and light Legal requirements and design options (Volume 18). Berlin, Germany: Published by Springer-Verlag GmbH.

Länderarbeitsgemeinschaft der Vogelschutzwarten (Working Group of German State Bird Conservancies): Decision 21/ 01: "Vermeidung von Vogelverlusten an Glasscheiben – Bewertung des Vogelschlagrisikos an Glas" (Prevention of bird losses at glass panes – Assessment of the bird-glass collision risk.) Augsburg 2021
http://www.vogelschutzwarten.de/downloads/LAG%20VSW%2021-01_Bewertungsverfahren%20Vogelschlag%20Glas.pdf

Ministerium für Wirtschaft, Arbeit und Wohnungsbau Baden-Württemberg, (Ministry of Economic Affairs, Labour and Housing Baden-Wurttemberg), 2019: "Artenschutz in der Bauleitplanung und bei Bauvorhaben – Handlungsleitfaden für die am Planen und Bauen Beteiligten" (Species protection in land-use planning and construction projects – A practical guide for those involved in planning and building)
https://mlw.baden-wuerttemberg.de/fileadmin/redaktion/m-mlw/intern/Dateien/06_Service/Publikationen/Bauen/Leitfaden_Artenschutz2019.pdf

NABU; Lachmann, Lars:"Tipps gegen Vogelschlag"
(Tips to prevent bird strikes)
https://www.nabu.de/tiere-und-pflanzen/voegel/gefaehrdungen/11932.html.

Rössler, Martin im Auftrag der WUA "Vogelanprall an Glasflächen – geprüfte Muster" (Bird strikes on glazed areas - tested patterns)
https://wua-wien.at/images/stories/publikationen/wua-vogelanprall-muster-2022.pdf

Rössler, M., W. Doppler, R. Furrer, H. Haupt, H. Schmid, A. Schneider, K. Steiof & C. Wegworth (2022): Vogelfreundliches Bauen mit Glas und Licht, (Bird-friendly building with glass and light), 3rd revised edition, Schweizerische Vogelwarte Sempach
https://vogelglas.vogelwarte.ch/assets/files/broschueren/Glasbroschuere_2022_D.pdf

Sheppard, Christine; Phillips, Glenn (2015):" Bird-Friendly Building Design", 2nd Ed. (The Plains, VA: American Bird Conservancy)
https://abcbirds.org/wp-content/uploads/2015/05/Bird-friendly-Building-Guide_20151.pdf.

Bundesverband
Flachglas

Bundesverband Flachglas e. V.
Mülheimer Strasse 1
53840 Troisdorf
bundesverband-flachglas.de