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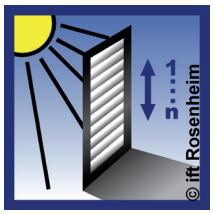
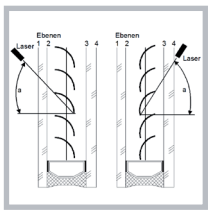
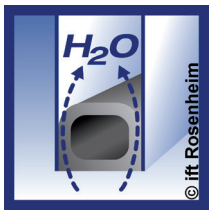
January 2018

Insulating glass unit with movable sun protection systems integrated in the cavity

Evidence for evaluation of the fitness for use of insulating glass unit (IGU) with integrated movable installations









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ift Rosenheim GmbH
Theodor-Gietl-Str. 7-9
83026 Rosenheim
Germany

Phone: 0 80 31/261-0
Fax: 0 80 31/261 290
E-mail: info@ift-rosenheim.de
www.ift-rosenheim.de

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Insulating glass unit with movable sun protection systems integrated in the cavity

Evidence for evaluation of the fitness for use of insulating glass unit (IGU) with integrated movable installations

Inhalt

Foreword

After appr. 10 years of testing experience and evaluation of integrated systems in the cavity of insulating glass unit (with ift guideline VE-07), adjustments of the testing procedure have become necessary. Compared to the previous edition VE-07/2 (2005 edition), changes have been made to the test cycles and test specimen sizes. This was done with the aim of adapting the testing and evaluation even more realistically to practical construction requirements for many years of trouble-free use. Changes to accompanying standards and regulations were also taken into account. This edition replaces the version VE-07/2 (2005 edition) and supplements its testing standards for future construction projects. The installation of sun protection systems in the closed cavity of insulating glass unit results in a product that must meet the requirements of both an insulating glass unit and a sun protection/daylight system.

This ift guideline serves for the holistic assessment of the fitness for use of insulating glass unit with integrated installations for testing and evaluation of the system in the laboratory.

Methods for the determination of building-physical characteristics are given in Annex A. Regarding the static design of the glass structures, the DIN 18008 standards series in the currently valid version applies.

The procedure described in this guideline is based on the findings of the research project "Integral Evaluation of Innovative Building Envelopes", which was carried out at ift Rosenheim in the years 2000 to 2003, as well as on existing experiences from the use of such systems up to 2017.

This ift guideline replaces the ift guideline VE-07/2 of August 2005.

1 Scope

This guideline determines the verification method for evaluation of the usability of insulating glass unit (IGU) with integrated movable installation in the cavity. The systems can be moved motor-operated or manually, e.g.

- Venetian blind/exterior blinds
- Adjustable slats
- Roller blinds
- Folding blinds

The guideline does not apply to insulating glass unit with a large cavity without movable installation.

The scope is defined for vertical glazing on windows, doors, facades, conservatories and internal partitions as well as for horizontal glazing. For internal partitions, the reduced effects in the interior must be taken into account with regard to the design.

2 Relevant Standards and Guidelines

The standards listed below contain specifications which are required in connection with the procedures mentioned in this guideline. Please make sure that the current versions of these documents are used. At the date of publication of this guideline, the editions indicated were valid. It shall be checked whether the latest issues of the following standards can be applied.

[1] EN 12216:2002
Shutters, external blinds, internal blinds - Terminology, glossary and definitions
Berlin: Beuth Verlag GmbH

[2] EN 13527:1999
Shutters and blinds - Measurement of operating force - Test methods
Berlin: Beuth Verlag GmbH

[3] EN 13659:2015
Shutters and external venetian blinds - Performance requirements including safety
Berlin: Beuth Verlag GmbH

[4] EN 13120:2009+A1:2014/AC:2015
Internal blinds - Performance requirements including safety
Berlin: Beuth Verlag GmbH

[5] EN 14201:2004
Blinds and shutters - Resistance to repeated operations (mechanical endurance) - Methods of testing
Berlin: Beuth Verlag GmbH

[6] EN 14202:2004
Blinds and shutters - Suitability for use of tubular and square motorizations - Requirements and test methods
Berlin: Beuth Verlag GmbH

[7] EN 14203:2004
Internal and external blinds and shutters - Capability for use of mechanical drive systems with crank handle (T.O.) - Requirements and test methods
Berlin: Beuth Verlag GmbH

[8] EN ISO 12543-4:2011
Glass in building - Laminated glass and laminated safety glass - Part 4: Test methods for durability
Berlin: Beuth Verlag GmbH

[9] EN 1279-1:2004 and prEN 1279-1:2016
Glass in Building - Insulating glass units - Part 1: Generalities, dimensional tolerances and rules for the system description
Berlin: Beuth Verlag GmbH

[10] EN 1279-2:2002
Glass in Building - Insulating glass units - Part 2: Long term test method and requirements for moisture penetration
Berlin: Beuth Verlag GmbH

[11] EN 1279-3:2002 and prEN 1279:2015
Glass in Building - Insulating glass units - Part 3: Long term test method and requirements for gas leakage rate and for gas concentration tolerances
Berlin: Beuth Verlag GmbH

[12] prEN 1279-4:2015
Glass in Building - Insulating glass units - Part 4: Glass in Building - Insulating glass units - Part 4: Methods of test for the physical properties of edge seals
Berlin: Beuth Verlag GmbH

[13] EN 1279-5:2005+A2:2010
Glass in Building - Insulating glass units - Part 5: Evaluation of conformity
Berlin: Beuth Verlag GmbH

[14] HV-WÄR 01
ift process instructions “Calorimetric Determination of Total Solar Energy Transmittance g”
ift Rosenheim 2002

[15] DIN EN ISO 52022-3:2018
Energy performance of buildings - Thermal, solar and daylight properties of building components and elements - Part 3: Detailed calculation method of the solar and daylight characteristics for solar protection devices combined with glazing

[16] DIN 18008-2:2010-12 and Corrigendum 1:2011-04
Glass in building - Design and construction rules - Part 2: Linearly supported glazings
Berlin Beuth Verlag GmbH

[17] EN 673:2011
Glass in building - Determination of thermal transmittance (U value) - Calculation method
Berlin: Beuth Verlag GmbH

[18] EN 674:2011
Glass in building - Determination of thermal transmittance (U value) - Guarded hot plate method
Berlin: Beuth Verlag GmbH

[19] EN 675:2011
Glass in building - Determination of thermal transmittance (U value) - Heat flow meter method
Berlin: Beuth Verlag GmbH

[20] EN ISO 10140-2:2010
Acoustics - Laboratory measurement of sound insulation of building elements - Part 2: Measurement of airborne sound insulation
Berlin: Beuth Verlag GmbH

[21] DIN 18008-1:2010-12
Glass in Building - Design and construction rules - Part 1: Terms and general bases

[22] EN 1096-3:2012
Glass in building - Coated glass - Part 3: Requirements and test methods for class C and D coatings

[23] BF Bulletin 007/2010
Guideline for assessing the visual quality for systems in multiple-sheet insulating glass

3 Definition of Terms

Stage
Movement from fully extended/retracted to fully retracted/extended position

Cycle
Complete retraction and extension movement from 2 phases with one turning cycle of the slats. In general, the turning cycle is included in the retraction and extension movement for blinds with individual control.

Turning cycle
The turning cycle involves turning the slats from a starting position via the possible end position back to the starting position.

Further definitions can be found in the respective cited testing standards.

4 Requirements

Some of the procedures comply with applicable standards. In these cases, reference is made to the relevant standard. For test procedures that are carried out following existing standards, the deviation from the standard is described in the guideline. The following specifications are tested:

- Moisture penetration of edge seals
- Gas tightness of edge seal
- Fogging in cavity
- Durability on integrated installation

The requirements and test fundamentals are summarized in table 1. The flow chart in image 1 describes the procedure for verifying the fitness for use of insulating glass unit with integrated installations. Optionally, the building-physical characteristics can be determined according to Annex A.

Table 1 Specifications for single tests

Chapter	Designation	Basis	Requirements
5.1	Moisture penetration of edge seals	EN 1279-2	Moisture penetration index $I_{av} \leq 0.20$; $I \leq 0.25$
5.2	Gas tightness, optionally with amended testing format	EN 1279-3	Gas leakage rate $L_i \leq 1.0$ % a^{-1} and/or $L_{i,max} \leq 1.20$ % a^{-1}
5.3	Fogging with higher temperature load	prEN 1279-4 Annex C Test temperature in cavity (80±5) °C	Continuously visible condensate not permissible
6.1	Durability test of the installation at high and low temperature	Durability test for 20,000 cycles, thereof simulated summer for 8,000 cycles at +80°C and simulated winter for 2,000 cycles at -10°C, 10,000 cycles at room temperature and then 10,000 turning cycles	Function and visual evaluation of curtains
6.2	Durability test of the installation with partial UV radiation	Durability test for 20,000 cycles, thereof at least 8,000 cycles with UV-partial radiation with 900 W/m², minimum 800 h	Function and visual evaluation of curtains

5 Fitness for use of insulating glass unit

At the time of publication of the guideline, the European product standard EN 1279 Part 2 and Part 3 were defined as type test for insulating glass unit (IGU). Deviating test dimensions are not intended. If testing is to be carried out with different dimensions, it has to be justified.

Therefore, the test evidence on gas-filled IGU is carried out within the scope of the guideline with the required test format (350 mm x 500 mm). In case of deviations from the standard regarding the format, the test is carried out following EN 1279-3 (500 mm x 500 mm). Regarding the construction, the manufacturer selects a representative construction from his product range. The transferability of the results to other pane gaps and glazing thicknesses than tested is in the manufacturer's responsibility.

Notes: Test results obtained in formats different from the standard may be used in an application for approval of the product. A normative test according to EN 1279-2 and -3 is carried out with the smallest available thickness of the spacer system used with the corresponding corner designs and necessary breakthroughs, e.g. for the cable bushing. The curtain need not be installed during the test for the tests according to EN 1279-2 and -3. However, the edge seals must correspond to the original.

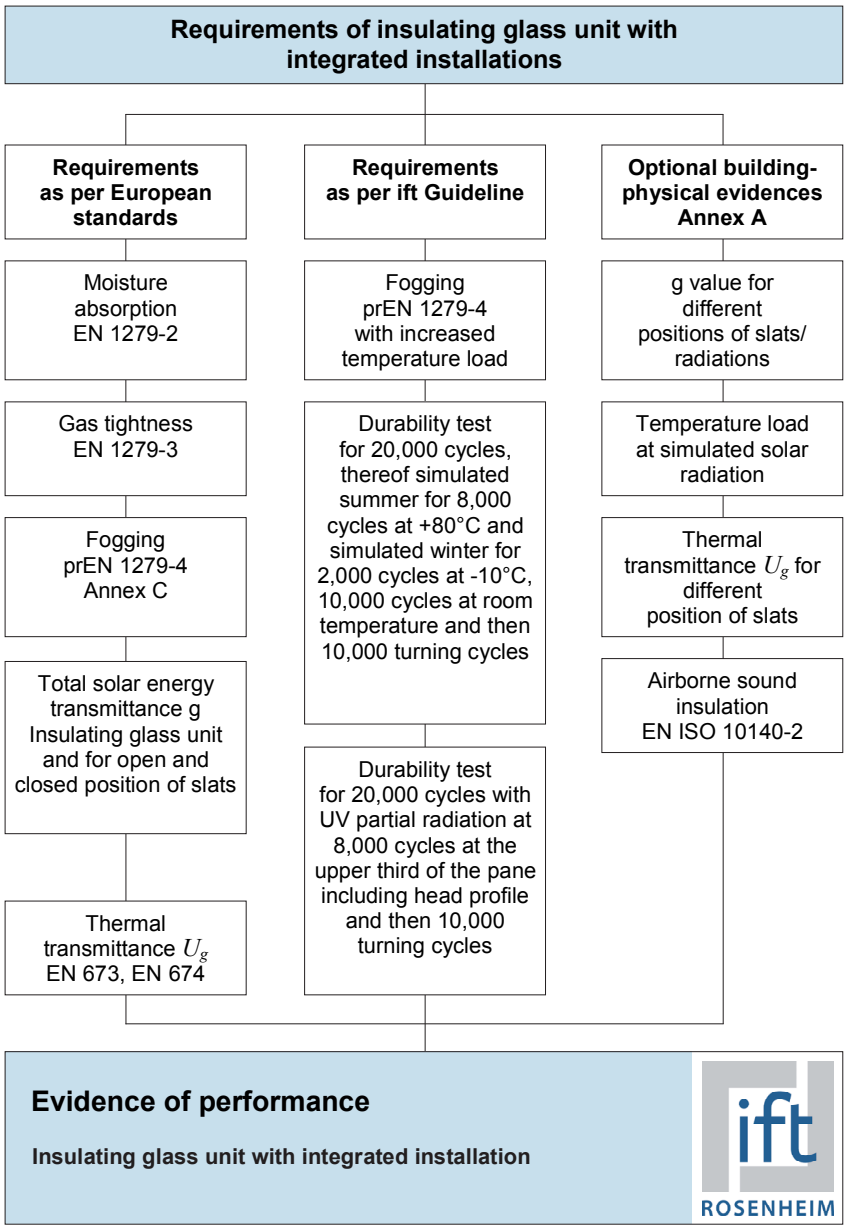

Image 1 Flow chart evidence of fitness for use for IGU with integrated installations

5.1 Moisture absorption

The moisture absorption of the desiccant is tested according to EN 1279-2.

The test consists of subjecting a number of insulating glass units to a climatic cycling load. The dew point and the moisture content of the desiccant are measured and the moisture absorption factor is calculated in initial state and after the climate test.

5.1.1 Test specimen

The quantity of the test specimen to be delivered is 15 insulating glass units. The test specimen shall be representative of the system description (see EN 1279-1). The size of the test specimen has to be (502 ± 2) mm and (352 ± 2) mm (L x W). Due to an increased risk of glass breakage due to the large cavity, the glass panes should be made of the thinnest possible TSG or thicker float glass for testing purposes. The cavity must comply with the specifications in the system description. The cavity is preferably air-filled, but other gases are permissible. The test specimen shall correspond to the design features of the delivered panes in the following points:

- Spacer
- Sealants
- Butyl application quantity/butyl width
- Back cut
- Corner cleat/corner seal
- Feedthroughs (mechanical/electrical) through the edge seal
- Mechanism for curtain installation
- Holding device for curtain installation

5.1.2 Result

The moisture absorption is evaluated according to EN 1279-2. The requirements are met if the average moisture absorption factor I_{av} of the at least five test specimen does not exceed 0.20 ($I_{av} \leq 0.20$) and the test specimen with the highest moisture absorption factor does not exceed 0.25 ($I \leq 0.25$). Additional test specimen serve as reference sample in the event of glass breakage.

5.2 Gas leakage rate of insulating glass unit

The gas leakage rate and limiting deviations for the gas concentration are tested according to or following EN 1279-3 (depending on format, see above). In this test, the gas leakage

rate at 20 °C is determined after loading the test specimen in the climatic test in accordance with EN 1279-3.

For the measurement of the gas leakage rate, the test specimen is enclosed in a gas-tight container. The quantity of gas escaping from the test specimen is measured over a certain period of time. After this measurement, the test specimen is opened, the gas concentration analysed and the gas leakage rate calculated.

5.2.1 Test specimen

For testing the gas leakage rate, preferably 8 test specimen in the dimensions (502 ± 2) mm and (352 ± 2) (W x L) are supplied.

Deviations from the standard exist if the test specimen is tested in the original assembly with the format (502 ± 2) mm and (502 ± 2) mm (W x L). At least eight test specimen shall be produced, of which at least two shall be tested for gas leakage rate according to EN 1279-3.

For testing purposes, the glass panes should preferably consist of the thinnest possible TSG panes (e.g. 3 mm).

The cavity and the edge seal geometry must correspond to the specifications of the system description.

The design features of the test specimen

- Spacer
- Sealants
- Butyl application quantity/butyl width
- Back cut
- Corner cleat/corner seal
- Feedthroughs (mechanical/electrical) through the edge seal
- Mechanism for curtain installation
- Holding device for curtain installation

must correspond to the design features of the delivered panes.

The test specimen must be produced in such a way that the actual gas concentration on delivery
$c_i = c_{i,o}$ +10 %, –5 %

is met. In the case of gas mixtures, this applies to each individual gas in the mixture.

5.2.2 Result

The gas leakage rate L_i for all gases with a concentration of more than 15 % measured according to EN 1279-3 must meet the following requirements:

$L_{i,av} \leq 1.0$ in % a^{-1} or a maximum gas leakage rate of $L_{i,max} \leq 1.20$ in % a^{-1}.

5.3 Fogging

This test is used to determine whether inadmissible condensation occurs on the glass surfaces bordering on the cavity due to release of volatile substances. The test is carried out in two individual tests on panes with the format (502 ± 2) mm and (352 ± 2) (W x L).
A complete IGU with all components of the drive unit and the curtain is required. At least 4 identical test specimen must be delivered, which are used for both procedures described below.

First test
Test according to prEN 1279-4 Annex C:

The release of gaseous substances is checked by heating the corresponding integrated component at one point. Condensation is achieved by cooling a part of the glass surface.

A lamp or a group of lamps is used to heat the corresponding components. Mercury high-pressure lamps with tungsten filaments (e.g. Osram lamps Ultra-Vitalux) can be used as radiation sources, simulating sunlike radiation at a distance of 300 mm (see Image 3).

- Two insulating glass units have to be tested.
- The temperature of the heated surface must be at least (60 ± 3) °C.
- The area of the irradiated surface must cover at least 20 to 30 % of the component concerned.
- The cooled area must be approximately in the middle of the tested unit. Its length and width shall be 1/3 of the length and width or 10 % of the surface of the unit.
- The surface temperature of the cooled area shall be (30 ± 3) K lower than the surface temperature of the irradiated area.
- The temperature at the other points of the unit must be high enough to ensure that all condensation occurs in the cooled area.
- The test duration shall be 168 h ± 4 h.

Second test
Increased temperature load

The test is repeated on the same test specimen following prEN 1279-4 Annex C. Due to the absorption behaviour of the integrated installations, higher temperatures can occur in the cavity in practical use. The following additions to the standard are made in order to be able to assess the fogging behaviour of the installations.

- Three test specimen are irradiated.
- The test specimen that were already assessed in the first test are used for evaluation.
- A temperature measuring point is secured into the third specimen through a hole in the edge seal in the cavity in the area of radiation on the side of the installation facing away from the radiation.
- The air temperature in the cavity must be at least (80 ± 5) °C.
- The surface temperature on test specimen 3 is also set on test specimen 1 and 2.
- The surface temperature of the cooled area must be (25 ± 5) °C.
- All other test conditions comply with the requirements of the standard.

5.3.1 Test specimen

The test specimen are determined by the respective test method described in prEN 1279-4 Annex C.
For the fogging test, preferably 4 test specimen in the dimensions (502 ± 2) mm and (352 ± 2) (W x L) are delivered.

The test specimen shall be made of float glass in the original structure with 4 mm TSG each without coatings. The installations in the cavity must be accessible for assessment or adjusted in such a way that a clear view to the opposite side is possible.

All materials used for integrated installation must be available in a representative quantity in the cavity of the test specimen for original structure.

5.3.2 Result

The evaluation of the test specimen takes place after completion of the individual tests. The requirements are met if no persistent visible condensation occurs in both individual tests.

The units to be tested are examined for interference phenomena and stray light caused by condensates using transmitted and incident light methods: e.g. the test specimen are cleaned on the outer surfaces and mounted at eye level one after the other in an observation box following prEN 1279-4, Annex C. The test specimen are viewed directly from the front

from a distance of about 1 m and searched for signs of dirt, other impurities or condensate on the interior glass surfaces.

If condensation is noticed in the observation box, the unit should be stored for 7 days at 15 °C to 25 °C and then viewed again in the observation box from a distance of 1 m. Persistent, visible condensation is not permitted.

6 Test of mechanical durability of movable, integrated installations

General

This chapter specifies the test for determining the mechanical service life of movable installations in the cavity of insulating glass units.

The test is performed following EN 14201. For this purpose, a fixed number of cycles or turning cycles is carried out. The aim is to simulate the functionality of the installation over a targeted period of use of 20 years. The diagram in image 2 describes the procedure of the durability test.

The number of repeated operations in both partial tests is set to 20,000 up and down cycles + 10,000 lamella turning cycles.

Notes: Blinds and pleated blinds are tested differently with 20,000 cycles as described.

During the durability test, the installations are always moved to their intended final position. In order to reach the final position, the inertial effect of the installation can be taken into account. A premature disconnect of the movement depends on the strength of the inertial effect. The boundary conditions are described in Table 2.

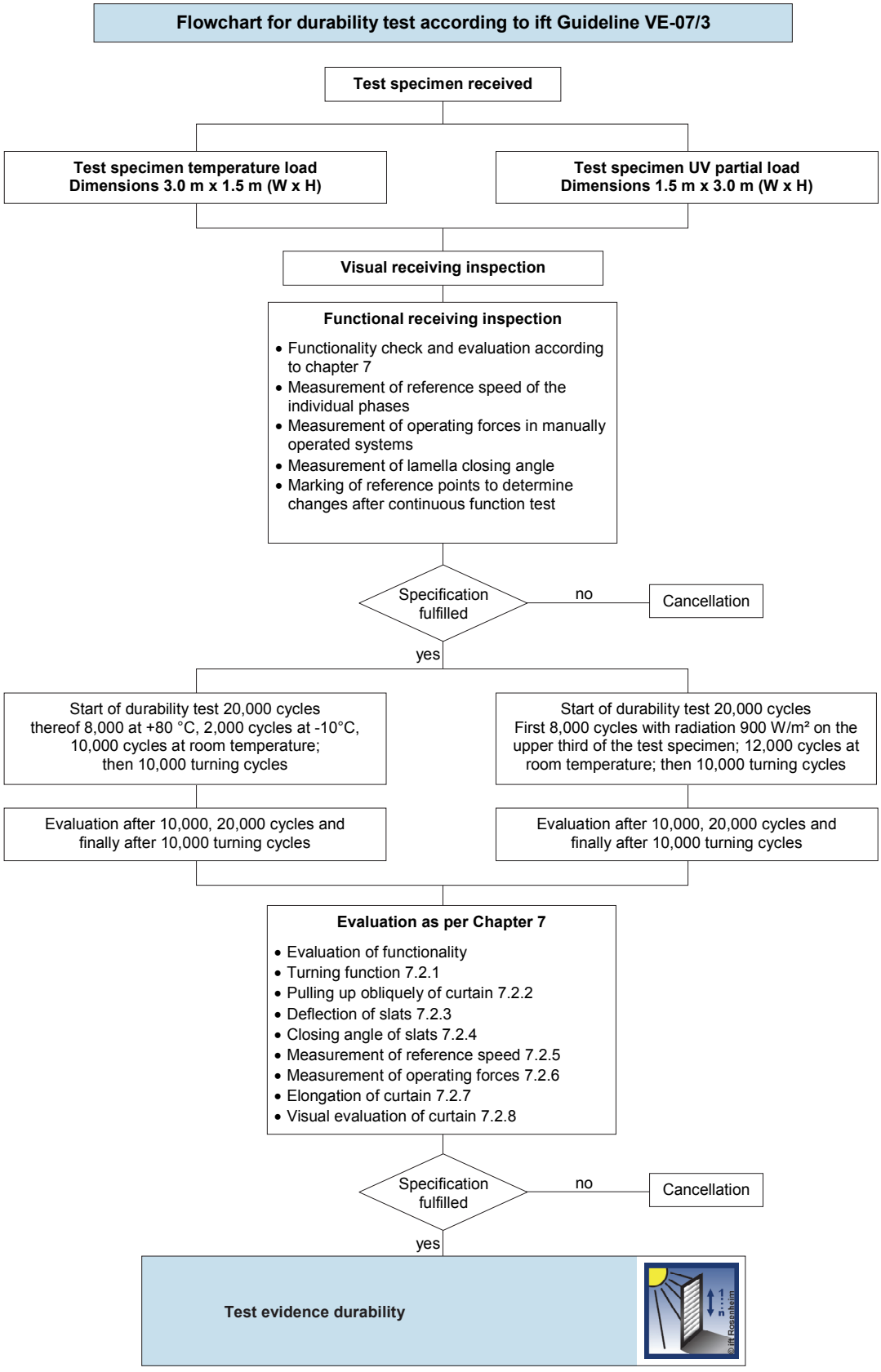

Image 2 Flow chart of durability test

Table 2 Boundary condition for power-operated installations

Designation	Definition	Settings during the test
Reference speed	Speed set by the manufacturer for raising and lowering of installation	approx. 1.5 m/min upon consultation with the client
Downtime per phase	Waiting time in fully extended and retracted position of the installation	Upper rest time: 30 s Lower rest time: 60 s
End stop	Built-in motor cut-off device when the upper or lower final position of the installation is reached	Activated limit stop according to the intended use

Turning cycles are preferably tested without rest time in consultation with the system manufacturer.

The motors and mechanical drive systems used should be tested according to EN 14202 or EN 14203.

If the product has external drive components that can be serviced without interfering with the edge seal system, it is permissible to service components during the durability test. If components are serviced during the test, this shall be documented in the test report stating the number of cycles.

The test is carried out in the installation position in which the product will be used later on.

Systems which can be tilted for ventilation purposes but remain mainly in a vertical position shall be tested in a vertical position. It must be taken into account whether the installation can or may be moved during tilt position. If movement in the tilted position is permissible, this must be constructively possible, otherwise movement of the curtain must be prevented by suitable measures. Damage to the glass coating for thermal insulation or contact with the glass surfaces is not permitted if the installation is actuated during tilt position.

According to DIN 18008-1, glazing with an inclination greater than 10° from the vertical is considered horizontal glazing. Different loads are applied horizontally and vertically depending on the installation situation. Products which are used at several inclinations from the vertical must be tested in two extreme positions 10 ° and 90 ° from the vertical.

Since manual installations are no longer common in the relevant sizes, the procedure for such systems is not adapted. If tests for manual systems are still required, reference is made to the version of the ift-Guideline VE-07/2 (2005 edition).

6.1 Test with higher temperature load

A test specimen is subjected to temperature load on both sides. 8,000 cycles are executed at +80 °C (summer) and 2,000 cycles at -10 °C (winter). The test is carried out on the complete test specimen; a one-sided climate burden is not necessary, since the "worst case" is to be simulated.

6.1.1 Test specimen

The test is performed on a test specimen with the dimensions 3.0 m x 1.5 m (W x H) or the maximum size of the system, if not available in this size. The glass configuration must be determined system-specifically.

Settings on the installations must be made according to Table 2. For testing manually operated installations, all parts and operating mechanisms of the test rig must correspond exactly to the actual application situation for operating the installations.

6.1.2 Test

Receiving inspection of test specimen

The test specimen shall undergo a visual initial assessment according to the "Guideline for Visual Assessment of Quality for Systems in Insulating Glass Units" and according to Chapter 7 as well as a test of all functional relevant characteristics.

Load

The required number of 20,000 up and down cycles including 10,000 lamella turning cycles must be performed. The condition of the test specimen shall be checked periodically. The test starts with 8,000 cycles summer case at +80 °C and 2,000 cycles winter case at -10 °C. After 10,000 cycles, the test shall be stopped and a visual assessment has to be made. The test is continued at room temperature for further 10,000 cycles, followed by 10,000 turning cycles also at room temperature.

The test is completed when either an irreversible malfunction occurs or the desired number of cycles is reached.

6.1.3 Results

The results are evaluated according to the evaluation criteria described in Chapter 7. Abrasion marks in the cavity are permissible if the function of the installation is not impaired and the abrasion has no influence on the optical appearance.

6.2 Test with UV partial radiation

It must be assumed that UV exposure over the period of use of the systems makes a significant contribution to ageing behaviour. In combination with high temperature load and UV radiation, premature ageing of the components and, if necessary, failure of the functionality of the installation may occur. Therefore, UV radiation must be taken into account in an additional test to prove fitness for use. Irradiation is carried out following EN 1096-3:2012 "Glass in building - Coated glass - Part 3: Requirements and test methods for class C and D coatings", Annex C, Figure C.1.

6.2.1 Test specimen

The test is performed on a test specimen with the dimensions 1.5 m x 3.0 m (W x H) or the maximum size of the system, if not available in this size. The glass configuration must be determined system-specifically.

Settings on the installations must be made according to Table 2. For testing manually operated installations, all parts and operating mechanisms of the test rig must correspond exactly to the actual application situation for operating the installations.

6.2.2 Test

Receiving inspection of test specimen

The test specimen shall undergo a visual initial assessment according to the Guideline “Assessment of Visual Quality of Insulating Glass Units" and according to Chapter 7 as well as a test of all functional relevant characteristics.

Load

Partial radiation takes place during the first 8,000 cycles in the upper third of the outside of the pane, including the head profile. The surface temperature is measured in the center of the radiated surface using a thermocouple.

Radiation sources shall be used which emit radiation with a spectral distribution comparable to the spectral distribution of global radiation specified in EN 410 and the percentages of UVB and UVA radiation as specified in Table 3. Such a spectral distribution can be achieved with different lamp types.

Table 3 (according to EN 1096-3)

Spectral characteristics of the lamp radiation used for the test	Wavelength range in nm	Percentage of total energy in %
ultraviolet range UVB	280 to 315	1 to 4
Ultraviolet range UVA	315 to 380	3 to 9
Visible and infrared range	> 380	Compensation of the difference to 100

Osram lamps of the Ultra-Vitalux type with a power consumption of 300 W can be used as an radiation source. At least 16 lamps are arranged in a square of 4 x 4 lamps at a distance of 250 mm from each other. The spectrum of such a radiation source was described in DIN 52344:1984-05 (withdrawn) and is shown in Image 3.

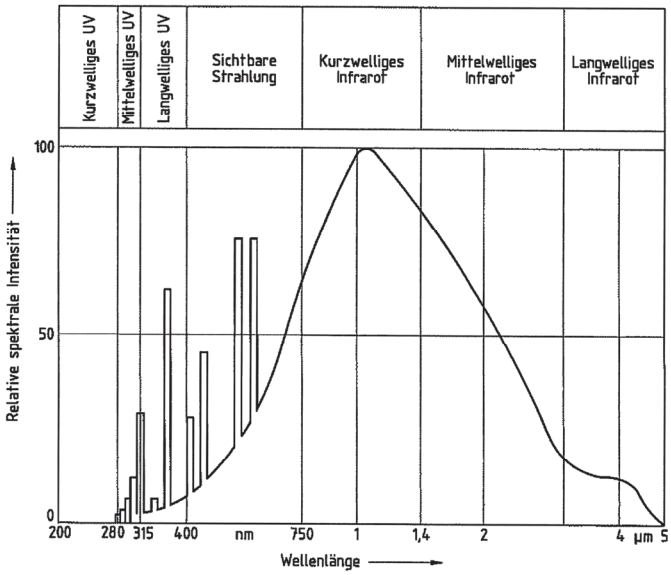

Image 3 Spectrum of a UV radiation source, e.g. an OSRAM lamp

The test specimen is radiated during the first 8,000 cycles. The speed should be adjusted so that this number of cycles corresponds to a radiation duration of (800 ± 24) h at a solar radiation intensity of (900 ± 100) W/m². The remaining 12,000 cycles are carried out at room temperature without UV radiation.

Notes: Pyranometers with ISO 9060 specifications and a spectral range between 305 nm and 2800 nm can be used to determine the total radiation intensity. When using these detectors, the measured radiation intensity in the sample plane is 730 ± 80 W/m².

The black body temperature is determined on the surface of the specimen facing the test lamps. The black body temperature must be 70 ± 5 °C.

A thermocouple is attached to each of the surfaces facing and facing from the lamps in the centre of the radiated area. Temperatures shall be recorded at least periodically.

6.2.3 Results

The results are evaluated according to the evaluation criteria described in Chapter 7. The following values are also specified:

- Surface temperature of the radiated side in the radiated and non-radiated area
- Black body temperature on the radiated side
- Surface temperature of the side facing from the radiation side
- Radiation intensity

7 Evaluation criteria

7.1 Function evaluation of insulating glass unit

Insulating glass unit shall be assessed according to the product standard EN 1279-5 "Glass in building - Insulating glass unit". The usability of the insulating glass is ensured by tests in accordance with the requirements of the standard.

Notes: The characteristic of a permanent hermetic seal is determined by testing an IGU system according to EN 1279-2 and -3. If testing according to the standard is not possible, this is an indication that the product does not correspond to the scope. It is therefore an unregulated construction product. In order to be able to install an unregulated construction product, another type of evidence of specified use is required, e.g. approval of individual cases, national approval or European technical assessment (ETA). Such verification methods are to be applied for at DIBt or at European technical assessment bodies (TAB) offices (in Germany: DIBt).

7.2 Function evaluation of installation

In order to pass the test, the entire product must be fully functional after the required number of cycles and meet the requirements of the evaluation criteria. The functional evaluation of the integrated installations is following EN 13120 or the criteria in Table 4 as well as the permissible deviations described in the following chapters.

Table 4 Summary of the evaluation criteria for the function of the installation

N°	Evaluation criterion	Evaluation
1	Slats remain permanently stuck together	not permitted
2	Slats turn not properly	7.2.1
3	Pulling up of installation obliquely	7.2.2
4	Deflection of slats	7.2.3
5	Closing angle of slats	7.2.4
6	Deviation of reference speed	0 $\Delta v < 20\%$
7	Operating forces	7.2.6
8	Elongation of curtain	7.2.7
9	Contact of the slats on the spacer	7.2.8
10	Torn ladder braid	not permitted
11	Torn pull cord (rod)	not permitted
12	Broken-off parts in cavity	not permitted
13	Motor failure	not permitted
14	Malfunction of deflections, gears, mechanics	not permitted
15	Malfunction of limit stop	not permitted
16	Failure of the electrical components	not permitted
17	Programming of the control failed (within the maintenance cycles specified by the manufacturer)	not permitted
18	Noise generation when using the installation (only for motor-driven installations)	Value must be indicated if 70 dB (A) is exceeded; otherwise, indication that value is ≤ 70 dB (Directive 2006/42/EC)

Notes: Colour changes to curtains are not subject of the evaluation.

7.2.1 Permissible deviation during incomplete turning

The permissible deviation from complete turning of the slats is 2 % of the total number of slats. When the slats are lowered, they may get stuck in such a way that they do not fold into the intended position until the turning process is repeated once after they get stuck. Permanent sticking of the slats is not permitted (Image 4). The observation takes place over a period of approx. 20 cycles.

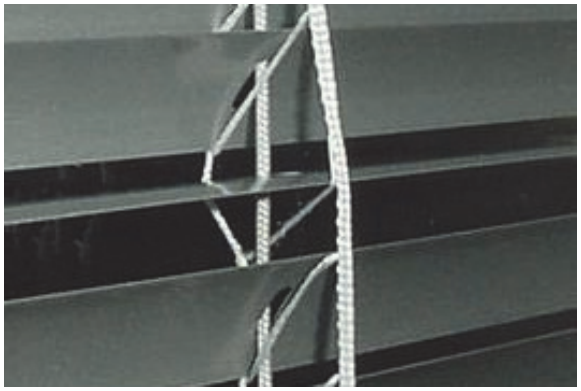

Image 4 Example of incomplete turning of the slats

7.2.2 Deviation from squareness

Permissible permanent deviation from the squareness (pulling up obliquely) according to EN 13120: The evaluation is made at the beginning of the test and at the end of the test cycles. The maximum permissible deviation A from squareness is 6 mm per metre of slat length L, maximum 15 mm (Image 5).

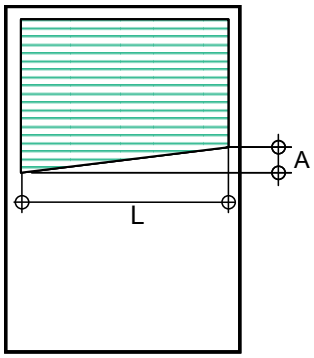

Image 5 Deviation from squareness

7.2.3 Deflection of slats and cover profile

Table 5 and image 6 display the permissible deflection of the slats and the cover profile following EN 13120.

Table 5 Maximum values of deflection of slats

Length of slats [m]	Deflection of slats [mm]
L > 1.5	≤ ± 5
1.5 < L > 2.5	≤ ± 10
2.5 < L > 3.5	≤ ± 15
L > 3.5	≤ ± 20

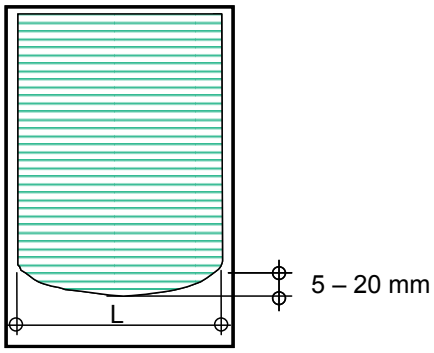

Image 6 Deflection of slats

7.2.4 Closing angle

The maximum closing angle is measured for both final positions of the slats. For the measurement a point laser is used, which is mounted on a device. This allows both slat edges to be located and the set angle to be read. The measurement is taken 100 mm from the upper edge and 100 mm from the lower edge of the visible installation (Image 7).

The permissible deviation in new condition from the maximum closing angle to be specified by the manufacturer must not exceed $\alpha \leq 10$ °.

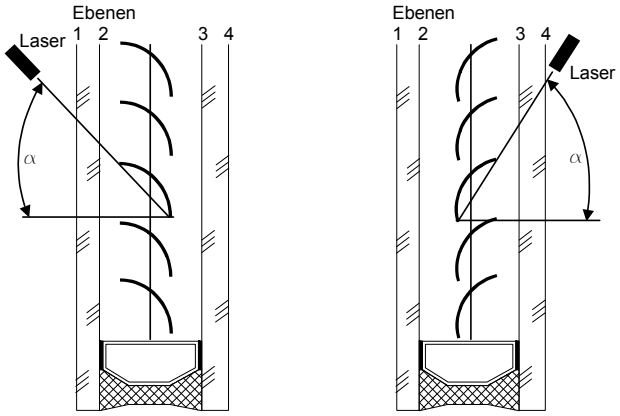

Image 7 Measurement of the slat angle

After completion of the durability test, the closing angle is checked at the same measuring points and must not exceed $\alpha \leq 10°$.

7.2.5 Reference speed of power-operated systems

The change of the reference speed after the durability test according to EN 13120 must meet the following condition:

$$\frac{T_1 - T_2}{T_1} \cdot 100 \leq 20\%$$

And there is:

T_1 Duration measured after five cycles at the beginning of the durability test, which is required for a complete retraction movement of the installation.

T_2 Duration measured after conclusion of the durability test, which is required for a complete retraction movement of the installation.

7.2.6 Operating forces

The operating forces for moving the installation are measured according to EN 13527. The operational force F_M is the force used to extend and retract, open and close the shutter/blind.

7.2.7 Elongation of installation and limit stop

The visible change of the final position from the new position after completion of the durability test of the fully retracted and extended installation must not exceed 1 % of the total length of the installation. The maximum change is limited to 20 mm (Image 8).

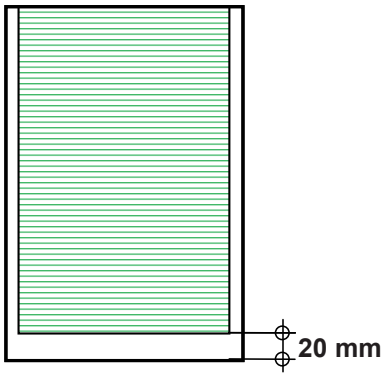

Image 8 Permissible elongation of curtain

7.2.8 Visual evaluation of exterior blinds

The evaluation criteria for the integrated installations are listed in Table 6.

Table 6 Summary of the optical evaluation criteria of the installation after loading

N°	Evaluation criterion	Evaluation
26	Discolouration of the slat ends due to abrasion	as per table 7
27	Abrasion marks in cavity	Permitted conditionally as per table 7
28	Pollution in the cavity: e.g. butyl on the slats	Permitted conditionally as per table 7

Contact with the slat ends during the movement cycles causes pollution of the slat ends. In order to evaluate the pollution of the slat ends, a scheme is introduced to assess the degree of pollution in conjunction with the contrast between slat colour and pollution. The evaluation is carried out if at least 10 % of the number of slats are polluted. The slat with the deepest and with the most severe pollution is evaluated. Both slats must meet the requirements.

The classification of the degree of pollution is given in Table 7. The maximum degree is measured. The slat colour and the colour of the pollution are assessed according to Table 8 by comparing the colour of the slat or contamination with the grey scale. If the assignment between two shades of grey is not clearly possible, the lighter shade of grey is used for the evaluation. The contrast between pollution and slat colour is determined according to the following relation.

Contrast = colour of pollution – colour of slats

Table 7 Depth t of pollution of slat ends

Example

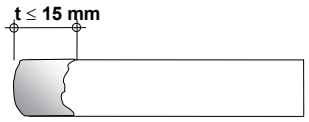
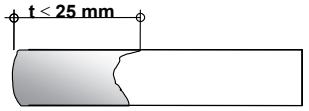
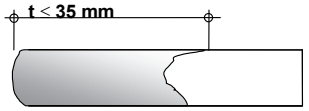

Table 8 Slat colour and contrast

Colour of slats Colour of pollution	
	0 – 20 %
	20 – 40 %
	40 – 60 %
	60 – 80 %
	80 – 100 %

The evaluation of the permissible pollution is carried out according to Table 9.

Example:

1. Check whether at least 10 % of the number of slat ends are discoloured
2. Determine the degree of discoloration according to Table 7
3. Determine the slat colour according to Table 8
4. Determine the colour of pollution according to Table 8
5. Determine the contrast between slat colour and pollution
6. Check whether the requirements for the permissible discolouration according to Table 9 are met

Table 9 Permissible discoloration of slats

Degree of discoloration	Contrast				
	0 – 20 %	> 20 – 40 %	> 40 – 60 %	> 60 – 80 %	> 80 – 100 %
t ≤ 5 mm	OK	OK	OK	OK	OK
t ≤ 15 mm	OK	OK	OK	OK	no
t ≤ 25 mm	OK	OK	OK	no	no
t ≤ 35 mm	OK	OK	no	no	no
> 35 mm	no	no	no	no	no

7.2.9 Evaluation of roller blind and pleated blinds

As described in BF leaflet 007/2010, sections 4.2, 4.4, 4.5, the evaluation is based on the following criteria:

Deviation from squareness
Deviations from squareness are assessed in the following positions
– upper final position (roller blind / pleated blind open)
– lower final position (roller blind / pleated blind closed)

Translucencies
– Direct translucencies (light transmission, without obstruction by the curtain, etc.) are not permitted
– Indirect translucencies (e.g. via reflections) are permissible

Rolling of free curtain edges
A free curtain edge is a cut edge which is not attached to any other component (bottom lath, winding tube, etc.). Rolling of free curtain edges is permitted if
– there are no direct translucencies when viewing at a rectangular viewing angle.
– the function of the blind is not impaired by this.

8 Extended field of application

A selection of the test specimen should be made from the point of view of the temperature to be expected in the cavity with almost horizontal radiation. Likewise, a maximum of UV percentages should strike through the outer pane in the cavity.

8.1 Influence of temperature and UV radiation

The results obtained from the tests described in Chapter 6 may be used if

- the temperatures during use are less than or equal to the tested version. the proof can be provided by means of a calculation according to DIN EN ISO 52022-3.
- the UV percentages during the test is equal to or higher than the expected percentages during use.

8.2 Glass thickness and pane configuration

The requirements under 8.1 apply to the use of double or triple insulating glass unit.

In addition, it is assumed that the glass design is carried out according to the specifications of DIN 18008-2 in individual cases. The rigidity of the single pane (maximum bulging in the center of the pane) must not be lower than during the test and must take into account the influences of the installation situation.

Notes:
With regard to the durability (prEN 1279-1: 2015, chapter 6.1) of the product, attention should also be paid to the dimensioning of the edge seal. The marginal load occurring during the climatic loads during the test according to Chapter 5 should not be exceeded (the marginal load occurring for the standard dimension 502 mm x 352 mm and the test setup 4/16/4 is approx. 1.0 N/cm of circumferential length).

8.3 Turning systems

The test results of systems with full function can be transferred to systems with the sub-function “turning and flipping only" for the same components that are necessary for this function as:

- Bearing blocks
- Shaft
- electric components and connectors
- Curtain, etc.

9 Reports

Individual reports

Individual test reports may be prepared for the following tests within the framework of the Directive:

1. Moisture penetration of edge seals	Chapter: 5.1
2. Gas tightness of insulating glass unit	Chapter: 5.2
3. Fogging	Chapter: 5.3
4. Test of mechanical durability of integrated installations	Chapter: 6

To Annex A Building-physical Characteristics:

1. Evidence regarding g value (required normative for IGU according to EN 1279)
2. Evidence regarding internal surface temperature (informative)
3. Evidence regarding thermal transmittance U_g (normative)
4. Evidence regarding airborne sound insulation (informative)

Literature

[1] ift-research report:
Integral evaluation of innovative building envelopes.
ift Rosenheim, July 2004

[2] Bavarian solar and wind atlas (Bayerischer Solar- und Windatlas).
Bavarian State Ministry for Economic Affairs, Transport and Technology

Annex A Building-physical Characteristics

A 1 Determination of g value

Two different methods are available for determining the g value:

- The calorimetric measuring method by solar simulation and
- The calculation procedure according to DIN EN ISO 52022-3.

Systems in which the g value changes at different radiation angles must be measured at radiation angles of 0 °, 30 ° and 60 °. Optionally, other radiation angles can also be measured.

If the g value additionally depends on the setting of slats or other devices, this must be taken into account during the measurement. Slat curtains are then measured with

- 0 ° radiation and closed slats
- 30 ° radiation at cut off position of the slats, tolerance +5 ° and
- 60 ° radiation and horizontally open slats

Optionally, further combinations of radiation angle and slat position can also be measured.

Systems which have no angle dependence of the g value on the radiation angle are measured at least at 0 ° radiation. Optionally, other radiation angles can also be measured.

A 1.1 Calorimetric measurement

The g value is determined according to the ift process instructions HV-WÄR 01 "Determination of the total solar energy transmittance of transparent and translucent components as well as sun protection devices by calorimetric measurement".

In the calorimetric test, the component to be tested is radiated with an artificial sun. The energy transmitted by the component is measured after the component with the aid of a liquid calorimeter in the stationary state. The ratios of the measured transmitted energy and the radiant flux to the component to be evaluated directly results in the total solar energy transmittance g. There is currently no standardized measurement method for this method.

A 1.1.1 Test specimen

The g-value is determined on a test specimen measuring 1.2 m x 1.2 m.

A 1.1.2 Result

As a result, the total solar energy transmittance g is given for the individual combinations of radiation angle and adjustment of the installation.

A 1.2 Calculation of g value according to DIN EN ISO 52022-3

The g value can be calculated according to DIN EN ISO 52022-3. The procedure is valid for all sun protection devices arranged in parallel to the glazing. The integrated installations can be transparent or opaque.

Necessary input parameters are the transmission and reflection data of the solar radiation for the single panes and the installation as well as the emissivities for the thermal radiation.

Reference conditions

external:

Air temperature	T_e	278 K (5 °C)
Radiation temperature	T_e	278 K (5 °C)
Convective heat transfer coefficient	$h_{c,e}$	18 W/(m² K)
Solar radiation intensity	E_S	300 W/m²

internal:

Air temperature	T_i	293 K (20 °C)
Radiation temperature	T_i	293 K (20 °C)
Convective heat transfer coefficient	$h_{c,i}$	3.6 W/(m² K)

A 1.2.1 Result

Table A1 Results of the calculation according to DIN EN ISO 52022-3

N° N°	Energy inwards through	Symbol
1	Solar direct transmittance	τ_e
2	Thermal radiation factor	g_{th}
3	Convection factor	g_c
4	Ventilation factor	g_v
5	Secondary heat transfer factor of inside	q_i
6	Total solar energy transmittance	g

A 2 Determination of room-side surface temperatures

The calorimetric measurement method and the calculation method following DIN EN ISO 52022-3 are available for determining the surface temperatures on the room side.

For both methods, adjustments must be made regarding the outside temperatures or external surface resistances in order to take a worst case-scenario into account. The methods are described below.

A 2.1 Calorimetric measurement

The room-side surface temperatures are determined following the ift process instructions HV-WÄR 01 "Determination of the total solar energy transmittance of transparent and translucent components as well as sun protection devices by calorimetric measurement". The test specimen is radiated with an artificial sun from metal halide lamps with a spectral distribution similar to the sun. In order to assess the worst case, the measurement is carried out under the following boundary conditions:

- Radiation intensity: approx. 900 ± 50 W/m²
- Temperature of outside section T_a = 35 °C
- Temperature of inside section T_a = 25 °C
- no forced convection on the outside of the test specimen
- Solar altitude angle 0 ° (perpendicular radiation)
- position of slats completely closed

The room-side surface temperatures are measured at three measuring points, at the centre of the pane and at a distance of 10 cm from the upper and lower outer edges of the visible

aperture surface. Optionally, further combinations of position of slats and radiation angle can be measured.

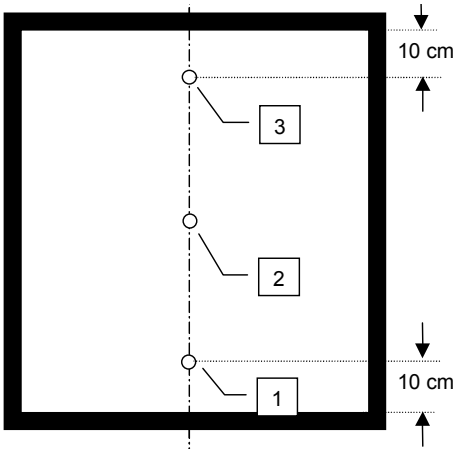

Image A 1 Position of thermocouples

A 2.1.1 Test specimen

The room-side surface temperatures are determined on a test specimen measuring 1.2 m x 1.2 m.

A 2.1.2 Result

The result is the average value of the surface temperatures at the achieved radiation intensity.

A 2.2 Surface temperatures according to DIN EN ISO 52022-3

The surface temperatures can be calculated as per the procedure according to DIN EN ISO 52022-3. The procedure is valid for all sun protection devices arranged in parallel to the glazing. The integrated installations can be transparent or opaque.

The summer conditions specified in the standard are used as reference conditions. In order to calculate the worst case-scenario, the external air and radiation temperature is increased to 35 °C.

Reference conditions

external:

Air temperature	T_e	35 °C
Radiation temperature	$T_{r,e}$	35 °C
Convective heat transfer coefficient	$h_{c,e}$	8 W/(m² K)
Solar radiation intensity	E_S	850 W/m²

internal:

Air temperature	T_i	25 °C
Radiation temperature	T_i	25 °C
Convective heat transfer coefficient	$h_{c,i}$	2.5 W/(m² K)

A 3 Thermal transmittance U_g

The following basics are available for determining the thermal transmittance U_g :

- EN 673
- EN 674
- EN 675

For the different systems, the determination is as follows:

a) Installation with turnable slats:

The U_g value is determined in the horizontally open state according to EN 674 or EN 675.

b) Installation that can be moved up and down:

In the upper condition according to EN 673 or EN 674 or EN 675.

Further settings can be measured optionally.

A 4 Measurement of airborne sound insulation

Determination of assessed airborne sound insulation $R_w\ (C,C_{tr})$ (dB):

The measurement is carried out according to EN 10140-2. The installation is measured in upper condition and in lowered condition with the slats closed.

ift Rosenheim
Theodor-Gietl-Straße 7-9
83026 Rosenheim
Germany

Phone: +49 (0) 80 31 / 261-0
Fax: +49 (0) 80 31 / 261-290
E-mail: info@ift-rosenheim.de
www.ift-rosenheim.de