Centre of Excellence
Seeing is believing

Special show at „fensterbau frontale india“
26. – 28. February, Bangalore
**Centre of excellence – Seeing is believing**

Understanding Quality as benefit

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Current market-research and consumer studies clearly show that many consumers do not base their purchase decision solely on price but also on quality features and safety aspects; the longer the life of a product the more important these factors become, especially for buildings which should last 30 years or more. To produce a proper quality is reasonable for many reasons, such as save the investment, improve comfort and safety, secure the investment, avoid maintenance cost and protect the environment by saving resources.

But what exactly is quality? One simple explanation would be: "When the customer is satisfied." In other words, when the customer gets what he expected to get. However, successful companies do not settle for this. Instead they want to wake the enthusiasm of their customers and get these to recommend their products to other customers. However, this high standard of quality is only obtainable through a deep knowledge and consistent implementation of effective quality strategies and quality assurance systems. But how can quality be defined, monitored and assured without costs getting out of hand? The entire cycle, from the harmonized product standard to the end user, must certainly be understood as a quality chain linking manufacturer, specialist suppliers to the construction trade, and installers. Furthermore, this cycle must also be mastered as such.

### 1 Product standards as first step

The basic principle underlying product standards in the window, facade, pedestrian and industrial door industry is the uniform description of the performance characteristics and the classification of various performance levels, which each client can select according his personal demand or climatic and cultural requirements. The product standards are not design standards for specific construction components, but form the basis for the definition of customer requirements and the framework for the quality chain of manufacturers and specialist suppliers. Since these rules are organized according to the "Performance Principle”, the characteristics of the products will become more transparent. The customer has the option of comparing the performance characteristics of the products directly with each other. The evaluation principles are uniform. As a result, characteristics based on different standards no longer lead to an unequal treatment and wrong assessment of the products.
The requirements and performance characteristics of windows, glass or doors are identical or similar depending on the field of application. This explains why products that differ largely in design principle, accessories and hardware or fittings are grouped into one single product standard. A product standard should provide the framework for the scope of requirements of construction components, which the client/contracting authorities have to define jointly with the designer. Ideally, the information should be prepared in such a way that the customer understands the performance potential of the respective product and can invite tenders correctly. Therefore, this quality chain is focused not only on the manufacturer, but also on the entire value added chain; from architects and specialist suppliers to manufacturers, installers and end customers.

### 2 Recommendations for tenders

The frequently occurring “phenomenon” of warped doors and windows is a typical example of what is known as “wrong user behaviour.” In actual fact, however, the phenomenon is due to a lack of knowledge regarding the area of application. To define the appropriate product, the user behaviour has to be clarified in the design phase and in the invitation to tender.

Product standards are a clear improvement, as they are performance oriented and no describe structural characteristics. The criteria the construction components have to meet are oriented to the area of application; for example, the installation height, wind and climatic load zones, site categories, location in the property, use, security etc. Exact knowledge of the intended use is necessary for the effective definition of the product quality – the first condition for ensuring the quality of the product.

The requirements for fulfilling this condition are more exacting for designers in their capacity as representatives of the client, for the specialist suppliers as well as for the manufacturer. The selection of the product characteristics could be supported with application notes of the product standards or the application recommendations such as ift Rosenheim guidelines. And it is here in particular that the product manufacturers have to supply information to architects, designers and specialist suppliers.

It is often the case that not even the actual product is defined clearly in the invitation to tender. For example, PVC windows are often ordered by the buyer from specialist suppliers as "White doors with insulated glass in various dimensions. What does the customer actually want? What does the specialist supplier understand this to mean? Which product window manufacturer delivers to the specialist supplier? Sure, the window in question is a white window in various dimensions. However, the term “white PVC door” is very wide and can cover anything from a window without steel enforcement to a window with special hardware, acoustic glass etc. It is unclear what design the frame should have and whether the glass is a simple one or the hardware is a safety kit – disputes are bound to arise in such circumstances.

**Fig. 2 Characteristics of the European window standard**
3 Customer requirements beyond standards

However, the question often is not only about what the customer wants, but what the customer will accept. In this respect the directives and standards describe only minimum requirements for the quality and workmanship of a product. With windows, the window gap often gives rise to complaints, caused by poor acoustic or comfort performance. Owing to the current requirements for windows there shouldn’t any gap. Within the quality chain, the designer, architect or party advising on the project have to come up with the "correct quality" for the respective customer. In clarifying what it is that the customer desires and requires, manufacturers and specialist suppliers can elaborate additional benefits and value added, which can be used to motivate the customer to invest more than planned.

Fig. 3  Windows has to fulfil several requirements and each part has a special meaning

Fig. 4  Burj Al Arab in Dubai is a worldwide known symbol for high customer demands
4 Test and certifications as reliable quality mark

With the introduction of product or certification standards, the responsibility for supplying evidence of performance of products and characteristics often lies solely with the manufacturer. Depending on the requirements placed on the construction products, tests, evidence of performance and audits of the factory production control have to be conducted by an experienced and competent testing and inspection body. Most product standards require that at least the initial type test be conducted by a notified test body.

Many manufacturers do not restrict themselves to their own manufacturer declaration alone, but also have the characteristics confirmed and verified by a neutral and competent test body. ift Rosenheim determines all characteristics of windows, facades, doors and gates since 50 years and summarizes these clearly in an ift product passport. This also includes regular monitoring within the scope of the product certification, which ift Rosenheim has developed for the different construction components. The certification by ift Rosenheim is highly esteemed and worldwide accepted by consumers, technicians and specialist suppliers. In instances where third-party control is no longer required, an ift certification is therefore regarded as a recognised evidence of compliance with standards and assured quality. Voluntary quality assurance by ift Rosenheim offers manufacturers, designers and clients the following benefits:

- Authorised characteristics of a neutral and internationally recognised test body and confirmation through an ift conformity certificate or ift product passport
- Avoidance of multiple tests and consideration of evidence provided by suppliers to reduce the costs for the initial type test.
- Evidence that is recognised and covered by construction law and that is widely accepted by designers, architects and building authorities
- The frequently required substitution of components – gaskets or fittings, for example – is technically assessed by a neutral body and confirmed according to building law
- The products of the manufacturer that are certified by ift are made centrally available to designers, architects and other construction related parties on the ift Web site
- The industry- and product competence of the ift auditors enables feasible solutions and an efficient combination of product and company audits

Fig. 5 ift Rosenheim could do all test for windows, curtain walls, glass and building materials and has 50 years competence in analysing quality and performance of building products
5 Centre of Excellence

Everybody in the world trust mainly what they see and experience first-hand. The special show "Centre od Excellence - Seeing is believing" will show how small glitches will affect the product quality of the whole window, for example poor screws to fix the hardware or weak steel profile to reinforce PVC windows.

Furthermore experts and decision makers will be informed about how to manage, produce and install a proper and acceptable quality product. A live presentation on an ift test rig will demonstrate factors which influence the product quality of windows such as construction principals, frames, glass, sealing, fixings and screws, hardware etc.

The participants such as producers and suppliers of windows, doors and facades, glass and related materials (profiles, glass, fixing material, hardware etc.), system houses, management of installation companies, general constructors, designers and architects and investors and operators of buildings could see the a life testing of a window sample with typical failures and the consequence to product quality and durability. Beside that the meaning and importance of test reports for several characteristics such as sound, safety of wind and water tightness will be explained. This will be supplemented by an elucidation of ways and means of establishing quality and surveillance systems and using suitable test equipment for quality management systems.

Fig. 6 Life presentations of window testing at fensterbau/frontale 2014 in Nurembourg
6. Visualisation of typical glitches and suitable test procedures to avoid this

**Window parts are working like a winning team**

Frame = Stability + Design  
Hardware = Function, Movement  
Handle = Function, Locking + Design  
Corner = Stability  
Sealing profiles = Tightness  

Plus many other invisible parts!

**Curtain walls - wrong dimensioning of glass**

**Typical problems with window constructions**

- Bent sashes  
- Leakage  
- Dented profiles  
- Installing fittings  
- Sagging sashes  
- Malfunctions  

**Poor processing of welded gasket**

**Wrong dimensioning of screw connection**

**Weakness through notching effect of metal composite profiles**
Open joints at ends of drainage system

Profile deformation as a result of glass load

Problem:
- Increased glass loads require stiffer profiles
- Profile deformations jeopardize the functionality of the window

Finding of leakages – Dish soap test

Rules for positions of glazing blocks

- Load bearing blocks transfer the weight of the glazing to the frame construction
- Spacer blocks ensure the distance between glass edge and rebate and ensures pressure-free installation

Analyzing of the air permeability on site

Mechanical strength of bearing points

Smoke testing at lift-sliding doors

Tensile and shear forces at the pivot point
Breakage of corner pivot

Sound insulation of windows
- Single window
- Coupled window
- Box-type window

Area of leaking windows
- Single window
- Coupled window
- Box-type window

Rated sound insulating capacity $R_w$

Repeated opening + closing according EN 1191

Classification for doors/windows
- Class 1: 5000 cycles
- Class 2: 10,000 cycles
- Class 3: 20,000 cycles
- Class 4: 30,000 cycles

Failure criteria:
- Damage, deformation, operation failure
- Classification of windows in class 2 (equivalent to 10,000 cycles)

Testing in the laboratory and on site

The testing of sound insulation of windows is performed with the two-room method.

Reduction by installation joints

Quality by training – From the bottom to the top

Skilled workers
- Masters
- Technicians
- Professionals
7. Simple surveillance system for product quality of UPVC windows
Verification of max. permissible casement/sash weights and sizes for hardware test
Testing body selects reference test specimens from system description on basis of following information:
1. max. permissible casement/sash weight
2. max. permissible casement/sash dimensions
3. Moment of inertia I₁ and I₂ of non-reinforced casement/sash profile
4. Regulations for reinforcement
For alternative designs with sealed and non-sealed glazed systems, data must be given for each profile for both designs. If testing of the window selected as per EN 1194 is positive, the permissible casement/sash weights and sizes in the system description are approved.

Fixing of load-bearing hardware components
Requirement:
- max. casement/sash mass for hardware fixing compared to actual casement mass
- e.g. 80 kg
- e.g. 55 kg

Water Leak test of corner joints
Requirement
- Water enters into cavities whose design does not allow it to drainage off externally, or where it could result in damage (e.g. corrosion in the reinforcement cavity).
Objective
- Ascertain whether:
  - Web bars are weld-tight
  - Bars have been broken or cracked during cutting
  - The corner weld is damaged due to climatic or wind loads
Water that has penetrated into the system should be drained off in a controlled way via the front cavity. Null stops are not welded together or have been cracked or broken during cutting, water can freely enter. e.g. the reinforcement cavity, where it can lead to rust formation. There is also the risk that water will remain in cavities, freeze in the winter, and cause the profile to warp.

Implementation of the test
Filling height of the cavities that carry water. The cavities of the horizontal bar which carry water are sealed with a plastic sealant. The cavities which carry water are filled with 10 cm water (around ~1000 Pa)

Testing of durability
Limitation of deflection 1/30 of window height

ift Rosenheim
Research, Verification, Certification, Training
Services:
- Standardization & guidelines
- Technical hot line
- Publication and literature
- ISO-9001, test centre, certification
Training:
- Seminars, workshops, in-house trainings
- Competencies

All services from a single source!
8. References for surveillance, quality and production control systems

Purpose of factory production control (FPC)

Aims
1. Guaranty for production of declared performance classes
2. Production according technical specification
3. Documentation of necessary controlling procedures
4. Identification and avoiding of trading of non-conformed products and components

Control of the pressing process and edge seal

Pressing:
- Positioning of the glass spacer on the glass panel
- Total thickness of the insulated glass unit (IGU) after pressing
- Position of the glass panels after pressing (displacement of panels)
- Width and size of the butyl after pressing

Edge seal:
- Air pockets between primary and secondary sealing and at the corner of the edge seal
- Dimension and Design of the concave fillet at the outer side

Installation of factory production control (FPC) and analyzing of production process

The analyst has to focus all relevant aspects of the production process including also the installation of building elements

Testing of composite profiles - transverse tensile strength

Main profiles of curtain walls (CfW): \( Q_{\text{m}} \geq 20 \text{ N/mm} \)
Window profiles Fensterprofile (W): \( Q_{\text{eq}} \geq 12 \text{ N/mm} \)
Testing bei low and high temperature (-10°-20°C - 70°C - 80°C)

Testing procedures of incoming material and manufactured products (sample IGU)

The production control offers the possibility to get information concerning the production quality of glass, such as
- delta-T test for desiccant
- Shore A testing
- Adhesion of butyl (profiles and glass)
- Mixture ratio of 2-component material (A-B)
- Control of random samples in various production stages (intermediate and final checking)
- Strict documentation of values as a function of machinery, stuff and general production conditions

Control of incoming material (sample hardware production)

- Analyzing of importance of material to the quality to the final product (steel coils, screws, hulls, riveted bolts etc.)
- Exact definition of material quality by agreement with supplier
- Production certificates according EN 10204
- Controlling of dimensions (Skip/Lot-procedure)
- Mobile spectrometer
- External testing by neutral institutes
### Requirement in accordance with DIN EN 14351-1

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>4.1 General</strong></td>
<td>Preliminary remarks</td>
</tr>
<tr>
<td><strong>4.2 Resistance to wind load</strong></td>
<td>The wind resistance is tested in accordance with EN 12211 and classified according to EN 12210. The classification necessary for a special construction project can be obtained from the ift recommendations for use. There is a simple online tool for this purpose, with which the required class can be determined by entering the post code and the building height. <a href="http://www.ift-einsatzempfehlungen.de">www.ift-einsatzempfehlungen.de</a></td>
</tr>
<tr>
<td><strong>4.3 Resistance to snow and permanent load</strong></td>
<td>The manufacturer must provide adequate information on the infill (filling / glass) of window elements in the roof, so that the load-bearing capacity of the infill (filling) can be determined, e.g. information about the glass thickness and type. NOTE: Permanent loads, for example, dead loads generally occur in the case of tilted glazing. In particular, skylight or roof windows need to be mentioned here. Notes on specifying the permissible tilt of vertically installed building components are given in Chapter 1.1 of the technical rules for glazing with linear support of the DIBt. mandated characteristic for skylight windows</td>
</tr>
<tr>
<td><strong>4.4 Fire characteristics</strong></td>
<td>The term &quot;fire characteristics&quot; refers to the fire behaviour and the protection against fire from outside in the context of DIN EN 14351-1. A special regulation for windows (external doors can be included here) can be derived from the Model Building Code (MBO, Musterbauordnung). Thus, combustible building materials used to a low extent in windows and doors are permissible. One of the significant requirements in Germany related to the reaction to fire is the regulation that building materials of at least normal flammability must be used. This yields the requirement in Germany for building supervisory approval that specifications on fire behaviour for the building materials used must also be drawn up. In DIN EN 14351-1, information on fire behaviour is demanded only for skylight windows.</td>
</tr>
<tr>
<td><strong>4.5 Watertightness</strong></td>
<td>The resistance to heavy rain (watertightness) is one of the important basic characteristics of windows and external doors. Nonetheless, there are no requirements that are anchored in German Building Law (Model Building Code, MBO, Musterbauordnung) which means that there are no requirements mandated by building law in Germany regarding watertightness. This is why it makes sense to have a special tender issued by designers and architects. During the test in accordance with DIN EN 1027 the test specimen is sprayed with water using nozzles and simultaneously also loaded with static pressure. The specimen is classified according to the pressure at which no water ingress has taken place. Watertightness is described with the classes 1A to maximum 9A. The higher the class, the greater is the tightness of windows and doors to penetrating rainwater on the room side (or in the construction). For external door constructions, you can achieve class 6A for direct external exposure, which is equivalent to a test pressure of 200 Pa. In doing so, however, more cumbersome or expensive construction-related measures are</td>
</tr>
</tbody>
</table>

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9. **Appendix: Description of characteristics according European product standard for windows and exterior doors EN 14351-1**
necessary. The requirements of resistance to heavy rain are omitted if the
external door construction is shielded against heavy rain by construction-
related measures such as air traps and canopies, arcades etc. There is a
simple online tool for this purpose, with which the required class can be de-
determined by entering the post code and the building height.
www.ift-einsatzempfehlungen.de

<table>
<thead>
<tr>
<th>4.6 Dangerous Substances</th>
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| Provided that the state of the art enables this, the manufacturer must specify
  the materials of the product, which with proper and intended use are subject
  to emissions or migrations and for which an emission or migration in the envi-
  ronment represents a possible hazard for hygiene, health or the environment.
  The manufacturer must prepare appropriate information for the constituents
  and submit the same in conformity with the legal requirements of the country
  of destination foreseen. In Germany at present, there are requirements only
  for the emission of formaldehyde and organic gases, which, for windows, is
  infinitesimally low and thus, unproblematic. This has just been confirmed by a
  research project undertaken at ift Rosenheim.
  For more information, please visit: www.ec.europa.eu or enquire with the re-
  spective Supreme Building Authority (Oberste Landesbaubehörde).

<table>
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<tr>
<th>4.7 Impact resistance</th>
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| The test for resistance to impacts simulates impact loads from customary use
  of windows or external doors. What is assessed primarily is the behaviour of
  the window construction, i.e. the fixing of the filling (glass) to the framed con-
  struction. The test is not used to evaluate the strength of the glazing, which is
  used as filling. The suitability of the filling, especially when using glazing
  (safety glazing and glass thickness), must be determined and verified taking
  the specific use into consideration. The test for impact strength is conducted
  in accordance with DIN EN 1349 with the dynamic load by the fall of a heavy
  impact body (dual tyre impactor). For this purpose, five heights have been
  specified for the fall. For this purpose, the test specimen is delivered by the
  manufacturer complete and in operationally ready condition in a suitable en-
  closing framework.

<table>
<thead>
<tr>
<th>4.8 Load-bearing capacity of safety devices</th>
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</table>
| Safety devices are elements that protect the user of windows and doors from
  risks that may arise from improper operation or use. For example, these may
  be rotary jars (security stays), door stops or opening restrictors. In general,
  opening restrictors are meant to absorb the loads resulting from static forces
  to restrict the angle of opening. They may be integrated in the door closer or
  installed in the form of additional devices in the window. Opening restrictors
  are deemed to be safety devices and must meet the loads in accordance with
  Section 4.8. The safety devices are subjected to stress with a single load of
  350 N in the most unfavourable direction of load over a loading time period of
  60 seconds. The load is applied at fixed points. In contrast to this, the load
  may also be introduced directly on the safety device in order to test the most
  unfavourable condition of stress, e.g. for the screw connections on the stay
  bearing.
### 4.9 Height and width of doorsets and French windows

The clear opening heights and widths must be specified for windows and doors in mm. The dimensions are specified as clear opening width $a$, and clear opening height $g$. Based on the construction-related conditions, the resulting clear passage width may get reduced by the previous fittings or opening restrictors. Since this cannot be taken into consideration while designing the product, this yields a task for planning that the architect must take into account while designing the passage width of doors in accordance with DIN EN 14351-1. This is particularly important if, according to the plan, objects with known dimensions must be moved through a door, for example, "pushing through" hospital beds or mobility with a wheelchair. This is why in Germany, even additional normative specifications for the clear width of doors must be kept in mind. In the standards for barrier-free building and living, at least 90 cm width or at least 80 cm is demanded for residences or residential premises suitable for wheelchair users. Interior doors in official buildings must always have a passage width of at least 90 cm.

### 4.10 Ability to release

Apart from the issue of selecting suitable building hardware, e.g. emergency exit devices conforming to EN 179 or panic locks conforming to DIN EN 1125, what is decisive to ensure the safety of an emergency exit is the selection of suitable fittings such as the door hinges. Thus, it must be ensured that doors designated in accordance with this section that can be cleared and hence, used in emergency exits and escape routes, are fitted with hinges that bear the CE mark and have been cleared for this application in accordance with EN 1935.

### 4.11 Acoustic performance

The sound insulation of a window is declared with the parameter $R_w(C;C_t)$ in dB. In the process, according to the planning, requirements on the parameters $R_w$ and/or $R_w+C$ and/or $R_w(C;C_t)$ can be specified. $R_w$ is the evaluated sound insulation measure; $C$ and $C_t$ are spectrum adjustment values for "normal" and for traffic noise. The required parameter and the individual value necessary must be specified by the planning. DIN 4109 is the critical document for sound insulation in building construction in Germany. According to it, a calculated value $R_{w,R}$ is specified, which is calculated as follows: $R_{w,R} = R_w - 2$ dB. The planning is done depending on the use (e.g. office building or residential building) and the critical outdoor noise level. This can be calculated, obtained from noise cards or it can be prescribed by law (Aircraft Noise Protection) and must be obtained.
### 4.12 Thermal transmittance

The UW value is the heat transfer coefficient in W/(m² K) and describes the transmission heat losses by the entire component, window. The UW value can be determined by measurement, calculation or using the tabular method. The requirements of heat insulation are described in the EnEV (Energy Conservation Regulations) or in DIN 4108-2 (Minimum requirements to thermal insulation). Apart from specifying the heat transfer coefficient of the entire window, it is also possible to describe the individual values of the heat transfer coefficient for the framed profile(s) (U_f), glass (U_g), panel(s) (U_p) and the glass and panel boundaries (Ψ). The minimum requirements in the EnEV and DIN 4108-2 must be taken into account. Side components or top lights must be described separately, if required, with UW-, U_g oder U_f-, U_p values. The ift energy label can be used to make a simple estimate.

### 4.13 Radiation properties

For windows and glazed doors, the light transmittance τ_v and the total energy transmit-tance g must be specified. In doing so, the impact of the frame is not considered. The specifications of light transmittance and of the total energy transmit-tance are product para-meters of the glass. These parameters may be changed by means of coatings. The heat-related and radiation-related properties of glass and its coatings are not independent of one another. Improving the U value generally leads to reduction in the light transmittance and the g value. You need to pay attention to this with the combination of the requirements of thermal protection.

### 4.14 Air permeability

With the specifications on air tightness of windows in the course of the CE mark, it is possible to determine the ventilation heat losses of buildings in the course of the thermal verification. For evaluating the actual tightness of the window under extreme conditions of stress or for evaluating additional criteria of comfort (e.g. appearance of draught over the rebates of windows), the less favourable values specified in the test report must be considered. Local leaks are not assessed separately according to the test standard. The air permea-bility must be tested according to EN 1026 and classified in accordance with EN 12207. In the process, the classification pertains to both the length of the joint as well as the entire surface area. Air permeability of class 1 is not permissible in the context of the Energy Conservation Regulations (EnEV). There is a simple online tool for this purpose, with which the required class can be determined by entering the post code and the building height. www.ift-einsatzempfehlungen.de
4.15 Durability

The durability is generally demanded for a product depending on the performance characteristics and it should have an economically meaningful life span. This means that the manufacturer must take the subject of durability into account both when selecting the components and raw materials as well as with the documentation. The requirements, however, have been formulated relatively generally. The durability of materials, building materials and components is described in a number of material-specific standards, which deal, for example, with the selection of wood types, surface treatment, the PVC quality or the metal composition. Apart from the standards describing the materials, the quality provisions of the RAL Quality Associations and ift Rosenheim provide a good overview of qualitative requirements as an approved certification body. Apart from functional criteria, the RAL quality provisions also deal with aspects of quality and suitability of use: The sealing profiles have a special significance for the durability of windows and doors, and they have a significant impact on important properties such as being heat-proof and sound-proof, wind tightness, watertightness and smoke leakage, and hence, they must be permanently elastic and replaceable. This is why the manufacturer must furnish information on maintenance and replaceability in the product description.

4.16 Operating forces

Hand-operated windows and external doors must be operated, in accordance with their purpose of use, even by children, older or handicapped people without any other problems, i.e. it must be possible to open and close them. This is why the operating forces or the torques that occur must be ensured permanently with the help of suitable measures. These include resistant fittings having a long life span, construction-related measures and comprehensible instructions on maintenance and care. On the one hand, operating force means the forces and torques needed to open and close windows and doors, and, on the other hand, the torque needed to lock and close the elements by operating the locking device (lock). This may be the rotary knob for doors, the latch with hand operation or the "key head" (grip of the key) in case of finger operation. In the course of the requirements for barrier-free construction, the operating force of windows and doors will have greater significance in future. Moreover, it must be noted that with the test methods described, no external influences such as pressure differences between two rooms or applied wind loads such as installed door closing devices are taken into consideration. (A practical case is entry to the underground garage). In practice, these influences often lead to considerably greater forces for opening and closing. In addition, deformations of the door frames or window sashes on account of thermal or hygroscopic loads lead to greater impact on the operating forces.

Classification of operating forces for windows

<table>
<thead>
<tr>
<th>Prüfung</th>
<th>Widerstand gegen Bodenkräfte</th>
<th>Klasse 0</th>
<th>Klasse 1</th>
<th>Klasse 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Schiebe- oder Flügelfenster</td>
<td>–</td>
<td>100 N</td>
<td>30 N</td>
<td></td>
</tr>
<tr>
<td>b) Beschläge</td>
<td>–</td>
<td>100 N oder 12 Nm</td>
<td>30 N oder 3 Nm</td>
<td></td>
</tr>
<tr>
<td>1) Hebelgriff (handbetätigt)</td>
<td>–</td>
<td>50 N oder 5 Nm</td>
<td>20 N oder 2 Nm</td>
<td></td>
</tr>
<tr>
<td>2) Fingerbetätigt</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td></td>
</tr>
</tbody>
</table>
4.17 Mechanical strength

The mechanical strength is formed by the vertical load and the static torsion. The test for mechanical strength in accordance with DIN EN 14608 "Windows – Determination of the resistance to racking" and DIN EN 14609 "Windows – Determination of the resistance to static torsion" must test the commonly expected misuse by the user in the course of use.

This includes the effects such as unintended stress on the window casement at the sash level, as it may happen, for example, by holding it tight during cleaning. Even torsional loads caused by window casements getting stuck, jammed or blocked are taken into account. The stresses resulting from improper use are simulated under specific boundary conditions by equivalent static loads that are applied to the windows or doors. The windows are then classified according to DIN EN 13115 "Windows – Classification of mechanical properties – Racking, torsion and operating forces". The use of these classes depends on the area of application. In Germany, the RAL Quality Association for windows and front doors recommends operating forces on windows according to class 1, resistance to loads at the casement level (racking) according to class 3 and bending or twisting (torsion) according to class 3.

Classification for vertical loads and static torsion

<table>
<thead>
<tr>
<th>Prüfung</th>
<th>Widerstandsfähigkeit gegen</th>
<th>Klasse 0</th>
<th>Klasse 1</th>
<th>Klasse 2</th>
<th>Klasse 3</th>
<th>Klasse 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Vertikallast</td>
<td>–</td>
<td>200 N</td>
<td>400 N</td>
<td>600 N</td>
<td>800 N</td>
<td></td>
</tr>
<tr>
<td>2 Statische Verwendung</td>
<td>–</td>
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<td>250 N</td>
<td>300 N</td>
<td>350 N</td>
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</table>
4.18 Ventilation

The design of ventilation of residential buildings takes place according to DIN 1946-6:2009 in Germany. From the perspective of the window builder, repair / modernisation of an existing building in accordance with the specifications of DIN 1946-6:2009 relevant if more than one third of the windows are replaced. Accordingly, the window manufacturer is obliged to inform the builder that replacing the windows is relevant from the ventilation point of view and that the builder must check if measures pertaining to ventilation are necessary for the existing building. As a decision-making aid to determine whether or not the design or implementation of ventilation-related measure (LTM, Lüftungstechnische Maßnahme) is necessary, ift Rosenheim has formulated the ift Guideline LU-02/1 "Ventilation systems for windows – Part 2: Recommendations for use". This contains a simplified method of reading off a diagram that enables the necessary air flow rate to be determined without detailed calculations for ventilation to protect against humidity and thus, to determine the requirement for the window fan. In addition, you can download a calculation program from the ift website, which enables detailed calculation of the air flow rates that are necessary for free ventilation. Apart from purely ventilation-related aspects, the ift Guideline LU-02/1 also contains information and instructions for: The necessity of measures pertaining to ventilation, airborne sound insulation, self-noise level, necessity of overflow openings, and ventilation of dwellings with windowless rooms.

4.19 Bullet resistance

Bullet resistance on windows, doors and shutters, and the classification of the elements takes place according to DIN EN standards. The selection of the test specimen size for determining the inhibition to penetration by shooting is done according to the area of application and must be coordinated in advance with a notified test body. The shooting conditions such as test distance, shooting speed, type of weapon and munitions are specified depending on the class that you would like to strive for.

4.20 Explosion resistance

The properties pertaining to inhibition of bombing action on windows and doors is done in accordance with DIN EN 13124-1. After the test with the impact pipe, the classification of the results and the properties related to inhibition of bombardment on windows and external doors is also specified by testing in open-air conditions.
4.21 Resistance to repeated opening and closing

The testing and durability is an important verification for the quality and long life span of windows and external doors, which, however, is not prescribed by law. The test is conducted by turning, tilting, opening and closing the complete window with all its assemblies such as e.g. frame, sash, infills, gaskets, fittings etc. The classifications obtained in the initial type tests are valid only for the selected configuration. Provided that there are deviations to this subsequently, the equivalence of the assembly chosen must be verified for itself and in interaction with the entire product. In general, the tests are conducted on test specimens with maximum dimensions and maximum weights. This procedure is repeated in accordance with the number of cycles specified or until failure. The associated classification standard is DIN EN 12400 "Windows and pedestrian doors – Mechanical durability – Requirements and classification". To ensure adequate product quality over a reasonable time period of use, the RAL Quality Association for windows and front doors (Gütegemeinschaft Fenster und Haustüren e.V.) recommends 10,000 cycles for windows and 100,000 cycles for front doors.

<table>
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<table>
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4.22 Behaviour between different climates

Windows and external doors are exposed to differential climate stresses as a result of their intended and proper use, i.e. different climatic conditions prevail on the outside and inside of the building component. These varying climates affect the property of the building component by the longitudinal expansion of the materials as a result of the impact of moisture and temperature as well as with wood on account of the impact of different wood dampness. Moreover, as a result of the higher component temperatures, moisture may get discharged in the form of increased quantities of water vapour or in liquid form. In the process, the moisture does not get discharged only at the surfaces, but, as a result of diffusion processes, it may also occur in the construction itself, generally at the boundary surfaces between different materials, for example, at the dividing layers of metals or on films. The test method should indicate any impairment of the functions caused by moisture or deformations. Depending on the construction variant, different test methods are applied, i.e. different climatic conditions, test procedures and load cycles are selected.
### 4.23 Burglar resistance

In general, the entire safety chain must be flawless as far as the design of burglar resistant windows is concerned. In other words, beginning with the wall connection to the material and the rebate area, an appropriate selection of fittings and their installation on the glazing used, every detail must meet the requirements of burglar resistance. A window is called burglar-resistant if mechanical resistance is offered to the burglar for a certain period of time. In order to take different types of burglars into consideration, ranging from the occasional thief to the experienced burglar, there are six resistance classes defined in DIN EN 1627.

### 4.24 Special requirements

The special requirements pertain to frameless glass doors and power-operated windows and electrical building components that are fixed on electrically operated windows. There are special requirements on the safety of use for the drive units and for fittings in this case.

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Centre of Excellence
Seeing is believing

Special show at „fensterbau frontale india”
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