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Power operated Windows

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Content

1 Introduction

Increasing window automation

Today's building technology relies more and more heavily on power-operated equipment such as power-operated windows.
Power operation allows

a) windows to be integrated in complicated building control system processes (power efficiency, heating, ventilation,...) and to control them as needed;
b) large and heavy casements to be opened and closed even if exposed to, e.g. heavy wind;
c) a much higher ease of use;
d) window use by persons in particular need of protection.

Objective: safe operation

Power operation causes a higher risk of potential hazards which need to be eliminated by appropriate precautions. This Guidance Sheet provides a code of practice with approaches to technical solutions and information on how to use power-operated windows, aiming to help making window operation safe without major risks.

2 Scope

This Guidance Sheet applies to the planning, construction, installation, commissioning and use of power-operated windows by professionals in commercial, public and private applications. It includes retrofitting windows with power drives. This Guidance Sheet does not apply to installation of drives by the final user.

3 Terminology

- Component for closing and opening in a wall or roof intended for letting in light or for ventilation and sometimes to provide an occasional passage (e.g. door height window, lifting sliding sash,…). The casement (driven part) is moved by drives.

Power-operated window
Power-operated door height window

- The casement is moved by human effort alone.

Manually operated

- Device for moving power-operated windows by means of energy fed to them (e.g. electric, pneumatic or hydraulic energy) including the fittings needed to transfer the required force. **Drives**
- A product which is almost machinery but which cannot in itself perform a power-operated function. Examples of partly completed machinery include drive systems or windows with a drive but no control unit. **Partly completed machinery**
- A power-operated product able to function as installed or the product as an assembly ready to be installed and able to function as it stands only if mounted on a means of transport, or installed in a building. A window fitted with a drive and control unit qualifies as a part of completed machinery. **(Completed) Machinery**
- Any natural or legal person who places the power-operated window on the market or who retrofits or makes major modifications to a product and places it on the market again (making the machinery or partly completed machinery available in der EU for the first time). **Manufacturer of the power-operated window**
- Any natural or legal person who assembles and installs the power-operated window on-site (locally) such that it is ready for operation and who commissions it (putting into service).
  An installer is considered as manufacturer of the power-operated window, if he modifies the product or assembles several products to make a new one. **Installer**
- A control system which needs to be operated continuously (such as a hold-to-run control device / pushbutton) in order to move the casement. **Dead man's control**

4 Fundamentals

4.1 Legal bases

EU Regulation and Directives

Planning, construction, installation, commissioning and use of power-operated windows are subject particularly to the following European regulations and the acts which adopt them into national law:

- EU Construction Products Regulation (EU CPR) (2011/305/EU)
- EU Machinery Directive (2006/42/EC)
- EU Low-Voltage Directive (LVD) (2014/35/EU)
- EU EMC Directive (2014/30/EU)

These legal bases with the related national acts stipulate final and general requirements of the performance characteristics in a building, how to avoid and control mechanical hazards, how to control electrical hazards, and how to avoid electromagnetic disturbances.

4.2 Standards and codes

General standards and codes

Substantiating the general requirements of the EU Regulations and Directives are usually defined by European Standards. Power-operated windows are covered by the scope of the product standard EN 14351-1. The safe operation of drives is subject to EN 60335-2-103 "Particular requirements for drives for gates, doors and windows". For definition of door height windows the Guidance Sheet does follow the EN 14351-1.

With regard to the safe operation of power-operated windows, the Machine Directive generally suggests an auxiliary reference to other codes and standards including but not limited to:

EN ISO 12100 Safety of machinery - Basic concepts, general principles for design - Part 1: Basic terminology, methodology, and Part 2: Technical principles

National Technical Rules may apply also, e.g. in Germany for Workplaces ASR A1.6 for windows substantiates the requirements of the German Workplace Ordinance which fully applies to workplaces.

Barrier-free construction may have to meet further requirements.

This Guidance Sheet KB.01 fills gaps in the standards and describes measures to be taken in order to assure the safe use of power-operated windows.

4.3 Responsibilities

The construction planner/architect and/or the procuring entity must define distinct requirements of power-operated windows with particular regard to the necessary protective measures. This process should be completed in close coordination with the client, the competent authorities (such as the building authority) and, in the case of commercial and public utilisation, the responsible accident insurer. The planner must clearly describe the interfaces between the trades involved. Unmistakeable details of transfer points and the requirements of the components are particularly important.	Construction planner/architect
The contractor manufacturing, installing and/or commissioning the power-operated window is also responsible for meeting the requirements of the request for proposal and for applying good engineering practices.	Contractor/manufacturer, installer of the window, installer of the machine
The client/operator/user must ensure that power-operated windows are operated and serviced in conformity with the user information for use/instruction handbook.	Client/operator/user

5 Liability

Everybody involved in the construction work must always provide the contractual services, which is to say that all (construction) services must be of the agreed performance and all generally recognized rules of technology must be applied, as appropriate. In order to avoid personal injury or material damage and the ensuring claims, it is essential to know the applicable regulations and good engineering practices and to comply with them when providing such agreed performance.	Comply with regulations and generally recognized rules of technology

6 Documentation

Apart from various legal documentation requirements (e.g. Machinery Directive Annex VII), the parties responsible for successful workmanship should generally keep records appropriately detailed to document their involvement in the work process (see Figure 1)

Responsible		Documents
Owner		• Usage specifications • Building permit • Authority constraints
Planner		• Usage concept • Risk assessment • Tender specifications of technical / structural requirements
Window manufacturer	without drive (not a machinery)	• Technical documentation to EU CPR (internal) • Window user information • Declaration of performance for windows to CPR and EN 14351-1 Annex ZA • CE marking of window (CPR)
	with drive (partly completed machinery)	• Technical documentation to EU CPR and Machinery Directive (internal) • Window user information • Declaration of performance for windows to CPR and EN 14351-1 Annex ZA • CE marking of window (CPR) • Declaration of incorporation of partly completed machinery, assembly instructions
	with drive and control unit (completed machinery)	• Technical documentation to EU CPR and Machinery Directive (internal) • Risk assessment for the intended use (internal) • Window user information and operating manual • Declaration of performance of power-operated windows to CPR and EN 14351-1 Annex ZA, ZB, ZC and ZD as well as to EN 12101-2, if the window classify as "natural smoke and heat exhaust ventilators" (NSHEV) covered by that standard. • CE marking of window to EU CPR and Machinery, EMC and LVD Directives
Drive manufacturer		• Product user information • Safety instructions • Declaration of incorporation of partly completed machinery, assembly instructions with reference to EN 60335-2-103 • Declaration of conformity and CE marking of the product (EMC and LVD)
Installer	Completion of window to make up a fully functional power-operated window; putting into service	• Electrical wiring diagram • Handover certificate • User information / operating manual • CE marking and declaration of conformity to Machinery Directive • Risk assessment for verifying compliance with the specifications (e.g. checklist)
	Putting power-operated window into service (completed machinery)	• Electrical wiring diagram • Handover certificate • Handover of manufacturer's documents (declaration of performance, CE marking of power-operated window, user information,…) • Risk assessment for verifying compliance with the specifications (e.g. checklist)
Operator		• Maintenance documentation

Figure 1: Plan of power-operated window documentation

7 Risk assessment

7.1 General

Safety assessment at the planning stage

It is necessary to carry out a risk assessment at the planning stage in order to identify both the hazards potentially caused by a power-operated window and the protective measures eligible to eliminate these hazards.

A risk assessment is a sequence of logical steps taken to investigate the hazards caused by the window.

Figure 2 illustrates the flow of risk assessment steps.

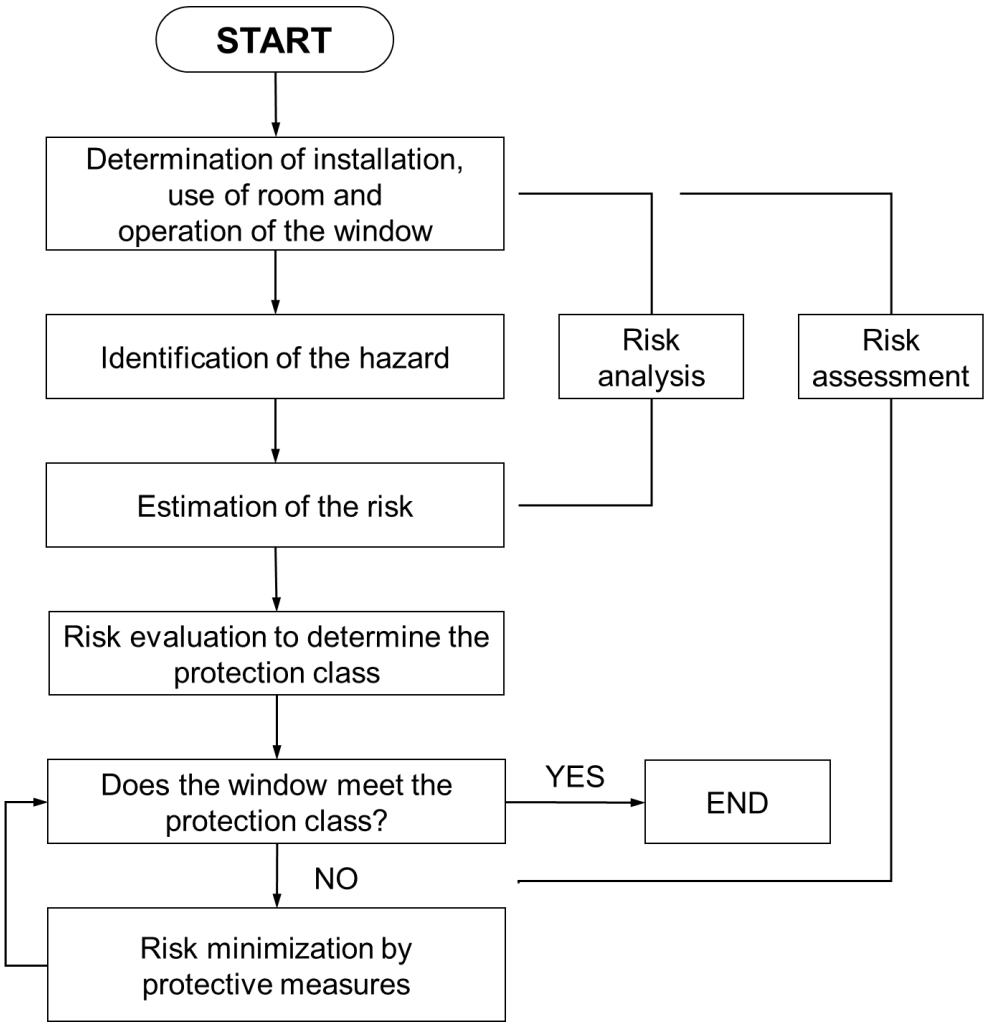

Figure 2: Risk assessment flow chart

The **risk analysis** provides the information required to evaluate the risk(s) and, in the next step, to take the risk analysis results to decide on the safety of the window.

The **risk assessment** is based on **balanced and calculated** decisions. It should be carried out so that both the path of the procedure and its results are comprehensible.

7.2 Hazard identification and risk estimation

7.2.1 General

The process should identify all hazards, hazardous situations and hazard events foreseeable due to the general factors of installation, the use and the actuation of the power-operated window.
A risk assessment is also required if drives to EN 60335-2-103 are used.
The following procedure has been tried and tested and shown to provide reliable risk assessments.

7.2.2 General factors of installation (position, accessibility)

Risk caused by situation of installation

The assessment must take account of where in the envelope of the building the window is installed. It must verify whether it takes any utilities to access the window.
The findings enable a risk evaluation as outlined in Table 1:

Table 1: Risk evaluation example with reference to the situation of installation

Situations of installation (examples)	Risk classification	Risk parameter
a) Bottom edge of casement installed at least 2.5 m above the floor or a firm access level b) Fixed installations in front of the window which prevent free access to the window c) Window sills or reveals preventing free user access to the window d) Window classified as "natural smoke and heat exhaust ventilator" (NSHEV) according to EN 12101-2 not used for ventilation	**Low risk**	**E1**
Unrestricted access to casement whose bottom edge is installed less than 2.5 m above the floor or a firm access level	**Higher risk**	**E2**

7.2.3 Use of room

Risk caused by type of use

The risk estimation must take account of what the room is used for. It should look at whether potential users can handle the product at any time. Factors to be assessed include

- whether this user is always the same user and familiar with the equipment
- whether the user is not familiar with the equipment
- which group of persons does the user belong to (e.g. persons in need of protection)
- every reasonably foreseeable misuse

A risk classification may be based on Table 2.

Table 2: Risk classification with reference to how a room is used

Use of room	Risk classification	Risk parameter
a) Commercial use by known users briefed on technological issues (e.g. offices, industrial use)	**Low risk**	**N1**
b) Private use by users briefed on technological issues **c) Rooms**, whose users/visitors are able to assess the hazards or are under supervision of persons who are briefed on technological issues	**Medium risk**	**N2**
d) Publicly accessible Rooms intended for regular use by persons who are not briefed on safe utilisation, but can assess hazards or are under supervision of persons able to assess hazards (e.g. shops, assembly points, restaurants, ...)	**High risk**	**N3**
e) Rooms intended for regular use by persons in need of protection (e.g. nursery schools, schools, hospitals, care facilities, ...)	**Very high risk**	**N4**

7.2.4 Operation

The risk estimation varies with the method of opening and closing the window. Table 3 summarises and grades the following risks:

Risk caused by operation

Table 3: Risk classification with reference to the method of operation

Operation	Risk classification	Risk parameter
Manual actuation without self-retaining mode and with visual control of all windows (Dead man's control, e.g. by using a key-operated hold-to-run control device or pushbutton)	**Very low risk**	**S0**
Manual actuation with self-retaining mode and with visual control of all windows (e.g. by using a switch)	**Low risk**	**S1**
Automatic operation (e.g. wind/rain control, building control system) **or manual operation without visual control** (e.g. central switch, remote control) of all windows	**Higher risk**	**S2**

7.3 Risk evaluation and identification of protection class

The risks itemised and described in section 7.2 are linked to the risk parameters to derive a protection class of the total risk identified for the planned construction project.

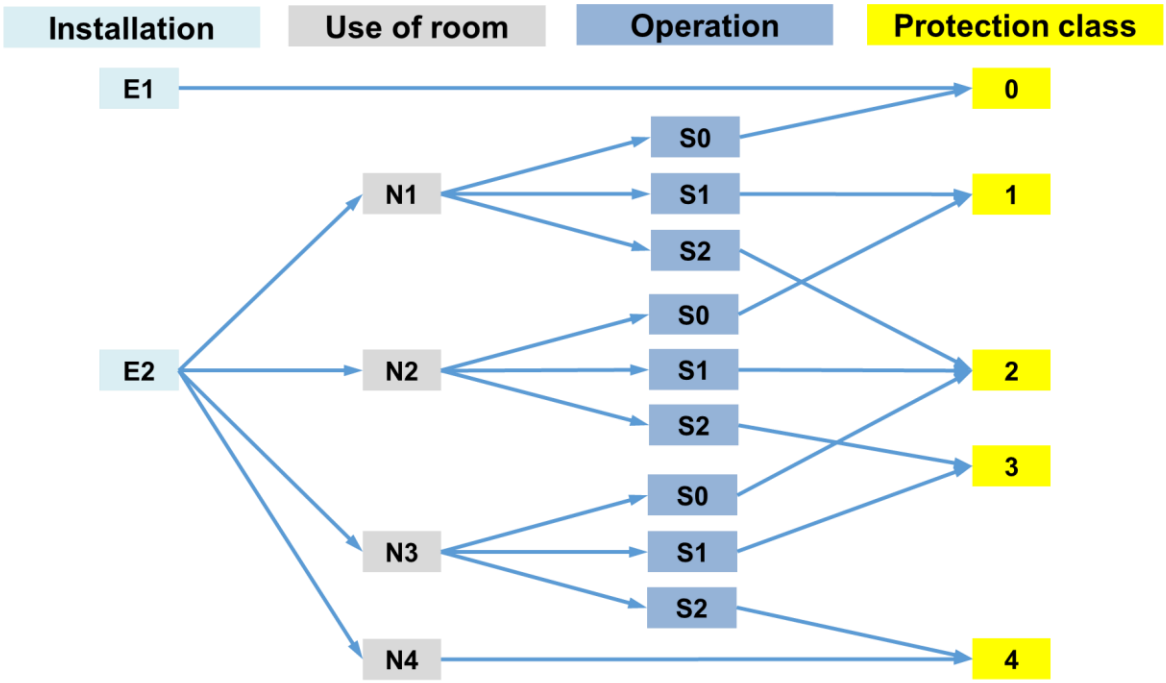

Figure 3: Identification of protection class

8 Approaches to protective measures

Protective measures are all measures taken to reduce the risks identified. Protective measures for reducing the risks will thus vary with the actual risk.

Functional and **economically feasible solutions** will always require an object-related risk analysis of the use of power-operated windows in buildings.

8.1 Allocation of protective measures

Protective measures can be allocated to the protection classes of Table 4 below:

Table 4: Allocation of protective measures to the protection classes (examples)

Class	Examples of protective measures
Protection class 0	No protective measures required
Protection class 1	• Hazard warnings
Protection class 2	• Access restrictions by structural measures, or • Rounded, padded edges, closing forces between 80 N and 150 N, no shearing, or • Acoustic warning signals, or • Hazard warning lights, or • EMERGENCY STOP switch at the window, or • Moveable installations in front of the window which prevent free access to the window
Protection class 3	• Dead man's control without a higher-level central control system, or • Casement moves slowly at max. 5 mm/s, or • Main closing edge opens by ≤ 200 mm and closing speed is ≤ 15 mm/s, or • Access gap is less than 8 mm wide, or • Rounded, padded edges, low closing forces below 80 N, no shearing, or • Sliding and lifting sliding (door height) windows with entrapment protection like motor current monitoring tested according to EN 60335-2-103:2016 Annex 20.ZAA.8.2 with limit of sash weight.
Protection class 4	• Control by contact-enabled safeguards such as pressure sensitive edges, contact sensors, or • Control by non-contact-enabled safeguards such as photocells, light grids, or • Dead man's control with authorised operation per window without a higher-level central control system (e.g. key-operated hold-to-run control device), or • Access gap is less than 4 mm wide, or • Access prevented by construction measures

The specified protection class is obtained by one of the above protective measures designed to be suitable for the actual case of use. Several measures may be combined. Measures of a higher protection class cover all lower classes.

Better precautions do no harm.

Generally, within the scope of risk analyses for all motorized closing and opening processes, special attention should be paid to the risk of injuries from jamming/crushing of body parts that reach into small opening widths of 8 - 200 mm or into small distances between the sash and surrounding solid parts. When indicated, hazard warnings should be applied.

Small opening width

8.2 Residual risk

It is impossible to ensure safety in a way that excludes all risks in every situation. The residual risk is the risk that remains after taking safety protections. The planning of protective measures should aim to minimise the residual risk.

Minimise the residual risk

8.3 Falling/knocking off of casements

Attachment, guiding or other means of design features such as double suspension, safety shear, catcher etc. should prevent casements from falling off, being knocked off or moving in an uncontrolled manner even if one of the suspension elements fails.

9 Commissioning

Completeness of the technical documents and risk assessment

The commissioning of a power-operated window represents the first intended use of this machine. The installer must ensure that all technical documents are available at this time (see section 6) and that the assumptions of the risk assessment (see section 7) are made.

Checking the function

In addition, the required functionalities must be checked according to the service specifications and their function in operation. It is advisable to document these points in a logbook.

Commissioning protocol

Examples of possible contents of a commissioning protocol:

- Visual inspection (system cleaned, fittings and screws tightened)
- Check, if necessary readjust the window fittings
- Teach the seal (zero position) and opening width and check for possible collision with the structural conditions
- Checking the locking points
- Inspection of the safety gears
- Checking and teaching of the protection devices
- Strain relief of the supply line
- Warnings attached
- Check protective conductor connections for continuity
- Check the condition of the insulation of the supply line
- Measurement of the insulation resistance
- Measurement of mains voltage and protective low voltage in standby and under load (if necessary, optimize power management or use additional power supply units)
- Function control of the single window or in a group with description
- Possibility of all-pole separation of the power supply for maintenance work
- etc.

Documentation for handover

The information in the operating instructions must be observed. The actual condition of the plant at the time of transfer should be documented. This information can also be used for maintenance (see section 10).

10 Maintenance / information for use

A warranty demands maintenance.

After site acceptance and subject to contract obligations, the contractor will grant a warranty for the products. The power-operated windows require professional maintenance/care and inspection, in order to assure their fitness for use and sustainable quality and also to avoid personal injury and material damage. This should be documented. Not conforming to the above may void the warranty.

Maintaining the safe operation and fitness for use of objects equipped with adjustment fixtures and/or designed for the replacement of wearing parts requires periodic maintenance and inspection, corrective maintenance and repair, as necessary. This particularly applies to power-operated windows because their hazard potential is normally greater than that of manually operated windows and because they require more maintenance due to the additional drive system components. Note that it is normally required to repeat the risk assessment when drives are being replaced.

Maintenance is based on the user information / operating manual

Extensive product warranty and liability assumes not only proper maintenance but also the so-called "intended use" of the products. The contractor should ensure this and should provide the client with user information / operating manual including documents with information on the intended use, the required maintenance and procedures of operation and other means of information. In order to account for the higher risk potential of power-

operated windows, the user information / operating manual should include at least the following points:

- Instructions for use including plain and understandable safety signs and hazard warnings making product users aware of the consequences of improper operation or reasonably foreseeable misuse, eventually residual risks
- Product-related maintenance instructions listing the safety-related inspection and maintenance actions, e.g. by way of a checklist of required activities
- Recommended inspection intervals with reference to the use of the room and frequency if window operation, as appropriate
- Additional cleaning and care instructions regarding the drive components

Translations must be marked with "Translation of the original instructions" and the original must be enclosed.

Duty to inform and maintain quality at the time of partial acceptance

The client is responsible for taking the maintenance and quality assurance actions regarding the products and services it has been supplied with. Non-compliance will void all warranty and product liability claims. The contractor must appropriately fulfil its associated duty to inform the client about the terms of warranty and product liability.

Service contract

An interesting option for clients is to transfer their maintenance obligations to the manufacturer of a window or facade by entering into a service contract. This will also ensure that all quality assuring actions will be taken professionally and that unqualified attempts at repairs by third parties are avoided in the first place.

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