EUROPEAN SOLAR-SHADING ORGANIZATION

Energy Savings & Comfort

Energy-efficient buildings with sustainable comfort

Passive cooling • Solar room heating • Daylight utilisation

SOLAR SHADING SYSTEMS PRODUCT SHEETS

compiled for IEEE project www.keep-cool.eu

Summary overview

Performance data of the various shading systems differ greatly. The table below provides a summary of the functions and features listed in the product factsheets by way of comparison. Each shading variant thus has its own characteristic profile.

Effect on ….			… construction-physical parameter						… energy saving energy balance				… Comfort			Other		
Reference building Energy requirement for heating, cooling, lighting 200 kWh/m2a Reference glazing 2-pane heat insulation glass g_{glass}=0,65, U_W=1,2 W/m2K, T_L=80% **Rating** + excellent + well capable - less capable - not capable n. r. not relevant			Influence on g value - winter	Influence on g value - summer	Variable energy transmittance g-value	Variable daylight transmission TL	Selectivity (TL/g value)	U_W improvement (glazing)	Passive cooling	Passive heating (solar gains)	Reduction of heat losses (winter)	Reduction of lighting energy	Thermal comfort	Visual comfort	Contact to the outside world	Preferred installation position	Wind resistance	Serviceable life
			1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*
Type of shading	Dynamic extendable / retractable	External Venetian blinds	+	+	+	+	+	+	+	+	+	+	+	+	+	ES WN	+	+
		Roller shutters	+	+	+	+	+	+	+	+	+	-	+	+	-	ES WN	+	+
		Roller blinds awnings	+	+	+	+	+	+	+	+	+	-	+	+	+	ES WN	+	+
		Light directing blinds	+	+	+	+	+	+	+	+	+	+	+	+	+	ES WN	n. r.	+
		Indoor products blinds, curtains, etc.	+	+	+	+	+	+	+	+	+	-	+	+	-	ES WN	n. r.	+
	Static non retractable	Solarfins and louvers horizontal, rigid	+	+	+	-	+	n. r.	-	+	n. r.	-	-	-	+	S	+	+
		Solarfins and louvers horizontal, swivelling	+	+	+	+	+	n. r.	+	+	n. r.	-	+	–	+	S	+	+
		Solarfins and louvers vertical, rigid	+	+	+	-	+	n. r.	-	+	n. r.	-	-	-	+	E W	+	+
		Solarfins and louvers vertical, swivelling	+	+	+	+	+	n. r.	+	+	n. r.	-	+	–	+	E W	+	+
	Permanent integrated	Functional glazing or sun protection glazing	-	+	-	-	-	n. r.	+	-	n. r.	-	+	–	+	ES WN	n. r.	+
		Sun protection foils, permanently mounted	-	+	-	-	-	n. r.	+	-	n. r.	-	+	–	+	ES WN	n. r.	+

1 *Maximum achievable energy transmission for use of solar energy / passive heating*

2 *Maximum achievable energy transmission for passive cooling purposes*

3 *Introduction of light through the shading*

4 *Variability of a shading - Adaptation to changed energy flow during heating/cooling period (the higher the value, the more flexible)*

5 *Selectivity number (light transmission TL to total energy transmission value gtotal, values above 5 are extremely good)*

6 *Heat loss through glazing can be reduced by certain shading systems*

7 *Effects on the cooling requirement of active cooling systems as a result of passive cooling / sun protection*

8 *Effects on the heating energy requirement during the day as a result of utilisation of solar energy (passive heating)*

9 *Effects on the heating requirement at night as a result of shading systems*

10 *Effects on the thermal comfort, e.g. overheating, transmission of cold*

11 *Effects on the visual comfort, e.g. protection against direct glaring, light density restriction, daylight regulation*

12 *Effects on psychological factors, in particular view to the outside, contact to the outside world when shading is activated*

13 *Effect on the electricity requirement for artificial lighting as a result of shading systems*

14 *Preferred installation position / orientation of the shading*

15 *Wind speed up to that a shading is functional*

16 *Average expected serviceable life of a product*

Notice: comparison figure 1-4 *based on low-e glazing g=0.64, Tv=0.8, U=1.2 W/m²K*

Dynamic external solar shading

EXTERNAL VENETIAN BLINDS

PRODUCT DESCRIPTION

The typical characteristic of external Venetian blinds, often called outside Venetian blinds, is the curtain of horizontal slats that can be tilted, raised and lowered. The tilting allows adjustment of the position of the slats in relation to the position of the sun in order to ensure good view to the outside and optimum use of free, natural daylight. Of course, it is possible to raise all the slats, for instance when there is no direct solar radiation or, conversely, if free solar gains are to be utilised.

External Venetian blinds are highly efficient, versatile shading systems that can be adapted very well to the outside climatic conditions, being adjustable and retractable.

When solar radiation is too strong, up to 90% of the incident solar energy can be blocked by external Venetian blinds, by reflection and absorption of the energy, so that overheating of the interior of the building is avoided and load on active cooling systems is drastically reduced - passive cooling.

In the heating period, significant free, natural solar gains can be achieved as the shading system can be retracted to allow the solar energy into the building - passive heating.

External Venetian blinds, in connection with motorised drives, a well designed control system and openable windows ensure that no or only little cooling energy is required during the day, while ensuring efficient cooling at night; besides, they provide the necessary protection of the private sphere.

PRODUCT WILL PROVIDE

- **Sun protection /passive cooling** - Protection against overheating and greenhouse effect. Significant reduction of heat transmission from outside; the load on the active cooling system can be minimised and/or active cooling is not necessary at all.
- **Use of free, renewable solar heat gains / passive heating** - The curtain can be retracted to let in welcome solar heat in winter time, which will reduce the load on the active heating system.
- **Better utilisation of natural daylight and better daylighting strategy** - Adjusting the slats according to the position of the sun allows optimum use of natural daylight, while at the same time providing protection against the sun. When selected properly (slat colour and size), the blinds will allow reduction of the energy need for artificial lighting, which indirectly helps reduce the load on any active cooling system.
- **Glare protection** - Reduces the luminance values (the brightness of the light) at the workspace whenever required by law or for better comfort (e.g. computer work).
- **Increased comfort** - The surface temperature of the glazing - and thus the room temperature - is considerably reduced when the sun is high and the blinds are down. During the heating period, a retracted blind will ensure relatively higher temperatures on the glass surface, which helps heat the building.
- **Heat loss through windows** - During winter, fully closed blinds (at night) can also help slightly reduce the heat loss through windows - depending on the U value of these.
- **Contact to the outside world** - As the slats are very flexible and can be adjusted as desired, contact to the outside world is ensured at all times.

FACTSHEET External Venetian Blinds

IMPORTANT PARAMETERS and Typical Performance

Energy transmittance value (g value)**, total energy transmittance value** (g_{total} value) **and shading coefficient** (Fc)

The **energy transmittance value (g value)** is the fraction of solar radiation that enters through the window and is converted to heat in the room. The energy transmission is composed of the direct transmission and the secondary heat transmission of the glazing.

The **total energy transmission value (g_{total}** or **g_t)** indicates the energy transmission for a system that comprises the glazing and the shading; this value is determined according to EN 13363.

The quality of a shading system is defined by the **shading coefficient (Fc value)** - Fc = g_t/g. The lower this value, the more efficient is the sun protection.
Fc = 1.0 … no shading
Fc = 0.1 … very good shading

Example - external Venetian blind
Glass g = 0.65 (according to EN 410)
Glass + solar shading g_t = 0.11 (acc to EN 13363)
Shading coefficient Fc = g_t/g = 0.15
As slats are tiltable, the shading coefficient can be adjusted as required)

Cooling period - solar shading activated
g_t = 0.15 - The load on the room climate is only 15% of the sun energy (corresponds to passive house standard).

Heating period - solar shading deactivated
g_t = g = 0.65 - 65 % of the solar energy can be utilised for heating.

Effect on energy consumption
Cooling period: energy saving of approx 30 kWh/m² a and more
Heating period: energy saving of up to 10 kWh/m²a

Heat transfer coefficient (U value), reduction of heat loss through the window

The U value (formerly k value) is the measured value of the heat transfer through a component; it is indicated in W/m²K. The smaller the U value the better, as less heat is transferred through the component.

Example - passive house
U value wall 0.12 W/m²K
U value window 0.80 W/m²K

Depending on the user behaviour, the glazing, the glazing percentage and the installation position and tightness of the curtain, an improvement of the U value by 5 - 10 % can be achieved.

Effect on heating energy requirement
Saving of up to 5 kWh/m²a

Light transmission (T_L or LT), reduction of power requirement for lighting

The light transmittance TL indicates how much of the visible light spectrum (380 nm to 780 nm) is transmitted through a glazing, in percent.

A high light transmission value of the glazing (T_L > 80 %) is required to ensure good lighting of the room.

Slats that can be adjusted in relation to the position of the sun ensure a more efficient utilisation of daylight than continuous shading systems mounted in front of or behind the glazing.

Effect on energy consumption
Saving of artificial light requirement during the day: up to -15 kWh/m²a

Other

Wind resistance during use	approx 10-20 m/s
Expected serviceable life	approx 10-20 years

The values listed in the factsheets are average values from tests and simulations and refer to a building situated at the outskirts of a city; they should indicate the potential of solar shading products in terms of energy savings. The values are not applicable in the individual case, many parameters must be considered depending on the specific object, with different results.

- *With regard to the cooling energy, the values refer to a conventional two-pane insulating glass without sun protection*
- *With regard to the heating energy, the values refer to a two-pane sun protection glass with low solar gains*
- *With regard to the lighting, the values refer to a simple, manually controllable glare protection.*

Energy values refer to the primary energy.

Dynamic external solar shading

ROLLER SHUTTERS

PRODUCT DESCRIPTION

Roller shutters are characterised by a curtain made of many horizontal profiled bars (mostly made of aluminium, plastic or wood) hinged together. These can be raised to open and can be closed tightly for solar protection and darkening purposes; to some extent, roller shutters fulfil some of the security requirements of the user. The entire curtain can be raised, for instance when there is no direct solar radiation or if free solar gains should be used.

Special designs may have adjustable slats (similar to blinds) or special profiles to ensure that more natural daylight is utilised better.

Roller shutters are very efficient passive shading systems that can be adapted well to the outside climatic conditions (height adjustable).

If solar radiation is too strong, up to 85% of the incident sun energy can be blocked (reflected and absorbed) from the interior of the building drastically reducing the use of active cooling systems.

During the heating period, significant solar gains can be achieved as the shading can be deactivated (retracted).

Roller shutters, in connection with motorised drives, a well designed control system and openable windows ensure that no or only little cooling energy is required during the day, while ensuring efficient cooling at night; besides, they provide the necessary protection of the private sphere.

PRODUCT WILL PROVIDE

- **Sun protection /passive cooling** - Protection against overheating and greenhouse effect. Significant reduction of heat transmission from outside; the load on the active cooling system can be minimised and/or active cooling is not necessary at all.
- **Use of free, renewable solar heat gains / passive heating** - The curtain can be retracted to let in welcome solar heat in winter time, which will reduce the load on the active heating system.
- **Better utilisation of natural daylight and better daylighting strategy** - Depending on the height of the curtain, the amount of daylight can be regulated from 0 - 100%. Roller shutters are consequently particularly suited for relaxation rooms or bedrooms.
- **Glare protection** - Only ensured to a minor extent if curtain is almost closed. Consequence: no contact to the outside world, artificial light must be switched on.
- **Increased comfort** - The surface temperature of the glazing - and thus the room temperature - is considerably reduced when the sun is high and the curtain is down. During the heating period, a closed curtain will ensure relatively higher temperatures on the glass surface, which helps heat the building.
- **Heat loss through windows** - Roller shutters can significantly reduce the heat loss through windows during winter - depending on the U value of these (between 10 and 40 %).
- C**ontact to the outside world** - Roller shutters with adjustable slats or specially shaped daylight profiles ensure contact to the outside world even when the curtain is closed.

FACTSHEET Roller Shutters

IMPORTANT PARAMETERS and Typical Performance

Energy transmittance value (g value)**, total energy transmittance value** (g_{total} value) **and shading coefficient** (Fc)

The **energy transmittance value (g value)** is the fraction of solar radiation that enters through the window and is converted to heat in the room. The energy transmission is composed of the direct transmission and the secondary heat transmission of the glazing.

The **total energy transmission value (g_{total}** or **g_t)** indicates the energy transmission for a system that comprises the glazing and the shading; this value is determined according to EN 13363.

The quality of a shading system is defined by the **shading coefficient (Fc value)** - Fc = g_t/g. The lower this value, the more efficient is the sun protection.
Fc = 1.0 … no shading
Fc = 0.1 … very good shading

Example - Roller shutter
Glass g = 0.65 (according to EN 410)
Glass + solar shading g_t = 0.14 (acc to EN 13363)
Shading coefficient Fc = g_t/g = 0.19

Cooling period - solar shading activated
g_t = 0.19 - The load on the room climate is only 19% of the sun energy (corresponds to passive house standard).

Heating period - solar shading deactivated
g_t = g = 0.65 - 65 % of the solar energy can be utilised for heating.

Effect on energy consumption
Cooling period: energy saving of approx 25 kWh/m²a and more
Heating period: energy saving of up to 10 kWh/m²a

Heat transfer coefficient (U value), reduction of heat loss through the window

The U value (formerly k value) is the measured value of the heat transfer through a component; it is indicated in W/m²K. The smaller the U value the better, as less heat is transferred through the component.

Example - passive house
U value wall 0.12 W/m²K
U value window 0.80 W/m²K

Improvement of the U value depending on the material of the curtain and the tightness of the system in percent according to EN ISO 10077-1:
3-pane insulating glass (U_G 0.8 W/m²K) 7-17%
2-pane insulating glass (U_G 2.1 W/m²K) 16-35%
Non insulating glass (U_G > 3.0 W/m²K) 20-44%

Effect on heating energy requirement
Saving of 5 to 30 kWh/m²a

Light transmission (T_L or LT), reduction of power requirement for lighting

The light transmittance TL indicates how much of the visible light spectrum (380 nm to 780 nm) is transmitted through a glazing, in percent.

A high light transmission value of the glazing (T_L > 80 %) is required to ensure good lighting of the room.

Continuous shading systems reduce the incident light (shading principle). In order to reduce the artificial light requirement, the height of the curtain must be adapted to the outside light conditions.

Effect on energy consumption
Conventional roller shutters: additional energy consumption of > 5 kWh/m²a
Daylight roller shutters: saving of up to 10 kWh/m²a

Other

Wind resistance during use	approx 20-30 m/s
Expected serviceable life	approx 15-25 years

The values listed in the factsheets are average values from tests and simulations and refer to a building situated at the outskirts of a city; they should indicate the potential of solar shading products in terms of energy savings. The values are not applicable in the individual case, many parameters must be considered depending on the specific object, with different results.
- *With regard to the cooling energy, the values refer to a conventional two-pane insulating glass without sun protection*
- *With regard to the heating energy, the values refer to a two-pane sun protection glass with low solar gains*
- *With regard to the lighting, the values refer to a simple, manually controllable glare protection.*

Energy values refer to the primary energy.

Dynamic external solar shading

ROLLER BLINDS and AWNINGS

PRODUCT DESCRIPTION

Roller blinds and awnings are characterised by a curtain made of textile that normally has a transmission value of 2-15% so that one can see through it; besides, the entire curtain can be retracted, for instance when there is no direct solar radiation or, conversely, if free solar gains are to be utilised.

When solar radiation is too strong, up to 80% of the incident solar energy can be blocked by external roller blinds and awnings, by reflection and absorption of the energy, so that overheating of the interior of the building is avoided and load on active cooling systems is drastically reduced - passive cooling.

In the heating period, significant free, natural solar gains can be achieved as the shading system can be retracted to allow the solar energy into the building - passive heating.

Roller blinds and awnings, in connection with motorised drives, a well designed control system and openable windows ensure that no or only little cooling energy is required during the day, while ensuring efficient cooling at night.

PRODUCT WILL PROVIDE

- **Sun protection /passive cooling** - Protection against overheating and greenhouse effect. Significant reduction of heat transmission from outside; the load on the active cooling system can be minimised and/or active cooling is not necessary at all.
- **Use of free, renewable solar heat gains / passive heating** - The curtain can be retracted to let in welcome solar heat in winter time, which will reduce the load on the active heating system.
- **Better utilisation of natural daylight and better daylighting strategy** - Transparent screens ensure utilisation of daylight while simultaneously providing protection against the sun.
- **Glare protection** - Reduces the luminance values (the brightness of the light) at the workspace whenever required by law or for better comfort (e.g. computer work).
- **Increased comfort** - The surface temperature of the glazing - and thus the room temperature - is considerably reduced when the sun is high and the blinds are down. During the heating period, a retracted blind will ensure relatively higher temperatures on the glass surface, which helps heat the building.
- **Heat loss through windows** - During winter, fully closed blinds (at night) can also help reduce the heat loss through windows - depending on the U value of these.
- **Contact to the outside world** - The view through a textile shading system is determined by its transparency, type of holes and colour of the fabric.

FACTSHEET External Roller Blinds and Awnings

IMPORTANT PARAMETERS and Typical Performance

Energy transmittance value (g value)**, total energy transmittance value** (g_{total} value) **and shading coefficient** (Fc)

The **energy transmittance value (g value)** is the fraction of solar radiation that enters through the window and is converted to heat in the room. The energy transmission is composed of the direct transmission and the secondary heat transmission of the glazing.

The **total energy transmission value (g_{total}** or **g_t)** indicates the energy transmission for a system that comprises the glazing and the shading; this value is determined according to EN 13363.

The quality of a shading system is defined by the **shading coefficient (Fc value)** - Fc = g_t/g. The lower this value, the more efficient is the sun protection.
Fc = 1.0 … no shading
Fc = 0.1 … very good shading

Example - Awning
Glass g = 0.65 (according to EN 410)
Glass + solar shading g_t = 0.17 (acc to EN 13363)
Shading coefficient Fc = g_t/g = 0.17

Cooling period - solar shading activated
g_t = 0.17 - The load on the room climate is only 17% of the sun energy (corresponds to passive house standard).

Heating period - solar shading deactivated
g_t = g = 0.65 - 65 % of the solar energy can be utilised for heating.

Effect on energy consumption
Cooling period: energy saving of approx 25 kWh/m² a and more
Heating period: energy saving of up to 10 kWh/m²a

Heat transfer coefficient (U value), reduction of heat loss through the window

The U value (formerly k value) is the measured value of the heat transfer through a component; it is indicated in W/m²K. The smaller the U value the better, as less heat is transferred through the component.

Example - passive house
U value wall 0.12 W/m²K
U value window 0.80 W/m²K

Depending on the user behaviour, the glazing, the glazing percentage and the installation position and tightness of the curtain, an improvement of the U value by 5 - 20 % can be achieved.

Effect on heating energy requirement
Saving up to 5 kWh/m²a

Light transmission (T_L or LT), reduction of power requirement for lighting

The light transmittance TL indicates how much of the visible light spectrum (380 nm to 780 nm) is transmitted through a glazing, in percent.

A high light transmission value of the glazing (T_L > 80 %) is required to ensure good lighting of the room.

Continuous shading systems reduce the incident light. In order to reduce the artificial light requirement, the height of the curtain or the light transmission must be adapted to the outside light conditions.

Effect on energy consumption
Higher use of artificial light during the day, > 5 possible

Other

Wind resistance during use	approx 10 m/s (+/- 5)
Expected serviceable life	approx 10-15 years

The values listed in the factsheets are average values from tests and simulations and refer to a building situated at the outskirts of a city; they should indicate the potential of solar shading products in terms of energy savings. The values are not applicable in the individual case, many parameters must be considered depending on the specific object, with different results.

- *With regard to the cooling energy, the values refer to a conventional two-pane insulating glass without sun protection*
- *With regard to the heating energy, the values refer to a two-pane sun protection glass with low solar gains*
- *With regard to the lighting, the values refer to a simple, manually controllable glare protection.*

Energy values refer to the primary energy.

Static external solar shading (swivelling or rigid)

Horizontal SOLAR FINS, LOUVERS and BALCONIES

PRODUCT DESCRIPTION

Horizontally mounted rigid or swivelling shading devices (protruding or mounted to the front) normally fulfil architectural requirements, while simultaneously offering protection against the sun and a largely unobstructed view.

Horizontally protruding systems are suited as sun protection for facades facing South; swivelling louvers mounted to the front are suited for low sun altitudes at Eastern and Western facades. Normally, the fins are made of aluminium, while some are made of glass, stainless steel or fabric.

Compared to outside dynamic solar shading systems, horizontally mounted louvers (rigid or swivelling) feature good sun protection values. As these shading systems are permanently present, they can be adapted to different outside conditions only to a certain extent, resulting in a reduced utilisation of diffuse daylight (natural light) and solar gains (passive heating).

The low flexibility of the systems consequently also affects the energy balance (cooling, heating, light). Accurate planning of the system is required to ensure optimal sun protection.

Front-mounted swivelling shading devices, in connection with motorised drives, a well designed control system and openable windows ensure that no or only little cooling energy is required during the day, while ensuring efficient cooling at night. The performance data for non-swivelling systems are accordingly lower, with a negative effect on the energy balance.

PRODUCT WILL PROVIDE

- **Sun protection /passive cooling** - Moderate reduction of heat transmission from outside; however, the load on active cooling systems can be minimised. In the case of horizontally protruding systems on a lightweight construction, thermal problems might still be experienced in the building when sun is low.
- **Use of free, renewable solar heat gains / passive heating** - Normally, the system does not provide shading when the sun is low; solar heating is thus ensured.
- **Better utilisation of natural daylight and better daylighting strategy** - Rigid horizontal shading systems hardly allow for any utilisation of the zenith light; swivelling louvers, on the other hand, may transmit daylight.
- **Glare protection** - When the sun is low, additional glare protection (mounted on the inside) is required.
- **Increased comfort** - Protruding louvers only shade the glass surface when the sun is high, however, the introduced heat is highest when the sun is low. Front-mounted swivelling louvers may reduce the surface temperature of the glazing and thus the room temperature.
- **Heat loss through windows** - Due to the design of the system, the heat loss through windows during winter cannot be reduced.
- **Contact to the outside world** - Contact to the outside world is ensured at all times.

FACTSHEET Horizontal Solarfins, Louvers and Balconies

IMPORTANT PARAMETERS and Typical Performance

Energy transmittance value (g value)**, total energy transmittance value** (g_{total} value) **and shading coefficient** (Fc)

The **energy transmittance value (g value)** is the fraction of solar radiation that enters through the window and is converted to heat in the room. The energy transmission is composed of the direct transmission and the secondary heat transmission of the glazing.

The **total energy transmission value (g_{total}** or **g_t)** indicates the energy transmission for a system that comprises the glazing and the shading.

The effectiveness of a permanent horizontal shading is defined by the **shading coefficient (F_0 value)** in DIN V 18599-2; it depends on the position of the sun, the orientation of the façade and the form of the shading, and is in the range between 0.6 and 1 (1 no shading effect).

Example - Large horizontal louvers
Glass g = 0.65 (according to EN 410)
Glass + solar shading g_t = 0.39 (acc to DIN V 18599-2)
Best shading coefficient F_0 = 0.6 (South-facing facades)

Cooling period (sun protection depends on position of the sun)
g_t = 0.39 - In the best case scenario, the load on the room climate is only 39% of the sun energy. Values above 0.25 normally do not suffice to cover peak loads.

Heating period (utilisation of solar energy depends on position of the sun)
Provided the systems do not produce an own shade, up to 65% of the solar energy can be used for heating when the sun is low.

Effect on energy consumption
Cooling period: energy saving of up to 10 kWh/m²a
Heating period: energy saving of up to 10 kWh/m²a
(effect is lower for unfavourable arrangement)

Heat transfer coefficient (U value), reduction of heat loss through the window

The U value (formerly k value) is the measured value of the heat transfer through a component; it is indicated in W/m²K. The smaller the U value the better, as less heat is transferred through the component.

Example - passive house
U value wall 0.12 W/m²K
U value window 0.80 W/m²K

No improvement is possible.

Effect on heating energy requirement
Saving of 0 kWh/m²a

Light transmission (T_L or LT), reduction of power requirement for lighting

The light transmittance TL indicates how much of the visible light spectrum (380 nm to 780 nm) is transmitted through a glazing, in percent.

A high light transmission value of the glazing (T_L > 80 %) is required to ensure good lighting of the room.

A permanently mounted shading system will result in a loss of valuable daylight (diffuse radiation) particularly during times of the day and year with little light.

Effect on energy consumption
Increased requirement for artificial light during the day, > 5 kWh/m²a

Other

Wind resistance during use	Requirement > 30 m/s (as non retractable)
Expected serviceable life	approx 10-20 years

The values listed in the factsheets are average values from tests and simulations and refer to a building situated at the outskirts of a city; they should indicate the potential of solar shading products in terms of energy savings. The values are not applicable in the individual case, many parameters must be considered depending on the specific object, with different results.

- *With regard to the cooling energy, the values refer to a conventional two-pane insulating glass without sun protection*
- *With regard to the heating energy, the values refer to a two-pane sun protection glass with low solar gains*
- *With regard to the lighting, the values refer to a simple, manually controllable glare protection.*

Energy values refer to the primary energy.

Static external solar shading (swivelling or rigid)

Vertical SOLAR FINS and LOUVERS

PRODUCT DESCRIPTION

Vertically mounted, swivelling louvers and solar fins must fulfil architectural requirements, while simultaneously offering protection against the sun and an unobstructed view.

Vertical louvers and solar fins are suited as sun protection in particular for Eastern and Western facades, however, they may also be used for facades facing South. Normally, the fins are made of aluminium, while some are made of glass, stainless steel, metal or fabric. To ensure visual contact to the outside world also when closed (when sun is low), metal systems are often perforated.

Most systems provide only a moderate shading effect and daylight utilisation; however, they do ensure good contact to the outside world. If the distance to the glazing is large, daylight utilisation, in particular of the zenith light part, can be reduced significantly owing to the produced own shade. The performance data for swivelling systems are significantly better.

Accurate planning of the system is required to ensure optimal sun protection.

Swivelling vertical louvers, in connection with motorised drives, a control system that automatically follows the sun, and openable windows ensure that only little heat is introduced during the day, while ensuring efficient cooling at night.

The performance data for non swivelling systems are accordingly lower, which normally affects the energy balance negatively.

PRODUCT WILL PROVIDE

- **Sun protection /passive cooling** - Depending on the type of product, good to moderate reduction of the introduced heat; the load on the active cooling system can be reduced and/or active cooling is not necessary at all.
- **Use of free, renewable solar heat gains / passive heating** - The fins can optionally be opened towards the sun to reduce the load on the active heating system during the heating period.
- **Better utilisation of natural daylight and better daylighting strategy** - Adjusting the fins according to the position of the sun allows optimum use of natural daylight, while at the same time providing protection against the sun. Rigid louvers, on the other hand, increase the artificial light requirement.
- **Glare protection** - Only swivelling systems combined with separate glare protection can reduce luminance values (the brightness of the light) at the workspace whenever required by law or for better comfort (e.g. computer work).
- **Increased comfort** - Only swivelling fins reduce surface temperatures of the glazing - and thus the room temperature - when the sun is high.
- **Heat loss through windows -** Normally, the heat loss through windows cannot be reduced due to the design of the system.
- **Contact to the outside world** - As the fins are flexible and can be adjusted as desired, contact to the outside world is ensured at all times.

FACTSHEET Vertical Solarfins and Louvers

IMPORTANT PARAMETERS and Typical Performance

Energy transmittance value (g value)**, total energy transmittance value** (g_{total} value) **and shading coefficient** (Fc)

The **energy transmittance value (g value)** is the fraction of solar radiation that enters through the window and is converted to heat in the room. The energy transmission is composed of the direct transmission and the secondary heat transmission of the glazing.

The **total energy transmission value (g_{total}** or **g_t)** indicates the energy transmission for a system that comprises the glazing and the shading.

The effectiveness of a permanent vertical shading is defined by the **shading coefficient (F_1 value)** in DIN V 18599-2; it depends on the position of the sun, the orientation of the façade and the form of the shading, and is in the range between 0.6 and 1 (1 no shading effect).

Example - Large vertical louvers
Glass g = 0.65 (according to EN 410)
Glass + solar shading g_t = 0.42 (acc to DIN V 18599-2)
Best shading coefficient F_1 = 0.65 (East- and Westh-facing facades)

Cooling period (sun protection depends on position of the sun)
g_t = 0.42 - In the best case scenario, the load on the room climate is only 42% of the sun energy. Values above 0.25 normally do not suffice to cover peak loads.

Heating period (utilisation of solar energy depends on position of the sun)
Provided the systems do not produce an own shade, up to 65% of the solar energy can be used for heating when the sun is low.

Effect on energy consumption
Cooling period: energy saving of up to 10 kWh/m²a
Heating period: energy saving of up to 10 kWh/m²a
(effect is lower for unfavourable arrangement)

Heat transfer coefficient (U value), reduction of heat loss through the window

The U value (formerly k value) is the measured value of the heat transfer through a component; it is indicated in W/m²K. The smaller the U value the better, as less heat is transferred through the component.

Example - passive house
U value wall 0.12 W/m²K
U value window 0.80 W/m²K

No improvement is possible.

Effect on heating energy requirement
Saving of 0 kWh/m²a

Light transmission (T_L or LT), reduction of power requirement for lighting

The light transmittance TL indicates how much of the visible light spectrum (380 nm to 780 nm) is transmitted through a glazing, in percent.

A high light transmission value of the glazing (T_L > 80 %) is required to ensure good lighting of the room.

A permanently mounted shading system will result in a loss of valuable daylight (diffuse radiation) particularly during times of the day and year with little light.

Effect on energy consumption
Increased requirement for artificial light during the day, > 5 kWh/m²a

Other

Wind resistance during use	Requirement > 30 m/s (as non retractable)
Expected serviceable life	approx 10-20 years

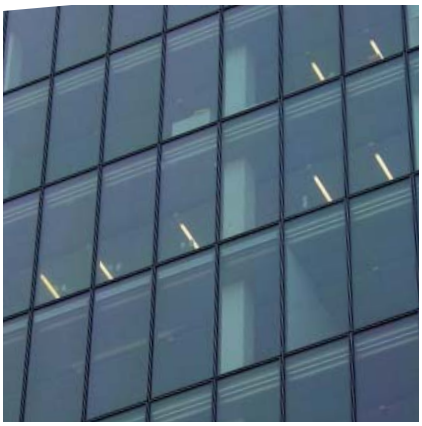
The values listed in the factsheets are average values from tests and simulations and refer to a building situated at the outskirts of a city; they should indicate the potential of solar shading products in terms of energy savings. The values are not applicable in the individual case, many parameters must be considered depending on the specific object, with different results.

- *With regard to the cooling energy, the values refer to a conventional two-pane insulating glass without sun protection*
- *With regard to the heating energy, the values refer to a two-pane sun protection glass with low solar gains*
- *With regard to the lighting, the values refer to a simple, manually controllable glare protection.*

Energy values refer to the primary energy.

Permanent, selective sun protection

SUN PROTECTION GLASS and SUN PROTECTION FOILS



PRODUCT DESCRIPTION

Sun protection glass and foil-laminated (laminated) glass primarily fulfil architectural requirements, ensuring “strut free” or respectively “unobstructed” contact to the outside world. The sun protection function results from the selection of specific wave lengths, i.e. specific sun spectra, primarily short-wave infrared, are filtered out. Systems with a low g value ($g < 0.4$) also filter out part of the visible light; this results in a low light yield and a colour shift of the daylight.

Due to the technology used, sun protection glass and laminated glazing have an unfavourable energy balance; they cannot reduce the energy input to the same extent as outside shading systems (ratio approx. 3:1). As they are permanently active, the solar gains for heating are reduced to a minimum. Besides, with an increasing sun protection effect, utilisation of daylight decreases or respectively the requirement for artificial illumination increases (percentage of electrically produced internal thermal loads increases). Trying to compensate for a reduced light yield by increasing the glazing part will result in increased heat losses. Sun protection glass and laminated glazing are also effective when there is no functional necessity for it!

PRODUCT WILL PROVIDE

- **Sun protection /passive cooling** - Sufficient to cover the basic load to prevent over-heating during summer. Additional passive or active measures are required for peak loads.
- **Use of free, renewable solar heat gains / passive heating** - Not ensured to a sufficient degree (not approved for passive house standard).
- **Better utilisation of natural daylight and better daylighting strategy** - Utilisation of daylight decreases the higher the sun protection!
- **Glare protection** - A dynamic glare protection mounted on the inside is required when sun is low.
- **Increased comfort** - As the glass surfaces are not positioned behind louvers or fabric, the surface temperatures are relatively high when the sun shines on them.
- **Heat loss through windows** - Sun protection lamination does not improve the U value of glazing.
  Increasing the part of the non-laminated glass surface to compensate for the daylight loss will result in increased losses of heating energy (deterioration of the U value of the façade).
- **Contact to the outside world** - Contact to the outside world is ensured at all times.

FACTSHEET Sun Protection Glass and Foils

IMPORTANT PARAMETERS and Typical Performance

Energy transmittance value (g value)**, total energy transmittance value** (g_{total} value) **and shading coefficient** (Fc)

The **energy transmittance value (g value)** is the fraction of solar radiation that enters through the window and is converted to heat in the room. The energy transmission is composed of the direct transmission and the secondary heat transmission of the glazing.

For sun protection glass, a shading coefficient is already included in the system (lamination); for additional shading systems, gt must be calculated according to EN 13363-2.

The **total energy transmission value (g_{total}** or **g_t)** indicates the energy transmission for a system that comprises the glazing and the shading.

Example - Sun protection glass without additional shading
Glass g = 0.35 (according to EN 410)

Cooling period - solar shading activated
g_t = 0.35 - The load on the room climate is only 35% of the sun energy. Values above 0.25 normally do not suffice to cover peak loads

Heating period - solar shading deactivated
30 to 65 % solar energy gains less result in accordingly higher heating requirement.

Effect on energy consumption
Cooling period: energy saving of up to 10 kWh/m²a
Heating period: additional energy requirement of up to 10 kWh/m²a

The result of the energy balance (saving for cooling relative to increased heating requirement and power requirement for lighting) may also be negative. Sun protection glazing may therefore not be installed in passive houses.

Heat transfer coefficient (U value), reduction of heat loss through the window

The U value (formerly k value) is the measured value of the heat transfer through a component; it is indicated in W/m²K. The smaller the U value the better, as less heat is transferred through the component.

Example - passive house
U value wall 0.12 W/m²K
U value window 0.80 W/m²K

No improvement is possible.

Effect on heating energy requirement
Saving of 0 kWh/m²a

Light transmission (T_L or LT), reduction of power requirement for lighting

The light transmittance TL indicates how much of the visible light spectrum (380 nm to 780 nm) is transmitted through a glazing, in percent.

A high light transmission value of the glazing (T_L > 80 %) is required to ensure good lighting of the room.

For g values < 0.45, the visible light is selectively blocked (20 - 50 %), resulting in an increased requirement for artificial light. Increasing the percentage of the glass surfaces cannot compensate the light loss, but causes a higher cooling load and heating energy requirement.

Effect on energy consumption
Increased requirement for artificial light
of 5 to 15 kWh/m²a

Other

Wind resistance during use	Requirements according to national standards
Expected serviceable life	Requirement: 20 years (+/- 5)

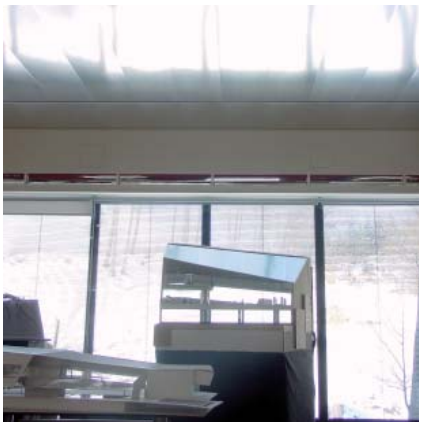
The values listed in the factsheets are average values from tests and simulations and refer to a building situated at the outskirts of a city; they should indicate the potential of solar shading products in terms of energy savings. The values are not applicable in the individual case, many parameters must be considered depending on the specific object, with different results.

- *With regard to the cooling energy, the values refer to a conventional two-pane insulating glass without sun protection*
- *With regard to the heating energy, the values refer to a two-pane sun protection glass with low solar gains*
- *With regard to the lighting, the values refer to a simple, manually controllable glare protection.*

Energy values refer to the primary energy.

Dynamic Solar Shading With Daylight Transport (in front of/in between/behind glazing)

LIGHT-DIRECTING BLINDS



PRODUCT DESCRIPTION

Light-directing blinds are characterised by their highly reflective slat curtain. In order to provide the best possible sun protection, the slats are adjusted depending on the position of the sun while diffuse (low-energy) light from the sky is simultaneously transported via the reflectors (slats) into the room.

The energy balance of such systems is optimal, they achieve the best sun protection values, reduce the requirement for artificial illumination by up to 80 %, and also ensure solar gains for passive room heating.

Light-directing blinds are highly efficient passive cooling systems that, as they are adjustable and retractable, can be adapted very well to the outside conditions(direct and diffuse radiation).

In the heating period, significant free, natural solar gains can be achieved as the shading system can be retracted to allow the solar energy into the building - passive heating.

Light-directing blinds require motorised drives in combination with a user-oriented, automatic control.

Motorised light-directing blinds, in connection with motorised drives, a well designed control system and openable windows ensure that no or only little cooling energy is required during the day, while ensuring efficient cooling at night.

PRODUCT WILL PROVIDE

- **Sun protection /passive cooling** - Protection against overheating and greenhouse effect. Significant reduction of the heat transmission from outside; the load on the active cooling system can be minimised and/or active cooling is not necessary at all.
- **Use of free, renewable solar heat gains / passive heating** - The curtain can be retracted and/or adjusted to let in welcome solar heat in winter time, which will reduce the load on the active heating system.
- **Better utilisation of natural daylight and better daylighting strategy** - The curtain can be adjusted to let daylight into the room , which reduces the energy requirement for artificial lighting (internal heat load) by up to 80%.
- **Glare protection** - The slats can be adjusted to provide glare protection while, at the same time, directing the daylight - important for computer work.
- **Increased comfort** - Mirror slats are normally mounted behind glazing, resulting in relatively high glass surface temperatures despite a low transmission of energy (referred to the room).
- **Heat loss through windows** - Closed curtains can significantly reduce the heat loss through windows during winter.
- **Contact to the outside world** - Since the curtain is very flexible, contact to the outside world is ensured at all times.

FACTSHEET Light-directing Blinds

IMPORTANT PARAMETERS and Typical Performance

Energy transmittance value (g value)**, total energy transmittance value** (g_{total} value) **and shading coefficient** (Fc)

The **energy transmittance value (g value)** is the fraction of solar radiation that enters through the window and is converted to heat in the room. The energy transmission is composed of the direct transmission and the secondary heat transmission of the glazing.

The **total energy transmission value (g_{total}** or **g_t)** indicates the energy transmission for a system that comprises the glazing and the shading; this value is determined according to EN 13363.

The quality of a shading system is defined by the **shading coefficient (Fc value)** - Fc = g_t/g. The lower this value, the more efficient is the sun protection.
Fc = 1.0 … no shading
Fc = 0.1 … very good shading

Example - Light-directing blind
Glass g = 0.65 (according to EN 410)
Glass + solar shading g_t = 0.10 (acc to EN 13363)
Shading coefficient Fc = g_t/g = 0.15
As slats are tiltable, the shading coefficient can be adjusted as required.

Cooling period - solar shading activated
g_t = 0.10 - The load on the room climate is only 15% of the sun energy (corresponds to passive house standard).

Heating period - solar shading deactivated
g_t = g = 0.65 - 65 % of the solar energy can be utilised for heating.

Effect on energy consumption
Cooling period: energy saving of approx 30 kWh/m²a and more
Heating period: energy saving of up to 10 kWh/m²a

Heat transfer coefficient (U value), reduction of heat loss through the window

The U value (formerly k value) is the measured value of the heat transfer through a component; it is indicated in W/m²K. The smaller the U value the better, as less heat is transferred through the component.

Example - passive house
U value wall 0.12 W/m²K
U value window 0.80 W/m²K

Depending on the user behaviour, the glazing, the glazing percentage and the installation position and tightness of the curtain, an improvement of the U value by 5 - 10 % can be achieved.

Effect on heating energy requirement
Saving of up to 5 kWh/m²a

Light transmission (T_L or LT), reduction of power requirement for lighting

The light transmittance TL indicates how much of the visible light spectrum (380 nm to 780 nm) is transmitted through a glazing, in percent.

A high light transmission value of the glazing (T_L > 80 %) is required to ensure good lighting of the room.

Reflector slats that follow the sun offer more efficient daylight utilisation than shading systems mounted in front of or behind the glazing over the entire window.

Effect on energy consumption
Saving of artificial light requirement during the day: up to 30 kWh/m²a

Other

Wind resistance during use	Not relevant (light-directing systems are protected against outside influences by the window glass.
Expected serviceable life	Requirement approx 15 years (+/- 5)

The values listed in the factsheets are average values from tests and simulations and refer to a building situated at the outskirts of a city; they should indicate the potential of solar shading products in terms of energy savings. The values are not applicable in the individual case, many parameters must be considered depending on the specific object, with different results.

- *With regard to the cooling energy, the values refer to a conventional two-pane insulating glass without sun protection*
- *With regard to the heating energy, the values refer to a two-pane sun protection glass with low solar gains*
- *With regard to the lighting, the values refer to a simple, manually controllable glare protection.*

Energy values refer to the primary energy.

Dynamic Indoor Solar Shading

ALL INDOOR PRODUCTS
(blinds, fabrics, curtains, foils)

PRODUCT DESCRIPTION

The characteristic of indoor shading systems is that they are installed inside the room; due to the physical conditions (conversion of sun energy into thermal radiation) this results in a relatively low sun protection effect. Only highly reflecting and pure white surface achieve more favourable values thanks to their high degree of reflection.

The type and the materials used for indoor shading devices are relatively insignificant in terms of the sun protection effect; aluminium slats, foil roller blinds and textile curtains differ primarily by their glare protection effect and by the degree of utilisation of daylight.

As far as energy balance is concerned, a combination of indoor shading devices and insulation glazing offers better results than a combination of indoor shading devices and sun protection glazing; even though overall energy transmission is slightly better if sun protection glazing is used, due to the low daylight transmission, the energy requirement for illumination and thus also the cooling required due to the electrically generated internal thermal loads will increase; also, the usable solar gains decrease during the heating period.

In connection with a well-thought out control and openable windows, indoor shading devices contribute to lowering the cooling energy requirement during the day while ensuring efficient cooling at night; in addition, some systems provide the necessary protection of the private sphere.

PRODUCT WILL PROVIDE

- **Sun protection /passive cooling** - Moderate reduction of heat transmission from outside; the requirement for active cooling may be minimised.
- **Use of free, renewable solar heat gains / passive heating** - The curtain can be retracted to let in welcome solar heat in winter time, which will reduce the load on the active heating system.
- **Better utilisation of natural daylight and better daylighting strategy** - Adjustable slats and height-adjustable curtains allow optimum use of natural daylight, while at the same time providing protection against the sun. When selected properly (slat colour and size), the blinds will allow reduction of the energy need for artificial lighting, which indirectly helps reduce the load on any active cooling system.
- **Glare protection** - Reduces the luminance values (the brightness of the light) at the workspace whenever required by law or for better comfort (e.g. computer work).
- I**ncreased comfort** - The surface temperatures of indoor shading systems are generally higher than those of comparable outdoor shading devices; this may result in discomfort during summer, whereas in winter, this is usually experienced as comfort.
- **Heat loss through windows** - Closed curtains can significantly reduce the heat loss through windows - depending on the U value of these. (In comparison, the heat loss is less than for outside shading systems).
- **Contact to the outside world** - As the curtains are very flexible and can be adjusted as desired, contact to the outside world is ensured at all times.

FACTSHEET all indoor solar shadings (blinds, fabrics, curtains, foils)

IMPORTANT PARAMETERS and Typical Performance

Energy transmittance value (g value)**, total energy transmittance value** (g_{total} value) **and shading coefficient** (Fc)

The **energy transmittance value (g value)** is the fraction of solar radiation that enters through the window and is converted to heat in the room. The energy transmission is composed of the direct transmission and the secondary heat transmission of the glazing.

The **total energy transmission value (g_{total}** or **g_t)** indicates the energy transmission for a system that comprises the glazing and the shading; this value is determined according to EN 13363.

The quality of a shading system is defined by the **shading coefficient (Fc value)** - Fc = g_t/g. The lower this value, the more efficient is the sun protection.
Fc = 1.0 … no shading
Fc = 0.1 … very good shading

Example - Textile inside shading
Glass g = 0.65 (according to EN 410)
Glass + solar shading g_t = 0.40 (acc to EN 13363)
Shading coefficient Fc = g_t/g = 0.56

Cooling period - solar shading activated
g_t = 0.40 - - The load on the room climate is only 40% of the sun energy. Values above 0.25 normally do not suffice to cover peak loads.

Heating period - solar shading deactivated
g_t = g = 0.65 - 65 % of the solar energy can be utilised for heating.

Effect on energy consumption
Cooling period: energy saving of approx 10 kWh/m² a and more
Heating period: energy saving of up to 10 kWh/m²a

Heat transfer coefficient (U value), reduction of heat loss through the window

The U value (formerly k value) is the measured value of the heat transfer through a component; it is indicated in W/m²K. The smaller the U value the better, as less heat is transferred through the component.

Example - passive house
U value wall 0.12 W/m²K
U value window 0.80 W/m²K

Two-dimensional shading systems reduce the incident light (shading principle). In order to reduce the artificial light requirement, the height of the curtain must be adapted to the outside light conditions.

Effect on heating energy requirement
Continuous glare protection: additional energy consumption of > 5 kWh/m²a
Glare protection slats: saving of < 5 kWh/m²a

Light transmission (T_L or LT), reduction of power requirement for lighting

The light transmittance TL indicates how much of the visible light spectrum (380 nm to 780 nm) is transmitted through a glazing, in percent.

A high light transmission value of the glazing (T_L > 80 %) is required to ensure good lighting of the room.

Depending on the adjustability of the curtains, light control between 5 and 100 % is possible (tightly closing systems may also darken a room).

Effect on energy consumption
For light, tiltable slats up to 10 kWh/m²a
Higher artificial light requirement for textile shading systems

Other

Wind resistance during use	Not relevant
Expected serviceable life	approx 10 years (+/- 5 years)

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- *With regard to the cooling energy, the values refer to a conventional two-pane insulating glass without sun protection*
- *With regard to the heating energy, the values refer to a two-pane sun protection glass with low solar gains*
- *With regard to the lighting, the values refer to a simple, manually controllable glare protection.*

Energy values refer to the primary energy.