

Certificado

Normativa de aplicación **ISO 45001:2018**

Nº registro certificado **01 213 2029598**

Titular del certificado: **Ingeniería de Protección SpA**
Gladys Marín Millie N°6290, Estación Central
Santiago, Región Metropolitana, Chile.

Ámbito de aplicación: Diseño, Fabricación, Comercialización, Despacho, Montaje y Desmontaje de productos manufacturados a partir de tejidos industriales, en base a polímeros plásticos, el Arriendo, Montaje y Desmontaje de carpas de grandes dimensiones desde Gladys Marín Mille #6290, Estación Central, Santiago y en instalaciones de cliente a nivel Nacional.

Mediante una auditoría se verificó el cumplimiento de los requisitos recogidos en la norma ISO 45001:2018

Validez: Este certificado es válido desde 2020-09-27 hasta 2023-09-26
Primera auditoría de certificación 2016 **(BS OHSAS 18001:2007)**

2021-08-06

TÜV Rheinland Cert GmbH
Am Grauen Stein · 51105 Köln

Certificado

Normativa de aplicación **ISO 14001:2015**

Nº registro certificado **01 104 2029597**

Titular del certificado: **Ingeniería de Protección SpA**
Gladys Marín Millie N°6290, Estación Central
Santiago, Región Metropolitana, Chile.

Ámbito de aplicación: Diseño, Fabricación, Comercialización, Despacho, Montaje y Desmontaje de productos manufacturados a partir de tejidos industriales, en base a polímeros plásticos, el Arriendo, Montaje y Desmontaje de carpas de grandes dimensiones desde Gladys Marín Mille #6290, Estación Central, Santiago y en instalaciones de cliente a nivel Nacional.

Mediante una auditoría se verificó el cumplimiento de los requisitos recogidos en la norma ISO 14001:2015.

Validez: Este certificado es válido desde 2020-09-27 hasta 2023-09-26.
Primera auditoría de certificación 2016

2021-05-25


TÜV Rheinland Cert GmbH
Am Grauen Stein · 51105 Köln

Certificado

Normativa de aplicación **ISO 9001:2015**

Nº registro certificado **01 100 2029596**

Titular del certificado: **INGENIERIA DE PROTECCION SPA**
Gladys Marín Millie N°6290, Estación Central,
Santiago, Región Metropolitana, Chile.

con las delegaciones según anexo

Ámbito de aplicación: Diseño, Fabricación, Comercialización, Despacho, Montaje y Desmontaje de productos manufacturados a partir de tejidos industriales, en base a polímeros plásticos, el Arriendo, Montaje y Desmontaje de carpas de grandes dimensiones desde Gladys Marín Mille #6290, Estación Central, Santiago y en instalaciones de cliente a nivel Nacional.

Mediante una auditoría se verificó el cumplimiento de los requisitos recogidos en la norma ISO 9001:2015.

Validez: Este certificado es válido desde 2020-09-27 hasta 2023-09-26.
Primera auditoría de certificación 2008

2021-05-25



TÜV Rheinland Cert GmbH
Am Grauen Stein · 51105 Köln

Anexo del certificado

Normativa de aplicación **ISO 9001:2015**

N° registro certificado **01 100 2029596**

N°	Emplazamiento	Ámbito de aplicación
/01	c/o Ingeniería de Protección SpA Gladys Marín Millie N°6290 Estación Central, Santiago, Región Metropolitana, Chile.	Diseño, Fabricación, Comercialización, Despacho, Montaje y Desmontaje de productos manufacturados a partir de tejidos industriales, en base a polímeros plásticos, el Arriendo, Montaje y Desmontaje de carpas de grandes dimensiones desde Gladys Marín Mille #6290, Estación Central, Santiago y en instalaciones de cliente a nivel Nacional.
/02	c/o Ingeniería de Protección SpA Miraflores, Parcela N° 35, Lipangue Lampa, Región Metropolitana, Chile.	Logística y Despacho de productos manufacturados a partir de tejidos industriales en base a polímeros plásticos y carpas de grandes dimensiones desde Chorrillos 3, Parcela 35, Miraflores de Lipangue, Lampa, Región Metropolitana, Chile.

2021-05-25


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Página 1 de 1

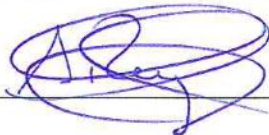
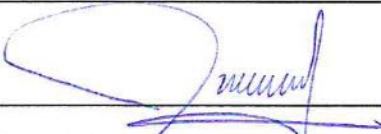
INFORME DE ENSAYOS N° 1726/2017

1.- IDENTIFICACIÓN DE LA MUESTRA			
N° DE INGRESO	1260/2017	FECHA DE INGRESO	12/09/2017
CLIENTE	INGENIERIA DE PROTECCION LTDA.		
CONTACTO	Nombre: Sr. Gonzalo Fernández Dirección: Portugal N° 1357 - Santiago Teléfono: 223477600		
MUESTRA	Dos muestras de tejido recubierto con PVC, una de color café claro y la otra de color verde.		
PRESUPUESTO N°	1069-A/2017	FECHA ACEPTACIÓN	11/09/2017
ENSAYOS SOLICITADOS	Inflamabilidad horizontal.		
INICIO ENSAYOS	14/09/2017	FINALIZACIÓN ENSAYOS	15/09/2017

2.- ANTECEDENTES
a) Los valores consignados en el presente informe corresponden a los resultados obtenidos en los análisis, expresamente, solicitados por el cliente, sobre la muestra por él aportada al laboratorio sin que representen certificación de lote, ni partida alguna. b) Cal-Tex no se hace responsable por defectos del tejido, durante el uso, producto de agentes distintos al analizado por esta empresa.

3.- RESULTADOS OBTENIDOS			
A. MUESTRA COLOR CAFÉ CLARO			
ENSAYO	VALOR MUESTRA	FECHA	MÉTODO DE ENSAYO
Inflamabilidad horizontal		14/09/17	ISO 3795/1989
-Velocidad de combustión			
Largo	46,6 mm/min.		
Ancho	49,3 mm/min.		
-Tipo de combustión	Autoextinguible Tipo B		
B. MUESTRA COLOR VERDE			
ENSAYO	VALOR MUESTRA	FECHA	MÉTODO DE ENSAYO
Inflamabilidad horizontal		14/09/17	ISO 3795/1989
-Velocidad de combustión			
Largo	38,4 mm/min.		
Ancho	46,7 mm/min.		
-Tipo de combustión	Autoextinguible Tipo B		

4.- COMENTARIOS	
RELATIVO A	COMENTARIO
INFLAMABILIDAD HORIZONTAL	Autoextinguible tipo B: Una vez retirada la fuente de ignición, la llama se detiene antes de alcanzar una longitud de 3,8 cm.

JEFE DE LABORATORIO	SERGIO REYES LISONI
FIRMA	
GERENTE OPERACIONES	M ^a GRACIELA CUMSILLE
FIRMA	

Importante: Los resultados de los ensayos se refieren únicamente la muestra analizada. Este informe de ensayo no puede ser reproducido, total ni parcialmente. Las muestras restantes serán destruidas después de 1 mes, a no ser que se solicite expresamente su devolución al cliente. Sólo el informe de ensayo original, firmado, es legalmente vinculante.

MGC/srl/csu/cch.
Ingreso N° 1260/2017



Hoja Caracteristicas Tecnicas no.: **1135.10**

Producto VALMEX® inflatable boat - Mainstream

Articulo no.: 7318 5340

clase de recubrimiento y acabado			
Clase de recubrimiento	PVC		
Comportamiento a la llama	ISO 3795 velocidad de la flama <100 mm/min.		
Peso total	1000	g/m ²	EN ISO 2286-2
Resistencia rotura cadena/trama	3000 / 3000	N/50 mm	EN ISO 1421/V1
Resist. al desgarro urdimbre/trama	250 / 250	N	DIN 53363
Adherencia	20	N/cm	PA 09.03 (intern)
Adherencia (ISO)	100	N/50 mm	EN ISO 2411 (soldadura alta frecuencia)
Resistencia al frio	-40	°C	EN 1876-1
Resistencia al calor	+70	°C	PA 07.04 (intern)
Solidez a la luz	>6	Note, Value	EN ISO 105 B02
Resistencia al pandeo	sin roturas	100000 x	DIN 53359 A
tejido base			
Material	PES		DIN EN ISO 2076
Hilo	1100	dtex	DIN EN ISO 2060
tejido	L 1/1		ISO 3572

Los datos tecnicos son valores aproximados, obtenidos a base de valores medios. Por razones técnicas puede haber ligeras variaciones durante la fabricación . Estas indicaciones corresponden a los conocimientos técnicos actuales y dan información sobre nuestros productos, sin vinculación jurídica. Estos datos son válidos para productos de nueva fabricación.



Hoja Características Técnicas no.: **1890.13**

Producto **POLYMAR®** **POLYMAR FR 750 ECLIPSE**

Artículo no.: 8296 6999

clase de recubrimiento y acabado

Clase de recubrimiento **PVC**

Acabado **barniz acrílico ambas caras, antimicrobiana, protegido contra los rayos UV**

Comportamiento a la llama **DIN 4102: B1, D.M. 26.06.84 (UNI 9177): CL. 2, NFPA 701 Test 2, ASTM E 84 Class A**

Peso total **765** g/m² EN ISO 2286-2

Resistencia rotura cadena/trama **2800 / 2800** N/50 mm EN ISO 1421/V1

Resist. al desgarro
urdimbre/trama **280 / 280** N DIN 53363

Adherencia **20** N/cm PA 09.03 (intern)

Resistencia al frío. **-40** °C EN 1876-1

Resistencia al calor **+70** °C PA 07.04 (intern)

Solidez a la luz **>6** Note,
Value EN ISO 105 B02

Resistencia al pandeo sin roturas **100000 x** DIN 53359 A

tejido base

Material **PES** DIN EN ISO 2076

Hilo **1100** dtex DIN EN ISO 2060

tejido **L 1/1** ISO 3572

Los datos técnicos son valores aproximados, obtenidos a base de valores medios. Por razones técnicas puede haber ligeras variaciones durante la fabricación. Estas indicaciones corresponden a los conocimientos técnicos actuales y dan información sobre nuestros productos, sin vinculación jurídica. Estos datos son válidos para productos de nueva fabricación.

	INGENIERÍA DE PROTECCIÓN SPA.	TARPULIN®
Ubicación / Instalación	Gladys Marín Millie 6290, Estación Central, Santiago.	
Ámbito de aplicación:	 Sistema de Gestión ISO 9001:2015 ISO 14001:2015 ISO 45001:2018 www.tuv.com ID 9105086774 Diseño, Fabricación, Comercialización, de productos manufacturados a partir de tejidos industriales, en base a polímeros plásticos, el Arriendo, Montaje y Desmontaje de carpas y campamentos de habitabilidad y logística.	
Normas aplicables, criterios de auditoría:	ISO 9001:2015, ISO 14001:2015, ISO 45001:2018. Documentación del sistema de gestión de la organización.	

<u>Tela base</u>	<u>Tela base ARENA/DESIERTO</u>
Material	Laminado compuesto por tejido soportante 100% poliéster recubrimiento PVC de origen alemán.
Tipo	Flexible
Peso	755 g/m ² +/- 7%
Espesor	0,58 mm +/- 7%
Densidad (pulgadas) Urdido y Trama	20 +/- 5%
Resistencia a la Tracción (Urdido/Trama/Costuras)	Mayor a 200 Kilos c/50 mm.
Impermeabilidad Telas AATCC127	55'' Col. agua (min)
Resistencia a la Llama ISO 3795/1989	Autoextinguible - No propaga la llama
Solidez del color a la Luz (escala de grises)	Grado 4-5 (leve-nada)
Color	ARENA/DESIERTO RAL 1009 (visual)
Construcción, características de fabricación comunes a todos los modelos carpas neumáticas.	Construcción principal en una pieza para techo y laterales. Todas las uniones de piezas mediante termo sellado electrónico.
Protección a la Luz	Filtro UV
Costuras	En las uniones principales de piezas con termosellado electrónico, de 20 mm. de Ancho

El presente certificado se apoya en ensayos propios y en certificados de fabricantes de las telas que se utilizarán. Trazabilidad comprobada.

En Santiago de Chile, se extiende en presente certificado, para ser presentado ante "El Benemérito Cuerpo de Bomberos Voluntarios de Cuenca, Ecuador", como parte de la documentación a ser evaluada durante el proceso de licitación.



LUIS A. LOBOS ESCOBAR

Sub- Gerente

Calidad, seguridad y medio ambiente

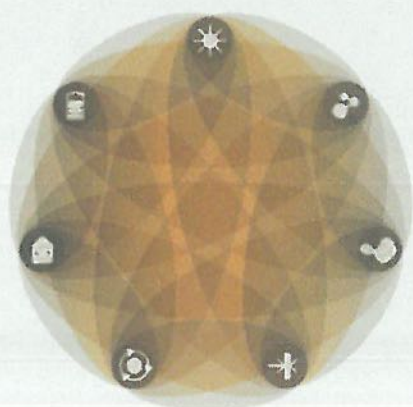
N° de Registro Seremi de Salud AM/P - 2650

Transmittance and reflectance in the solar spectral range and solar factor of two samples

commissioned by

Mehler Texnologies GmbH

Report ZAE 2 - 0116 - 11 (2016)



**BAYERISCHES ZENTRUM FÜR
ANGEWANDTE ENERGIEFORSCHUNG E.V.
BAVARIAN CENTER FOR
APPLIED ENERGY RESEARCH**

REPORT

January 25, 2016

Client: Mehler Technologies GmbH
Rheinstraße 11
41836 Hückelhoven, Germany

Your Order: dated 01/19/2016

Our Offer: dated 01/19/2016

Our Order No.: 203 / 160005

Subject of Investigation: Transmittance and reflectance in the solar spectral range and solar factor according to EN 14501 of two samples

Measuring Devices: Perkin-Elmer Lambda 950

ZAE Employees Involved: Dr. W. Körner

Number of **Pages:** 10

Figures: 3

Tables: 9

Vorstand
Prof. Dr. Christoph J. Brabec,
Vorsitzender
Prof. Dr. Vladimir Dyakonov
Dr. Bernd Malkowski,
Geschäftsführer
Prof. Dr. Hartmut Spliethoff

Vereinssitz (VR 1386)
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IBAN: DE84 7909 0000 0006 1432 97
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USt-IDNr. (VAT Registration):
DE 134187649

1 Aim of the Investigation

Aim of the investigation was the determination of the solar factor according to EN 14501¹ for two samples **8596 6999 908908 white** and **8296 6999 112112 beige**. In order to calculate the solar factor the normal-hemispherical transmittance τ_{nh} and the normal-hemispherical reflectance ρ_{nh} in the solar spectral range (wavelength range 250 nm to 2500 nm) was measured. Using the measured values the properties of a combination of the sample as inner or outer shading device, combined with different glazing, was calculated according to EN 13363-2².

2 Test Procedure

The spectral normal-hemispherical transmittance τ_{nh} and reflectance ρ_{nh} of the samples were measured with a diffraction spectrometer Lambda 950 from Perkin-Elmer equipped with a Spectralon®-coated integrating sphere with a diameter of 150 mm (Figure 1).

For measuring the **transmittance** the sample is irradiated normal to the surface. The radiation which is transmitted into the hemisphere behind the sample is detected (normal-hemispherical transmittance τ_{nh}).

The measurement of the **reflectance** is very similar. The sample is irradiated normal to the surface and the radiation, which is reflected into the hemisphere in front of the sample is detected (Fig. 1b).

The accuracy of the spectrophotometer setup is ± 0.02 . The measurements were performed at different parts of the samples, the averages of the individual measurements are shown.

The visual or daylight transmittance $\tau_{nh,vis}$ and reflectance $\rho_{nh,vis}$, the solar transmittance $\tau_{nh,solar}$ and reflectance $\rho_{nh,solar}$ as well as the ultraviolet transmittance $\tau_{nh,Uv}$ and reflectance $\rho_{nh,Uv}$ were derived from the spectral transmittance τ_{nh} and reflectance ρ_{nh} , respectively, as described in EN 410³.

¹ EN 14501 *Blinds and shutters – Thermal and visual comfort – Performance characteristics and classification*; German version EN 14501:2005

² EN 13363-2 *„Solar protection devices combined with glazing – Calculation of solar and light transmittance – Part 2: Detailed calculation method“*; German version DIN EN 13363-2:2005-06

³ EN 410 *„Glass in Building – Determination of luminous and solar characteristics of glazing“*; German Version EN 410:1998

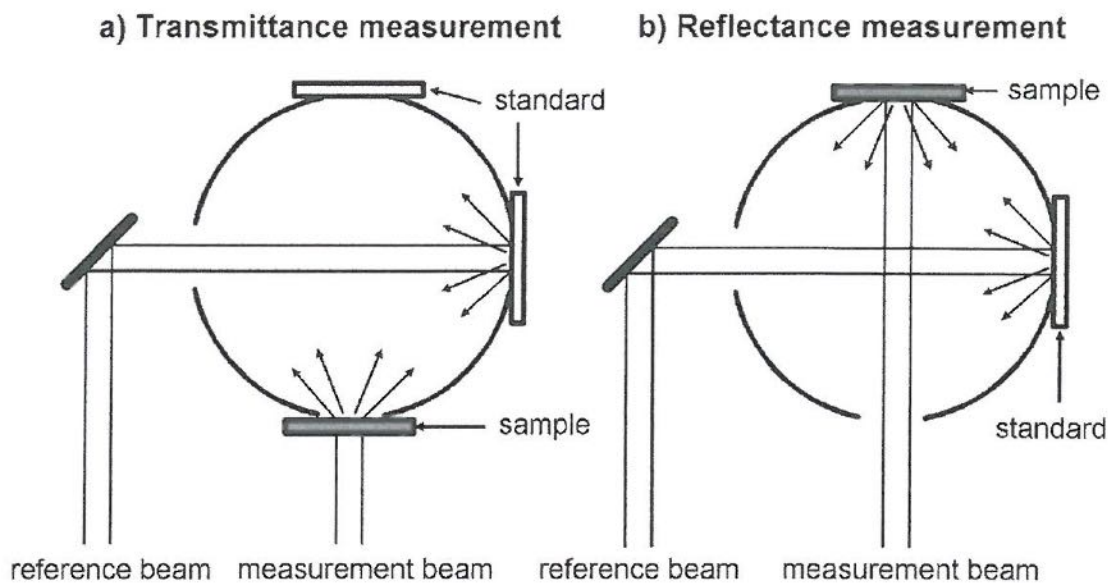


Figure 1: Measurement of the directional-hemispherical transmittance τ_{nh} (a) and reflectance ρ_{nh} (b) using an integrating sphere. The internal surface of the integrating sphere is coated with Spectralon, which has a very high reflectance and which reflects the radiation diffusely.

EN 13363-2 describes a method to calculate the solar transmittance, the secondary heat transfer coefficient q_i and the total solar energy transmittance g_{tot} of glazing combined with an inside or outside sun protection system consisting of the sample investigated.

The glazing used for this calculation were:

1. Reference glazing type B (EN 14501): Uncoated double glazing, two float glass panes with a thickness of 4 mm and an air-filled gap with a thickness of 16 mm, $g = 0.76$, $U_g = 2.9 \text{ W/(m}^2\text{K)}$.
2. Reference glazing type C (EN 14501): Heat-protection glazing, two float glass panes with a thickness of 4 mm and a coating with an emittance of 0.05 on pos. 3 and an argon-filled gap with a thickness of 16 mm, $g = 0.59$, $U_g = 1.2 \text{ W/(m}^2\text{K)}$.
3. Reference glazing type D (EN 14501): Sun-protection glazing, two float glass panes with a thickness of 4 mm and a coating with an emittance of 0.04 on pos. 2 and an argon-filled gap with a thickness of 16 mm, $g = 0.32$, $U_g = 1.1 \text{ W/(m}^2\text{K)}$.

For the calculations a glazing with a width of 1 m and a height of 1.5 m was used, the sun protection system was mounted at a distance of 5 cm from the glazing. The open area of the gaps on both sides as well as on the top and the bottom of the air gap between sun protection system and glazing was 50% of the total area.

EN 14501 lists only the solar parameters of the glazing, the visual parameters are missing. For calculating the visual parameters spectral data sets of glass panes were used. The glass panes were selected from IGDB⁴ and chosen to match the solar properties of the reference glazing. For the uncoated panes a float glass with a thickness of 4 mm was used (IGDB-Nr. 11004 (Saint-Gobain Glass Planilux 4 mm)). For the coated panes of the heat-protection glazing IGDB-Nr. 4031 (Pilkington Optitherm SN 4mm) was used, for the sun-protection glazing IGDB-Nr. 2049 (Cardinal IG LoE² 256 on 6mm Clear) was selected.

3 Results

Figure 2 and Figure 3 show the spectral transmittance and reflectance of the samples in the solar spectral range, Table 1 summarizes the transmittance and reflectance and absorptance values calculated according to EN 410. The solar, visual and UV-transmittance of both samples is smaller than 0.001.

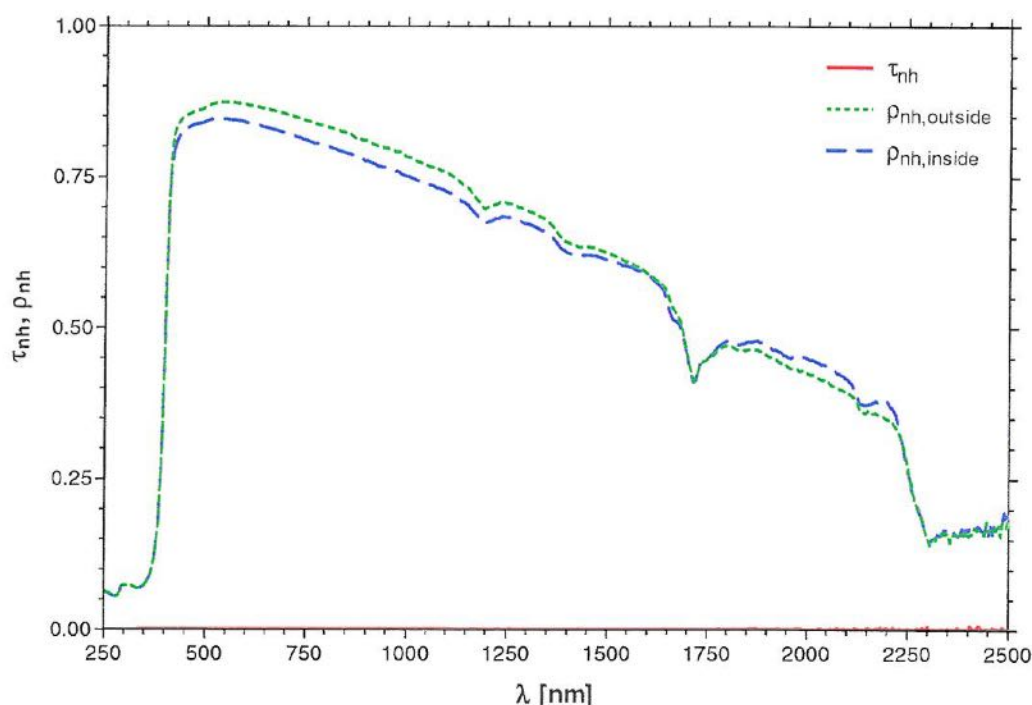


Figure 2: Spectral normal-hemispherical transmittance τ_{nh} and reflectance ρ_{nh} of both sides of sample 8596 6999 908908 white in the solar spectral range.

⁴ International Glazing Database IGDB Version 17.1, release date: 10 August 2009, <http://windows.lbl.gov/materials/igdb/>.

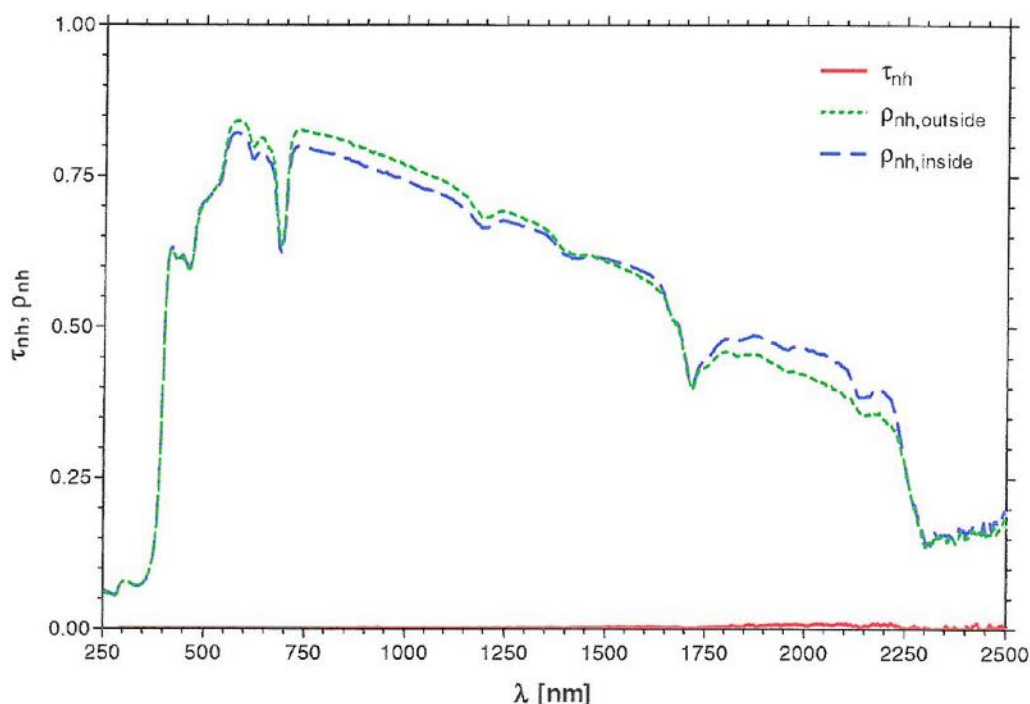


Figure 3: Spectral normal-hemispherical transmittance τ_{nh} and reflectance ρ_{nh} of both sides of sample 8296 6999 112112 beige in the solar spectral range.

Table 1: Solar, visual and UV normal-hemispherical transmittance τ_{nh} and reflectance ρ_{nh} according to EN 410.

	$\tau_{nh,solar}$	$\tau_{nh,VIS}$	$\tau_{nh,UV}$	$\rho_{nh,solar}$	$\rho_{nh,VIS}$	$\rho_{nh,UV}$
8596 6999 908908 white / outside	< 0.001	< 0.001	< 0.001	0.75	0.87	0.08
8596 6999 908908 white / inside				0.72	0.84	0.08
8296 6999 112112 beige / outside	< 0.001	< 0.001	< 0.001	0.68	0.78	0.08
8296 6999 112112 beige / inside				0.67	0.77	0.08

Table 2 and Table 3 show the solar transmittance, the secondary heat transfer coefficient q_i and the total solar energy transmittance g_{tot} of different glazing combined with an outside sun protection system consisting of the sample investigated, calculated according to EN 13363-2. These values were calculated for the summer and reference (winter) environmental conditions listed in EN 13363-2. Additionally the shading coefficient SC, the ratio of the total solar energy transmittance of the glazing with sun protection system to the total solar energy transmittance of the glazing without sun protection system is shown. Table 4 and Table 5 show the same values for an inside sun protection system.

Table 2: Solar transmittance $\tau_{\text{nh,solar}}$, secondary heat transfer coefficient $q_{\text{i,tot}}$ and total solar energy transmittance g_{tot} calculated according to EN 13363-2 for an **outside** sun protection system in front of different glazing for **reference** environmental conditions. Additionally the Shading Coefficient SC is shown.

glazing	shading (outside)	$\tau_{\text{nh,solar}}$	$q_{\text{i,tot}}$	g_{tot}	SC
double	none	0.69	0.06	0.76	
double	8596 6999 908908 white	0.00	0.02	0.02	0.03
double	8296 6999 112112 beige	0.00	0.03	0.03	0.04
heat protection	none	0.52	0.09	0.62	
heat protection	8596 6999 908908 white	0.00	0.02	0.02	0.03
heat protection	8296 6999 112112 beige	0.00	0.02	0.02	0.03
sun protection	none	0.30	0.04	0.34	
sun protection	8596 6999 908908 white	0.00	0.02	0.02	0.05
sun protection	8296 6999 112112 beige	0.00	0.02	0.02	0.06

Table 3: ... for **summer** environmental conditions.

Glazing	shading (outside)	$\tau_{\text{nh,solar}}$	$q_{\text{i,tot}}$	g_{tot}	SC
double	none	0.69	0.07	0.76	
double	8596 6999 908908 white	0.00	0.04	0.04	0.05
double	8296 6999 112112 beige	0.00	0.04	0.05	0.06
heat protection	none	0.52	0.10	0.62	
heat protection	8596 6999 908908 white	0.00	0.02	0.02	0.04
heat protection	8296 6999 112112 beige	0.00	0.03	0.03	0.05
sun protection	none	0.30	0.05	0.36	
sun protection	8596 6999 908908 white	0.00	0.02	0.02	0.06
sun protection	8296 6999 112112 beige	0.00	0.03	0.03	0.08

Table 4: Solar transmittance $\tau_{nh,solar}$, secondary heat transfer coefficient $q_{i,tot}$ and total solar energy transmittance g_{tot} calculated according to EN 13363-2 for an **inside** sun protection system in front of different glazing for **reference** environmental conditions. Additionally the Shading Coefficient SC is shown.

glazing	shading (inside)	$\tau_{nh,solar}$	$q_{i,tot}$	g_{tot}	SC
double	none	0,69	0,06	0,76	
double	8596 6999 908908 white	0,00	0,24	0,24	0,32
double	8296 6999 112112 beige	0,00	0,28	0,28	0,38
heat protection	none	0,52	0,09	0,62	
heat protection	8596 6999 908908 white	0,00	0,25	0,25	0,41
heat protection	8296 6999 112112 beige	0,00	0,29	0,29	0,48
sun protection	none	0,30	0,04	0,34	
sun protection	8596 6999 908908 white	0,00	0,11	0,11	0,33
sun protection	8296 6999 112112 beige	0,00	0,14	0,14	0,42

Table 5: ... for **summer** environmental conditions.

glazing	shading (inside)	$\tau_{nh,solar}$	$q_{i,tot}$	g_{tot}	SC
double	none	0.69	0.07	0.76	
double	8596 6999 908908 white	0.00	0.26	0.26	0.34
double	8296 6999 112112 beige	0.00	0.30	0.30	0.40
heat protection	none	0.52	0.10	0.62	
heat protection	8596 6999 908908 white	0.00	0.27	0.27	0.44
heat protection	8296 6999 112112 beige	0.00	0.31	0.31	0.51
sun protection	none	0.30	0.05	0.36	
sun protection	8596 6999 908908 white	0.00	0.13	0.13	0.37
sun protection	8296 6999 112112 beige	0.00	0.16	0.16	0.46

Table 6 to Table 9 show classifications according to EN 14501 for the thermal comfort in combination with the reference glazing for summer environmental conditions (classification with respect to the total solar energy transmittance g_{tot} and the secondary heat transfer coefficient $q_{l,tot}$). Class 0 means „very low effect“, class 4 „very high effect“.

Table 6: Classification according to EN 14501 for thermal comfort in combination with the reference glazing (classification with reference to total solar energy transmittance g_{tot}) for an **outside** sun protection system and **summer** environmental conditions. Class 0 means „very low effect“, class 4 „very high effect“.

shading (outside)	double glazing	heat protection glazing	sun protection glazing
none	0	0	2
8596 6999 908908 white	4	4	4
8296 6999 112112 beige	4	4	4

Table 7: Classification according to EN 14501 for thermal comfort in combination with the reference glazing (classification with reference to secondary heat transfer coefficient $q_{l,tot}$) for an **outside** sun protection system and **summer** environmental conditions. Class 0 means „very low effect“, class 4 „very high effect“.

shading (outside)	double glazing	heat protection glazing	sun protection glazing
none	3	3	3
8596 6999 908908 white	3	4	4
8296 6999 112112 beige	3	4	4

Table 8: Classification according to EN 14501 for thermal comfort in combination with the reference glazing (classification with reference to total solar energy transmittance g_{tot}) for an **inside** sun protection system and **summer** environmental conditions. Class 0 means „very low effect“, class 4 „very high effect“.

shading (inside)	double glazing	heat protection glazing	sun protection glazing
none	0	0	2
8596 6999 908908 white	2	2	3
8296 6999 112112 beige	2	2	3

Table 9: Classification according to EN 14501 for thermal comfort in combination with the reference glazing (classification with reference to secondary heat transfer coefficient $q_{i,tot}$) for an **inside** sun protection system and summer environmental conditions. Class 0 means „very low effect“, class 4 „very high effect“.

shading (inside)	double glazing	heat protection glazing	sun protection glazing
none	3	3	3
8596 6999 908908 white	1	1	2
8296 6999 112112 beige	0	0	2

Würzburg, January 25, 2016



Dr. W. Körner
(Contact)



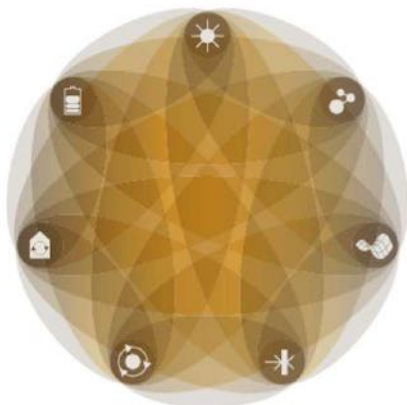
Dr. Hans-Peter Ebert
(Head of Division)

Transmittance and Reflectance in the Solar Spectral Range and Solar Factor of Membrane Samples

commissioned by

Low&Bonar GmbH

Report ZAE 2 - 0719 - 02 - 4 (2019)



**BAYERISCHES ZENTRUM FÜR
ANGEWANDTE ENERGIEFORSCHUNG E.V.
BAVARIAN CENTER FOR
APPLIED ENERGY RESEARCH**

R E P O R T

July 12, 2019

Client: Low&Bonar GmbH
Rheinstraße 11
41836 Hückelhoven, Germany

Your Order: dated June 19, 2019

Our Offer: 202 / 190047 dated June 19, 2019

Our Order No.: 203 / 190048

Subject of Investigation: Transmittance and Reflectance in the solar spectral range and solar factor according to EN 14501 of Membrane Samples

Measuring Devices: Perkin-Elmer Lambda 950

ZAE Employees Involved: Dr. W. Körner

Number of **Pages:** 11

Figures: 3

Tables: 9

1 Aim of the Investigation

Aim of the investigation was the determination of the solar factor according to EN 14501 of membrane samples. In order to calculate the solar factor the normal-hemispherical transmittance τ_{nh} and the normal-hemispherical reflectance ρ_{nh} in the solar spectral range (wavelength range 250 nm to 2500 nm) was measured. Using the measured values the properties of a combination of the sample as inner or outer shading device, combined with different glazing, was calculated according to EN ISO 52022-3.

2 Test Procedure

The spectral normal-hemispherical transmittance τ_{nh} and reflectance ρ_{nh} of the samples were measured with a diffraction spectrometer Lambda 950 from Perkin-Elmer equipped with a Spectralon®-coated integrating sphere with a diameter of 150 mm (Figure 1).

For measuring the **transmittance**, the sample is irradiated normal to the surface. The radiation that is transmitted into the hemisphere behind the sample is detected (normal-hemispherical transmittance τ_{nh}).

The measurement of the **reflectance** is very similar. The sample is irradiated normal to the surface and the radiation, which is reflected into the hemisphere in front of the sample is detected (Fig. 1b).

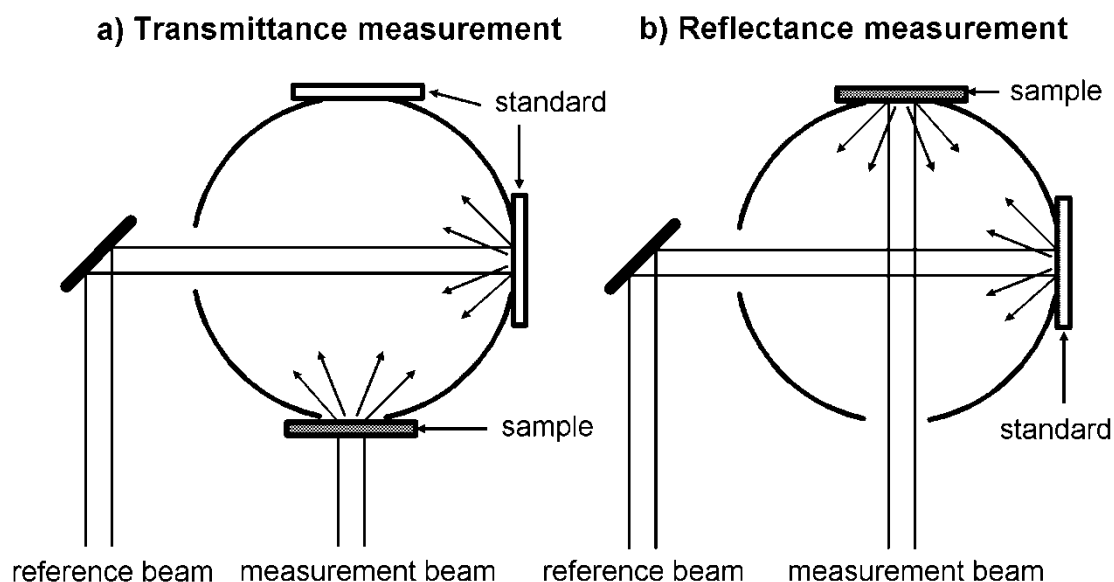


Figure 1: Measurement of the directional-hemispherical transmittance τ_{nh} (a) and reflectance ρ_{nh} (b) using an integrating sphere. The internal surface of the integrating sphere is coated with Spectralon, which has a very high reflectance and which reflects the radiation diffusely.

The accuracy of the spectrophotometer setup is ± 0.02 . The measurements were performed at different parts of the samples; the averages of the individual measurements are shown.

The visual or daylight transmittance $\tau_{nh,vis}$ and reflectance $\rho_{nh,vis}$, the solar transmittance $\tau_{nh,solar}$ and reflectance $\rho_{nh,solar}$ as well as the ultraviolet transmittance $\tau_{nh,Uv}$ and reflectance $\rho_{nh,Uv}$ were derived from the spectral transmittance τ_{nh} and reflectance ρ_{nh} , respectively, as described in EN 410¹. Additionally the solar transmittance and reflectance according to the standards ASHRAE 74², ASTM E 903³ and ISO 9050 (2003)⁴ was calculated.

EN ISO 52022-3⁵ describes a method to calculate the solar transmittance, the secondary heat transfer coefficient q_i and the total solar energy transmittance g_{tot} of glazing combined with an inside or outside sun protection system consisting of the sample investigated.

The glazing used for this calculation were:

1. Reference glazing type B (EN 14501⁶): Uncoated double glazing, two float glass panes with a thickness of 4 mm and an air-filled gap with a thickness of 16 mm, $g = 0.76$, $U_g = 2.9 \text{ W/(m}^2\text{K)}$.
2. Reference glazing type C (EN 14501): Heat-protection glazing, two float glass panes with a thickness of 4 mm and a coating with an emittance of 0.05 on pos. 3 and an argon-filled gap with a thickness of 16 mm, $g = 0.59$, $U_g = 1.2 \text{ W/(m}^2\text{K)}$.

¹ EN 410 „Glass in Building – Determination of luminous and solar characteristics of glazing“, German Version EN 410:2011

² ASHRAE 74-1988 “Method of Measuring Solar-Optical Properties of Materials”

³ ASTM E903-12 (2012) “Standard Test Method for Solar Absorptance, Reflectance, and Transmittance of Materials Using Integrating Spheres”

⁴ ISO 9050:2003 “Glass in building -- Determination of light transmittance, solar direct transmittance, total solar energy transmittance, ultraviolet transmittance and related glazing factors”

⁵ EN ISO 52022-3:2017 “Energy performance of buildings - Thermal, solar and daylight properties of building components and elements - Part 3: Detailed calculation method of the solar and daylight characteristics for solar protection devices combined with glazing”

⁶ EN 14501 Blinds and shutters – Thermal and visual comfort – Performance characteristics and classification“, German version EN 14501:2005

3. Reference glazing type D (EN 14501): Sun-protection glazing, two float glass panes with a thickness of 4 mm and a coating with an emittance of 0.04 on pos. 2 and an argon-filled gap with a thickness of 16 mm, $g = 0.32$, $U_g = 1.1 \text{ W/(m}^2\text{K)}$.

For the calculations a glazing with a width of 1 m and a height of 1.5 m was used, the sun protection system was mounted at a distance of 5 cm from the glazing. The open area of the gaps on both sides as well as on the top and the bottom of the air gap between sun protection system and glazing was 50% of the total area.

EN 14501 lists only the solar parameters of the glazing, the visual parameters are missing. For the calculation spectral data sets of glass panes were used. The glass panes were selected from IGDB⁷ and chosen to match the solar properties of the reference glazing. For the uncoated panes a float glass with a thickness of 4 mm was used (IGDB-Nr. 11004 (Saint-Gobain Glass Planilux 4 mm)). For the coated panes of the heat-protection glazing IGDB-Nr. 4031 (Pilkington Optitherm SN 4mm) was used, for the sun-protection glazing IGDB-Nr. 2049 (Cardinal IG LoE² 256 on 6mm Clear) was selected.

3 Results

The following figures show the spectral transmittance and reflectance of the samples in the solar spectral range. Table 1 shows the averaged solar, visual and UV transmittance and reflectance values according to different standards.

⁷ International Glazing Database IGDB Version 17.1, release date: 10 August 2009, <http://windows.lbl.gov/materials/igdb/>.

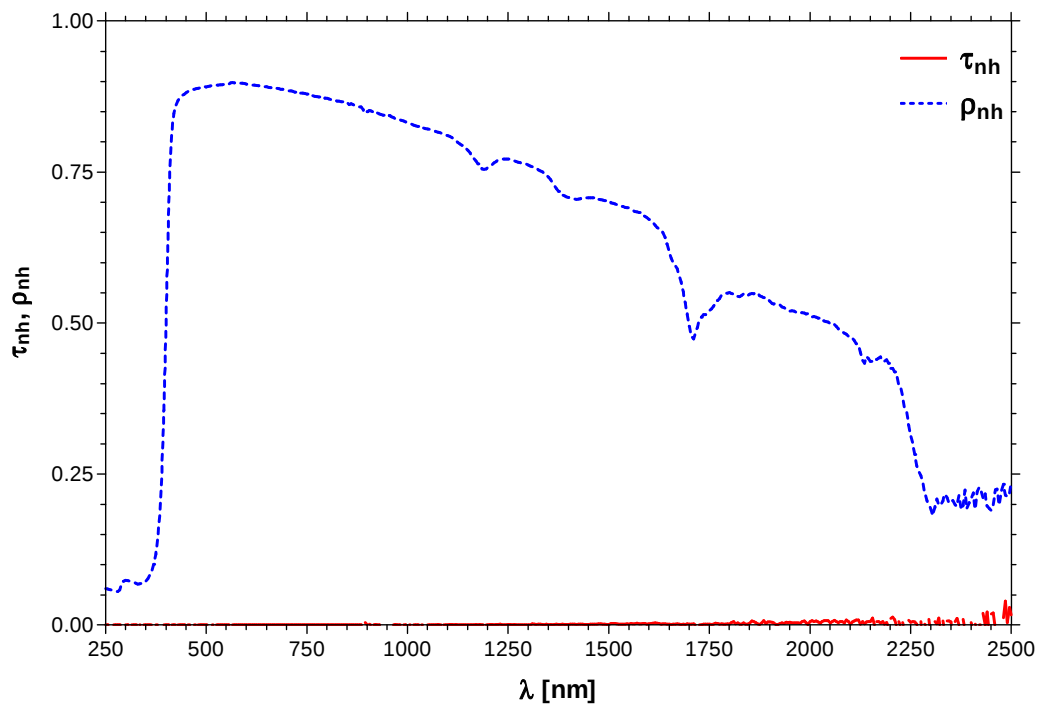


Figure 2: Spectral normal-hemispherical transmittance τ_{nh} and reflectance ρ_{nh} of sample **8296-6999-908908** in the solar spectral range.

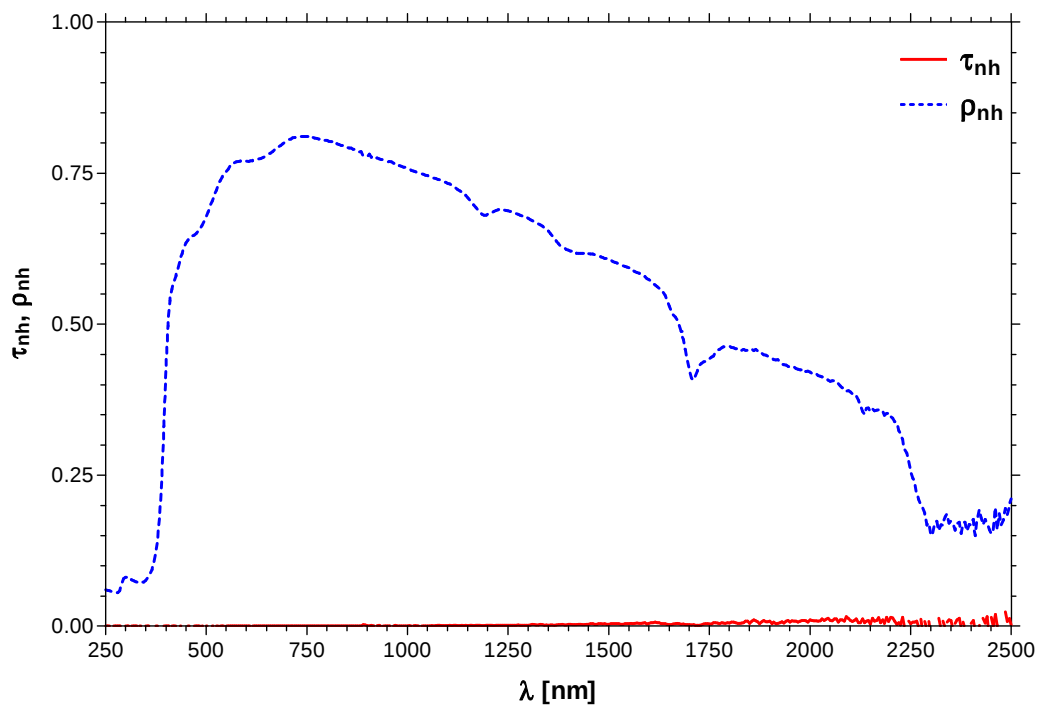


Figure 3: Spectral normal-hemispherical transmittance τ_{nh} and reflectance ρ_{nh} of sample **8296-6999-141141** in the solar spectral range.

Table 1: Solar, visual and UV normal-hemispherical transmittance τ_{nh} and reflectance ρ_{nh} according to EN 410, solar transmittance τ_{nh} and reflectance ρ_{nh} according to different standards.

8296-6999-908908						
	EN 410			ASTM E903	ISO 9050	ASHRAE 74
	solar	VIS	UV	solar	solar	solar
τ_{nh}	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
ρ_{nh}	0.78	0.89	0.08	0.77	0.80	0.79
α	0.21	0.11	0.92	0.23	0.20	0.21

8296-6999-141141						
	EN 410			ASTM E903	ISO 9050	ASHRAE 74
	solar	VIS	UV	solar	solar	solar
τ_{nh}	0.001	< 0.001	< 0.001	0.001	0.001	0.001
ρ_{nh}	0.67	0.74	0.09	0.66	0.68	0.68
α	0.33	0.26	0.91	0.34	0.32	0.32

Table 2 and Table 3 show the solar transmittance $\tau_{nh,solar}$, the secondary heat transfer coefficient q_i and the total solar energy transmittance g_{tot} of different glazing combined with an outside sun protection system calculated according to EN ISO 52022-3 for the summer and reference (winter) environmental conditions listed in EN ISO 52022-3. Additionally the shading coefficient SC, the ratio of the total solar energy transmittance of the glazing with sun protection system to the total solar energy transmittance of the glazing without sun protection system is shown. Table 4 and Table 5 show the same values for an inside sun protection system.

Table 2: Solar transmittance $\tau_{nh,solar}$, secondary heat transfer coefficient $q_{i,tot}$ and total solar energy transmittance g_{tot} according to EN 52022-3 for an **outside** sun protection system in front of different glazing for **reference** environmental conditions. Additionally the Shading Coefficient SC is shown.

glazing	shading (outside)	$\tau_{nh,solar}$	$q_{i,tot}$	g_{tot}	SC
double	none	0.69	0.07	0.76	
double	8296-6999-908908	0.00	0.02	0.02	0.02
double	8296-6999-141141	0.00	0.03	0.03	0.04

glazing	shading (outside)	$\tau_{nh,solar}$	$q_{i,tot}$	g_{tot}	SC
heat protection	none	0.52	0.10	0.62	
heat protection	8296-6999-908908	0.00	0.01	0.01	0.02
heat protection	8296-6999-141141	0.00	0.02	0.02	0.03

glazing	shading (outside)	$\tau_{nh,solar}$	$q_{i,tot}$	g_{tot}	SC
sun protection	none	0.30	0.05	0.36	
sun protection	8296-6999-908908	0.00	0.01	0.01	0.04
sun protection	8296-6999-141141	0.00	0.02	0.02	0.06

Table 3: ... for **summer** environmental conditions.

glazing	shading (outside)	$\tau_{nh,solar}$	$q_{i,tot}$	g_{tot}	SC
double	none	0.69	0.07	0.76	
double	8296-6999-908908	0.00	0.03	0.03	0.04
double	8296-6999-141141	0.00	0.05	0.05	0.06

glazing	shading (outside)	$\tau_{nh,solar}$	$q_{i,tot}$	g_{tot}	SC
heat protection	none	0.52	0.10	0.62	
heat protection	8296-6999-908908	0.00	0.02	0.02	0.03
heat protection	8296-6999-141141	0.00	0.03	0.03	0.05

glazing	shading (outside)	$\tau_{nh,solar}$	$q_{i,tot}$	g_{tot}	SC
sun protection	none	0.30	0.05	0.36	
sun protection	8296-6999-908908	0.00	0.02	0.02	0.05
sun protection	8296-6999-141141	0.00	0.03	0.03	0.08

Table 4: Solar transmittance $\tau_{nh,solar}$, secondary heat transfer coefficient $q_{i,tot}$ and total solar energy transmittance g_{tot} according to EN 52022-3 for an **inside** sun protection system in front of different glazing for **reference** environmental conditions. Additionally the Shading Coefficient SC is shown.

glazing	shading (inside)	$\tau_{nh,solar}$	$q_{i,tot}$	g_{tot}	SC
double	none	0.69	0.07	0.76	
double	8296-6999-908908	0.00	0.22	0.22	0.28
double	8296-6999-141141	0.00	0.29	0.29	0.38

glazing	shading (inside)	$\tau_{nh,solar}$	$q_{i,tot}$	g_{tot}	SC
heat protection	none	0.52	0.10	0.62	
heat protection	8296-6999-908908	0.00	0.24	0.24	0.38
heat protection	8296-6999-141141	0.00	0.30	0.30	0.48

glazing	shading (inside)	$\tau_{nh,solar}$	$q_{i,tot}$	g_{tot}	SC
sun protection	none	0.30	0.05	0.36	
sun protection	8296-6999-908908	0.00	0.10	0.10	0.29
sun protection	8296-6999-141141	0.00	0.14	0.14	0.41

Table 5: ... for **summer** environmental conditions.

glazing	shading (inside)	$\tau_{nh,solar}$	$q_{i,tot}$	g_{tot}	SC
double	none	0.69	0.07	0.76	
double	8296-6999-908908	0.00	0.23	0.23	0.30
double	8296-6999-141141	0.00	0.30	0.30	0.39

glazing	shading (inside)	$\tau_{nh,solar}$	$q_{i,tot}$	g_{tot}	SC
heat protection	none	0.52	0.10	0.62	
heat protection	8296-6999-908908	0.00	0.26	0.26	0.41
heat protection	8296-6999-141141	0.00	0.32	0.32	0.51

glazing	shading (inside)	$\tau_{nh,solar}$	$q_{i,tot}$	g_{tot}	SC
sun protection	none	0.30	0.05	0.36	
sun protection	8296-6999-908908	0.00	0.12	0.12	0.35
sun protection	8296-6999-141141	0.00	0.16	0.16	0.46

Table 6 to Table 9 show classifications according to EN 14501 for the thermal comfort in combination with the reference glazing for summer environmental conditions (classification with respect to the **total solar energy transmittance g_{tot}** and the **secondary heat transfer coefficient $q_{i,tot}$**).

The classification for the thermal comfort “**protection from direct transmission**”, which depends on the normal-normal solar transmittance, yields a result of 4 for all samples as the solar and visual normal-normal transmittance of all samples is smaller than 0.001. The different glazing without sun protection shows a classification level of 0. Class 0 means „very low effect“, class 4 „very high effect“.

Table 6: Classification according to EN 14501 for thermal comfort in combination with the reference glazing (classification with reference to total solar energy transmittance g_{tot}) for an **outside** sun protection system and **summer** environmental conditions. Class 0 means „very low effect“. class 4 „very high effect“.

shading (outside)	double glazing	heat protection glazing	sun protection glazing
none	0	0	2
8296-6999-908908	4	4	4
8296-6999-141141	4	4	4

Table 7: Classification according to EN 14501 for thermal comfort in combination with the reference glazing (classification with reference to secondary heat transfer coefficient $q_{i,tot}$) for an **outside** sun protection system and **summer** environmental conditions. Class 0 means „very low effect“. class 4 „very high effect“.

shading (outside)	double glazing	heat protection glazing	sun protection glazing
none	3	3	3
8296-6999-908908	4	4	4
8296-6999-141141	3	3	4

Table 8: Classification according to EN 14501 for thermal comfort in combination with the reference glazing (classification with reference to total solar energy transmittance g_{tot}) for an **inside** sun protection system and **summer** environmental conditions. Class 0 means „very low effect“. class 4 „very high effect“.

shading (inside)	double glazing	heat protection glazing	sun protection glazing
none	0	0	2
8296-6999-908908	2	2	3
8296-6999-141141	2	2	2

Table 9: Classification according to EN 14501 for thermal comfort in combination with the reference glazing (classification with reference to secondary heat transfer coefficient $q_{i,tot}$) for an **inside** sun protection system and **summer** environmental conditions. Class 0 means „very low effect“. class 4 „very high effect“.

shading (inside)	double glazing	heat protection glazing	sun protection glazing
none	3	3	3
8296-6999-908908	1	1	2
8296-6999-141141	0	0	2

Würzburg, July 12, 2019

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