

Declarations of equivalence of Verosol sun screens

SilverScreen and EnviroScreen





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Principal	Verosol Fabrics B.V.
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Representative	ir. G.M. van Uffelen
Author	ir. G.M. van Uffelen +31 24 3570744 m.vanuffelen@peutz.nl

peutz bv, postbus 66, 6585 zh mook, +31 24 357 07 07, info@peutz.nl, www.peutz.nl

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1 Introduction

Verosol Fabrics B.V. of Eibergen, The Netherlands, have commissioned Peutz B.V. to formulate two declarations of equivalence concerning some Verosol interior sun screens combined with solar glazing.

Two types of Verosol SilverScreen fabric and two types of EnviroScreen fabric in combination with solar (ZHR⁺⁺) insulation glazing have been compared with normal (HR⁺⁺) insulation glazing combined with standard exterior sun screens. On behalf of Energy Performance calculations they have been compared with default values of the solar heat gain coefficient, g-value, conforming to the Dutch Standard NEN 7120:2012 Energieprestatie van Gebouwen – Bepalingsmethode (Energy Performance of Buildings – Determination Method) paragraph 11.7.2 and the Dutch ISSO publication 75.1 EPA-U Energieprestatiecertificaat (Energy Performance Certificate). For both fabrics, a declaration of equivalence has been edited. They both cover the two types of either fabric respectively.

Since the g-values are determined by the light reflecting and absorbing properties of the face of the fabric facing the window, and therefore are independent of the color of the interior face, the declarations are valid for all colors of a product range.

The report in hand describes and explains the underlying measurement data as well as the calculations and provides the declarations in the appendix.

2 Approach and basic assumptions

The declarations of equivalence, which can be found in appendices 1 and 2 to the report in hand, concern four fabrics from two product ranges.

It concerns the following SilverScreen and EnviroScreen fabric types, all provided with a reflecting metal layer at the exterior face, i.e. facing the window, of the fabric:

- SilverScreen 205 (4% open)
- SilverScreen 202 (2% open)
- EnviroScreen 805 (4% open)
- EnviroScreen 802 (2% open)

These must be combined with solar insulating glazing (ZHR⁺⁺) with a g-value of $g = 0.335$ or lower in case of EnviroScreen 805 (4% open) and solar insulating glazing (ZHR⁺⁺) with a g-value of $g = 0.419$ or lower in case of the three other fabrics. With a tighter, less open, fabric, so one that is less permeable to air and is more light reflecting, one can reach a lower g-value. Thus, a glazing with a higher g-value may be combined with it. So, a less open fabric has a wider range of applicability with respect to solar shading.

The reference glazing with default exterior shading conforming to the Dutch Standard NEN 7120:2012 paragraph 11.7.2. possesses a g-value amounting to $g_{gl} = 0,6$ conforming to table 11.2 from that Standard and the combination with exterior shading $g_{gl+sh} = 0,18$, conforming to table 11.4 from that Standard. The control of the shading, manual or automatic, or whether it is applied in a residential or office building does not matter, provided the control and application of the Verosol fabric is identical. After all, the control only affects the time the screens are lowered (as described in table 11.3 from the above-mentioned Standard) and, as a consequence, the cooling demand of the building, but it does not affect the g-value of the fabric or shadings as such.

Verosol Fabrics B.V. have computed the g-value with the TNO package WIS 3.0.1. sp2 conforming to the detailed method of the European Standard EN 13363-2:2005, under reference conditions. The same package has been used to compute the default values prescribed in the Standard referred to in the above, NEN 7120:2012, as can be verified in the explanatory Remark 3 in paragraph 11.7.3. These WIS calculations have been assessed by Peutz B.V. Please refer to appendices 3 to 6 for dumps of the calculations. The solar insulation glazing applied in combination with the Verosol fabrics is 60/30 ZHR⁺⁺ glazing with a thermal transmission value amounting to $U = 1,06 \text{ W/m}^2\text{K}$ and a g-value $g_{gl} = 0.335$ in case of EnviroScreen 805. It concerns 70/40 ZHR⁺⁺ glazing with a thermal transmission value amounting to $U = 1,07 \text{ W/m}^2\text{K}$ and a g-value $g_{gl} = 0,419$ in case of SilverScreen 202, SilverScreen 205 and EnviroScreen 802.

The WIS calculation model is a so-called thermal network node model that computes the energy balance over the total system, that comprises the exterior glass pane, the cavity between the window panes, the interior glass pane, cavity between glass and fabric as well as the fabric itself. The heat transfer coefficients (convective and radiative) between glass

and air nodes as well as the ambient temperature nodes and solar heat gains to the nodes have been employed conforming to EN 13363-2.

It has been assumed there occurs a limited amount of ventilation of the cavity between fabric and glazing, upon application of cassette roller blinds combined with side guidance profiles. As a result, the heat that is gathered between fabric and glass cannot flow towards the dwelling, but will be mainly transmitted towards the exterior by means of thermal transmission and radiation. In this manner, the absorbed solar radiation (despite the reflecting metal layer) contributed less to the g-value. The WIS node model computes these effects in an integral manner.

The reflection factors of the exterior face of SilverScreen 205 fabrics have been measured by TNO and laid down in their report: TNO-report2007-D-R0251/B Determination of the optical properties of SilverScreen fabrics dated March 8th, 2007 and have been adopted in the WIS model for wave length bands of 10 nm width.

The reflection factors of the exterior face of SilverScreen 202 fabrics have been measured by Solar Energy Materials Research Laboratory Sonnergy Limited and laid down in their report No. 14/464 THE OPTICAL PROPERTIES OF THE VEROSOL SILVERSCREEN 2% 202 ED01 BLIND SAMPLE dated May 2014 and the reflection factors of the exterior face of EnviroScreen have as well been measured by Solar Energy Materials Research Laboratory Sonnergy Limited and laid down in their report: Report No. 14/465 en 14/466 THE OPTICAL PROPERTIES OF THE VEROSOL ENVIROSCREEN 802-000 AND 802-829 BLIND SAMPLES and THE OPTICAL PROPERTIES OF VEROSOL ENVIROSCREEN 805-000 AND 805-829 BLIND SAMPLES respectively. These have as well been adopted in the WIS model for wave length bands of 10 nm width.

In appendices 3 to 6 the WIS calculations can be found.

In the table down here the calculated g-values have been summarized.

t2.1 Calculated g-values SilverScreen and EnviroScreen in combination with solar ZHR++ glazing

Type of fabric	Type of glazing	g_{gl+sh}
SilverScreen 205 (4% open)	70/40	0,158
SilverScreen 202 (2% open)	70/40	0,152
EnviroScreen 805 (4% open)	60/30	0,171
EnviroScreen 802 (2% open)	70/40	0,165

This table shows that for all four fabrics considered, the g-values are lower than the default value valid for thermal HR⁺⁺ glazing in combination with exterior solar shading: $g_{gl+sh} = 0,18$, conforming to table 11.4 of the Dutch Standard NEN 7120:2012. The calculations even show a small margin between the calculated values and the default value, which makes the conclusions with respect to equivalence slightly conservative, i.e on the safe side.

3 Summary and conclusions

Verosol Fabrics B.V. of Eibergen, The Netherlands, have commissioned Peutz B.V. to formulate two declarations of equivalence concerning some Verosol interior sun screens combined with solar glazing.

Two types of Verosol SilverScreen fabric and two types of EnviroScreen fabric in combination with solar (ZHR⁺⁺) insulation glazing have been compared with normal (HR⁺⁺) insulation glazing combined with standard exterior sun screens. On behalf of Energy Performance calculations they have been compared with default values of the solar heat gain coefficient, g-value, conforming to the Dutch Standard NEN 7120:2012 Energieprestatie van Gebouwen – Bepalingsmethode (Energy Performance of Buildings – Determination Method) paragraph 11.7.2 and the Dutch ISSO publication 75.1 EPA-U Energieprestatiecertificaat (Energy Performance Certificate). For both fabrics a declaration of equivalence has been edited, which both cover the two types of either fabric respectively.

Since the g-values are determined by the properties of the face of the fabric facing the window, and therefore are independent of the color of the interior face, the declarations are valid for all colors of a product range.

It has been assumed there is a limited amount of ventilation of the cavity between fabric and glazing, upon application of cassette roller blinds combined with side guidance profiles.

Each combination of fabric and solar insulating ZHR⁺⁺ glazing considered, possesses a g-value beneath $g_{gl+sh} = 0,18$, the default value for normal HR⁺⁺ glazing combined with exterior shading in the Dutch Standard NEN 7120:2012. A lower value is more favourable in terms of cooling demands, so in this manner, equivalence has been proved.

For SilverScreen 202 and 205 as well as EnviroScreen 802 (2% open) fabrics the equivalence is valid for solar glazing with a g-value of 0.419 or lower. So it is valid for 70/40 (ZHR⁺⁺) glazing or better.

For the EnviroScreen 805 (4% open) fabrics the equivalence is valid for solar glazing with a g-value of 0.335 or lower. So it is valid for 60/30 (ZHR⁺⁺) glazing or better.



Mook,

This report contains 7 pages and 6 appendices

Appendix 1 Declaration of equivalence Verosol SilverScreen

PEUTZ

Subject:	Controlled declaration of equivalence
Application:	NEN 7120:2012 and ISSO 75.1
Manufacturer:	Verosol Fabrics B.V.
Type:	SilverScreen
Date of commencement:	September 16 th , 2014
Period of validity:	unlimited

For Verosol SilverScreen in side guidance profiles it is verified that for all interior face colors:
Type 205 combined with ZHR⁺⁺ solar glazing with a g-value of 0.419 or lower is equivalent to default external sun shading conforming to NEN 7120:2012 combined with HR⁺⁺ glazing
Type 202 combined with ZHR⁺⁺ solar glazing with a g-value of 0.419 or lower is equivalent to default external sun shading conforming to NEN 7120:2012 combined with HR⁺⁺ glazing

The underlying calculations have been described in report D 2923-2E-RA dated May 4th, 2015 by Peutz bv.

Mook, May 4th, 2015



Appendix 2 Declaration of equivalence Verosol EnviroScreen

PEUTZ

Subject:	Controlled declaration of equivalence
Application:	NEN 7120:2012 and ISSO 75.1
Manufacturer:	Verosol Fabrics B.V.
Type:	EnviroScreen
Date of commencement:	September 16 th , 2014
Period of validity:	unlimited

For Verosol EnviroScreen in side guidance profiles it is verified that for all interior face colors:
Type 802 combined with ZHR⁺⁺ solar glazing with a g-value of 0.419 or lower is equivalent to default external sun shading conforming to NEN 7120:2012 combined with HR⁺⁺ glazing
Type 805 combined with ZHR⁺⁺ solar glazing with a g-value of 0.335 or lower is equivalent to default external sun shading conforming to NEN 7120:2012 combined with HR⁺⁺ glazing

The underlying calculations have been described in report D 2923-2E-RA dated May 4th, 2015 by Peutz bv.

Mook, May 4th, 2015



**Appendix 3 WIS
calculation Verosol
SilverScreen 205**



tbv gelijkwaardigheidsverklaring met 7040 glas-met silverScreen4%open
--- Registered WIS user ---
Registered organisation : Verosol
Registered user name : Evert Bos

--- Report transparent system : tbv Gelijkwaardigheidsverklaring met 7040 glas met SilverScreen 4% open---

--- Basics (key thermal and solar properties) ---

name transparent system : tbv Gelijkwaardigheidsverklaring met 7040 glas
U-value : 0.714 [W/(m2.K)]
solar factor (g) : 0.158 [-] (total solar energy transmittance)

The g-value includes the effect of all changes in the situation with sun and situation without sun. Consequently, the g-value in case of free (thermally driven) ventilation in one of the gaps is also influenced by the increase in the air flow with sun compared to the situation without sun. This air flow may be cold or warm. This may lead to g-values higher than 1 (one) or lower than 0 (zero). See the help file for more information.

solar direct transmittance outdoor tot : 0.0202 [-]
solar direct transmittance indoor tot : 0.0182 [-]
solar direct reflectance outdoor tot : 0.452 [-]
solar direct reflectance indoor tot : 0.0955 [-]

solar direct transmittance outdoor diff : 0.00712 [-]
solar direct transmittance indoor diff : 0.00515 [-]
solar direct reflectance outdoor diff : 0.169 [-]
solar direct reflectance indoor diff : 0.0951 [-]

light transmittance outdoor tot : 0.0364 [-]
light transmittance indoor tot : 0.0322 [-]
light reflectance outdoor tot : 0.491 [-]
light reflectance indoor tot : 0.0884 [-]

light transmittance outdoor diff : 0.0123 [-]
light transmittance indoor diff : 0.00806 [-]
light reflectance outdoor diff : 0.375 [-]
light reflectance indoor diff : 0.0883 [-]

UV transmittance outdoor tot : 0.00390 [-]
UV transmittance indoor tot : 0.00352 [-]
UV reflectance outdoor tot : 0.102 [-]
UV reflectance indoor tot : 0.0831 [-]

UV transmittance outdoor diff : 0.00149 [-]
UV transmittance indoor diff : 0.00112 [-]
UV reflectance outdoor diff : 0.00939 [-]
UV reflectance indoor diff : 0.0828 [-]

general colour rendering index (Ra) : 95.0 [-]

--- Split U-value ---

Uconv : 0.280 [W/m2.K]
Uir : 0.357 [W/m2.K]
Uvent : 0.0768 [W/m2.K]
-----+
Utotal : 0.714 [W/m2.K]

--- split all 'dark' heat flow coefficients into fractions (h-values) ---

h_conv,indoor : 0.280 [W/m2.K]

tbv gelijkwaardigheidsverklaring met 7040 glas-met silverScreen4%open

h_ir,indoor	:	0.357	[w/m2.K]
h_conv,outdoor	:	0.582	[w/m2.K]
h_ir,outdoor	:	0.132	[w/m2.K]
h_vent	:	-0.0768	[w/m2.K]

checksum (expected value = h_indoor - h_outdoor - h_vent = 0) : 0.000
[w/m2.K]

--- Split solar factor (g) into fractions ---

solar direct transmittance	:	0.0202	[-]
solar factor convective	:	0.0567	[-]
solar factor thermal radiative ir	:	0.0737	[-]
solar factor ventilation	:	0.00698	[-]
		-----	+
solar factor (g)	:	0.158	[-]

--- Split solar gain coefficients to outdoor side into fractions ---

solar fraction reflected to outdoor	:	0.452	[-]
solar fraction convected to outdoor	:	0.316	[-]
solar fraction th. radiated to outdoor	:	0.0740	[-]
solar fraction ventilated to outdoor	:	0.000	[-]
		-----	+
solar fraction to outdoor	:	0.842	[-]

--- Split all solar fractions, optical part ---

solar direct transmittance	:	0.0202	[-]
solar direct reflectance	:	0.452	[-]
solar absorption fraction layer 1	:	0.373	[-]
solar absorption fraction layer 2	:	0.000	[-]
solar absorption fraction layer 3	:	0.0508	[-]
solar absorption fraction layer 4	:	0.000	[-]
solar absorption fraction layer 5	:	0.104	[-]

checksum (expected value = 1) : 1.00 [-]

--- Split all solar fractions, thermal part (a-values) ---

solar absorbed	:	0.527	[-]
conv indoor	:	0.0567	[-]
ir indoor	:	0.0737	[-]
conv outdoor	:	0.316	[-]
ir outdoor	:	0.0740	[-]
gap vent	:	0.00698	[-]

checksum (abs-others. expected value = 0) : 0.000 [-]

--- Short description conditions used for calculations ---

Calculated using setting: No restrictions (expert level)
Therefore results are calculated using user selected methods and settings

For solar calculations in the total solar range, spectral properties are used

For solar calculations in the visual range, spectral properties are used

For solar calculations in the uv range, spectral properties are used

The solar spectrum of EN 410 is used with air mass 1

tbv gelijkwaardigheidsverklaring met 7040 glas-met silverScreen4%open

--- Short system description ---

(from outdoor to indoor)

layer 1 is a Pane named : Energy5.gvb with pane in original position.
layer 2 is a Gap named : Air-Argon 10/90
layer 3 is a Pane named : clear_05.gvb with pane in original position.
layer 4 is a Gap named : Air which is free ventilated !
layer 5 is a Shading named : SilverScreen EB02-2012

Interpolated wavelength values !!

--- Spectral Properties Total Solar ---

For perpendicular incidence angle

wavel : wavelength [nm]
Refl_o : spectral reflectance outdoor side
Refl_i : spectral reflectance indoor side
Transm : spectral transmittance

Wavel	Transm	Refl_o	Refl_i
300.0	0.000	0.048	0.071
320.0	0.000	0.047	0.067
340.0	0.001	0.056	0.077
360.0	0.004	0.103	0.092
380.0	0.014	0.247	0.100
400.0	0.026	0.375	0.104
420.0	0.031	0.413	0.101
440.0	0.033	0.427	0.100
460.0	0.034	0.446	0.099
480.0	0.036	0.476	0.097
500.0	0.037	0.494	0.095
520.0	0.037	0.513	0.093
540.0	0.037	0.519	0.090
560.0	0.038	0.511	0.086
580.0	0.036	0.491	0.084
600.0	0.035	0.463	0.083
620.0	0.034	0.432	0.083
640.0	0.033	0.399	0.087
660.0	0.032	0.367	0.088
680.0	0.030	0.341	0.082
700.0	0.028	0.325	0.075
720.0	0.026	0.316	0.090
740.0	0.024	0.314	0.093
760.0	0.021	0.322	0.098
780.0	0.019	0.335	0.100
800.0	0.016	0.349	0.100
850.0	0.011	0.395	0.101
900.0	0.009	0.445	0.103
950.0	0.006	0.467	0.105
1000.0	0.005	0.490	0.102
1050.0	0.004	0.508	0.103
1100.0	0.003	0.523	0.103
1150.0	0.003	0.536	0.102
1200.0	0.002	0.552	0.102
1250.0	0.002	0.564	0.103
1300.0	0.002	0.586	0.104
1350.0	0.002	0.604	0.103
1400.0	0.001	0.623	0.103
1450.0	0.001	0.653	0.104
1500.0	0.001	0.677	0.104
1550.0	0.001	0.699	0.106

tbv gelijkwaardigheidsverklaring met 7040 glas-met silverScreen4%open

1600.0	0.001	0.715	0.105
1650.0	0.001	0.722	0.104
1700.0	0.001	0.728	0.097
1750.0	0.001	0.729	0.099
1800.0	0.000	0.723	0.103
1850.0	0.000	0.721	0.103
1900.0	0.000	0.713	0.105
1950.0	0.001	0.718	0.105
2000.0	0.001	0.723	0.106
2050.0	0.001	0.732	0.107
2100.0	0.000	0.731	0.108
2200.0	0.000	0.695	0.106
2300.0	0.000	0.721	0.070
2400.0	0.000	0.727	0.078
2500.0	0.000	0.728	0.096

--- Spectral Properties Light ---

For perpendicular incidence angle

wavel : wavelength [nm]
 Refl_o : spectral reflectance outdoor side
 Refl_i : spectral reflectance indoor side
 Transm : spectral transmittance

wavel	Transm	Refl_o	Refl_i
380.0	0.014	0.247	0.100
390.0	0.021	0.323	0.102
400.0	0.026	0.375	0.104
410.0	0.029	0.402	0.102
420.0	0.031	0.413	0.101
430.0	0.031	0.424	0.101
440.0	0.033	0.427	0.100
450.0	0.033	0.433	0.099
460.0	0.034	0.446	0.099
470.0	0.035	0.460	0.098
480.0	0.036	0.476	0.097
490.0	0.037	0.485	0.096
500.0	0.037	0.494	0.095
510.0	0.037	0.505	0.094
520.0	0.037	0.513	0.093
530.0	0.037	0.517	0.092
540.0	0.037	0.519	0.090
550.0	0.037	0.514	0.087
560.0	0.038	0.511	0.086
570.0	0.037	0.503	0.085
580.0	0.036	0.491	0.084
590.0	0.036	0.478	0.084
600.0	0.035	0.463	0.083
610.0	0.035	0.449	0.082
620.0	0.034	0.432	0.083
630.0	0.034	0.414	0.085
640.0	0.033	0.399	0.087
650.0	0.032	0.383	0.088
660.0	0.032	0.367	0.088
670.0	0.031	0.356	0.087
680.0	0.030	0.341	0.082
690.0	0.029	0.330	0.077
700.0	0.028	0.325	0.075
710.0	0.027	0.316	0.086
720.0	0.026	0.316	0.090
730.0	0.025	0.313	0.091
740.0	0.024	0.314	0.093
750.0	0.023	0.318	0.096
760.0	0.021	0.322	0.098
770.0	0.020	0.329	0.099
780.0	0.019	0.335	0.100

tbv gelijkwaardigheidsverklaring met 7040 glas-met silverScreen4%open

--- Spectral Properties Uv ---

For perpendicular incidence angle

wavel : wavelength [nm]
Refl_o : spectral reflectance outdoor side
Refl_i : spectral reflectance indoor side
Transm : spectral transmittance

Wavel	Transm	Refl_o	Refl_i
282.5	0.000	0.098	0.049
287.5	0.000	0.071	0.053
292.5	0.000	0.056	0.062
297.5	0.000	0.049	0.070
302.5	0.000	0.047	0.071
307.5	0.000	0.047	0.069
312.5	0.000	0.047	0.069
317.5	0.000	0.047	0.068
322.5	0.000	0.047	0.067
327.5	0.000	0.049	0.066
332.5	0.000	0.052	0.068
337.5	0.001	0.054	0.074
342.5	0.001	0.059	0.080
347.5	0.001	0.066	0.085
352.5	0.002	0.075	0.087
357.5	0.003	0.091	0.090
362.5	0.005	0.119	0.092
367.5	0.008	0.159	0.093
372.5	0.011	0.203	0.096
377.5	0.014	0.234	0.099

--- temperatures ---

for perpendicular incidence angle

Outdoor air temperature : 5.000
Outdoor radiant temperature : 5.000

Outdoor surface temperature : 10.751
layer (center) 1 : 11.061
border : 11.099
layer (center) 2 : 17.022
border : 22.945
layer (center) 3 : 22.983
border : 22.985
layer (center) 4 : 22.948
border : 23.609
layer (center) 5 : 23.612
Indoor surface temperature : 23.563

Indoor air temperature : 20.000
Indoor radiant temperature : 20.000

--- Network ---

Layer and node properties from outdoor side to indoor side

-- solar absorption fractions for layers [0-1]:

Solar absorption fraction of layer 1 : 0.373
Solar absorption fraction of layer 2 : 0.000
Solar absorption fraction of layer 3 : 0.051
Solar absorption fraction of layer 4 : 0.000
Solar absorption fraction of layer 5 : 0.104

-- conduction / convection heat transfer coefficients for layers:

IR and ventilation not included !

tbv gelijkwaardigheidsverklaring met 7040 glas-met silverScreen4%open
 Heat transfer coeff of layer 1 : 206.186
 Heat transfer coeff of layer 2 : 1.127
 Heat transfer coeff of layer 3 : 206.186
 Heat transfer coeff of layer 4 : 0.644
 Heat transfer coeff of layer 5 : 300.000

Network of thermal coefficients (h) for perpendicular incidence angle

-- Total Network:

hs are given between all nodes
 nodes are from outdoor to indoor
 all layers (including gaps) have 3 nodes of which 2 are joined with
 neighboring layers

1 : node 1 (node at outdoor surface)
 2 : node 2 (center node of outdoor side layer) ...
 o_air : outdoor air node
 o_rad : outdoor radiant node
 i : indoor node

8	9	1	10	2	11	3	4	5	6	7
						o_air	o_rad		i	
0.000	1	0.000	412.371	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	2	412.371	0.000	412.371	0.000	18.000	4.207	0.000	0.000	0.000
0.000	3	0.000	412.371	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	4	0.000	0.000	0.000	2.253	0.000	0.000	0.000	0.000	0.000
0.000	5	0.000	0.000	0.203	2.253	0.000	0.000	412.371	0.000	0.000
0.000	6	0.000	0.000	0.000	0.000	0.000	412.371	0.000	412.371	0.000
1.348	7	0.000	0.000	0.000	0.000	0.000	0.000	412.371	0.000	0.000
0.000	8	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.348
1.348	9	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.915
0.000	10	0.000	600.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	o_air	18.000	0.000	0.000	0.000	0.000	0.000	0.000	8.306	0.000
0.000	o_rad	4.207	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	i	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

-- gap properties conduction/convection/ventilation :

Layer : 2 is a gap with the following calculated properties :

Nusselt_number : 1.000
 Prandtl_number : 0.683
 Grashof_number ; 9076.711

layer : 4 is a ventilated gap with the following calculated ventilation
 properties :

h between bordering layers (h_gap) [W/(m2.K)] : 0.674

tbv gelijkwaardigheidsverklaring met 7040 glas-met SilverScreen4%open
 h between incoming air and air in layer (h_between) [w/(m2.K)] : 0.319
 air speed [m/s] : 0.015
 air temperature at center [oC] : 22.948
 air temperature at exit [oC] : 23.296

--- System description ---
 (from outdoor to indoor for perpendicular incidence angle)

-- layer : 1 is a : Pane --

name : Energy5.gvb
 id : 2755
 thickness : 4.850 [mm]
 thermal conductance : 1.000 [w/(m.k)]
 coating code : UC [-]
 IR transmittance : 0.000 [-]
 IR emissivity outdoor : 0.837 [-]
 IR emissivity indoor : 0.037 [-]
 solar direct transmittance : 0.436 [-]
 solar direct reflectance outdoor : 0.260 [-]
 solar direct reflectance indoor : 0.366 [-]
 light transmittance : 0.786 [-]
 light reflectance outdoor : 0.066 [-]
 light reflectance indoor : 0.063 [-]
 UV transmittance : 0.084 [-]
 UV reflectance outdoor : 0.091 [-]
 UV reflectance indoor : 0.205 [-]
 General colour rendering index (Ra) : 98.000 [-] (0-100)

component information
 Type: Coated Appearance:

-- layer : 2 is a : Gap --

name	:	Air-Argon 10/90		
gap width	:	16.000 [mm]		
		-10 oC	0 oC	10 oC
conduction	:	0.017	0.017	0.018
0.018				
dynamic viscosity	:	0.000	0.000	0.000
0.000				
density	:	1.779	1.681	1.652
1.595				
CP	:	567.900	567.900	567.900
567.900				

-- layer : 3 is a : Pane --

name : clear_05.gvb
 id : 2629
 thickness : 4.850 [mm]
 thermal conductance : 1.000 [w/(m.k)]

tbv gelijkwaardigheidsverklaring met 7040 glas-met silverScreen4%open
coating code : UU [-]

IR transmittance : 0.000 [-]
IR emissivity outdoor : 0.837 [-]
IR emissivity indoor : 0.837 [-]

solar direct transmittance : 0.827 [-]
solar direct reflectance outdoor : 0.074 [-]
solar direct reflectance indoor : 0.074 [-]

light transmittance : 0.893 [-]
light reflectance outdoor : 0.080 [-]
light reflectance indoor : 0.080 [-]

UV transmittance : 0.590 [-]
UV reflectance outdoor : 0.067 [-]
UV reflectance indoor : 0.067 [-]

General colour rendering index (Ra) : 99.000 [-] (0-100)

component information
Type: Monolithic Appearance: Clear

-- layer : 4 is a : Gap --

name	: Air			
gap width	: 40.000	[mm]		
		-10 oC	0 oC	10 oC
20 oC				
conduction	:	0.023	0.024	0.025
0.026				
dynamic viscosity	:	0.000	0.000	0.000
0.000				
density	:	1.326	1.277	1.232
1.189				
CP	:	1008.000	1008.000	1008.000
1008.000				

This is a free ventilated layer

air is coming from indoors
air is going to indoors

width opening bottom [mm], per m width: 2.000
width opening top [mm], per m width: 2.000
width opening side [mm], per m width: 0.000

h between bordering layers (h_gap) [w/(m2.K)] : 0.674
h between incoming air and air in layer (h_between) [w/(m2.K)] : 0.319
air speed in gap [m/s] : 0.015
air flux [dm3/s] per m width : 0.595
air temperature at center [oC] : 22.948
air temperature at exit [oC] : 23.296

-- layer : 5 is a : Shading --

calculation method : View factor method
name : SilverScreen EB02-2012
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tbv gelijkwaardigheidsverklaring met 7040 glas-met silverScreen4%open
id : 1234
thickness : 0.500 [mm]
thermal conductance : 0.150 [w/(m.k)]

IR transmittance outdoor : 0.000 [-]
IR transmittance indoor : 0.000 [-]
IR emissivity outdoor : 0.160 [-]
IR emissivity indoor : 0.810 [-]

Following properties are total properties (direct + diffuse) for perpendicular incidence angle

solar transmittance outdoor : 0.043 [-]
solar transmittance indoor : 0.043 [-]
solar reflectance outdoor : 0.760 [-]
solar reflectance indoor : 0.094 [-]

light transmittance outdoor : 0.042 [-]
light transmittance indoor : 0.042 [-]
light reflectance outdoor : 0.747 [-]
light reflectance indoor : 0.088 [-]

UV transmittance outdoor : 0.042 [-]
UV transmittance indoor : 0.042 [-]
UV reflectance outdoor : 0.756 [-]
UV reflectance indoor : 0.083 [-]

component information
datasource Verosol Laboratory Lambda 900

--- Environment ---

name : EN13363-2 referentie
id : 49

radiant temperature outdoor : 5.000 [oC]
air temperature outdoor : 5.000 [oC]
radiant temperature indoor : 20.000 [oC]
air temperature indoor : 20.000 [oC]

Solar radiation : 300.000 [w/m2]
Convection coeff. outdoor : 18.000 [w/(m2.k)]
Convection coeff. indoor : 3.600 [w/(m2.k)]

--- Disclaimer ---

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**Appendix 4 WIS
calculation Verosol
SilverScreen 202**



tbv gelijkwaardigheidsverklaring met 7040 glas-met silverScreen2%open
 --- Registered WIS user ---
 Registered organisation : Verosol
 Registered user name : Evert Bos

--- Report transparent system : tbv Gelijkwaardigheidsverklaring met 7040 glas

--- Basics (key thermal and solar properties) ---

name transparent system : tbv Gelijkwaardigheidsverklaring met
 7040 glas met SilverScreen 2% open
 U-value : 0.685 [W/(m2.K)]
 solar factor (g) : 0.152 [-] (total solar energy
 transmittance)

The g-value includes the effect of all changes in the situation
 with sun and situation without sun.
 Consequently, the g-value in case of free (thermally driven)
 ventilation in one of the gaps is also influenced by the
 increase in the air flow with sun compared to the situation
 without sun. This air flow may be cold or warm.
 This may lead to g-values higher than 1 (one) or lower than 0 (zero).
 See the help file for more information.

solar direct transmittance outdoor tot : 0.0135 [-]
 solar direct transmittance indoor tot : 0.0120 [-]
 solar direct reflectance outdoor tot : 0.456 [-]
 solar direct reflectance indoor tot : 0.714 [-]

solar direct transmittance outdoor diff : 0.00610 [-]
 solar direct transmittance indoor diff : 0.00467 [-]
 solar direct reflectance outdoor diff : 0.173 [-]
 solar direct reflectance indoor diff : 0.714 [-]

light transmittance outdoor tot : 0.0244 [-]
 light transmittance indoor tot : 0.0213 [-]
 light reflectance outdoor tot : 0.499 [-]
 light reflectance indoor tot : 0.797 [-]

light transmittance outdoor diff : 0.0109 [-]
 light transmittance indoor diff : 0.00777 [-]
 light reflectance outdoor diff : 0.384 [-]
 light reflectance indoor diff : 0.797 [-]

UV transmittance outdoor tot : 0.00227 [-]
 UV transmittance indoor tot : 0.00205 [-]
 UV reflectance outdoor tot : 0.101 [-]
 UV reflectance indoor tot : 0.172 [-]

UV transmittance outdoor diff : 0.000880 [-]
 UV transmittance indoor diff : 0.000663 [-]
 UV reflectance outdoor diff : 0.00906 [-]
 UV reflectance indoor diff : 0.172 [-]

general colour rendering index (Ra) : 95.0 [-]

--- Split U-value ---

Uconv : 0.232 [W/m2.K]
 Uir : 0.373 [W/m2.K]
 Uvent : 0.0794 [W/m2.K]

 Utotal : 0.685 [W/m2.K]

--- split all 'dark' heat flow coefficients into fractions (h-values) ---

h_conv,indoor : 0.232 [W/m2.K]

tbv gelijkwaardigheidsverklaring met 7040 glas-met silverScreen2%open

h_ir,indoor	:	0.373	[w/m2.K]
h_conv,outdoor	:	0.560	[w/m2.K]
h_ir,outdoor	:	0.128	[w/m2.K]
h_vent	:	-0.0794	[w/m2.K]

checksum (expected value = h_indoor - h_outdoor - h_vent = 0) : 0.000
[w/m2.K]

--- Split solar factor (g) into fractions ---

solar direct transmittance	:	0.0135	[-]
solar factor convective	:	0.0528	[-]
solar factor thermal radiative ir	:	0.0789	[-]
solar factor ventilation	:	0.00688	[-]
		-----	+
solar factor (g)	:	0.152	[-]

--- Split solar gain coefficients to outdoor side into fractions ---

solar fraction reflected to outdoor	:	0.456	[-]
solar fraction convected to outdoor	:	0.318	[-]
solar fraction th. radiated to outdoor	:	0.0744	[-]
solar fraction ventilated to outdoor	:	0.000	[-]
		-----	+
solar fraction to outdoor	:	0.848	[-]

--- Split all solar fractions, optical part ---

solar direct transmittance	:	0.0135	[-]
solar direct reflectance	:	0.456	[-]
solar absorption fraction layer 1	:	0.375	[-]
solar absorption fraction layer 2	:	0.000	[-]
solar absorption fraction layer 3	:	0.0519	[-]
solar absorption fraction layer 4	:	0.000	[-]
solar absorption fraction layer 5	:	0.104	[-]

checksum (expected value = 1) : 1.00 [-]

--- Split all solar fractions, thermal part (a-values) ---

solar absorbed	:	0.531	[-]
conv indoor	:	0.0528	[-]
ir indoor	:	0.0789	[-]
conv outdoor	:	0.318	[-]
ir outdoor	:	0.0744	[-]
gap vent	:	0.00688	[-]

checksum (abs-others. expected value = 0) : 0.000 [-]

--- Short description conditions used for calculations ---

Calculated using setting: No restrictions (expert level)
Therefore results are calculated using user selected methods and settings

For solar calculations in the total solar range, spectral properties are used

For solar calculations in the visual range, spectral properties are used

For solar calculations in the uv range, spectral properties are used

The solar spectrum of EN 410 is used with air mass 1

tbv gelijkwaardigheidsverklaring met 7040 glas-met silverscreen2%open

--- Short system description ---

(from outdoor to indoor)

layer 1 is a Pane named : Energy5.gvb with pane in original position.
layer 2 is a Gap named : Air-Argon 10/90
layer 3 is a Pane named : clear_05.gvb with pane in original position.
layer 4 is a Gap named : Air which is free ventilated !
layer 5 is a Shading named : Silverscreen 2% 202 ED01 Sonnergy

Interpolated wavelength values !!

--- Spectral Properties Total Solar ---

For perpendicular incidence angle

wavel : wavelength [nm]
Refl_o : spectral reflectance outdoor side
Refl_i : spectral reflectance indoor side
Transm : spectral transmittance

Wavel	Transm	Refl_o	Refl_i
300.0	0.000	0.048	0.059
320.0	0.000	0.047	0.055
340.0	0.000	0.056	0.104
360.0	0.002	0.103	0.231
380.0	0.009	0.245	0.348
400.0	0.016	0.372	0.663
420.0	0.020	0.412	0.764
440.0	0.021	0.427	0.782
460.0	0.022	0.448	0.792
480.0	0.024	0.480	0.797
500.0	0.025	0.499	0.800
520.0	0.025	0.519	0.801
540.0	0.025	0.527	0.802
560.0	0.026	0.520	0.800
580.0	0.024	0.501	0.797
600.0	0.024	0.473	0.793
620.0	0.023	0.442	0.790
640.0	0.022	0.409	0.782
660.0	0.021	0.377	0.756
680.0	0.020	0.350	0.726
700.0	0.018	0.333	0.690
720.0	0.017	0.323	0.668
740.0	0.015	0.320	0.693
760.0	0.014	0.328	0.740
780.0	0.013	0.340	0.746
800.0	0.011	0.353	0.744
850.0	0.008	0.397	0.734
900.0	0.006	0.447	0.737
950.0	0.004	0.468	0.744
1000.0	0.003	0.491	0.750
1050.0	0.003	0.508	0.753
1100.0	0.002	0.523	0.757
1150.0	0.002	0.536	0.746
1200.0	0.002	0.552	0.700
1250.0	0.001	0.564	0.750
1300.0	0.001	0.586	0.752
1350.0	0.001	0.604	0.745
1400.0	0.001	0.623	0.700
1450.0	0.001	0.653	0.722
1500.0	0.001	0.678	0.735
1550.0	0.001	0.700	0.735

tbv gelijkwaardigheidsverklaring met 7040 glas-met silverScreen2%open

1600.0	0.001	0.715	0.733
1650.0	0.001	0.722	0.690
1700.0	0.001	0.728	0.487
1750.0	0.001	0.729	0.500
1800.0	0.000	0.723	0.588
1850.0	0.000	0.721	0.621
1900.0	0.000	0.713	0.635
1950.0	0.001	0.718	0.638
2000.0	0.000	0.723	0.654
2050.0	0.001	0.732	0.655
2100.0	0.000	0.731	0.652
2200.0	0.000	0.695	0.604
2300.0	0.000	0.721	0.189
2400.0	0.000	0.727	0.230
2500.0	0.000	0.728	0.294

--- Spectral Properties Light ---

For perpendicular incidence angle

wavel : wavelength [nm]
 Refl_o : spectral reflectance outdoor side
 Refl_i : spectral reflectance indoor side
 Transm : spectral transmittance

Wavel	Transm	Refl_o	Refl_i
380.0	0.009	0.245	0.348
390.0	0.013	0.320	0.489
400.0	0.016	0.372	0.663
410.0	0.019	0.400	0.744
420.0	0.020	0.412	0.764
430.0	0.021	0.424	0.773
440.0	0.021	0.427	0.782
450.0	0.022	0.434	0.788
460.0	0.022	0.448	0.792
470.0	0.023	0.463	0.794
480.0	0.024	0.480	0.797
490.0	0.024	0.490	0.799
500.0	0.025	0.499	0.800
510.0	0.025	0.511	0.800
520.0	0.025	0.519	0.801
530.0	0.025	0.524	0.801
540.0	0.025	0.527	0.802
550.0	0.025	0.522	0.801
560.0	0.026	0.520	0.800
570.0	0.025	0.511	0.797
580.0	0.024	0.501	0.797
590.0	0.024	0.488	0.794
600.0	0.024	0.473	0.793
610.0	0.023	0.460	0.792
620.0	0.023	0.442	0.790
630.0	0.023	0.424	0.786
640.0	0.022	0.409	0.782
650.0	0.022	0.393	0.773
660.0	0.021	0.377	0.756
670.0	0.021	0.366	0.725
680.0	0.020	0.350	0.726
690.0	0.019	0.338	0.711
700.0	0.018	0.333	0.690
710.0	0.018	0.324	0.680
720.0	0.017	0.323	0.668
730.0	0.016	0.320	0.661
740.0	0.015	0.320	0.693
750.0	0.015	0.324	0.727
760.0	0.014	0.328	0.740
770.0	0.013	0.334	0.744
780.0	0.013	0.340	0.746

tbv gelijkwaardigheidsverklaring met 7040 glas-met silverScreen2%open
 --- Spectral Properties Uv ---
 For perpendicular incidence angle
 wavel : wavelength [nm]
 Refl_o : spectral reflectance outdoor side
 Refl_i : spectral reflectance indoor side
 Transm : spectral transmittance

Wavel	Transm	Refl_o	Refl_i
282.5	0.000	0.098	0.053
287.5	0.000	0.071	0.055
292.5	0.000	0.056	0.057
297.5	0.000	0.049	0.059
302.5	0.000	0.047	0.059
307.5	0.000	0.047	0.057
312.5	0.000	0.047	0.057
317.5	0.000	0.047	0.055
322.5	0.000	0.047	0.055
327.5	0.000	0.049	0.056
332.5	0.000	0.052	0.063
337.5	0.000	0.054	0.086
342.5	0.001	0.059	0.125
347.5	0.001	0.066	0.169
352.5	0.001	0.075	0.201
357.5	0.002	0.091	0.222
362.5	0.003	0.119	0.240
367.5	0.005	0.158	0.259
372.5	0.006	0.201	0.282
377.5	0.008	0.233	0.321

--- temperatures ---

for perpendicular incidence angle

Outdoor air temperature : 5.000
 Outdoor radiant temperature : 5.000
 Outdoor surface temperature : 10.758
 layer (center) 1 : 11.068
 border : 11.106
 layer (center) 2 : 16.938
 border : 22.770
 layer (center) 3 : 22.807
 border : 22.807
 layer (center) 4 : 22.810
 border : 23.462
 layer (center) 5 : 23.463
 Indoor surface temperature : 23.433
 Indoor air temperature : 20.000
 Indoor radiant temperature : 20.000

--- Network ---

Layer and node properties from outdoor side to indoor side

-- solar absorption fractions for layers [0-1]:

Solar absorption fraction of layer 1 : 0.375
 Solar absorption fraction of layer 2 : 0.000
 Solar absorption fraction of layer 3 : 0.052
 Solar absorption fraction of layer 4 : 0.000
 Solar absorption fraction of layer 5 : 0.104

-- conduction / convection heat transfer coefficients for layers:

IR and ventilation not included !

tbv gelijkwaardigheidsverklaring met 7040 glas-met silverScreen2%open
 Heat transfer coeff of layer 1 : 206.186
 Heat transfer coeff of layer 2 : 1.126
 Heat transfer coeff of layer 3 : 206.186
 Heat transfer coeff of layer 4 : 0.644
 Heat transfer coeff of layer 5 : 500.000

Network of thermal coefficients (h) for perpendicular incidence angle

-- Total Network:

hs are given between all nodes
 nodes are from outdoor to indoor
 all layers (including gaps) have 3 nodes of which 2 are joined with
 neighboring layers

1 : node 1 (node at outdoor surface)
 2 : node 2 (center node of outdoor side layer) ...
 o_air : outdoor air node
 o_rad : outdoor radiant node
 i : indoor node

8	9	1	10	2	11	3	4	5	6	7
						o_air	o_rad		i	
0.000	1	0.000	412.371	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	2	412.371	0.000	412.371	0.000	18.000	4.207	0.000	0.000	0.000
0.000	3	0.000	412.371	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	4	0.000	0.000	0.000	2.252	0.000	0.000	0.000	0.000	0.000
0.000	5	0.000	0.000	0.203	2.252	0.000	0.000	412.371	0.000	0.000
0.000	6	0.000	0.000	0.000	0.000	0.000	412.371	0.000	412.371	0.000
1.346	7	0.000	0.000	0.000	0.000	0.000	0.000	412.371	0.000	0.000
0.000	8	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.346
1.346	9	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.405
0.000	10	0.000	1000.000	0.000	0.000	0.000	0.000	0.000	0.002	0.000
0.000	11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	o_air	18.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	o_rad	4.207	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	i	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.114
0.000		0.002	0.000	8.768	0.000	0.000	0.000	0.000	0.000	

-- gap properties conduction/convection/ventilation :

Layer : 2 is a gap with the following calculated properties :

Nusselt_number : 1.000
 Prandtl_number : 0.683
 Grashof_number ; 8949.146

layer : 4 is a ventilated gap with the following calculated ventilation properties :

h between bordering layers (h_gap) [W/(m2.K)] : 0.673

tbv gelijkwaardigheidsverklaring met 7040 glas-met silverScreen2%open
 h between incoming air and air in layer (h_between) [w/(m2.K)] : 0.311
 air speed [m/s] : 0.015
 air temperature at center [oC] : 22.810
 air temperature at exit [oC] : 23.134

--- system description ---
 (from outdoor to indoor for perpendicular incidence angle)

-- layer : 1 is a : Pane --

name : Energy5.gvb
 id : 2755
 thickness : 4.850 [mm]
 thermal conductance : 1.000 [w/(m.K)]
 coating code : UC [-]
 IR transmittance : 0.000 [-]
 IR emissivity outdoor : 0.837 [-]
 IR emissivity indoor : 0.037 [-]
 solar direct transmittance : 0.436 [-]
 solar direct reflectance outdoor : 0.260 [-]
 solar direct reflectance indoor : 0.366 [-]
 light transmittance : 0.786 [-]
 light reflectance outdoor : 0.066 [-]
 light reflectance indoor : 0.063 [-]
 UV transmittance : 0.084 [-]
 UV reflectance outdoor : 0.091 [-]
 UV reflectance indoor : 0.205 [-]
 General colour rendering index (Ra) : 98.000 [-] (0-100)

component information
 Type: Coated Appearance:

-- layer : 2 is a : Gap --

name	:	Air-Argon 10/90		
gap width	:	16.000 [mm]		
		-10 oC	0 oC	10 oC
conduction	:	0.017	0.017	0.018
0.018				
dynamic viscosity	:	0.000	0.000	0.000
0.000				
density	:	1.779	1.681	1.652
1.595				
CP	:	567.900	567.900	567.900
567.900				

-- layer : 3 is a : Pane --

name : clear_05.gvb
 id : 2629
 thickness : 4.850 [mm]
 thermal conductance : 1.000 [w/(m.K)]

tbv gelijkwaardigheidsverklaring met 7040 glas-met silverScreen2%open
coating code : UU [-]

IR transmittance : 0.000 [-]
IR emissivity outdoor : 0.837 [-]
IR emissivity indoor : 0.837 [-]

solar direct transmittance : 0.827 [-]
solar direct reflectance outdoor : 0.074 [-]
solar direct reflectance indoor : 0.074 [-]

light transmittance : 0.893 [-]
light reflectance outdoor : 0.080 [-]
light reflectance indoor : 0.080 [-]

UV transmittance : 0.590 [-]
UV reflectance outdoor : 0.067 [-]
UV reflectance indoor : 0.067 [-]

General colour rendering index (Ra) : 99.000 [-] (0-100)

component information
Type: Monolithic Appearance: Clear

-- layer : 4 is a : Gap --

name	: Air			
gap width	: 40.000	[mm]		
		-10 oC	0 oC	10 oC
20 oC				
conduction	:	0.023	0.024	0.025
0.026				
dynamic viscosity	:	0.000	0.000	0.000
0.000				
density	:	1.326	1.277	1.232
1.189				
CP	:	1008.000	1008.000	1008.000
1008.000				

This is a free ventilated layer

air is coming from indoors
air is going to indoors

width opening bottom [mm], per m width: 2.000
width opening top [mm], per m width: 2.000
width opening side [mm], per m width: 0.000

h between bordering layers (h_gap) [w/(m2.K)] : 0.673
h between incoming air and air in layer (h_between) [w/(m2.K)] : 0.311
air speed in gap [m/s] : 0.015
air flux [dm3/s] per m width : 0.581
air temperature at center [oC] : 22.810
air temperature at exit [oC] : 23.134

-- layer : 5 is a : Shading --

calculation method : View factor method
name : silverScreen 2% 202 ED01 Sonnergy
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tbv gelijkwaardigheidsverklaring met 7040 glas-met silverScreen2%open
id : 1320
thickness : 0.400 [mm]
thermal conductance : 0.200 [w/(m.k)]

IR transmittance outdoor : 0.020 [-]
IR transmittance indoor : 0.020 [-]
IR emissivity outdoor : 0.070 [-]
IR emissivity indoor : 0.890 [-]

Following properties are total properties (direct + diffuse) for perpendicular incidence angle

solar transmittance outdoor : 0.029 [-]
solar transmittance indoor : 0.029 [-]
solar reflectance outdoor : 0.781 [-]
solar reflectance indoor : 0.714 [-]

light transmittance outdoor : 0.028 [-]
light transmittance indoor : 0.028 [-]
light reflectance outdoor : 0.760 [-]
light reflectance indoor : 0.797 [-]

UV transmittance outdoor : 0.025 [-]
UV transmittance indoor : 0.025 [-]
UV reflectance outdoor : 0.734 [-]
UV reflectance indoor : 0.172 [-]

component information
Openness Factor 2 %

--- Environment ---

name : EN13363-2 referentie
id : 49

radiant temperature outdoor : 5.000 [oC]
air temperature outdoor : 5.000 [oC]
radiant temperature indoor : 20.000 [oC]
air temperature indoor : 20.000 [oC]

Solar radiation : 300.000 [w/m2]
Convection coeff. outdoor : 18.000 [w/(m2.k)]
Convection coeff. indoor : 3.600 [w/(m2.k)]

--- Disclaimer ---

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**Appendix 5 WIS
calculation Verosol
EnviroScreen 805**



tbv gelijkwaardigheidsverklaring met 6030 glas-met EnviroScreen 805
 --- Registered WIS user ---
 Registered organisation : Verosol
 Registered user name : Evert Bos

--- Report transparent system : tbv gelijkwaardigheidsverklaring met 6030 glas met EnviroScreen 805---

--- Basics (key thermal and solar properties) ---

name transparent system : tbv gelijkwaardigheidsverklaring met 6030 glas
 U-value : 0.792 [W/(m2.K)]
 solar factor (g) : 0.171 [-] (total solar energy transmittance)

The g-value includes the effect of all changes in the situation with sun and situation without sun. Consequently, the g-value in case of free (thermally driven) ventilation in one of the gaps is also influenced by the increase in the air flow with sun compared to the situation without sun. This air flow may be cold or warm. This may lead to g-values higher than 1 (one) or lower than 0 (zero). See the help file for more information.

solar direct transmittance outdoor tot	:	0.0275	[-]
solar direct transmittance indoor tot	:	0.0246	[-]
solar direct reflectance outdoor tot	:	0.400	[-]
solar direct reflectance indoor tot	:	0.546	[-]
solar direct transmittance outdoor diff	:	0.0136	[-]
solar direct transmittance indoor diff	:	0.0108	[-]
solar direct reflectance outdoor diff	:	0.0917	[-]
solar direct reflectance indoor diff	:	0.545	[-]
light transmittance outdoor tot	:	0.0556	[-]
light transmittance indoor tot	:	0.0487	[-]
light reflectance outdoor tot	:	0.375	[-]
light reflectance indoor tot	:	0.572	[-]
light transmittance outdoor diff	:	0.0276	[-]
light transmittance indoor diff	:	0.0208	[-]
light reflectance outdoor diff	:	0.222	[-]
light reflectance indoor diff	:	0.572	[-]
UV transmittance outdoor tot	:	0.00661	[-]
UV transmittance indoor tot	:	0.00614	[-]
UV reflectance outdoor tot	:	0.157	[-]
UV reflectance indoor tot	:	0.230	[-]
UV transmittance outdoor diff	:	0.00228	[-]
UV transmittance indoor diff	:	0.00180	[-]
UV reflectance outdoor diff	:	0.00986	[-]
UV reflectance indoor diff	:	0.230	[-]
general colour rendering index (Ra)	:	92.0	[-]

--- Split U-value ---

Uconv	:	0.265	[W/m2.K]
Uir	:	0.437	[W/m2.K]
Uvent	:	0.0897	[W/m2.K]
			+
Utotal	:	0.792	[W/m2.K]

--- split all 'dark' heat flow coefficients into fractions (h-values) ---

h_conv,indoor	:	0.265	[W/m2.K]
---------------	---	-------	----------

tbv gelijkwaardigheidsverklaring met 6030 glas-met EnviroScreen 805

h_ir,indoor	:	0.437	[w/m2.K]
h_conv,outdoor	:	0.646	[w/m2.K]
h_ir,outdoor	:	0.147	[w/m2.K]
h_vent	:	-0.0897	[w/m2.K]
-----+			
checksum (expected value = h_indoor - h_outdoor - h_vent = 0)	:		0.000
			[w/m2.K]

--- Split solar factor (g) into fractions ---

solar direct transmittance	:	0.0275	[-]
solar factor convective	:	0.0550	[-]
solar factor thermal radiative ir	:	0.0802	[-]
solar factor ventilation	:	0.00854	[-]
-----+			
solar factor (g)	:	0.171	[-]

--- Split solar gain coefficients to outdoor side into fractions ---

solar fraction reflected to outdoor	:	0.400	[-]
solar fraction convected to outdoor	:	0.347	[-]
solar fraction th. radiated to outdoor	:	0.0816	[-]
solar fraction ventilated to outdoor	:	0.000	[-]
-----+			
solar fraction to outdoor	:	0.829	[-]

--- Split all solar fractions, optical part ---

solar direct transmittance	:	0.0275	[-]
solar direct reflectance	:	0.400	[-]
solar absorption fraction layer 1	:	0.421	[-]
solar absorption fraction layer 2	:	0.000	[-]
solar absorption fraction layer 3	:	0.0447	[-]
solar absorption fraction layer 4	:	0.000	[-]
solar absorption fraction layer 5	:	0.107	[-]
-----+			
checksum (expected value = 1)	:	1.00	[-]

--- Split all solar fractions, thermal part (a-values) ---

solar absorbed	:	0.572	[-]
conv indoor	:	0.0550	[-]
ir indoor	:	0.0802	[-]
conv outdoor	:	0.347	[-]
ir outdoor	:	0.0816	[-]
gap vent	:	0.00854	[-]
-----+			
checksum (abs-others. expected value = 0)	:	0.000	[-]

--- Short description conditions used for calculations ---

Calculated using setting: No restrictions (expert level)
 Therefore results are calculated using user selected methods and settings

For solar calculations in the total solar range, spectral properties are used

For solar calculations in the visual range, spectral properties are used

For solar calculations in the uv range, spectral properties are used

The solar spectrum of EN 410 is used with air mass 1

tbv gelijkwaardigheidsverklaring met 6030 glas-met EnviroScreen 805

--- Short system description ---

(from outdoor to indoor)

layer 1 is a Pane named : SGG COOL-LITE SKN165B.sgg with pane in original position.

layer 2 is a Gap named : Air-Argon 10/90

layer 3 is a Pane named : SGG Planilux_6mm.sgg with pane in original position.

layer 4 is a Gap named : Air which is free ventilated !

layer 5 is a Shading named : EnviroScreen V6 805 000

Interpolated wavelength values !!

--- Spectral Properties Total Solar ---

For perpendicular incidence angle

wavel : wavelength [nm]
Refl_o : spectral reflectance outdoor side
Refl_i : spectral reflectance indoor side
Transm : spectral transmittance

Wavel	Transm	Refl_o	Refl_i
300.0	0.000	0.047	0.089
320.0	0.000	0.047	0.104
340.0	0.002	0.103	0.152
360.0	0.010	0.218	0.267
380.0	0.018	0.263	0.458
400.0	0.030	0.328	0.547
420.0	0.040	0.358	0.571
440.0	0.047	0.378	0.578
460.0	0.053	0.400	0.581
480.0	0.055	0.410	0.580
500.0	0.057	0.413	0.579
520.0	0.058	0.412	0.577
540.0	0.058	0.403	0.576
560.0	0.057	0.385	0.573
580.0	0.055	0.361	0.570
600.0	0.053	0.332	0.567
620.0	0.050	0.299	0.563
640.0	0.047	0.270	0.559
660.0	0.043	0.249	0.558
680.0	0.040	0.241	0.554
700.0	0.036	0.240	0.550
720.0	0.030	0.248	0.548
740.0	0.027	0.269	0.544
760.0	0.022	0.290	0.541
780.0	0.018	0.314	0.538
800.0	0.015	0.339	0.536
850.0	0.010	0.392	0.536
900.0	0.007	0.430	0.550
950.0	0.005	0.453	0.560
1000.0	0.004	0.472	0.570
1050.0	0.003	0.487	0.577
1100.0	0.002	0.501	0.581
1150.0	0.002	0.513	0.578
1200.0	0.002	0.528	0.583
1250.0	0.001	0.543	0.589
1300.0	0.001	0.563	0.593
1350.0	0.001	0.583	0.583
1400.0	0.001	0.603	0.573
1450.0	0.001	0.632	0.584

tbv gelijkwaardigheidsverklaring met 6030 glas-met EnviroScreen 805

1500.0	0.001	0.658	0.593
1550.0	0.001	0.680	0.598
1600.0	0.001	0.696	0.595
1650.0	0.001	0.705	0.470
1700.0	0.001	0.710	0.520
1750.0	0.001	0.711	0.547
1800.0	0.001	0.708	0.556
1850.0	0.001	0.704	0.569
1900.0	0.000	0.705	0.521
1950.0	0.001	0.707	0.540
2000.0	0.000	0.704	0.567
2050.0	0.000	0.703	0.559
2100.0	0.001	0.703	0.515
2200.0	0.000	0.668	0.492
2300.0	0.000	0.681	0.318
2400.0	0.000	0.676	0.319
2500.0	0.000	0.636	0.402

--- Spectral Properties Light ---

For perpendicular incidence angle

wavel : wavelength [nm]
 Refl_o : spectral reflectance outdoor side
 Refl_i : spectral reflectance indoor side
 Transm : spectral transmittance

Wavel	Transm	Refl_o	Refl_i
380.0	0.018	0.263	0.458
390.0	0.024	0.296	0.514
400.0	0.030	0.328	0.547
410.0	0.036	0.349	0.562
420.0	0.040	0.358	0.571
430.0	0.044	0.371	0.575
440.0	0.047	0.378	0.578
450.0	0.050	0.387	0.580
460.0	0.053	0.400	0.581
470.0	0.054	0.406	0.580
480.0	0.055	0.410	0.580
490.0	0.057	0.413	0.580
500.0	0.057	0.413	0.579
510.0	0.058	0.413	0.578
520.0	0.058	0.412	0.577
530.0	0.058	0.408	0.576
540.0	0.058	0.403	0.576
550.0	0.057	0.394	0.574
560.0	0.057	0.385	0.573
570.0	0.057	0.375	0.571
580.0	0.055	0.361	0.570
590.0	0.055	0.347	0.568
600.0	0.053	0.332	0.567
610.0	0.052	0.315	0.566
620.0	0.050	0.299	0.563
630.0	0.049	0.285	0.561
640.0	0.047	0.270	0.559
650.0	0.045	0.261	0.559
660.0	0.043	0.249	0.558
670.0	0.042	0.244	0.555
680.0	0.040	0.241	0.554
690.0	0.038	0.238	0.552
700.0	0.036	0.240	0.550
710.0	0.033	0.243	0.549
720.0	0.030	0.248	0.548
730.0	0.028	0.256	0.546
740.0	0.027	0.269	0.544
750.0	0.024	0.278	0.543
760.0	0.022	0.290	0.541
770.0	0.020	0.302	0.539
780.0	0.018	0.314	0.538

tbv gelijkwaardigheidsverklaring met 6030 glas-met EnviroScreen 805

--- Spectral Properties Uv ---

For perpendicular incidence angle

wavel : wavelength [nm]
Refl_o : spectral reflectance outdoor side
Refl_i : spectral reflectance indoor side
Transm : spectral transmittance

Wavel	Transm	Refl_o	Refl_i
282.5	0.000	0.047	0.096
287.5	0.000	0.047	0.094
292.5	0.000	0.047	0.092
297.5	0.000	0.047	0.089
302.5	0.000	0.047	0.090
307.5	0.000	0.047	0.093
312.5	0.000	0.047	0.098
317.5	0.000	0.047	0.101
322.5	0.000	0.049	0.110
327.5	0.000	0.058	0.124
332.5	0.001	0.071	0.135
337.5	0.001	0.090	0.146
342.5	0.003	0.117	0.160
347.5	0.004	0.147	0.178
352.5	0.006	0.178	0.204
357.5	0.009	0.206	0.243
362.5	0.011	0.229	0.294
367.5	0.013	0.246	0.348
372.5	0.015	0.256	0.398
377.5	0.017	0.261	0.440

--- temperatures ---

for perpendicular incidence angle

Outdoor air temperature : 5.000
Outdoor radiant temperature : 5.000

Outdoor surface temperature : 11.321
layer (center) 1 : 11.743
border : 11.785
layer (center) 2 : 17.136
border : 22.486
layer (center) 3 : 22.529
border : 22.531
layer (center) 4 : 22.574
border : 23.504
layer (center) 5 : 23.507
Indoor surface temperature : 23.477

Indoor air temperature : 20.000
Indoor radiant temperature : 20.000

--- Network ---

Layer and node properties from outdoor side to indoor side

-- solar absorption fractions for layers [0-1]:

Solar absorption fraction of layer 1 : 0.421
Solar absorption fraction of layer 2 : 0.000
Solar absorption fraction of layer 3 : 0.045
Solar absorption fraction of layer 4 : 0.000
Solar absorption fraction of layer 5 : 0.107

-- conduction / convection heat transfer coefficients for layers:

tbv gelijkwaardigheidsverklaring met 6030 glas-met EnviroScreen 805
 IR and ventilation not included !

Heat transfer coeff of layer 1 : 166.667
 Heat transfer coeff of layer 2 : 1.127
 Heat transfer coeff of layer 3 : 166.667
 Heat transfer coeff of layer 4 : 0.644
 Heat transfer coeff of layer 5 : 500.000

Network of thermal coefficients (h) for perpendicular incidence angle

-- Total Network:

hs are given between all nodes
 nodes are from outdoor to indoor
 all layers (including gaps) have 3 nodes of which 2 are joined with
 neighboring layers

1 : node 1 (node at outdoor surface)
 2 : node 2 (center node of outdoor side layer) ...
 o_air : outdoor air node
 o_rad : outdoor radiant node
 i : indoor node

8	9	10	11	o_air	o_rad	i	7
0.000	0.000	333.333	0.000	0.000	0.000	0.000	0.000
0.000	333.333	0.000	333.333	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	333.333	0.000	2.254	0.198	0.000	0.000
0.000	0.000	0.000	2.254	0.000	2.254	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.198	2.254	0.000	333.333	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	333.333
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1.372	1.443	0.000	0.000	0.000	0.000	333.333	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.273	0.000
0.000	1.372	0.000	0.000	0.000	0.000	0.000	1.372
1.372	0.000	0.000	0.000	0.000	0.000	0.000	1.443
0.000	0.000	1000.000	0.000	0.000	0.000	0.014	0.000
0.000	1000.000	0.000	1000.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	1000.000	0.000	0.000	0.000	8.420	0.000
0.000	o_air	18.000	0.000	0.000	0.000	0.000	0.000
0.000	o_rad	4.220	0.000	0.000	0.000	0.000	0.000
0.000	i	0.000	0.000	0.000	0.000	0.000	0.273
0.000	0.014	0.000	8.420	0.000	0.000	0.000	0.000

-- gap properties conduction/convection/ventilation :

Layer : 2 is a gap with the following calculated properties :

Nusselt_number : 1.000
 Prandtl_number : 0.683
 Grashof_number ; 8183.618

layer : 4 is a ventilated gap with the following calculated ventilation
 properties :

tbv gelijkwaardigheidsverklaring met 6030 glas-met EnviroScreen 805

h between bordering layers (h_gap) [W/(m2.K)] : 0.686
 h between incoming air and air in layer (h_between) [W/(m2.K)] : 0.473
 air speed [m/s] : 0.021
 air temperature at center [oC] : 22.573
 air temperature at exit [oC] : 23.014

--- System description ---
 (from outdoor to indoor for perpendicular incidence angle)

-- layer : 1 is a : Pane --

name : SGG COOL-LITE SKN165B.sgg
 id : 2914
 thickness : 6.000 [mm]
 thermal conductance : 1.000 [W/(m.K)]
 coating code : UC [-]
 IR transmittance : 0.000 [-]
 IR emissivity outdoor : 0.837 [-]
 IR emissivity indoor : 0.036 [-]
 solar direct transmittance : 0.342 [-]
 solar direct reflectance outdoor : 0.293 [-]
 solar direct reflectance indoor : 0.436 [-]
 light transmittance : 0.665 [-]
 light reflectance outdoor : 0.117 [-]
 light reflectance indoor : 0.111 [-]
 UV transmittance : 0.124 [-]
 UV reflectance outdoor : 0.145 [-]
 UV reflectance indoor : 0.298 [-]
 General colour rendering index (Ra) : 94.000 [-] (0-100)

component information
 Type: Coated Appearance:

-- layer : 2 is a : Gap --

name	:	Air-Argon 10/90		
gap width	:	16.000 [mm]		
		-10 oC	0 oC	10 oC
20 oC				
conduction	:	0.017	0.017	0.018
0.018				
dynamic viscosity	:	0.000	0.000	0.000
0.000				
density	:	1.779	1.681	1.652
1.595				
CP	:	567.900	567.900	567.900
567.900				

-- layer : 3 is a : Pane --

name : SGG Planilux_6mm.sgg
 id : 2952
 thickness : 6.000 [mm]

tbv gelijkwaardigheidsverklaring met 6030 glas-met EnviroScreen 805
thermal conductance : 1.000 [W/(m.K)]

coating code : UU [-]

IR transmittance : 0.000 [-]
IR emissivity outdoor : 0.837 [-]
IR emissivity indoor : 0.837 [-]

solar direct transmittance : 0.788 [-]
solar direct reflectance outdoor : 0.072 [-]
solar direct reflectance indoor : 0.072 [-]

light transmittance : 0.885 [-]
light reflectance outdoor : 0.080 [-]
light reflectance indoor : 0.080 [-]

UV transmittance : 0.530 [-]
UV reflectance outdoor : 0.065 [-]
UV reflectance indoor : 0.065 [-]

General colour rendering index (Ra) : 98.000 [-] (0-100)

component information
Type: Monolithic Appearance:

-- layer : 4 is a : Gap --

name	:	Air		
gap width	:	40.000 [mm]		
		-10 oC	0 oC	10 oC
20 oC				
conduction	:	0.023	0.024	0.025
0.026				
dynamic viscosity	:	0.000	0.000	0.000
0.000				
density	:	1.326	1.277	1.232
1.189				
CP	:	1008.000	1008.000	1008.000
1008.000				

This is a free ventilated layer

air is coming from indoors
air is going to indoors

width opening bottom [mm], per m width: 3.000
width opening top [mm], per m width: 3.000
width opening side [mm], per m width: 0.000

h between bordering layers (h_gap) [W/(m2.K)] : 0.686
h between incoming air and air in layer (h_between) [W/(m2.K)] : 0.473
air speed in gap [m/s] : 0.021
air flux [dm3/s] per m width : 0.843
air temperature at center [oC] : 22.573
air temperature at exit [oC] : 23.014

-- layer : 5 is a : Shading --

calculation method : View factor method
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tbv gelijkwaardigheidsverklaring met 6030 glas-met EnviroScreen 805

name : EnviroScreen V6 805 000
id : 1329
thickness : 0.400 [mm]
thermal conductance : 0.200 [W/(m.K)]

IR transmittance outdoor : 0.050 [-]
IR transmittance indoor : 0.050 [-]
IR emissivity outdoor : 0.260 [-]
IR emissivity indoor : 0.830 [-]

Following properties are total properties (direct + diffuse) for perpendicular incidence angle

solar transmittance outdoor : 0.078 [-]
solar transmittance indoor : 0.078 [-]
solar reflectance outdoor : 0.648 [-]
solar reflectance indoor : 0.543 [-]

light transmittance outdoor : 0.077 [-]
light transmittance indoor : 0.077 [-]
light reflectance outdoor : 0.632 [-]
light reflectance indoor : 0.571 [-]

UV transmittance outdoor : 0.054 [-]
UV transmittance indoor : 0.054 [-]
UV reflectance outdoor : 0.634 [-]
UV reflectance indoor : 0.230 [-]

component information
Openness Factor 5 %

--- Environment ---

name : EN13363-2 referentie
id : 49

radiant temperature outdoor : 5.000 [oC]
air temperature outdoor : 5.000 [oC]
radiant temperature indoor : 20.000 [oC]
air temperature indoor : 20.000 [oC]

Solar radiation : 300.000 [W/m2]
Convection coeff. outdoor : 18.000 [W/(m2.K)]
Convection coeff. indoor : 3.600 [W/(m2.K)]

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**Appendix 6 WIS
calculation Verosol
EnviroScreen 802**



tbv gelijkwaardigheidsverklaring met 7040 glas-met Envisoscreen 802
 --- Registered WIS user ---
 Registered organisation : Verosol
 Registered user name : Evert Bos

--- Report transparent system : tbv Gelijkwaardigheidsverklaring met 7040 glas met EnviroScreen 802 ---

--- Basics (key thermal and solar properties) ---

name transparent system : tbv Gelijkwaardigheidsverklaring met 7040 glas
 U-value : 0.737 [W/(m2.K)]
 solar factor (g) : 0.165 [-] (total solar energy transmittance)

The g-value includes the effect of all changes in the situation with sun and situation without sun. Consequently, the g-value in case of free (thermally driven) ventilation in one of the gaps is also influenced by the increase in the air flow with sun compared to the situation without sun. This air flow may be cold or warm. This may lead to g-values higher than 1 (one) or lower than 0 (zero). See the help file for more information.

solar direct transmittance outdoor tot : 0.0172 [-]
 solar direct transmittance indoor tot : 0.0150 [-]
 solar direct reflectance outdoor tot : 0.448 [-]
 solar direct reflectance indoor tot : 0.572 [-]

solar direct transmittance outdoor diff : 0.0115 [-]
 solar direct transmittance indoor diff : 0.00932 [-]
 solar direct reflectance outdoor diff : 0.165 [-]
 solar direct reflectance indoor diff : 0.572 [-]

light transmittance outdoor tot : 0.0317 [-]
 light transmittance indoor tot : 0.0271 [-]
 light reflectance outdoor tot : 0.481 [-]
 light reflectance indoor tot : 0.606 [-]

light transmittance outdoor diff : 0.0211 [-]
 light transmittance indoor diff : 0.0165 [-]
 light reflectance outdoor diff : 0.365 [-]
 light reflectance indoor diff : 0.606 [-]

UV transmittance outdoor tot : 0.00218 [-]
 UV transmittance indoor tot : 0.00194 [-]
 UV reflectance outdoor tot : 0.101 [-]
 UV reflectance indoor tot : 0.249 [-]

UV transmittance outdoor diff : 0.00114 [-]
 UV transmittance indoor diff : 0.000896 [-]
 UV reflectance outdoor diff : 0.00923 [-]
 UV reflectance indoor diff : 0.248 [-]

general colour rendering index (Ra) : 95.0 [-]

--- Split U-value ---

Uconv : 0.275 [W/m2.K]
 Uir : 0.389 [W/m2.K]
 Uvent : 0.0727 [W/m2.K]

 Utotal : 0.737 [W/m2.K]

--- split all 'dark' heat flow coefficients into fractions (h-values) ---

h_conv,indoor : 0.275 [W/m2.K]

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h_ir,indoor	:	0.389	[w/m2.K]
h_conv,outdoor	:	0.607	[w/m2.K]
h_ir,outdoor	:	0.139	[w/m2.K]
h_vent	:	-0.0727	[w/m2.K]

checksum (expected value = h_indoor - h_outdoor - h_vent = 0) : -0.0101 [w/m2.K]

--- Split solar factor (g) into fractions ---

solar direct transmittance	:	0.0172	[-]
solar factor convective	:	0.0587	[-]
solar factor thermal radiative ir	:	0.0818	[-]
solar factor ventilation	:	0.00688	[-]
-----+			
solar factor (g)	:	0.165	[-]

--- Split solar gain coefficients to outdoor side into fractions ---

solar fraction reflected to outdoor	:	0.448	[-]
solar fraction convected to outdoor	:	0.313	[-]
solar fraction th. radiated to outdoor	:	0.0734	[-]
solar fraction ventilated to outdoor	:	0.000	[-]
-----+			
solar fraction to outdoor	:	0.835	[-]

--- Split all solar fractions, optical part ---

solar direct transmittance	:	0.0172	[-]
solar direct reflectance	:	0.448	[-]
solar absorption fraction layer 1	:	0.372	[-]
solar absorption fraction layer 2	:	0.000	[-]
solar absorption fraction layer 3	:	0.0500	[-]
solar absorption fraction layer 4	:	0.000	[-]
solar absorption fraction layer 5	:	0.113	[-]

checksum (expected value = 1) : 1.00 [-]

--- Split all solar fractions, thermal part (a-values) ---

solar absorbed	:	0.535	[-]
conv indoor	:	0.0587	[-]
ir indoor	:	0.0818	[-]
conv outdoor	:	0.313	[-]
ir outdoor	:	0.0734	[-]
gap vent	:	0.00688	[-]

checksum (abs-others. expected value = 0) : 0.000 [-]

--- Short description conditions used for calculations ---

Calculated using setting: No restrictions (expert level)
Therefore results are calculated using user selected methods and settings

For solar calculations in the total solar range, spectral properties are used

For solar calculations in the visual range, spectral properties are used

For solar calculations in the uv range, spectral properties are used

The solar spectrum of EN 410 is used with air mass 1

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--- Short system description ---

(from outdoor to indoor)

layer 1 is a Pane named : Energy5.gvb with pane in original position.
layer 2 is a Gap named : Air-Argon 10/90
layer 3 is a Pane named : clear_05.gvb with pane in original position.
layer 4 is a Gap named : Air which is free ventilated !
layer 5 is a Shading named : Enviroscreen 802 000 Sonnergy

Interpolated wavelength values !!

--- Spectral Properties Total Solar ---
For perpendicular incidence angle
wavel : wavelength [nm]
Refl_o : spectral reflectance outdoor side
Refl_i : spectral reflectance indoor side
Transm : spectral transmittance

Wavel	Transm	Refl_o	Refl_i
300.0	0.000	0.048	0.101
320.0	0.000	0.047	0.120
340.0	0.000	0.056	0.171
360.0	0.002	0.103	0.286
380.0	0.009	0.246	0.478
400.0	0.019	0.371	0.564
420.0	0.024	0.408	0.595
440.0	0.026	0.420	0.607
460.0	0.029	0.438	0.612
480.0	0.030	0.467	0.613
500.0	0.031	0.483	0.613
520.0	0.033	0.502	0.611
540.0	0.033	0.508	0.609
560.0	0.032	0.500	0.606
580.0	0.032	0.481	0.604
600.0	0.031	0.454	0.600
620.0	0.030	0.423	0.597
640.0	0.029	0.391	0.593
660.0	0.027	0.361	0.590
680.0	0.026	0.335	0.586
700.0	0.024	0.320	0.582
720.0	0.022	0.312	0.579
740.0	0.020	0.310	0.575
760.0	0.018	0.320	0.572
780.0	0.016	0.333	0.570
800.0	0.014	0.348	0.569
850.0	0.010	0.394	0.568
900.0	0.008	0.445	0.580
950.0	0.006	0.467	0.589
1000.0	0.005	0.490	0.596
1050.0	0.004	0.507	0.603
1100.0	0.003	0.523	0.606
1150.0	0.003	0.536	0.598
1200.0	0.002	0.551	0.603
1250.0	0.002	0.564	0.611
1300.0	0.002	0.586	0.612
1350.0	0.002	0.604	0.601
1400.0	0.001	0.623	0.588
1450.0	0.001	0.653	0.600
1500.0	0.001	0.677	0.610
1550.0	0.001	0.699	0.613

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1600.0	0.001	0.715	0.608
1650.0	0.001	0.722	0.459
1700.0	0.001	0.728	0.513
1750.0	0.001	0.729	0.546
1800.0	0.000	0.723	0.560
1850.0	0.000	0.721	0.573
1900.0	0.000	0.713	0.525
1950.0	0.001	0.718	0.542
2000.0	0.001	0.723	0.572
2050.0	0.001	0.732	0.560
2100.0	0.000	0.731	0.508
2200.0	0.000	0.695	0.483
2300.0	0.000	0.721	0.308
2400.0	0.000	0.727	0.314
2500.0	0.000	0.728	0.336

--- Spectral Properties Light ---

For perpendicular incidence angle

wavel : wavelength [nm]
 Refl_o : spectral reflectance outdoor side
 Refl_i : spectral reflectance indoor side
 Transm : spectral transmittance

Wavel	Transm	Refl_o	Refl_i
380.0	0.009	0.246	0.478
390.0	0.015	0.320	0.531
400.0	0.019	0.371	0.564
410.0	0.022	0.398	0.583
420.0	0.024	0.408	0.595
430.0	0.025	0.418	0.602
440.0	0.026	0.420	0.607
450.0	0.027	0.426	0.610
460.0	0.029	0.438	0.612
470.0	0.029	0.451	0.612
480.0	0.030	0.467	0.613
490.0	0.031	0.475	0.613
500.0	0.031	0.483	0.613
510.0	0.032	0.494	0.611
520.0	0.033	0.502	0.611
530.0	0.033	0.506	0.610
540.0	0.033	0.508	0.609
550.0	0.032	0.503	0.608
560.0	0.032	0.500	0.606
570.0	0.032	0.491	0.604
580.0	0.032	0.481	0.604
590.0	0.031	0.468	0.601
600.0	0.031	0.454	0.600
610.0	0.031	0.440	0.599
620.0	0.030	0.423	0.597
630.0	0.030	0.406	0.595
640.0	0.029	0.391	0.593
650.0	0.028	0.376	0.591
660.0	0.027	0.361	0.590
670.0	0.026	0.350	0.588
680.0	0.026	0.335	0.586
690.0	0.025	0.324	0.584
700.0	0.024	0.320	0.582
710.0	0.023	0.312	0.581
720.0	0.022	0.312	0.579
730.0	0.021	0.310	0.577
740.0	0.020	0.310	0.575
750.0	0.019	0.316	0.574
760.0	0.018	0.320	0.572
770.0	0.017	0.327	0.570
780.0	0.016	0.333	0.570

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--- Spectral Properties Uv ---

For perpendicular incidence angle

wavel : wavelength [nm]
Refl_o : spectral reflectance outdoor side
Refl_i : spectral reflectance indoor side
Transm : spectral transmittance

Wavel	Transm	Refl_o	Refl_i
282.5	0.000	0.098	0.111
287.5	0.000	0.071	0.108
292.5	0.000	0.056	0.105
297.5	0.000	0.049	0.102
302.5	0.000	0.047	0.102
307.5	0.000	0.047	0.106
312.5	0.000	0.047	0.111
317.5	0.000	0.047	0.115
322.5	0.000	0.047	0.127
327.5	0.000	0.049	0.142
332.5	0.000	0.052	0.153
337.5	0.000	0.054	0.164
342.5	0.000	0.059	0.178
347.5	0.001	0.066	0.196
352.5	0.001	0.075	0.221
357.5	0.001	0.091	0.261
362.5	0.002	0.119	0.313
367.5	0.004	0.159	0.368
372.5	0.006	0.202	0.418
377.5	0.008	0.233	0.460

--- temperatures ---

for perpendicular incidence angle

Outdoor air temperature : 5.000
Outdoor radiant temperature : 5.000

Outdoor surface temperature : 10.730
layer (center) 1 : 11.039
border : 11.077
layer (center) 2 : 17.004
border : 22.931
layer (center) 3 : 22.970
border : 22.972
layer (center) 4 : 23.014
border : 23.779
layer (center) 5 : 23.781
Indoor surface temperature : 23.749

Indoor air temperature : 20.000
Indoor radiant temperature : 20.000

--- Network ---

Layer and node properties from outdoor side to indoor side

-- solar absorption fractions for layers [0-1]:

Solar absorption fraction of layer 1 : 0.372
Solar absorption fraction of layer 2 : 0.000
Solar absorption fraction of layer 3 : 0.050
Solar absorption fraction of layer 4 : 0.000
Solar absorption fraction of layer 5 : 0.113

-- conduction / convection heat transfer coefficients for layers:

IR and ventilation not included !

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Heat transfer coeff of layer 1 : 206.186
 Heat transfer coeff of layer 2 : 1.126
 Heat transfer coeff of layer 3 : 206.186
 Heat transfer coeff of layer 4 : 0.644
 Heat transfer coeff of layer 5 : 500.000

Network of thermal coefficients (h) for perpendicular incidence angle

-- Total Network:

hs are given between all nodes
 nodes are from outdoor to indoor
 all layers (including gaps) have 3 nodes of which 2 are joined with
 neighboring layers

1 : node 1 (node at outdoor surface)
 2 : node 2 (center node of outdoor side layer) ...
 o_air : outdoor air node
 o_rad : outdoor radiant node
 i : indoor node

8	9	1	10	2	11	3	4	5	6	7
						o_air	o_rad		i	
0.000	1	0.000	412.371	2	11	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	18.000	4.207	0.000	0.000	0.000	0.000
0.000	2	412.371	0.000	412.371	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	3	0.000	412.371	0.000	2.253	0.203	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	4	0.000	0.000	2.253	0.000	2.253	0.000	412.371	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	5	0.000	0.000	0.203	2.253	0.000	412.371	0.000	412.371	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	412.371
0.000	6	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	7	0.000	0.000	0.000	0.000	0.000	0.000	412.371	0.000	0.000
1.348	1.080	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.056	0.000
0.000	8	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.348
0.000	1.348	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1.348	9	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.080
0.000	0.000	1000.000	0.000	1000.000	0.000	0.000	0.000	0.000	0.002	0.000
0.000	10	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	1000.000	0.000	1000.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	1000.000	0.000	0.000	0.000	0.000	0.000	8.543	0.000	0.000
0.000	o_air	18.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	o_rad	4.207	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	i	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.056
0.000	0.002	0.000	8.543	0.000	0.000	0.000	0.000	0.000	0.000	0.000

-- gap properties conduction/convection/ventilation :

Layer : 2 is a gap with the following calculated properties :

Nusselt_number : 1.000
 Prandtl_number : 0.683
 Grashof_number ; 9085.170

layer : 4 is a ventilated gap with the following calculated ventilation properties :

h between bordering layers (h_gap) [W/(m2.K)] : 0.674

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 h between incoming air and air in layer (h_between) [w/(m2.K)] : 0.323
 air speed [m/s] : 0.015
 air temperature at center [oC] : 23.014
 air temperature at exit [oC] : 23.375

--- System description ---
 (from outdoor to indoor for perpendicular incidence angle)

-- layer : 1 is a : Pane --

name : Energy5.gvb
 id : 2755
 thickness : 4.850 [mm]
 thermal conductance : 1.000 [w/(m.K)]
 coating code : UC [-]
 IR transmittance : 0.000 [-]
 IR emissivity outdoor : 0.837 [-]
 IR emissivity indoor : 0.037 [-]
 solar direct transmittance : 0.436 [-]
 solar direct reflectance outdoor : 0.260 [-]
 solar direct reflectance indoor : 0.366 [-]
 light transmittance : 0.786 [-]
 light reflectance outdoor : 0.066 [-]
 light reflectance indoor : 0.063 [-]
 UV transmittance : 0.084 [-]
 UV reflectance outdoor : 0.091 [-]
 UV reflectance indoor : 0.205 [-]
 General colour rendering index (Ra) : 98.000 [-] (0-100)

component information
 Type: Coated Appearance:

-- layer : 2 is a : Gap --

name	:	Air-Argon 10/90		
gap width	:	16.000 [mm]		
		-10 oC	0 oC	10 oC
20 oC				
conduction	:	0.017	0.017	0.018
0.018				
dynamic viscosity	:	0.000	0.000	0.000
0.000				
density	:	1.779	1.681	1.652
1.595				
CP	:	567.900	567.900	567.900
567.900				

-- layer : 3 is a : Pane --

name : clear_05.gvb
 id : 2629
 thickness : 4.850 [mm]
 thermal conductance : 1.000 [w/(m.K)]

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coating code : UU [-]

IR transmittance : 0.000 [-]
IR emissivity outdoor : 0.837 [-]
IR emissivity indoor : 0.837 [-]

solar direct transmittance : 0.827 [-]
solar direct reflectance outdoor : 0.074 [-]
solar direct reflectance indoor : 0.074 [-]

light transmittance : 0.893 [-]
light reflectance outdoor : 0.080 [-]
light reflectance indoor : 0.080 [-]

UV transmittance : 0.590 [-]
UV reflectance outdoor : 0.067 [-]
UV reflectance indoor : 0.067 [-]

General colour rendering index (Ra) : 99.000 [-] (0-100)

component information
Type: Monolithic Appearance: Clear

-- layer : 4 is a : Gap --

name	: Air			
gap width	: 40.000	[mm]		
		-10 oC	0 oC	10 oC
20 oC				
conduction	:	0.023	0.024	0.025
0.026				
dynamic viscosity	:	0.000	0.000	0.000
0.000				
density	:	1.326	1.277	1.232
1.189				
CP	:	1008.000	1008.000	1008.000
1008.000				

This is a free ventilated layer

air is coming from indoors
air is going to indoors

width opening bottom [mm], per m width: 2.000
width opening top [mm], per m width: 2.000
width opening side [mm], per m width: 0.000

h between bordering layers (h_gap) [w/(m2.K)] : 0.674
h between incoming air and air in layer (h_between) [w/(m2.K)] : 0.323
air speed in gap [m/s] : 0.015
air flux [dm3/s] per m width : 0.602
air temperature at center [oC] : 23.014
air temperature at exit [oC] : 23.375

-- layer : 5 is a : Shading --

calculation method : View factor method
name : EnviroScreen 802 000 Sonnergy
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id : 1330
thickness : 0.400 [mm]
thermal conductance : 0.200 [w/(m.k)]

IR transmittance outdoor : 0.010 [-]
IR transmittance indoor : 0.010 [-]
IR emissivity outdoor : 0.190 [-]
IR emissivity indoor : 0.850 [-]

Following properties are total properties (direct + diffuse) for perpendicular incidence angle

solar transmittance outdoor : 0.038 [-]
solar transmittance indoor : 0.038 [-]
solar reflectance outdoor : 0.743 [-]
solar reflectance indoor : 0.571 [-]

light transmittance outdoor : 0.037 [-]
light transmittance indoor : 0.037 [-]
light reflectance outdoor : 0.730 [-]
light reflectance indoor : 0.606 [-]

UV transmittance outdoor : 0.021 [-]
UV transmittance indoor : 0.021 [-]
UV reflectance outdoor : 0.755 [-]
UV reflectance indoor : 0.248 [-]

component information
Openness Factor 2 %

--- Environment ---

name : EN13363-2 referentie
id : 49

radiant temperature outdoor : 5.000 [oC]
air temperature outdoor : 5.000 [oC]
radiant temperature indoor : 20.000 [oC]
air temperature indoor : 20.000 [oC]

Solar radiation : 300.000 [w/m2]
Convection coeff. outdoor : 18.000 [w/(m2.k)]
Convection coeff. indoor : 3.600 [w/(m2.k)]

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