Validation report

No. 410 43944 e

Issue date	10 January 2011
Client	**Glas Trösch AG Silverstar** Industriestr. 29 4922 Bützberg Switzerland
Order	Re-certification of the calculation software **SILVERSTAR® glaCE Version 3.00** for conformity of the calculation of luminous, solar and thermal characteristics of glazing to the specifications of the standards EN 410 and EN 673 according to the position paper of Sector Group SG09 on the basis of the validation of SILVERSTAR® glaCE Version 1.53 dated 30 January 2008
Subject	Calculation programme: **SILVERSTAR® glaCE Version 3.00**
Content	1 Problem 2 Basis of evaluation 3 Results and statement

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1 Order

The company Glas Trösch AG Silverstar, CH-4922 Bützberg, commissioned the **ift** Rosenheim to re-certify the calculation software

SILVERSTAR® glaCE Version 3.00

The validation is based on the position paper DMP-LTR-050000 of Sector Group SG 09 dated 15 February 2005 as well as the initial validation of version 1.53 dated 30 January 2008.

With the application for re-certification, the client confirmed that the calculation routines of versions 1.53 and 3.00 are identical.

Re-certification is based on a plausibility check via comparative calculations of ift reference configurations. Verification was based on **ift** software programs for calculation of thermal transmittance U_g as per EN 673 and solar characteristics as per EN 410 as well as the SILVERSTAR® glaCE version 1.53.

The **ift** was provided with an executable version of the calculation software SILVERSTAR® glaCE version 3.00. For the necessary spectral data, the database of version 1.53 was used and imported by the client into the calculation software.

Calculation of thermal transmittance U_g and solar characteristics for the specified reference configurations was carried out by the **ift**. Validation of the software program is restricted to double insulating glass units and triple insulating glass units composed of coated and uncoated basic glass and coated and uncoated LSG glass.

This validation does not cover calculation of basic data for PVB films.

2 Basis of validation

ift Report	410 35089 dated 30 January 2008
Manufacturer certification	Application of recertification dated 23 August 2010
Position paper	Ref. No. DMP-LTR-050000 Sector group SG09 dated 15 February 2005
EN 673 : 1997-11 +A1 : 2000-10 +A2 : 2002-12	Glass in building - Determination of thermal transmittance - - Calculation method
EN 410 : 1998-04	Glass in building – Determination of luminous and solar characteristics of glazing

2.1 General approach to validate calculation of thermal transmittance U_g as per EN 673

For evaluation, comparative calculations of the reference configurations described in table 1 were carried out. The following parameters were varied to detect any effects on the accuracy of calculation:

- Configuration of the insulating glass unit, thickness of the individual glass panes
- Type, composition and gas fill rate
- Normal emissivity of the coating
- Position of coating

Table 1 Reference structure for calculations as per EN 673

No.	Structure	Gas filling	Emissivity ε_n	Position of coating
1	4/16/4	Air	-	-
2	4/16/4	90% Argon	0.02	3
3	4/16/4	90% Argon	0.03	3
4	4/16/4	90% Argon	0.04	3
5	4/16/4	90% Argon	0.06	3
6	4/16/4	90% Argon	0.10	3
7	4/16/4	90% Argon	0.20	3
8	4/16/4	90% Argon	0.04	2
9	4/16/4	Air	0.04	3
10	4/16/4	100% Argon	0.04	3
11	4/16/4	50% Argon	0.04	3
12	4/16/4	90% Krypton	0.04	3
13	4/16/4	90% Xenon	0.04	3
14	4/16/4	45% Xenon 45% Krypton	0.04	3
15	4/16/4	45% Argon 45% Krypton	0.04	3
16	4/16/4	33% Argon 33% Xenon 33% Krypton	0.04	3
17	4/8/4	90% Argon	0.04	3
18	4/10/4	90% Argon	0.04	3
19	4/12/4	90% Argon	0.04	3
20	4/14/4	90% Argon	0.04	3
21	4/18/4	90% Argon	0.04	3
22	4/20/4	90% Argon	0.04	3
23	10/16/10	90% Argon	0.04	3
24	4/10/4/10/4	90% Argon	0.10	3+4
25	4/12/4/12/4	90% Krypton	0.04	2+5
26	4/12/4/12/4	Air	-	-

2.2 General approach to validate calculation of solar characteristics as per EN 410

For validation of calculation as per EN 410 the **ift** Rosenheim specified spectral data which were used to validate the following features and components of the calculation software Glas Trösch SILVERSTAR® glaCE version 3.00:

a) Calculation of solar properties of double and triple insulating glass units as per EN 410.
b) Conversion of substrate thicknesses as per EN 410 Annex A
c) Conversion of a coating on a new substrate as per EN 410 Annex A
d) Verification of calculation of heat transport

The spectra in the wavelength range of 250 nm to 2,500 nm were generated by the **ift** Rosenheim and are retained at the **ift** Rosenheim. The client provided the ift with the spectrum of the 9mm LSG pane.

For validation the following spectra were used for transmittance and reflectance.

- Float glass of 4 mm thickness
- Float glass of 4 mm with thermal control coating
- Float glass of 6 mm with solar control coating
- Laminated safety glass of 9 mm - uncoated
- Opaque sheet steel with permanent reflectance in wavelength range of 280 nm to 2,500 nm

For validation of heat transport a configuration featuring an opaque black sheet steel panel was used. The g-value obtained is calculated exclusively on the basis of the secondary heat flow qi.

The configurations given in the following were computed on the basis of the specified spectra as per EN 410 using the ift software and the software version Glas Trösch SILVERSTAR® glaCE version 1.53 and version 3.00. For configurations 3, 4 and 7, the uncoated 10 mm individual pane, coated 10 mm individual pane and coated 9 mm LSG single pane were calculated as per EN 410 Annex A.

Table 2 Reference structure for calculations as per EN 410

No.	Structure	Gas filling	Coating	Coating level
1	4/16/4	90% Argon	Coating WS	Pos. 3
2	4/16/4	90% Krypton	Coating WS	Pos. 3
3	10/16/4	90% Argon	Coating WS	Pos. 3
4	4/16/10	90% Argon	Coating WS	Pos. 3
5	6/12/4	90% Argon	Coating SS	Pos. 2
6	VSG9/12/4	90% Argon	Coating WS	Pos. 3
7	4/16/VSG9	90% Argon	Coating WS	Pos. 3
8	SB/16/4	Air	-	-
9	SB/16/4	90% Argon	Coating WS	Pos. 3
10	4/12/4/12/4	90% Krypton	Coating WS	Pos. 2+5

WS Thermal control coating
SS Solar control coating
SB Black steel plate
VSG9 Laminated glass 8mm

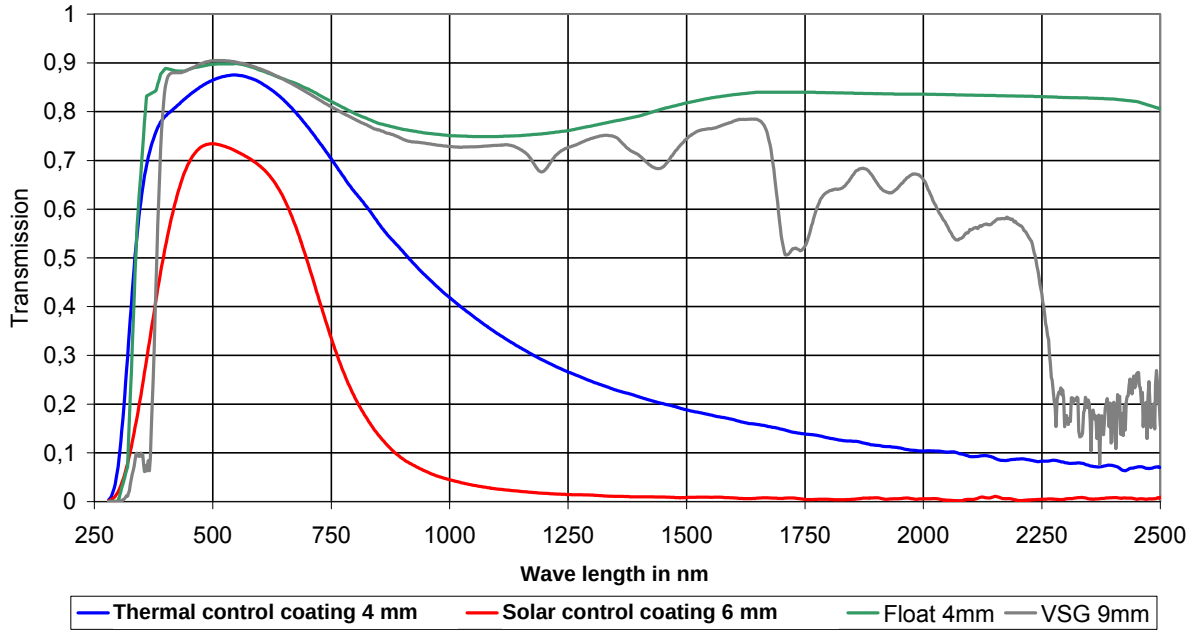

Fig. 1 Transmission of sample spectra

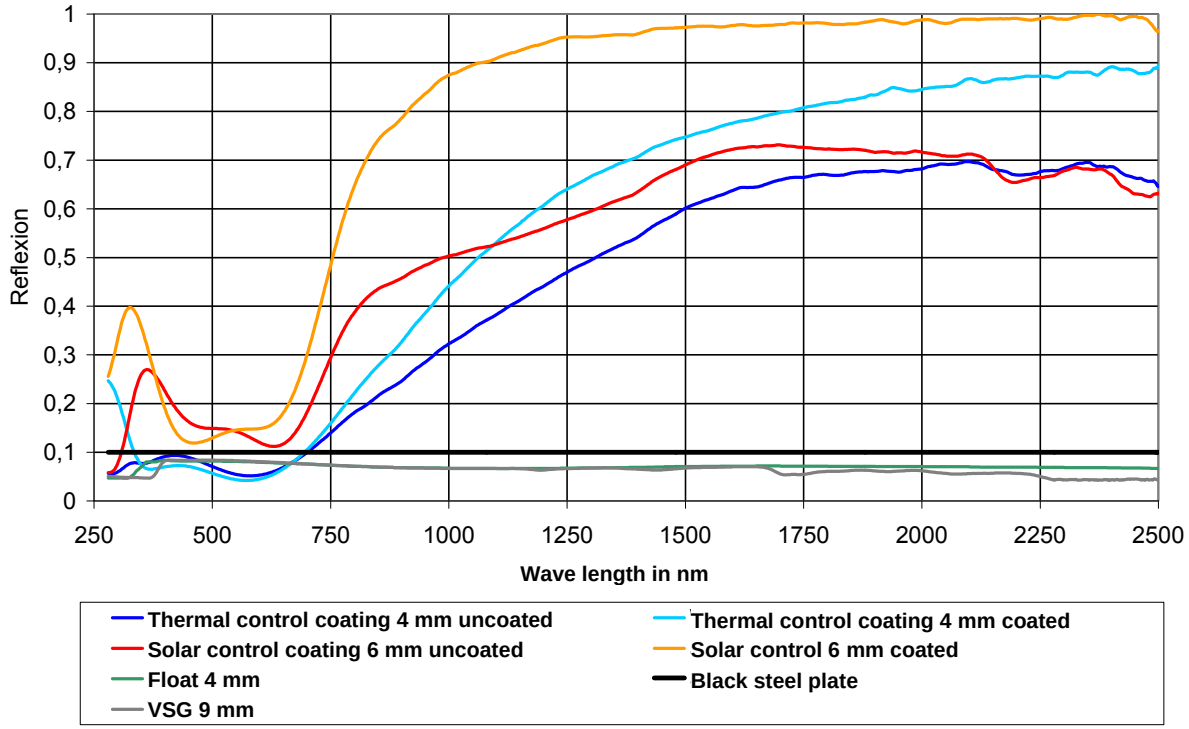

Fig. 2 Reflection of sample spectra

3 Results

3.1 Calculated thermal transmittance U_g as per EN 673

Table 3 Calculated Ug-values as per EN 673

No.	Structure	Gas filling	ε_n Emissivity	Coating level	U_g Calculation ift [W/(m²K)]	U_g Calculation glaCE 1.53 [W/(m²K)]	U_g Calculation glaCE 3.00 [W/(m²K)]	Deviation (V 1.53 – V 3.00) [W/(m²K)]
1	4/16/4	Air		-	2.741	2.742	2.742	0.000
2	4/16/4	90% Argon	0.02	3	1.087	1.089	1.089	0.000
3	4/16/4	90% Argon	0.03	3	1.126	1.126	1.126	0.000
4	4/16/4	90% Argon	0.04	3	1.163	1.162	1.162	0.000
5	4/16/4	90% Argon	0.06	3	1.232	1.23	1.230	0.000
6	4/16/4	90% Argon	0.10	3	1.361	1.362	1.362	0.000
7	4/16/4	90% Argon	0.20	3	1.637	1.637	1.637	0.000
8	4/16/4	90% Argon	0.04	2	1.163	1.162	1.162	0.000
9	4/16/4	Air	0.04	3	1.399	1.399	1.399	0.000
10	4/16/4	100% Argon	0.04	3	1.125	1.125	1.125	0.000
11	4/16/4	50% Argon	0.04	3	1.289	1.288	--	--
12	4/16/4	90% Krypton	0.04	3	1.134	1.134	1.134	0.000
13	4/16/4	90% Xenon	0.04	3	1.161	1.161	1.161	0.000
14	4/16/4	45% Xe, 45% Kr	0.04	3	1.174	1.173	1.173	0.000
15	4/16/4	45% Ar, 45% Kr	0.04	3	1.211	1.211	1.211	0.000
16	4/16/4	33% Ar, 33% Xe, 33% Kr	0.04	3	1.176	1.175	--	--
17	4/8/4	90% Argon	0.04	3	1.711	1.71	1.710	0.000
18	4/10/4	90% Argon	0.04	3	1.483	1.483	1.483	0.000
19	4/12/4	90% Argon	0.04	3	1.317	1.316	1.316	0.000
20	4/14/4	90% Argon	0.04	3	1.189	1.189	1.189	0.000
21	4/18/4	90% Argon	0.04	3	1.175	1.175		0.000
22	4/20/4	90% Argon	0.04	3	1.187	1.186	1.186	0.000
23	10/16/10	90% Argon	0.04	3	1.147	1.146	--	--
24	4/10/4/10/4	90% Argon	0.10	3+4	0.966	0.966	0.966	0.000
25	4/12/4/12/4	90% Krypton	0.04	2+5	0.512	0.511	0.511	0.000
26	4/12/4/12/4	Air		-	1.899	1.899	1.899	0.000

3.2 Calculated luminous and solar characteristic values as per EN 410

Table 4 Calculated luminous and solar characteristic values as per EN 410 – ift calculation

No.	Structure	Gas filling	Coating	Coating level	τ_v	ρ_v	τ_e	ρ_e	q_i	g
1	4/16/4	90% Argon	Coating WS	Pos. 3	0.776	0.119	0.535	0.243	0.088	0.623
2	4/16/4	90% Krypton	Coating WS	Pos. 3	0.776	0.119	0.535	0.243	0.088	0.623
3	10/16/4	90% Argon	Coating WS	Pos. 3	0.746	0.113	0.478	0.181	0.082	0.560
4	4/16/10	90% Argon	Coating WS	Pos. 3	0.746	0.117	0.478	0.241	0.139	0.617
5	6/12/4	90% Argon	Coating SS	Pos. 2	0.640	0.179	0.332	0.341	0.033	0.365
6	VSG9/12/4	90% Argon	Coating WS	Pos. 3	0.780	0.121	0.513	0.211	0.083	0.596
7	4/16/VSG9	90% Argon	Coating WS	Pos. 3	0.780	0.120	0.513	0.243	0.108	0.621
8	SB/16/4	Air	-	-	0.000	0.100	0.000	0.100	0.108	0.108
9	SB/16/4	90% Argon	Coating WS	Pos. 3	0.000	0.100	0.000	0.100	0.044	0.044
10	4/12/4/12/4	90% Krypton	Coating WS	Pos. 2+5	0.676	0.149	0.407	0.285	0.096	0.503

Table 5 Calculated luminous and solar characteristic values as per EN 410 –SILVERSTAR® glaCE Version 1.53 calculation

No.	Structure	Gas filling	Coating	Coating level	τ_v	ρ_v	τ_e	ρ_e	q_i*	g
1	4/16/4	90% Argon	Coating WS	Pos. 3	0.776	0.119	0.536	0.244	0.088	0.624
2	4/16/4	90% Krypton	Coating WS	Pos. 3	0.776	0.119	0.536	0.244	0.088	0.624
3	10/16/4	90% Argon	Coating WS	Pos. 3	0.746	0.113	0.479	0.181	0.082	0.561
4	4/16/10	90% Argon	Coating WS	Pos. 3	0.746	0.117	0.479	0.241	0.139	0.618
5	6/12/4	90% Argon	Coating SS	Pos. 2	0.640	0.179	0.332	0.341	0.033	0.365
6	VSG9/12/4	90% Argon	Coating WS	Pos. 3	0.780	0.121	0.514	0.211	0.083	0.597
7	4/16/VSG9	90% Argon	Coating WS	Pos. 3	0.780	0.120	0.514	0.243	0.107	0.621
8	SB/16/4	Air	-	-	0.000	0.100	0.000	0.100	0.107	0.107
9	SB/16/4	90% Argon	Coating WS	Pos. 3	0.000	0.100	0.000	0.100	0.044	0.044
10	4/12/4/12/4	90% Krypton	Coating WS	Pos. 2+5	0.676	0.149	0.407	0.285	0.095	0.502

Table 6 Calculated luminous and solar characteristic values as per EN 410 –SILVERSTAR® glaCE Version 3.00 calculation

No.	Structure	Gas filling	Coating	Coating level	τ_v	ρ_v	τ_e	ρ_e	q_i*	g
1	4/16/4	90% Argon	Coating WS	Pos. 3	0.776	0.119	0.536	0.244	0.088	0.624
2	4/16/4	90% Krypton	Coating WS	Pos. 3	0.776	0.119	0.536	0.244	0.088	0.624
3	10/16/4	90% Argon	Coating WS	Pos. 3	0.746	0.113	0.479	0.181	0.082	0.561
4	4/16/10	90% Argon	Coating WS	Pos. 3	0.746	0.117	0.479	0.241	0.139	0.618
5	6/12/4	90% Argon	Coating SS	Pos. 2	0.640	0.179	0.332	0.341	0.033	0.365
6	VSG9/12/4	90% Argon	Coating WS	Pos. 3	--	--	--	--	--	--
7	4/16/VSG9	90% Argon	Coating WS	Pos. 3	--	--	--	--	--	--
8	SB/16/4	Luft	-	-	0.000	0.100	0.000	0.100	0.107	0.107
9	SB/16/4	90% Argon	Coating WS	Pos. 3	0.000	0.100	0.000	0.100	0.044	0.044
10	4/12/4/12/4	90% Krypton	Coating WS	Pos. 2+5	0.676	0.149	0.407	0.285	0.095	0.502

Table 7 Calculated luminous and solar characteristic values as per EN 410 – Deviation between SILVERSTAR® glaCE Version 1.53 and Version 3.00 calculation

No.	Structure	Gas filling	Coating	Coating level	τ_v	ρ_v	τ_e	ρ_e	q_i	g
1	4/16/4	90% Argon	Coating WS	Pos. 3	0.000	0.000	0.000	0.000	0.000	0.000
2	4/16/4	90% Krypton	Coating WS	Pos. 3	0.000	0.000	0.000	0.000	0.000	0.000
3	10/16/4	90% Argon	Coating WS	Pos. 3	0.000	0.000	0.000	0.000	0.000	0.000
4	4/16/10	90% Argon	Coating WS	Pos. 3	0.000	0.000	0.000	0.000	0.000	0.000
5	6/12/4	90% Argon	Coating SS	Pos. 2	0.000	0.000	0.000	0.000	0.000	0.000
6	VSG9/12/4	90% Argon	Coating WS	Pos. 3	--	--	--	--	--	--
7	4/16/VSG9	90% Argon	Coating WS	Pos. 3	--	--	--	--	--	--
8	SB/16/4	Air	-	-	0.000	0.000	0.000	0.000	0.000	0.000
9	SB/16/4	90% Argon	Coating WS	Pos. 3	0.000	0.000	0.000	0.000	0.000	0.000
10	4/12/4/12/4	90% Krypton	Coating WS	Pos. 2+5	0.000	0.000	0.000	0.000	0.000	0.000

3 Evaluation

Table 3 shows that the Ug values computed as per EN 673 by the calculation software SILVERSTAR® glaCE version 1.53 as well as version 3.00 are within the specified tolerance of

$\Delta U_g \leq \pm 0.002$ W/(m^{2}K)

and that the glaCE versions do not deviate.

Tables 4 to 7 show that the luminous and solar values computed as per EN 410 by the calculation software SILVERSTAR® glaCE version 1.53 as well as version 3.00 are within the specified tolerance of

$\Delta\tau_v \leq \pm 0.002$	$\Delta\rho_v \leq \pm 0.002$
$\Delta\tau_e \leq \pm 0.002$	$\Delta\rho_e \leq \pm 0.002$
$\Delta q_i \leq \pm 0.004$	$\Delta g \leq \pm 0.004$

and that the glaCE versions do not deviate.

Conformity to the standards of calculation of thermal transmittance Ug and luminous characteristics as per

EN 673 : 1997-11	Glass in building - Determination of thermal transmittance – calculation method
EN 410 : 1998-04	Glass in building – Determination of luminous and solar characteristics of glazing

For double and triple insulating glass units according to the paper of Sector Group SG09 is confirmed for the software

SILVERSTAR® glaCE version 3.00.

3 Validity

This validation report covers only the calculation software described in Section 1. Validation of the calculation software covers the functions described in Section 2. The ift Guidance Sheet "Conditions and Guidance for the Use of **ift** Test Documents" applies.

ift Rosenheim
10 January 2011

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