Lengheim Consulting u. Entwicklung GmbH
Bahnstraße 16
2213 Bockfließ

Magistrat der Stadt Wien
MAGISTRATSABTEILUNG 39
Prüf-, Überwachungs- und Zertifizierungsstelle der Stadt Wien
Standort: Rinnböckstraße 15
1110 WIEN
Tel.: (+43 1) 79514-8039
Fax: (+43 1) 79514-99-8039
E-Mail: post@ma39.wien.gv.at
Homepage: www.ma39.wien.at

MA 39 – VFA 2019-0766.01-.02

Vienna, 25-th of July 2019

Laboratory R e p o r t

concerning

heat-reflecting glass-coating "SGIR17" containing infrared pigments

Applicant: Lengheim Consulting und Entwicklung GmbH

Ordering date: 19-th of June 2019

Test sample: One PVC-window with inserted twofold insulating glass. First the glass surface temperature has been measured without coating at the outside (reference measurement), and afterwards with additional transparent IR-coating at the outside float glass.

Testing program: Measuring of temperatures at the insulating glass during outside-radiation.
The outside radiation has been switched on and off within 6 hour periods during the whole testing time (switching on and off two IR-lamps).

Shortcut of result: By radiating the two samples at the outside using two 250 W IR-lamps under similar conditions up to outdoor surface temperatures of appr. 37,4 °C, an averaged lower surface-temperature-difference in favour of the IR-coated sample of approximately -1,5 K has been detected. Decreased averaged surface temperatures of appr. -2,1 K have been measured at the inner surface of the insulating glass element.

The report includes 10 pages.

1 General

The producing company of the described IR-glass-coating (with infrared pigments) ordered measurements of thermal performance at MA 39. As test sample a standard PVC-window with twofold insulating glass has been chosen.

1.1 Order

Due to the order from 19-th of June 2019 following a short discussion with the producer two simplified measurements of thermal performance concerning the described sample below (outside coated and uncoated) have been carried out. Due to the applicant a direct derivable effect has been expected.

It is noticed that these measurements are due to scientific interest only and not covered by adequate standards and are carried out only as a rough test (indication) and first approach. For simplification only simple periodical radiation (switching the radiation lamps on and off always within a 6 h-period) has been observed.

Since the executed tests do not give a complete view of the infrared reflecting behaviour of the transparent coating, additional measurements — for instance of thermal emission ε as described in /3/ — are recommended.

1.2 Documents, Descriptions

/1/ photographs of the sample and measurement procedure look at the appendix.

/2/ EN 1121 doors; Behaviour between two different climates - Test method, see appendix A (latest version).

/3/ EN 16012 Thermal insulation of buildings — Reflective insulation products — Determination of declared thermal performance, see annex D (latest version).

2 Test-samples

On the 28-th of June 2019 the measurements at MA 39 have been started by a co-worker of MA 39 (see also picture at page 7):

window with outside uncoated glass:	standard PVC-window (overall dimensions 107 cm x 132 cm, width of PVC-profile 90 mm) with twofold insulating glass 4/18/b4 mm inserted. Visible glass aperture: 71,2 cm x 96,5 cm adhesive label at insulating glass: "Floatglass PLC 4 mm SGG CLIMAPLUS XN 18 mm Swisspacer U-schwarz Planitherm XN 1.1 4 mm"

window with outside IR-coated glass:	same standard PVC-window (overall dimensions 107 cm x 132 cm, width of PVC-profile 90 mm) with twofold insulating glass 4/18/b4 mm inserted. Visible glass aperture: 71,2 cm x 96,5 cm adhesive label at insulating glass: "Floatglass PLC 4 mm SGG CLIMAPLUS XN 18 mm Swisspacer U-schwarz Planitherm XN 1.1 4 mm" **additional at the outside surface of the twofold insulating glass-element a transparent IR-coating with brandname "SGIR17" ("Sun Reflector Glas") has been applied by the applicant.**

3 Tests and results

3.1 Testing device

3.1.1 General

The PVC-window (first with uncoated and second with the outside IR-coated glass) has been radiated with 2 IR-lamps (brandname "Philips"; description: IR 250 RH IR2; 230-250 V BR 125 250 W E27 ES 173 mm x 125 mm) under same conditions within a repeated 6-h-period. The inclination angle for radiation has been chosen to be 45 degrees. The laboratory air temperature has been regulated by a climate aggregate (split-aggregate).

For the measurement of (absolute) temperatures at the surfaces and in the air (front side and backwards) calibrated thermocouples of type "K" have been adjusted, see page 7. The temperatures have been periodically scanned and stored with the help of a "Keithley"-Multiplexer ("DAQ 6510 / Data Acquisition / Multimeter System").Examined accuracy of temperature measurement < ± 0,1 K.

In summa 2 x 5 surface-thermocouples (5 at each side of the insulating glass surface at exact opposite spots) and 2 air-thermocouples (one at each opposite side at a distance of 10 cm from the glass-surface) have been used. Therefore at both sides (at exact opposite spots) of the insulating glass-element the temperatures have been measured.

Opposite channel-description:

CH 101 and CH 107 external surface / internal surface
CH 102 and CH 108 external surface / internal surface
CH 103 and CH 109 external surface / internal surface
CH 104 and CH 110 external surface / internal surface
CH 105 and CH 111 external surface / internal surface

CH 106 and CH 112 external air to internal air (surface distance 10 cm in front of glass center)

For good comparison of the results among both radiation-experiments always the same thermocouples have been used at the same local positions using the same type of masking tapes.

3.1.2 Outside Radiation

The thermal performance of the IR-coating has been investigated with the help of two 250 W radiation lamps showing a spectrum in the near infrared.

The two used IR-lamps (with description: "Philips Incandescent 230 – 250 V 250 W E27 infrared, double reflective system IR RE ES 173 x 125 mm") are showing a spectrum distribution primary including the near infrared spectrum (mainly up to a wavelength of ca. 2500 nm).

The distance of the IR-lamps to the radiated sample surface has been fixed at 29 cm (distance in direct beam direction, - perpendicular distance to the glass surface 19 cm) for both experiments. The inclination angle of 45 degrees has been fixed too.

The distance of the axis of both lamps has been adjusted at 46 cm in that way that both lamps showed the same distance from the center of the radiated insulating glass.

3.2 Duration of measurements

The total testing time of the 2 radiation experiments lasted from the 28^{-th} of June 2019 until the 19^{-th} of July 2019.

3.3 Measurement results

3.3.1 Uncoated sample (reference-sample) radiated

After reaching a quasi-stationary thermal equilibrium the following absolute temperatures in [°C] have been obtained, look also at pages 8 and 10.

Averaged air temperature of laboratory: 21,0 °C

Thermocouple:	TE1	TE2	TE3	TE4	TE5	TE6
Multiplexer-Channel:	CH101	CH102	CH103	CH104	CH105	CH106
MIN	33,1	37,0	34,3	31,6	34,6	26,3
AV	33,6	37,3	34,8	31,9	34,8	26,9
MAX	33,7	37,4	35,0	32,0	34,9	27,3

3.3.2 IR-coated sample radiated

After reaching a quasi-stationary thermal equilibrium the following averaged absolute temperatures in [°C] have been obtained, see pages 9 and 10.

Averaged air temperature of laboratory: 21,3°C

Thermocouple:	TE 1	TE 2	TE 3	TE 4	TE 5	TE 6
Multiplexer-Channel:	CH101	CH102	CH103	CH104	CH105	CH106
MIN	32,0	36,0	33,7	29,7	32,7	26,8
AV	32,3	36,2	33,8	29,9	32,8	27,5
MAX	32,4	36,4	34,0	30,0	33,0	28,8

By a rough comparence of the coated with the uncoated sample averaged lower outside surface temperatures (at minimum down till – 2K) have been obtained at the radiated surface in favour of the IR-coated sample, see the following table (temperatur-differences in [K]).

Outside:

Thermocouple:	ΔTE 1	ΔTE 2	ΔTE 3	ΔTE 4	ΔTE 5	ΔTE 6
Multiplexer-Channel:	CH101	CH102	CH103	CH104	CH105	CH106
AV	-1,3	-1,1	-1,0	-2,0	-2,0	+0,6

Only air temperature at the outside has been slightly higher (appr.+ 0,6 K).

The same tendency has been obtained comparing the inner surface temperatures (look also at page 10).

Inside:

Thermocouple:	ΔTE 7	ΔTE 8	ΔTE 9	ΔTE 10	ΔTE 11	ΔTE 12
Multiplexer-Channel:	CH107	CH108	CH109	CH110	CH111	CH112
AV	-2,1	-2,1	-1,9	-2,0	-2,6	-2,4

As it can be seen at the opposite (inner) side of the window also lower averaged temperatures have been received at the glass surface positions. In this case also the inner air temperatur has been lower (-2,4 K).

4 Conclusion, hints

As it can be seen from the results lower surface temperatures have been obtained by direct radiation of the IR-coated insulating glass surface with the used IR –lamps compared with the uncoated insulating glass element. The decrease in surface temperature amounted to be appr. -1,5 K at the outside radiated surface and appr. -2,1 K at the inner glass-surface.

Also the inner air temperature has been lower (-2,4 K) in the case of the coated sample.

Since the laboratory air temperature has been slightly higher by measuring the temperatures of the outside coated sample the improvements (lower temperature levels) in the surface temperatures are on the safe side.

Note: It is noticed that these measurements are due to scientific interest only and not covered by adequate standards and are carried out as rough test (indication) and first approach.

This report has been issued in German and English. In case of doubt the German version is valid.

Technical official:	Head of Laboratory:	Head of Testing-, Inspection und Certification Body:
Dipl.-Ing. Werner Kuhnert	Dipl.-Ing. Dieter Werner MSc Oberstadtbaurat	Dipl.-Ing. Georg Pommer Senatsrat

Outside radiation experiment:

Photo no. 1

outside view of tested standard window (at this photo the already coated -"SGIR17"- insulating glass has been measured)

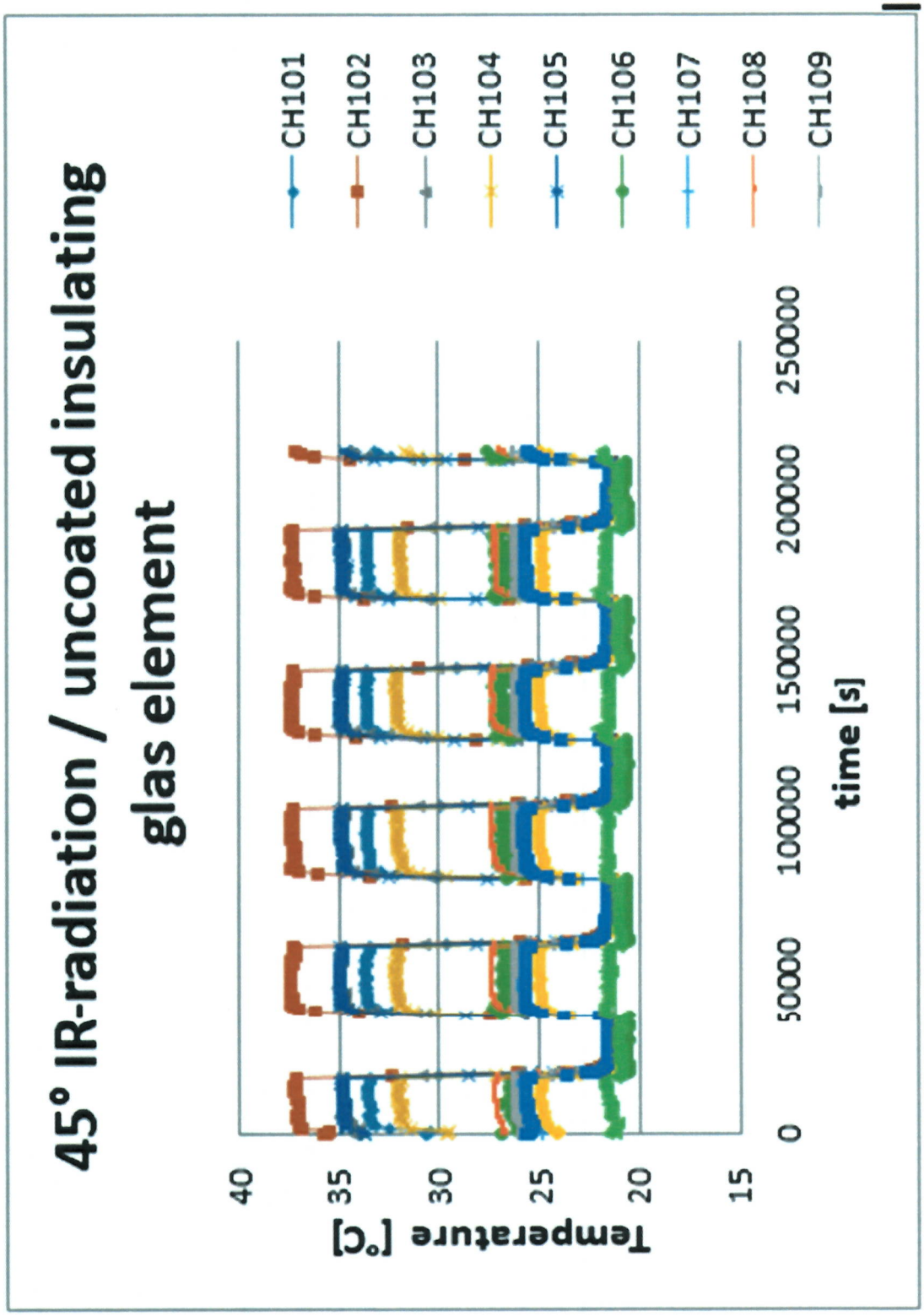
at the front of the window:
two radiation infrared lamps for heating the surface of the insulating glass at the outside with an 45 ° inclination.

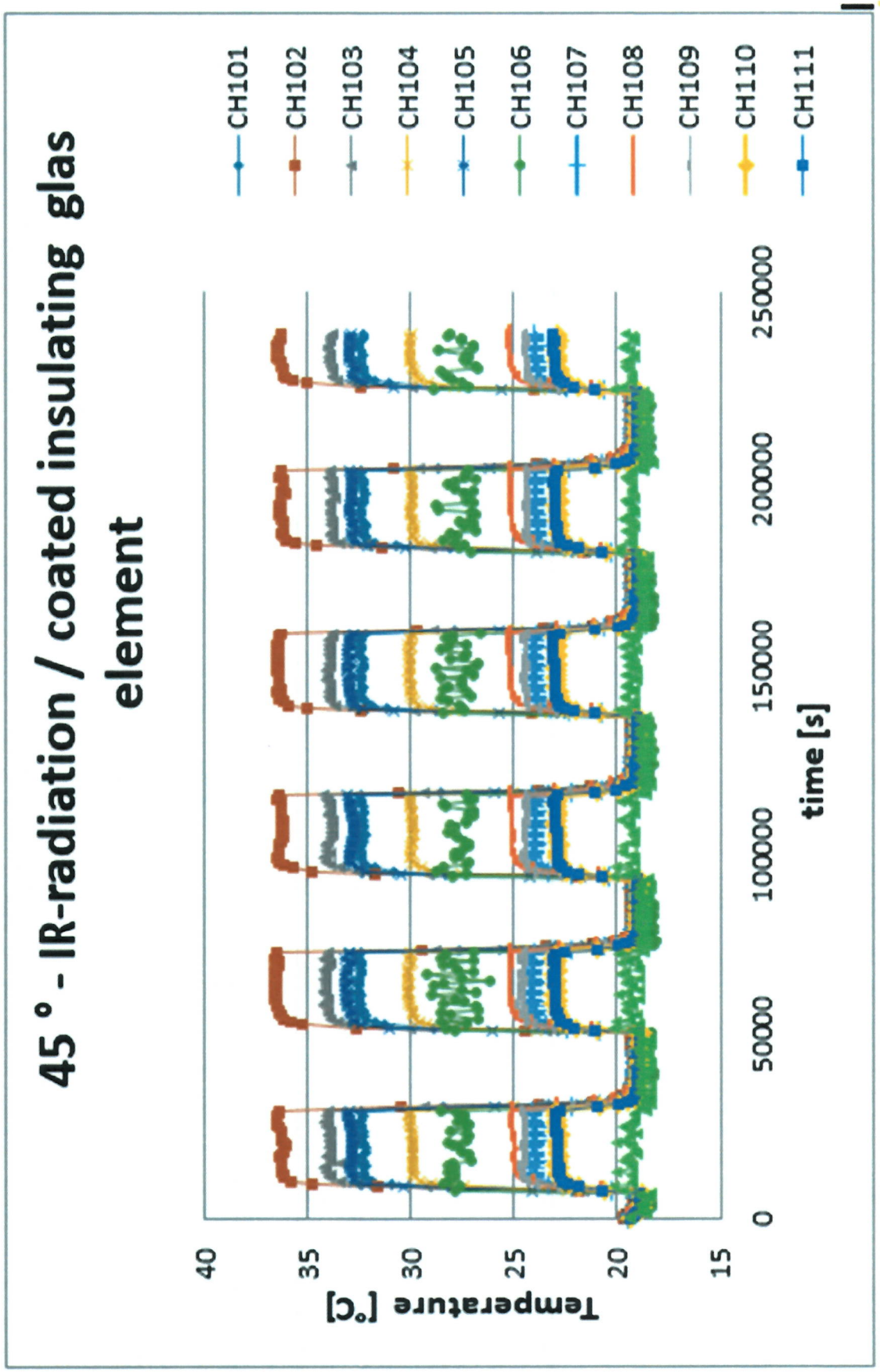
Photo no. 2

Thermocouple spots (marked green) at the outside glass-surface with numbers 1 – 5.

At the opposite spots (inside glass surface) thermocouples with numbers 7-11 have been mounted.

Additionally shielded air thermocouples at a distance of 10 cm from the surfaces have been mounted. (numbers 6 and 12)





Temperatures in [°C]

Analysis of last complete radiation-intervall of outside uncoated insulating glass element:

Thermocouple	TE1	TE2	TE3	TE4	TE5	TE6	TE7	TE8	TE9	TE10	TE11	TE12
Multiplexer-Channel	CH10 1	CH10 2	CH10 3	CH10 4	CH10 5	CH10 6	CH10 7	CH10 8	CH10 9	CH11 0	CH11 1	CH11 2
MIN	33,1	37,0	34,3	31,6	34,6	26,3	25,7	26,9	26,0	24,6	25,3	21,1
AV	33,6	37,3	34,8	31,9	34,8	26,9	26,0	27,2	26,3	24,8	25,6	21,7
MAX	33,7	37,4	35,0	32,0	34,9	27,3	26,1	27,3	26,4	24,9	25,7	22,1

Analysis of last complete radiation-intervall of outside coated insulating glass element:

Thermocouple	TE 1	TE 2	TE 3	TE 4	TE 5	TE 6	TE 7	TE 8	TE 9	TE 10	TE 11	TE 12
Multiplexer-Channel	CH10 1	CH10 2	CH10 3	CH10 4	CH10 5	CH10 6	CH10 7	CH10 8	CH10 9	CH11 0	CH11 1	CH11 2
MIN	32,0	36,0	33,7	29,7	32,7	26,8	23,9	24,8	24,3	22,8	22,8	18,7
AV	32,3	36,2	33,8	29,9	32,8	27,5	23,9	25,1	24,4	22,8	23,0	19,3
MAX	32,4	36,4	34,0	30,0	33,0	28,8	24,0	25,2	24,6	23,0	23,1	19,7