



Special chemistry for Glass

Vindico Surface Technologies

Technical information

Vindico PV+™ test results

patent number NL 2 003 486



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Technical information

Vindico PV+™ Test results

GLASS SPECIFICATIONS

Glass type	Toughened - LOW IRON Prismatic / Matt coated
Thickness	3,2mm / 4,0mm

DOUBLE LAYER COATING:

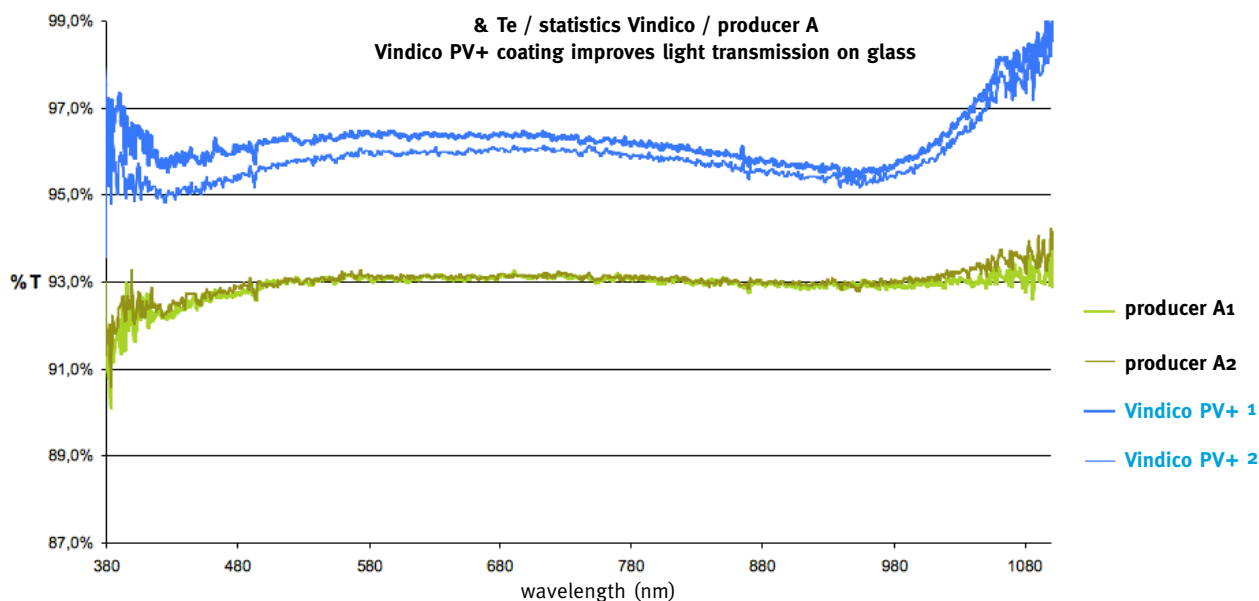
SIOx anti-reflection coating (burning application)
Inorganic SIOx hydrophilic coating, self cleaning effect (spray application)

TESTED AND PASSED:

Damp Test AR Glass IEC1215, constant 85°, 85% rh, 2000 hours
Condensation water climate test AR Glass EN1096-2, constant 40°, 100% rh, 480 hours
Thermal cycling test AR Glass IEC1215, -40/85°, 400 cycles
Salt spray test AR Glass EN1096-2, 1000 hours
Hail impact test AR Glass IEC1215, with 25mm nylon grains
Boiling test, 10min. boiling in demineralized water at 100°C
Abrasion test AR Glass EN1096-2, mechanical rubbing with felt fingers, weight 400gr, 50.000 cycles



abrasion test equipment



AVERAGE DEVIATION

	Te %	average deviation / producer A
competitor	92,96 %	93,00 % producer A
competitor	93,03 %	
Vindico PV+ 2	96, 25 %	96,05 % Vindico PV+
PV+ 1	95,84 %	

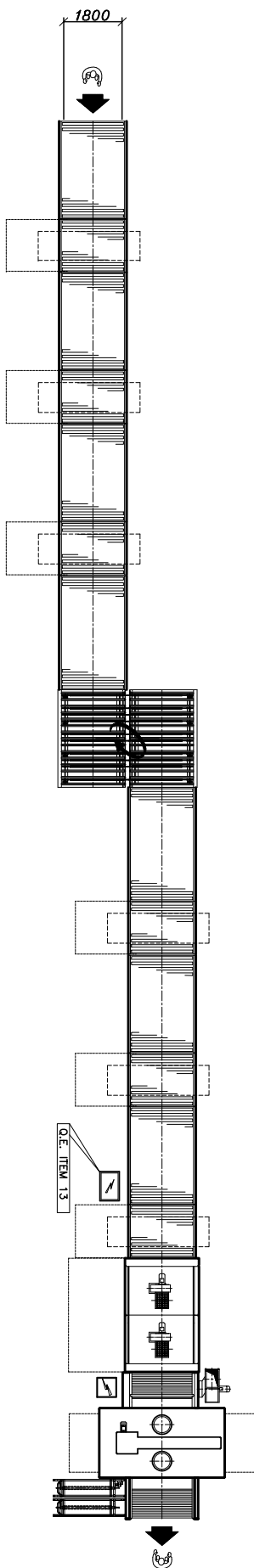


< Vindico PV+™ line in Portugal

Field test since April 2009:
N 40 42' 51" W 8 12' 41"
low soiling properties,
not cleaned since installation >



PRISMATIC LOW IRON VINDICO PV+ GLASS PROPERTIES



PERFORMANCE PROPERTIES

Transmittance Visible light	>95%
Thickness tolerance	+/- 0,2mm
Dimension tolerance	+/- 1,5mm
Diagonal difference	<0,2%
Iron content (Fe2O3)	<0,015%
Antimony content	<0,3%
Overall bow/warp	max. 3mm/m
Local warp	max. 0,3mm/300mm

THERMAL PROPERTIES

Heat transfer coefficient	5,8W/m2.K
Expansion coefficient (between 20-300°C)	per °C = 9,03x10^-6m/k
Specific heat capacity	0,2J/kg.K
Calculated thermal conductivity at 20°C	1,0W/mK
Softening point	~600°C
Annealing point	~550°C
Strain point	~500°C

MECHANICAL PROPERTIES

Moh's scale (scratch hardness)	4~5
Knoop hardness number (indenter load 500gr)	470
Poisson's ratio	0,2
Density	2,5gr/cc
(Yong's) Modulus os elasticity	70.000N/mm
Tensile strenght	42N/mm
Pressure resistance	700-900N/mm
Mechanical strenght	120N/mm
Fragmentation	EN12150 / ANSI Z97.1
QUALITY STANDARDS and ANALYSIS CRITERIA	EN 572-5
PACKING	Wood pallets or metallic racks
SPACER	Powder or paper

POWERGAIN

		Voc	Isc	Im	Vm	Pm	Rs	ff %
average	standard production	43,97	5,43	4,95	35,51	175,74	0,935	73,6%
	competitor A	44,21	5,42	4,97	35,66	177,40	0,960	74,1%
	Vindico PV+ coated	44,11	5,53	5,05	35,73	180,41	0,937	73,9%
deviation	competitor A	0,23%	2,16%	1,50%	0,19%	1,70%	2,37%	0,22%
	Vindico PV+ coated	0,32%	1,92%	2,00%	0,63%	2,65%	0,26%	0,40%

BENCHMARK POWER GAIN GLASS TYPES

	watt peak
low iron fl oat glass	220
low iron fl oat glass AR	224
low iron prismatic glass	224
low iron prismatic glass AR	228



Boiling test, 10min. boiling in demineralized water at 100°C

Application line Vindico PV+™ anti reflection SiO2 and top sealing low-soiling™
Line of 43 meters, automatically application, capacity of 2,6 million m² per year of PV module glass sizes.





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Vindico Surface Technologies
Postbus 196, 3370 AD Hardinxveld-Giessendam
Transportweg 11, 3371 MA Hardinxveld-Giessendam
The Netherlands
tel +31 (0) 184 - 675 875
fax +31 (0) 184 630036
p.bastianen@vindico.info
jzaman@vindico.info
www.vindico.info

