

NSG TEC™
Transparent Electrically Conductive Glass



Product description

NSG **TEC**[™] (Transparent Electrically Conductive glass), is a glass made up of a series of thin films of metal oxides, deposited on a clear or extra clear glass substrate through an on-line pyrolytic process. The coating has low-emissivity (down to 0.10), neutral appearance and is electrically conductive, with sheet resistance from 6-8 Ω/\square up to 5000 Ω/\square .

This coating has high durability and for many applications the product can be processed like uncoated glass. NSG **TEC**[™] can be laminated, toughened, bent and screen printed. The wide range makes the glass suitable for various applications, depending on the required performance (electrical conductivity, thermal insulation, etc.).

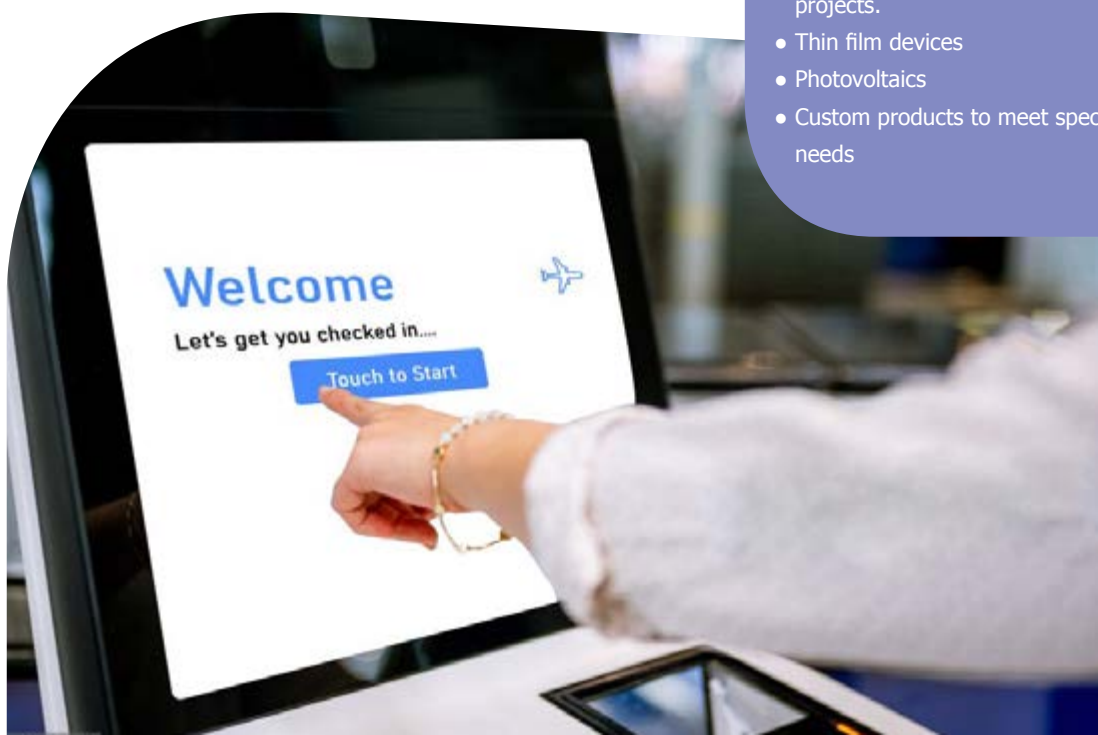
Applications

NSG **TEC**[™] is a glass that can be used in a wide range of applications: from touchscreens to commercial refrigerated counters, from oven doors to heated glass, and much more.

NSG **TEC**[™] offers a wide range of thermal and electrical properties that can be optimized for customer requirements.

Applications:

- Touch screens and displays.
- White goods, including commercial refrigeration units and freezers.
- Heated glass for commercial and residential projects.
- Thin film devices
- Photovoltaics
- Custom products to meet specific application needs





© Cohda

Product Features and Benefits

- Electrically conductive for heated and thermal control, electrostatic dissipation and reduced transmittance of electromagnetic radiation.
- Available in a variety of glass thicknesses and sheet resistances ranging from 6 ohms/sq. up to several thousand ohms/sq.
- Colour neutral, minimizing reflected colour, and will not change colour over time.
- Easily fabricated durable pyrolytic surface can be handled, cut, insulated, laminated, heat-strengthened and tempered.
- Bendable which allows the glass to be heat processed and bent after production.
- Excellent availability for reduced lead times and control of costs and offers virtually unlimited shelf-life.
- Durable pyrolytic surface which is scratch and abrasion resistance.

There are a variety of NSG **TEC™** glass products to meet your specific needs, including:

NSG **TEC™** 15

The best choice for applications requiring passive condensation control and thermal performance with low emissivity and clear colour-neutral appearance.

NSG **TEC™** 35, 50, 70, and 250

For use in heated glass applications, these products combine thermal control with superior electro-optical properties.

NSG **TEC™** SB

A barrier layer to block sodium migration into a deposited film, particularly at elevated temperatures. Therefore, the performance of an off-line coating is unaffected with the use of NSG **TEC™** SB as the coating substrate.



© Cohda

Commercial refrigeration

NSG **TEC**[™] is an electrically conductive and low emissivity coated glass. It can be used for the glass walls of refrigerated cabinets in the refrigeration industry to promote thermal insulation of the environment to be cooled and to prevent the formation of condensation on the glass. This can be achieved passively or by electrically heating the coating.

NSG **TEC**[™] can be installed in single or double glazing, flat or bent.

Passive cooling

NSG **TEC**[™] has the best thermal insulation in its category. It can be bent, screen-printed, it has low light reflection and perfect neutrality, exceptional colour rendering and remarkable abrasion resistance.

Installed in double glazing, NSG **TEC**[™] offers excellent thermal transmission values that limit heat dispersion and allow energy savings; it also controls condensation on the glazing.

The glass types mainly used for this application are:

NSG **TEC**[™] 6, NSG **TEC**[™] 10, NSG **TEC**[™] 15.

Active refrigeration

With high humidity values and large temperature differences between the external environment and the refrigerated environment (refrigerated cabinet with temperatures below 0°C), use of heated glazing is a highly effective method to avoid the formation of condensation, which provide heat to the glazing in order to avoid the formation of condensation.

In these cases, electrical contacts will be applied to the glass, which will use the conductivity of the coating to heat the glass plate above the dew point. Depending on the power supply voltage envisaged by the application, the parameters (temperature, humidity, etc.) of the internal and external environments, the dimensions of the heated glazing, it is possible to choose from the wide range of NSG **TEC**[™], the most suitable glass product that has resistivity appropriate to the application. In general, a power of about 70 to 80 W/m, distributed evenly over the glass plate, is sufficient to prevent the formation of condensation on the outer surface of the glazing and to provide a clear view of the contents located inside the refrigerated glass cabinet.

The glass types mainly used for active refrigeration range from NSG **TEC**[™] 15 to NSG **TEC**[™] 70, NSG **TEC**[™] 250 and NSG **TEC**[™] 550.







Oven doors

The low-emissivity properties of NSG **TEC™** are also used in the household appliances sector, for oven doors, to insulate the hot oven environment from the outside.

The low-emissivity coating of NSG **TEC™** glass protects the user from the risk of burns thanks to the thermal insulation which reduces the temperature on the oven door, limits consumption and ensures transparency thanks to the excellent neutrality and colour rendering of the coating.

The glass, which can be toughened and easily screen-printed, also allows you to obtain modern and innovative designs.

The glass types mainly used for oven doors are:
NSG **TEC™** 6, NSG **TEC™** 10, NSG **TEC™** 15.

Active windows

NSG **TEC**[™] can be used in active windows to provide a transparent heating function. This is an ideal solution in restaurants, residences and commercial buildings to improve comfort levels, particularly in colder climates. There are a number of different functionalities that can be achieved depending on glazing design.

- Primary heating: Glazing becomes the primary source of heating for the room or complements an existing heating system.
- Improved comfort: Elimination of the “cold wall”/“cold shoulder” effect to make the environment more comfortable.
- Anti-ice: Ice and snow removal in glazed roofs through heating of the exterior pane.

By exploiting the electrical conductivity of NSG **TEC**[™], it is possible to create electrically powered, transparent radiant elements, which aesthetically appear like normal glazing. Many different designs are possible, depending on desired functionality. NSG **TEC**[™] 15 and the higher sheet resistance products are most commonly used for this application.





Radiant panels (radiators or mirrors with anti-fog function)

The wide range, in terms of electrical conductivity, makes it possible to choose the most suitable glass depending on the size of the radiator to be installed, the power required, etc. It is possible to screen print or digitally print and toughen the glass, thus allowing design and energy efficiency to be combined according to the customer's tastes.

These radiators are about 1 cm thick, much thinner than any other type; the temperature is uniform throughout the panel.

The layer remains stable even above 250°C (heaters normally operate below 100°C).

The radiator can be transparent, screen-printed or digitally printed, it is easy to maintain.

Heated mirrors for bathrooms with anti-fog function can also be created.

The glass types mainly used for internal radiators and radiant panels are: NSG **TEC**™ 15, NSG **TEC**™ 35, NSG **TEC**™ 70.



Infra-red/normal view of a glass radiator
– whole glass-area heats-up uniformly.

Photovoltaics

Photovoltaic Applications

NSG **TEC**™ products can be used to optimize photovoltaic (PV) performance.

NSG Group produces a range of transparent conductive oxides on glass substrates that have been specifically tuned to meet the requirements of the PV industry.

NSG Group Transparent Electrically Conductive Glass, by acting as the superstrate in a PV module, is designed to maximize the light transmittance and optimize module efficiency for a variety of PV technologies.

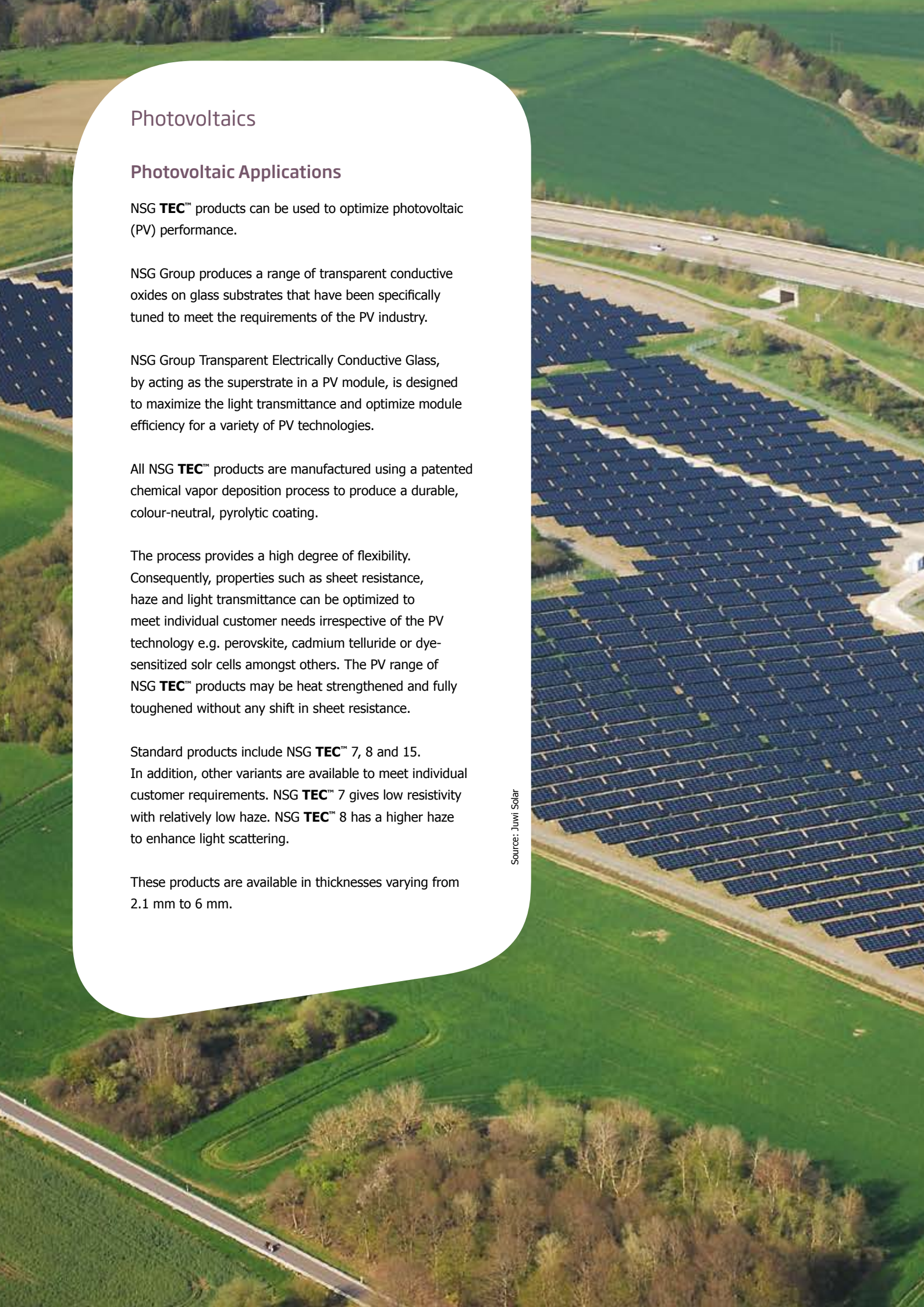
All NSG **TEC**™ products are manufactured using a patented chemical vapor deposition process to produce a durable, colour-neutral, pyrolytic coating.

The process provides a high degree of flexibility. Consequently, properties such as sheet resistance, haze and light transmittance can be optimized to meet individual customer needs irrespective of the PV technology e.g. perovskite, cadmium telluride or dye-sensitized solar cells amongst others. The PV range of NSG **TEC**™ products may be heat strengthened and fully toughened without any shift in sheet resistance.

Standard products include NSG **TEC**™ 7, 8 and 15. In addition, other variants are available to meet individual customer requirements. NSG **TEC**™ 7 gives low resistivity with relatively low haze. NSG **TEC**™ 8 has a higher haze to enhance light scattering.

These products are available in thicknesses varying from 2.1 mm to 6 mm.

Source: Juwi Solar





Other applications

The NSG **TEC**[™] range can also be applied in the following sectors:

- Electrochromic panels;
- Digital Signage, particularly for resistive and capacitive touchscreens where a transparent conductive layer is required;
- The transport industry (military, maritime, railway, etc.), where the heating property of the conductive layer makes it possible to eliminate frost and snow from the glass surfaces of vehicles and rolling stock;
- Protective screen panels (EMI/RFI), for example for the military sector, which exploit the reduced transmission of electromagnetic radiation through glass.

For specific requirements in the industrial sector, it is possible to study customized layer solutions.

Product	Thickness (mm)	Visible Light Transmittance (%)	Sheet Resistance (Ω/\square)	Typical Sheet Resistance (Ω/\square)	Typical Haze (%)
NSG TEC ™ 7	2.2, 3.0, 3.2	80.0 - 82.0	<8	7	1.5
NSG TEC ™ 8	2.2, 3.2	80.0 - 81.5	<9	8	12.0
NSG TEC ™ 10	4.0, 6.0	81.5 - 84.4	<11	10	0.6
NSG TEC ™ 15	2.2, 3.0, 3.2, 4.0, 5.0, 6.0	81.5 - 84.5	<14	13	0.4
NSG TEC ™ 20	4.0, 6.0	82.3 - 85.2	<20	19	0.4
NSG TEC ™ 25	4.0	82.5 - 84.9	<26	23	0.3
NSG TEC ™ 35	3.2, 6.0	82.0 - 84.0	<48	40	0.5
NSG TEC ™ 70	3.2, 4.0	82.0 - 85.7	<75	65	0.3
NSG TEC ™ 160	3.2	82.0 - 84.0	<200	170	0.4
NSG TEC ™ 250	3.2, 4.0	84.0 - 87.0	<325	240	0.3
NSG TEC ™ 450	3.2	82.0 - 84.0	<600	550	0.7
NSG TEC ™ 550	4.0	83.8 - 86.2	<600	550	0.3
NSG TEC ™ SB	2.2, 3.2	91.0 - 92.0	—	—	0.1
Clear	3.2	90.0	—	—	—

The technical data are calculated according to EN 410, EN 673, and EN 12898.

The above performance data should be considered representative. There may be differences within a single production run or from one production run to another, but these are subject to manufacturing tolerances.

The data presented in this table is related to the as-supplied product. Some values, such as sheet resistance, may change after the toughening process depending on toughening/tempering conditions.

Please note that not all NSG **TEC**™ glass types are available in all markets. Please contact your local NSG Group representative to check the available offer.

Glazing (Room/Cool Side)	Airspaces (Number)	U-value [W/m ² K]	Room-Side Glass Temp. [°C]	Condensation RH** (%)	RH Improvement (%)	Heat Flow Through Glass [W/m ²]	Heat Flow Reduction (%)	Power Density [W/m ²]
NSG TEC™ Refrigerator Door Applications*								
Clear/Clear	1	2.4	20	64	Base Case	54	Base Case	0
Triple Clear***	2	2.0	21	69	8	45	17	0
NSG TEC ™ 15/Clear	1	1.7	22	73	14	38	30	0
NSG TEC™ Freezer Door Applications****								
Triple Clear***	2	1.9	15	48	Base case	87	Base case	0
NSG TEC ™ 70 / Clear / Clear	2	1.7	24	81	70	82	6	82
NSG TEC ™ 70 / NSG TEC ™ 15	1	1.6	25	87	82	75	14	82
NSG TEC ™ 70 / NSG TEC ™ 15 / Clear	2	1.5	25	90	88	73	17	82

* Room-side temperature = 27°C, refrigeration temperature = 4°C.

** Condensation along the room-side glass surface away from the frame when the relative humidity (RH) within the room is greater than the value noted.

*** No power.

**** Room-side temperature = 27°C, freezer temperature = -20°C.

Notes: All glass 3.2 mm; Airspace 12 mm for doubles, 6 mm for triples; Airspace filled with air; All simulations utilizing LBL Windows 5.2; Demist heater power of 100 Watts (82 W/m²); Input voltage = 120 volts; Units 800 mm × 1700 mm, bus bars along 800 mm dimensions.



This publication provides only a general description of the products. Further, more detailed, information may be obtained from your local supplier of Pilkington products. It is the responsibility of the user to ensure that the use of these products is appropriate for any particular application and that such use complies with all relevant legislation, standards, codes of practice and other requirements. To the fullest extent permitted by applicable laws, Nippon Sheet Glass Co. Ltd. and its subsidiary companies disclaim all liability for any error in or omission from this publication and for all consequences of relying on it. Pilkington and "TEC" are trademarks owned by Nippon Sheet Glass Co. Ltd, or a subsidiary thereof.



CE Marking confirms that a product meets the requirements of its relevant harmonised European Norm and can be placed on the market in the EU. The CE Marking Declaration of Performance for each product can be found at www.pilkington.com/ce



Pilkington Group Limited
European Technical Centre
Hall Lane – Lathom Nr Ormskirk L40 5UF – United Kingdom
marketing.communications@nsg.com
www.pilkington.com

March 2024