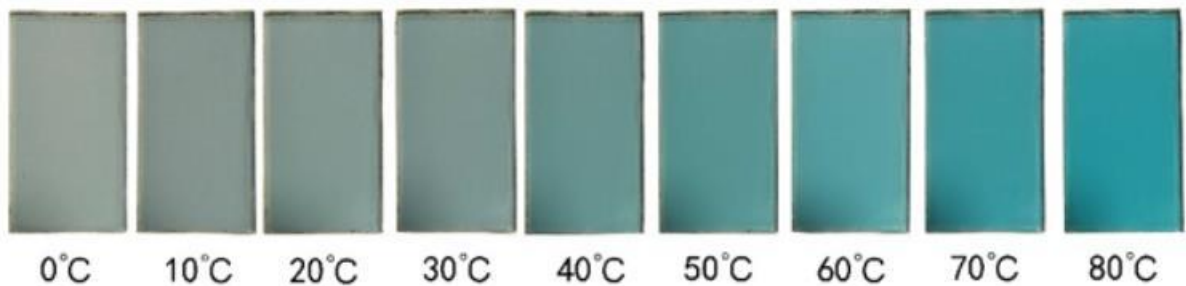


Thermochromic smart glass Performance test

Thermochromic smart glass, is a kind of new laminated glass with thermochromic PVB interlayer whose color will change with different temperature. The glass basic color is fixed on 25 degrees, once glass temperature increase, glass color will change from light to grey gradually.

<https://www.youtube.com/watch?v=ZKZnbl80BuU>

Thermochromic smart glass can be combined with normal PVB interlayer to make solar shading and thermal insulation safety laminated glass.



It is specially designed for architecture, which increases the sun-shading function of the architectural glass itself and saves the use of sun-shading materials. It can also perceive changes in the outside temperature to automatically change the appearance of the building, enhance the two-way performance of heat insulation, and give traditional buildings more low-carbon and smarter characteristics.



Morning

Noon

The main function of the thermochromic PVB is to absorb the solar radiation and change color, work as a barrier to prevent solar radiation transfer the glass. Then what's the real performance of the thermochroic smart glass? Here let's check below test conducted in summer.



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Test environment: Glass conservatory

Glass Combination:

TSG GLASS ROOM: 5+0.76 Thermochromic PVB+5+12A+5 online low-E

Normal Glass Room: 5+0.76 PVB+5+12A+5 online low-E



TSG test room



Normal glass test room



Test content: Summer(closed windows&doors),comparison of solar radiation,indoor temperature,inner and out glass surface temperature.

1.Glass performance data compare:

Glass Combination	Light transmittance 25°C	Light transmittance 80°C	Light reflectance	Solar transmittance 25°C	Solar transmittance 80°C	SC 25°C	SC 80°C	U value
5+0.76 Thermochromic PVB+5+12A+5 online low-E	54.1	41	10.1	30.9	21.1	0.48	0.37	1.86
5+0.76 PVB+5+12A+5 online low-E	76.3	76.3	16.9	58.6	58.6	0.82	0.82	1.86

2.Test temperature:July 20,2019 in Qingdao,22-34 °C.All windows&doors are closed.

3.Test result:

3.1 Solar radiation comparison:



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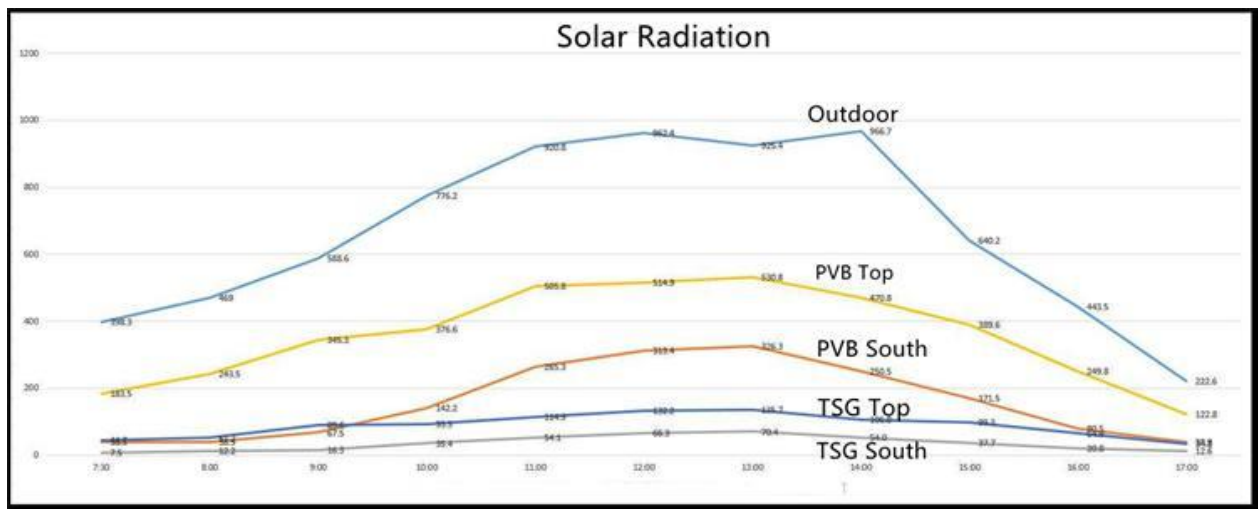
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Due to the direct sunlight from top to bottom in summer, the glass facade is severely blocked. In order to make the data more accurate, the data of the glass vertical facade and the conservatory top are collected separately.

Time	7:30	9:00	11:00	13:00	15:00	17:00	Average
Outdoor	398.3	588.6	920.8	925.4	640.2	222.6	664.88
PVB-SOUTH	38.5	67.5	265.3	326.3	171.5	38.9	157.59
TSG-SOUTH	7.5	16.3	54.1	70.4	37.7	12.6	35.21
PVB-TOP	183.5	345.3	505.8	530.8	389.6	122.8	357.58
TSG-TOP	44.7	89.6	114.9	135.7	99.3	34.8	88.01

Conclusion:

- (1) The ability of normal PVB laminated to block solar radiation is basically constant throughout the day, and the solar radiation intensity transmit the top surface has an average of 54%. The solar radiation intensity through the south facade has an average of 21%.
- (2) The intensity of solar radiation through TSG is very low. The average intensity of solar radiation through the top surface is 13%. The average solar radiation intensity transmit the south facade is 5%.
- (3) Regardless of the south elevation or the top surface, the solar radiation intensity through the TSG room is only 25% of that of the PVB room, indicating that the TSG has a significant effect in blocking solar radiation intensity.



3.2 Indoor Temperature test

Time	7:30	9:00	11:00	13:00	15:00	17:00	Average
Temperature	27.8	29.6	34.3	38.3	39.2	37.1	34.45
Wind speed m/s	1.2	1	1.1	1.9	2.5	0.9	1.43
PVB room	39	48	63.5	64	63	56	56.5
TSG room	26	35.5	52.5	56	56	52	46.64

Conclusions:

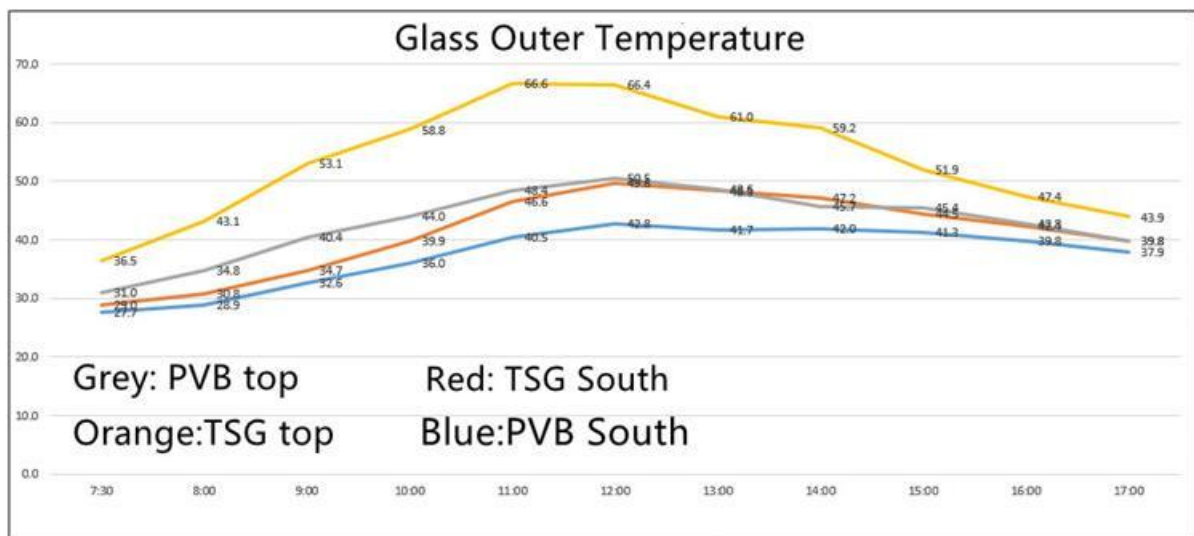
(1) Due to the closed doors and windows, when the outdoor temperature is only 27.8°C at 7:30 in the morning, the indoor temperature of the PVB room is already 39°C, while the TSG room is only 26°C. It shows that the solar heat is transmitted directly into the PVB room, while the STG room blocks the solar heat from the outside.

(2) The temperature in the two rooms in the morning is constantly rising. The maximum indoor temperature difference between the TSG room and the PVB room is 14°C; The average temperature difference throughout the day is about 10°C.

(3) This kind of closed doors and windows is unlikely to occur in summer in real life. The purpose of this test is to verify the actual energy-saving effect of STG.

3.3 Outer glass temperature

Time	7:30	9:00	11:00	13:00	15:00	17:00	Average
PVB South	27.7	32.6	40.5	41.7	41.3	37.9	37.78
TSG South	29	34.7	46.6	48.3	44.5	39.8	41.16
PVB Top	31	40.4	48.4	48.6	45.4	39.8	42.85
TSG Top	36.5	53.1	66.6	61	51.9	43.9	53.45



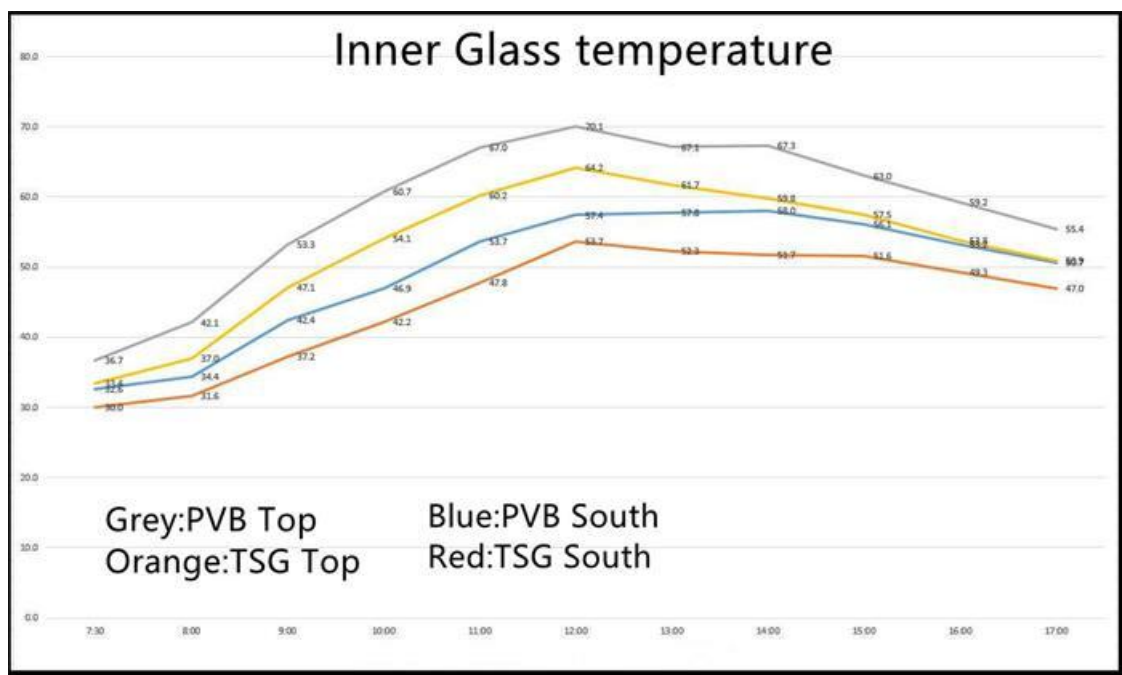
Conclusion:

(1) The temperature of the outer surface of the TSG top reaches a maximum of 66.6°C at 11:00, which is 32.3°C higher than the outdoor temperature and 16.1°C higher than the highest temperature of the outer surface of the PVB top glass. As a result, the visible light transmittance of TSG is reduced by about 4%. At this time, the indoor illuminance is only 39.5% of the outdoor.

(2) When the doors and windows are closed in summer, the temperature of the outer surface of the TSG room is 10.6°C higher than that of the PVB room's top glass, and the average temperature of the south glass is 3.8°C higher.

3.3 Inner glass temperature

Time	7:30	9:00	11:00	13:00	15:00	17:00	Average
PVB South	32.6	42.4	53.7	57.8	56.1	50.7	49.38
TSG South	30	37.2	47.8	52.3	51.6	47	44.95
PVB Top	36.7	53.3	67	67.1	63	55.4	58.35
TSG Top	33.4	47.1	60.2	61.7	57.5	50.9	52.7



Conclusion:

(1) The average temperature of the glass inner surface of the TSG room, whether it is the top surface or the south facade, is always 3~6°C lower than that of the PVB room.

(2) The temperature of the inner surface of the TSG room glass is always lower than outer, while the temperature of the inner surface of the PVB room glass is always higher than outer.

Test result:

1. The solar radiation intensity of the TSG room in summer is only 25% of that of the PVB room, indicating that TSG can significantly reduce the solar radiation incident into the room and increase people's physical comfort.



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2. TSG can significantly reduce the intensity of glare. It can reduce the intensity of glare by about 62% at noon when the light is strongest in summer, ensuring soft indoor light and increasing visual comfort.

3. In summer, the maximum temperature difference between the TSG room and the PVB room is 14°C, indicating that STG has a significant energy-saving effect when used in a glass conservatory.

4. The highest external surface temperature of TSG in summer is 66.6°C, which is 32.3°C higher than the outdoor temperature, and is similar to the 30°C temperature rise in the winter test, and the effect of changing the color tone is also similar. However, at this time, the TSG temperature is higher, the color is deeper, and the visible light transmittance is lower, which effectively improves the indoor lighting quality.

5. The temperature of the inner surface of the glass of the TSG room is 3~6°C lower than that of the PVB room, and the temperature of the inner surface is always lower than the temperature of the outer surface, effectively blocking the solar heat.

Cooperating with China thermochromic smart PVB film manufacturers, Morn now is able to manufacture and supply thermochromic laminated safety glass, with gradual color changes to protect your home and enhance your living room environment.

Thermochromic glass can be applied in exterior projects to remove the solar shading facility and get natural shading effect, such as glass skylight, glass roof, below pics shows the actual application in train station.





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