

The TORAY logo is displayed in a bold, blue, sans-serif font. The letters 'T' and 'Y' have a distinctive slanted top edge. The background of the slide features a faint, light blue chemical structure with various functional groups like COOH, OH, and COCl.

Innova

NREL PVRWS 2013 %

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Test Procedure for UV Weathering % Resistance of Backsheet %

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Based on the past discussion of weathering sub-group, WG2 material group consider the followings about the test procedure of Backsheet.

“Polymeric materials that are exposed to direct sunlight but are protected by glass, or other transparent medium ,may be tested with an equivalent layer of that medium attenuating the UV light exposure during the test”.

The preparation of samples and test procedure are proposed in this presentation. Moreover, preliminary exam results of UV weathering resistance of backsheet are illustrated.

Apparatus:

Xenon weathering tester. Modified ISO 4892-2 (discussed in Weathering group)

- Irradiance of UV were increased from that of IEC61730-1 A2 to increase accretion ratio.
- Dark cycles were employed to consider dark chemical reaction.

Test conditions and sequences:

Condition 1 (108min.) => Condition 2 (18min) :120min (2 hrs)

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=> Condition 3(120 min) :120min (2 hrs)

=> repeat above test cycle

Front : 2000 hrs , Back :1000hrs (Duration will be discussed in material group)

Condition 1:

Irrad .E(300-400 nm) = **88.0 W/m²** , Filter type (SPD) DL filter

CHTemp 65 degC, RH = 50%RH, BPTemp = 89degC

Condition 2:

Irrad .E(300-400 nm) = **88.0 W/m²** , Filter type (SPD) DL filter

Water Spray CHTemp 65 degC, RH is NC , BPTemp is NC.

Condition 3:

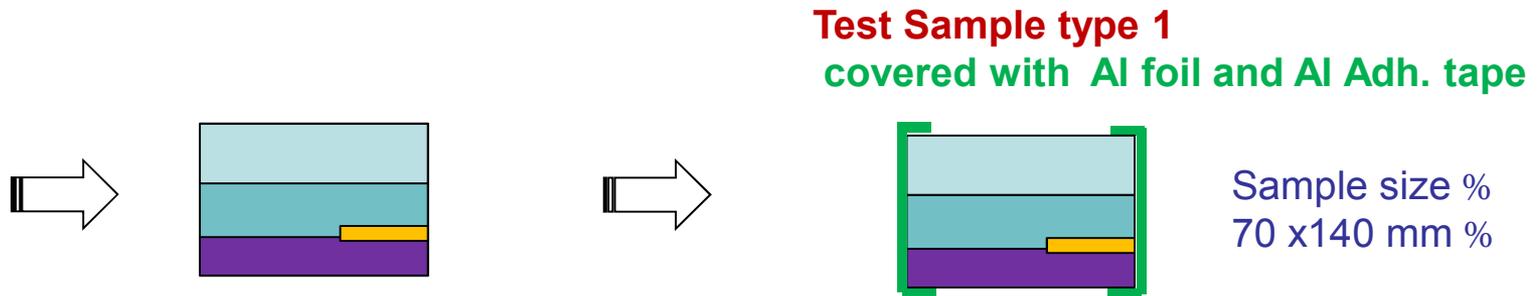
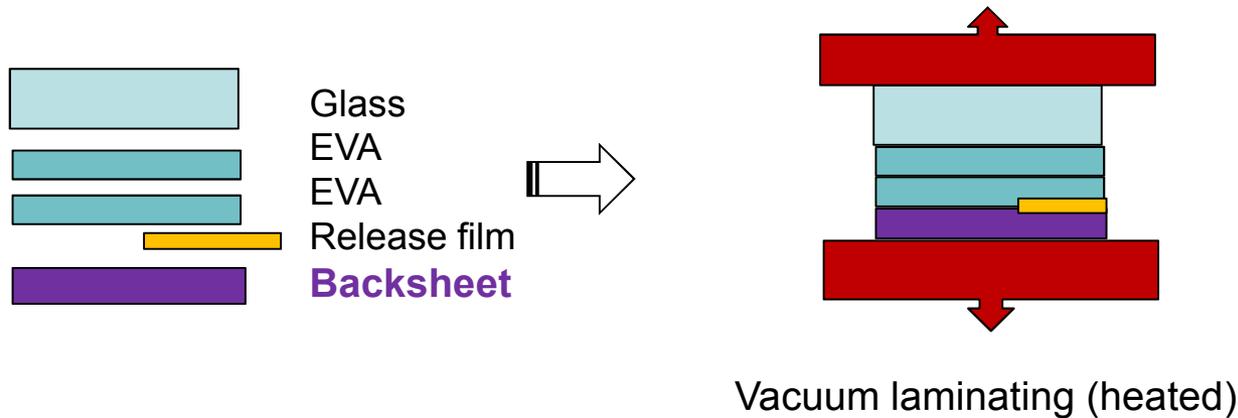
Dark CHTemp 65 degC, RH = 50%RH

NOTE: IEC61730-1 A2 Ed.1 describes UV test condition as following;

ANSI/UL 746C or ISO 4892-2. Test condition defined by Xenon cycle 1 at 0,35 W/m²/nm or **41 W/m² (in the wavelength range from 300 nm to 400 nm)**, test duration 1 000 h; equivalent pass/fail-criteria as in UL 746C shall be applied.

Sample preparation and setup (1) %

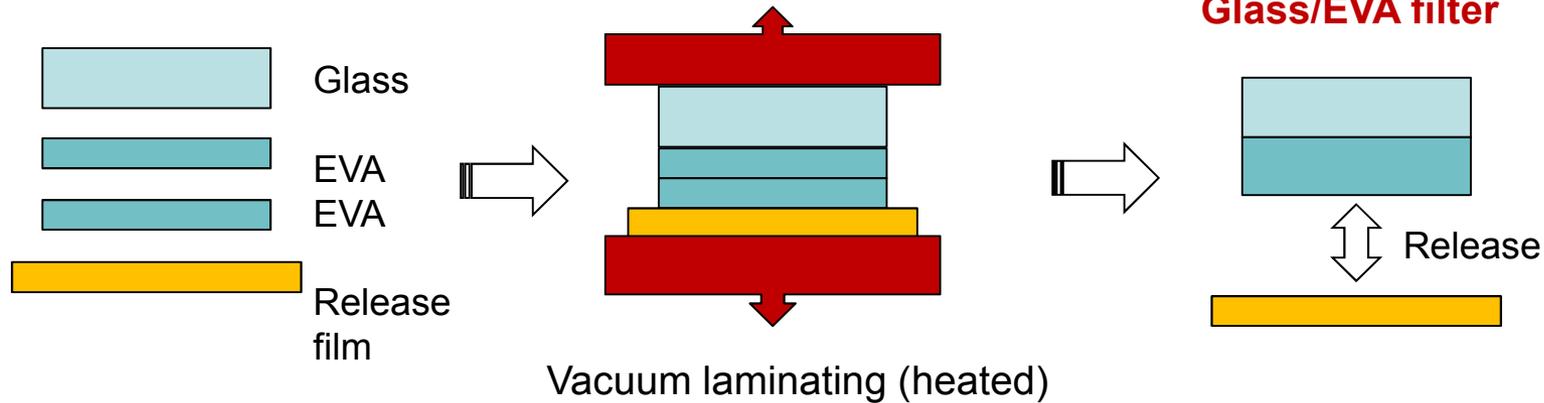
1. Preparation of test sample for peel-strength after UV weathering test %



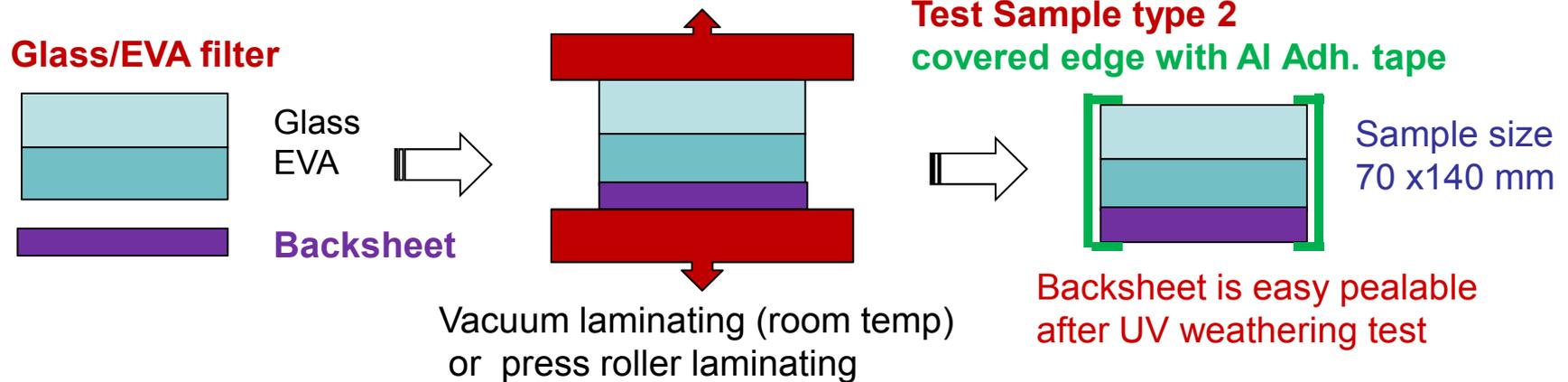
Note; %
It is preferable to cover the edge of the samples with aluminum adhesive tape to prevent water %
penetrating. %
Because the regular size sample holder is 150mm in long side, it is difficult to hold glass sample using %
3.2mm t and 150mm length.

Sample preparation and setup (2) %

2. Preparation of Glass/EVA filter parts %



3. Preparation of test sample for breaking strength after UV weathering test



Note;

It is important to remove air gap between glass and backsheet at the following points of view.

(a) Remove light reflection at the interface of Glass-Air and Air- Backsheet.

(b) Avoid degradation of the polymer by ozone or active oxygen caused by UV light.

Test sample and sample holder %

Sample (back view)

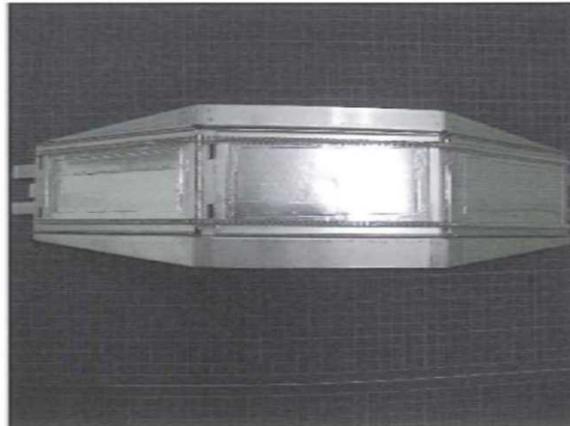
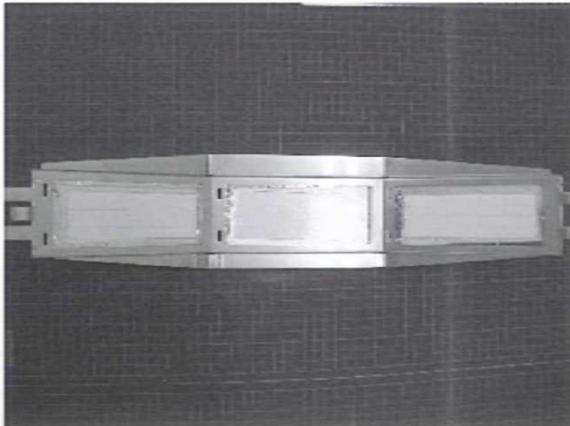


Sample size
70 x140 mm

Sample backsheet was pre-cured in the shape of 10mm width in this experiment.

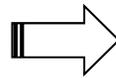
Note. 15mm width is required in ISO standard measurement

Sample holder of UV test chamber

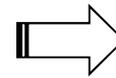
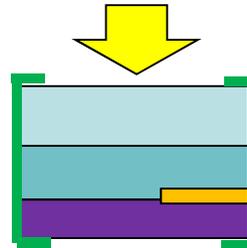


Procedure of UV Weathering Test %

Test Sample type 1 %



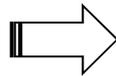
UV light %



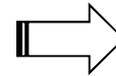
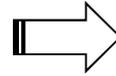
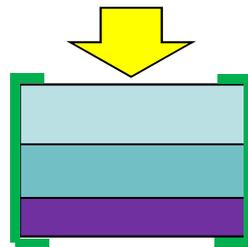
**Measurement
(for requirement)**

- (a) **Bond strengths between encapsulant and Backsheet 180° peel % (NEW proposal % from TORAY) %**

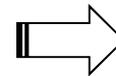
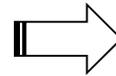
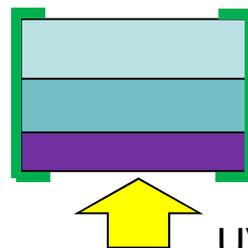
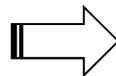
Test Sample type 2 %



UV light %



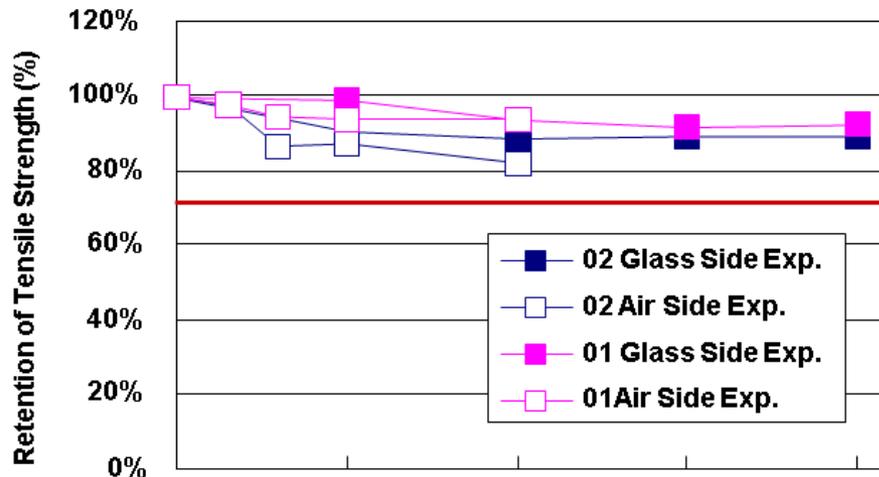
- (b) **Tensile strength / elongation**
- (c) **Yellowing (Front view)**
- (d) **Reflection**



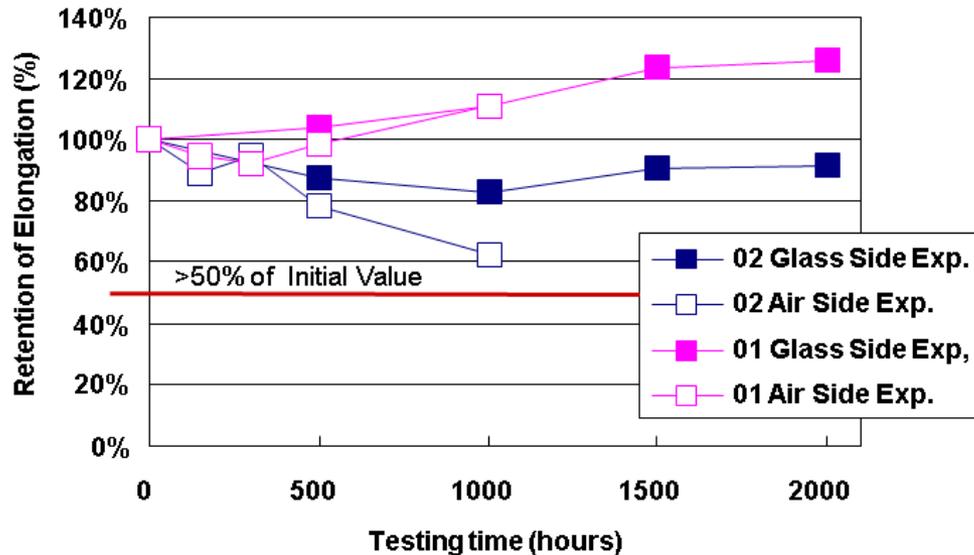
- (b) **Tensile strength / elongation**
- (c) **Yellowing (Back view)**

UV light

Measurement result : Tensile strength, Elongation



>70% of Initial Value
(same as UL746C)



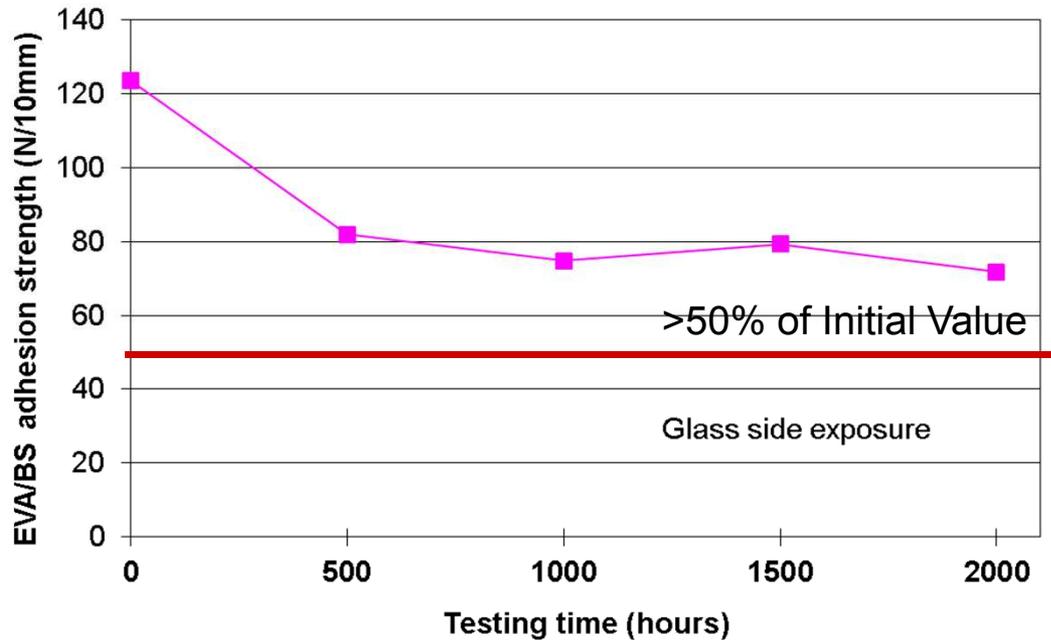
>50% of Initial Value



Note: 2000 hrs. test = 117.3kW hrs. UV(300-400nm)

Measurement result : %

Bond Strength between EVA and Backsheet %



Measurement result : Yellowing of EVA and Backsheet

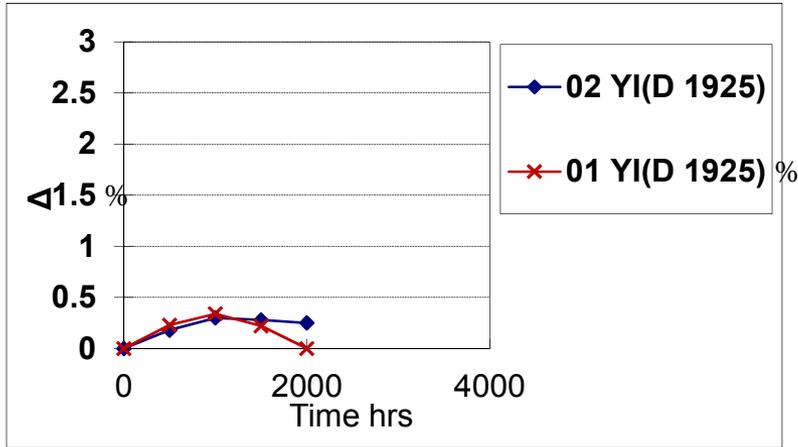


Fig1. Glass side Exp. (Sample type 1)
YI of front face of BS , through the glass

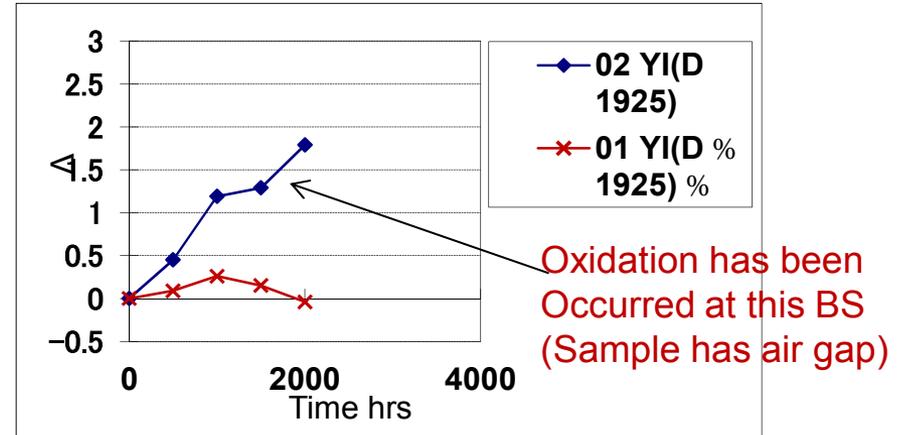


Fig2. Glass side Exp. (Sample type 2 with air gap)
YI of front face of BS after separate BS from glass

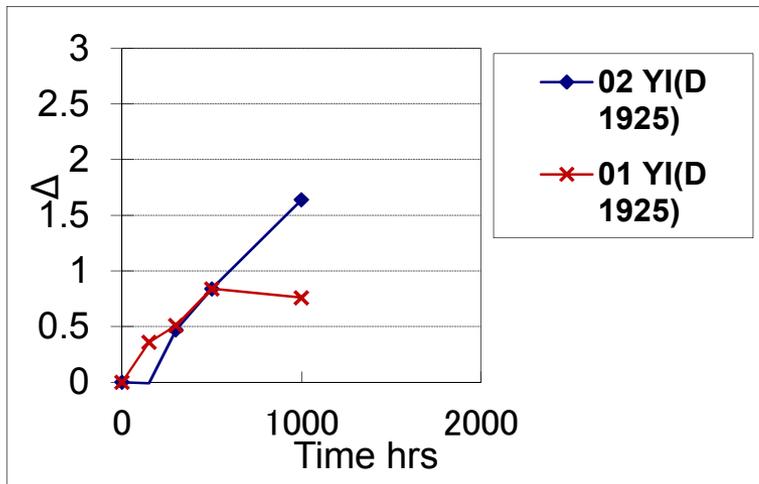
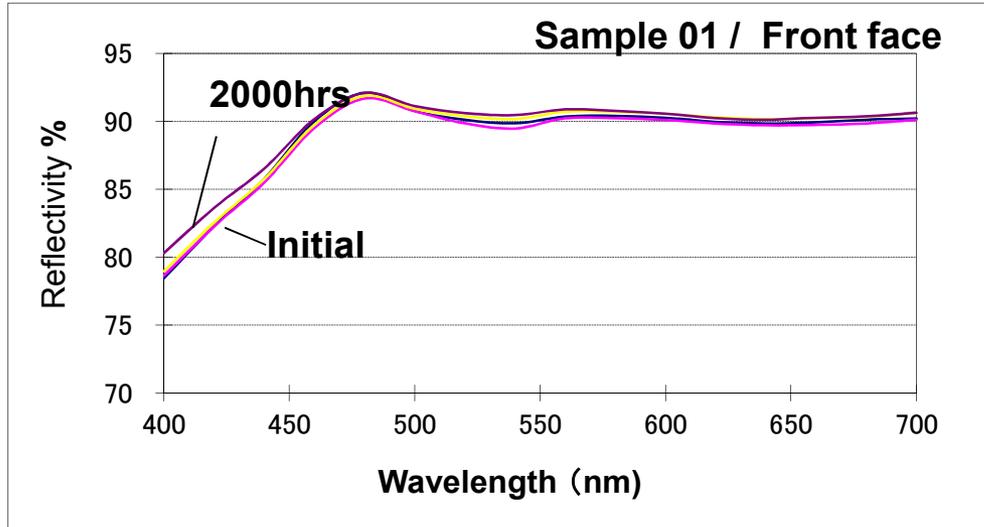


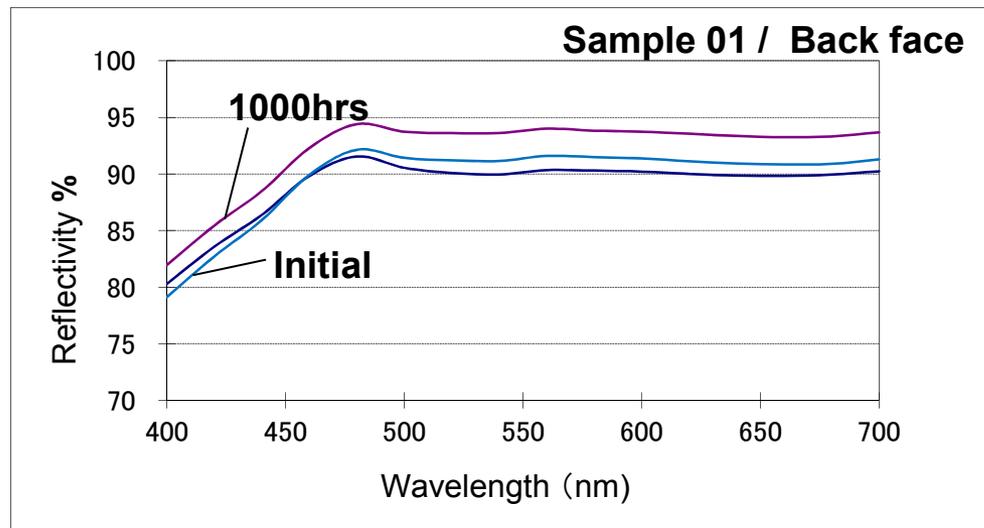
Fig3. Back side Exp.
YI of back face of BS

Reflectance after UV Weathering test %



Note
Exp. Through the glass

2000 hrs. test
= 117.3kW hrs. UV(300-400nm)



Note
Exp. directly

1000 hrs. test
= 58.7 kW hrs. UV(300-400nm)

Conclusion and proposal %

Procedure of sample preparation for UV weathering test of backsheet are proposed.

- (a) Backsheet can be temporarily fixed on Glass/Encapsulant component % without air gap, using a conventional laminating machine. %**
- (b) Bond Strength between EVA and Backsheet after UV weathering test % can be measured by 180 degree peel test method. %**

To be shortened test time, we may consider that increase in the irradiance to 2-SUN (90W/m², 300-400nm) is permitted in IEC standard.

It is necessary to further discussion at WG2 (& FS,BS sub group, Weathering sub-group) to determine the test conditions and duration in detail.