1.WINLITE® PVB中間膜 WINLITE® PVB SHEET

1.1 簡介 Introduction

穩麗得®聚乙烯醇縮丁醛中間膜（以下簡稱WINLITE®)是將特殊的可塑劑、添加劑與PVB樹脂混合後，經由押出加工，形成厚度均勻的PVB膜。WINLITE® 除了具有優異的黏彈性、透明性、耐候性、低溫耐衝擊性及光學性質之外，對玻璃具有適中的接著性。因此，WINLITE® 可廣泛應用於汽車、建築及太陽能電池模組用夾層玻璃。

使用WINLITE® 之夾層玻璃具有以下特性:

- 安全性
- 防盜性
- 隔音性
- 防紫外線
- 色彩多樣化
- 信賴性

WINLITE® is produced by extrusion using PVB resin, plasticizer and additives. It possesses excellent physical properties such as outstanding viscoelasticity, superb transparency, weatherability, impact-resistance at low temperature, optical characteristics, and optimal adhesive ability to glass. WINLITE® finds major use in the manufacturing of laminated safety glass for automotive, architectural application and solar panel.

The unique characteristics of laminated glass, with WINLITE®, are listed below

- Safety
- Security
- Sound control
- Ultraviolet screening
- Colorful
- Reliability

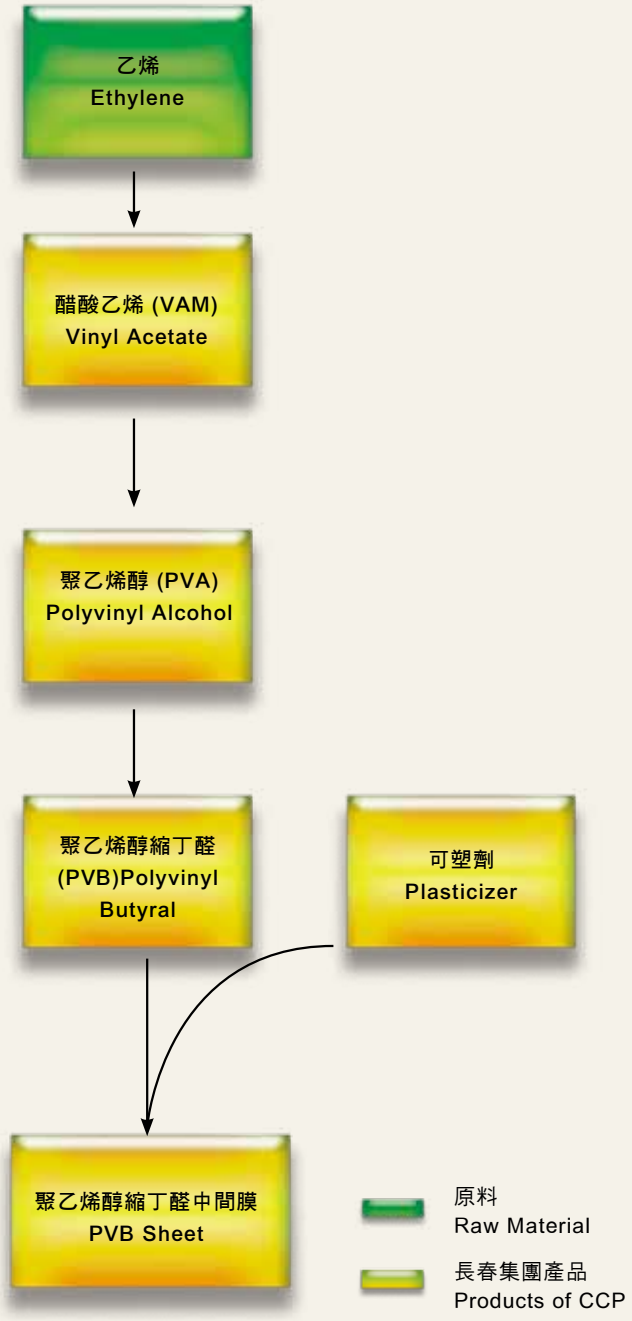
1.2 製造流程 Manufacturing Flowchart

2. 原料 Raw Material

2.1 上游原料整合之優勢 Advantages of Vertical Integration

由於VAM、PVA、PVB及可塑劑等WINLITE®之上游原料，均為長春集團自有產品，原料之供應無虞，並且能對原料品質做最嚴格之控管，使得WINLITE®在市場上非常具競爭力。

VAM, PVA, PVB, and pasticizer are upstream raw materials of WINLITE® and all of them are CCP group's products. That means raw materials are not only supplied sufficiently but also with good quality under control. Thus, WINLITE® is very competitive in the market.



長春PVA工廠外觀 CCP PVA Plant

長春PVB工廠外觀 CCP PVB Plant

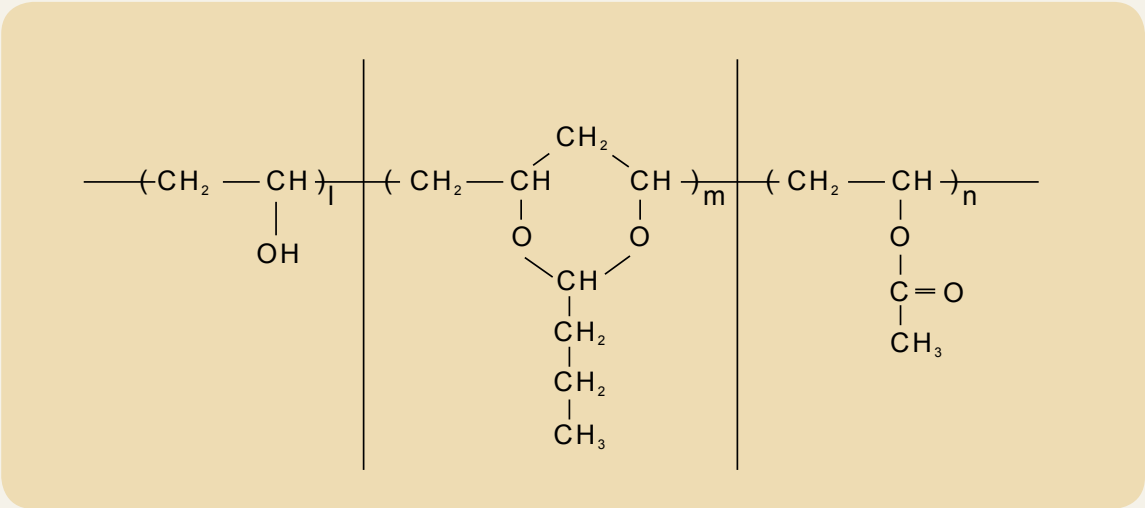
長春生產之PVB樹脂原料 CCP PVB Resin

長春PVB Sheet新廠外觀 CCP PVB Sheet Plant

2.2 聚乙烯醇縮丁醛樹脂 Polyvinyl Butyral Resin

聚乙烯醇縮丁醛樹脂（PVB resin)為WINLITE®之主要原料。它是由聚乙烯醇(PVA)與丁醛(Butyral)進行縮合反應而得之熱可塑性樹脂，具有優良的韌性、成膜性及適宜的黏著性。夾層玻璃的中間膜主要以PVB為主要原料，其分子構造式如下：

The base material for WINLITE®, PVB resin is a thermoplastic polymer obtained by condensation reaction of polyvinyl alcohol and butyraldehyde. This resin shows excellent flexibility, film-forming and optimal adhesion properties. The molecular structure of PVB resin is shown below:



2.3 可塑劑 Plasticizer

PVB必須加入可塑劑以利加工成膜。用於WINLITE®的可塑劑，具有以下特性：

- 與PVB的相容性佳
- 優良的耐熱性
- 優良的耐侯性
- 優良的耐黃變性
- 低揮發性

The plasticizer used in WINLITE® PVB sheet has following characteristics:

- Excellent compatibility to PVB resin
- Excellent heat resistance
- Superior weatherability
- No discoloration
- Low volatility

3.規格 Specification

3.1 用於建築夾層玻璃 For Construction Laminated Glass

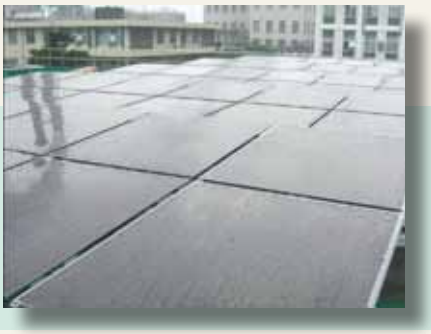
Grade	厚度 Thickness (mm)	長度 Length (m/roll)	顏 色 Color	寬度 Width
PFAT	0.38+0.04 -0.02	400	透明 Clear	24 ～ 96 inch (610 ～ 2,440 mm)
PFAS	0.38+0.04 -0.02	400	白 色 Opaque White	
PFBT	0.76+0.04 -0.02	250	透明 Clear	24 ～ 126 inch (610 ～ 3,215 mm)
PFET	1.14+0.04 -0.02	150	透明 Clear	
PFDT	1.52+0.04 -0.02	125	透明 Clear	

3.2 用於汽車夾層玻璃 For Automobile Laminated Glass

Grade	厚度 Thickness (mm)	長度 Length (m/roll)	顏 色 Color	寬度 Width
PFCT	0.76+0.04 -0.02	250	透明 Clear	24 ～ 96 inch (610 ～ 2,440 mm)
PFCG	0.76+0.04 -0.02	250	色帶(綠) Shade Green	24～ 48 inch (610～ 1,220 mm) Shade Width 4~10 inch(102~254 mm)
PFCB	0.76+0.04 -0.02	250	色帶(藍) Shade Blue	24 ～ 48inch (610 ～ 1,220mm) Shade Width 4~10inch(102~254mm)

3.3 用於太陽能電池 For Solar Cell

Grade	厚度 Thickness (mm)	長度 Length (m/roll)	顏 色 Color	寬度 Width
PFVT	0.76+0.04 -0.02	250	透明 Clear	24 ～ 126 inch (610 ～ 3,215 mm)
PFVT	1.14+0.04 -0.02	150	透明 Clear	24 ～ 126 inch (610 ～ 3,215 mm)
PFVS	0.76+0.04 -0.02	250	白色 White	24 ～ 96 inch (610 ～ 2,440 mm)



備註 Remark:

如有其他特殊需求，請洽長春營業人員。

Other widths and lengths available on request, please contact out sales representatives for further information.

4.性質 General Properties

項 目 Item	單 位 Unit	規 格 Specification	一般分析值 Typical Value	測試條件 Test Method
外 觀 Appearance	~	半透明膜 Translucence	半透明膜 Translucence	~
比 重 Specific Density	~	1.06~1.08	1.07	沈浮法 Sink-float test
熱傳導度 Heat Conductivity	J / (cm · sec · ° K)	~	1.95×10^{-3} (65℃)	熱傳導率測定儀 Heat Conductivity Measuring Apparatus
拉力強度 Tensile Strength	kg/cm^2	>200	320	23℃, 200 mm/min
伸長率 Elongation	%	>200	250	23℃, 200 mm/min
熱收縮率 Heat Shrinkage	%	<10 for 0.38mm <6 for 0.76mm <6 for 1.14mm <6 for 1.52mm	6 4 3 3	50℃×1hr.
含水率 Moisture	%	0.3~0.6	0.45	NIR
粗糙度 Roughness	μm	15~55	20~40	粗糙度計 Roughness Meter

5. 特性 Characteristics

5.1 安全性/保全性 Safety/ Security

WINLITE®之質地相當強韌，可藉由其形變，來吸收夾層玻璃受到之衝擊力。再加上WINLITE® 與玻璃有強大的接著力，即使夾層玻璃受到外力撞擊，玻璃碎片會黏著於膜上，不易飛散，減低了對人體的傷害。

夾層玻璃的典型構造如下：

≧3mm Glass / 0.76mm WINLITE®/ ≧3mm Glass
≧3mm Glass / 0.38mm WINLITE®/ ≧3mm Glass

多層之夾層玻璃，可應用在防彈汽車玻璃或住宅門窗玻璃，以防止暴力入侵。下圖為夾層玻璃 (3mm玻璃/ 0.38mm WINLITE®/3mm玻璃）經霰彈袋試驗之結果。由圖可見，夾層玻璃除了不被貫穿之外，玻璃依然牢牢附著於膜上。

Laminated glasses with WINLITE® act as a good barrier. It can resist penetration and absorb strong mechanical shock. Laminated glass with WINLITE® can also prevent damage and injury by holding dangerous glass shards after breakage.

Typical configurations of laminated glass:

≧3mm Glass / 0.76mm WINLITE®/ ≧3mm Glass
≧3mm Glass / 0.38mm WINLITE®/ ≧3mm Glass

Anti-bandit and bullet resistance glass obtained by increasing WINLITE® thickness or number of layers. The result of “impact test” of laminated glass (3mm glass/0.38mm WINLITE®/ 3mm glass) is as shown below. It is clear that the splinters are adhesive on sheet without penetration.

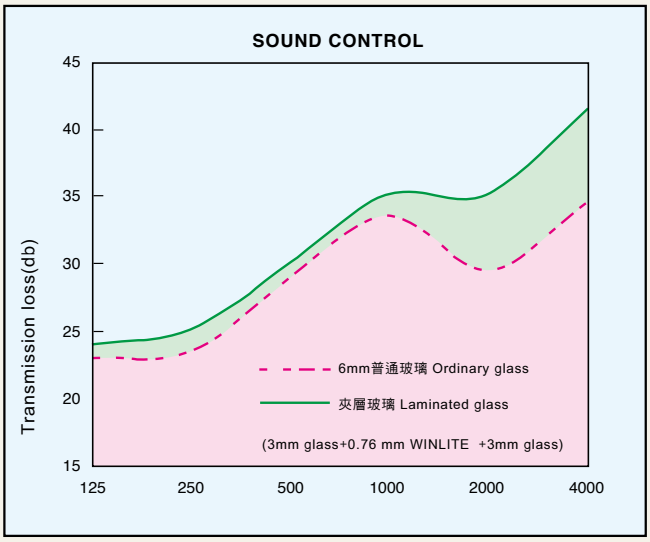
5.2 隔音性 Soundproof

WINLITE®能在音波穿透玻璃時，減弱其振幅，故能有效地隔絕噪音，達到隔音的效果。一般公共場所或是噪音大的場所，皆可使用夾層玻璃來隔絕噪音。

單層玻璃(6mm)與夾層玻璃 [3mm 玻璃+0.76mm WINLITE +3mm玻璃] 之隔音效果比較如右圖：

Laminated glass offers improved sound barrier effect. Public places, especially where are noisy, therefore were constructed with laminated glass windows.

The comparison of soundproof effect between single-layered glass (6mm) and laminated glass (3mm glass+0.76mm WINLITE®+3mm glass) is as shown as the right chart.



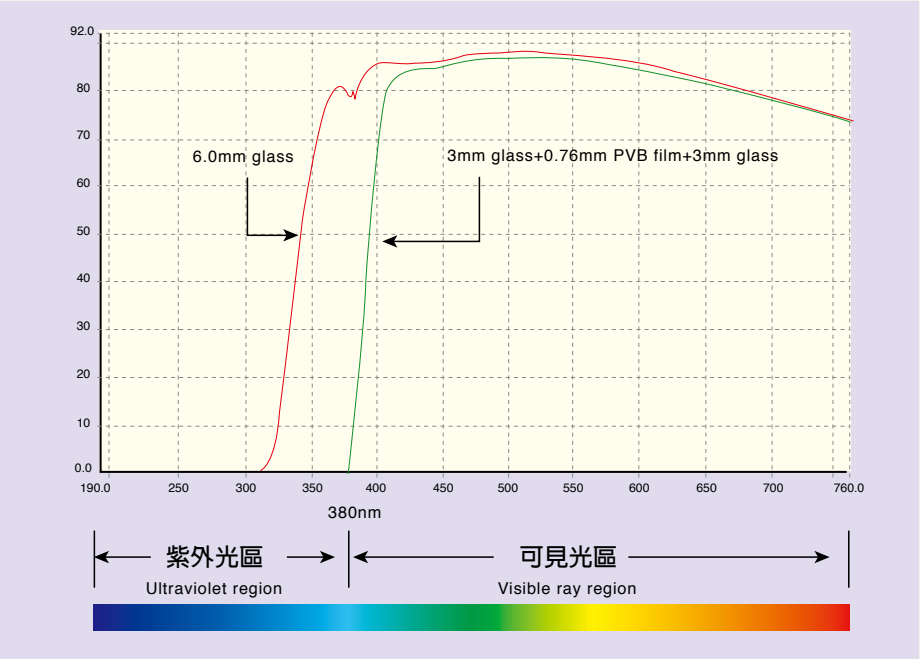
5.3 防紫外線 Ultraviolet Screening

紫外線是造成家具、圖畫、塗料、紡織品等物品變色的主因。使用WINLITE®製成之夾層玻璃，能幾乎完全阻隔紫外光，防止家具等物品變色。

單層玻璃(6mm)與夾層玻璃 (3mm玻璃+0.76mm WINLITE®+3mm玻璃)之紫外線隔絕效果比較如下圖：

Ultraviolet ray may generally cause deterioration of furniture, pictures, paints, textile goods etc. Laminated glass using WINLITE® PVB sheet is able to absorb nearly 100% of UV ray to prevent such problem.

The UV-proof effect comparison between the single-layered glass (6mm) and laminated glass (3mm glass+0.76mm WINLITE® +3mm glass) is shown as below.



5.4 色彩 Color

WINLITE®的色膜能讓建築師或室內設計師，有更多樣化之選擇去完成其構想。

Tinted WINLITE® provides the architect or interior designer various choices to fulfill their ideas.

6. 包裝與儲存 Packaging and Storage

6.1 包裝 Packaging

項 目 Item	隔離膜 PE Interleaved	冷凍膜 Refrigerated	目 的 Purpose
隔離膜 Interleaved Film	聚乙烯膜 PE Film	-	防 黏 Anti-Adhesion
捲 心 Core	PVC(ID(內徑）=154mm)		捲取 Winder
內層包裝 Inner Packing	鋁 箔 Aluminum Foil		防吸水 Waterproof
外層包裝 Outer Packing	紙桶、紙箱或木箱 Paper Carton, Paper Box or Wooden Box		保 護 Protection

- 寬度1600mm (63 inch)以下(含)之成品，外包裝為垂直放置之紙桶或紙箱。
- 寬度1600mm (63 inch)以上之成品，外包裝為水平放置之木箱。

- Width ≦ 1,600 mm(63 inch) ：Vertical paper carton or paper box.
- Width ＞ 1,600 mm(63 inch) ：Horizontal wooden box.

6.2 儲存 Storage

項 目 Item	隔離膜 PE Interleaved	冷凍膜 Refrigerated
儲存溫度 Storage Temperature	< 25℃	<10℃
儲 存 Storage Conditions	・避免陽光照射或高濕度的環境。 ・Avoid storage in high humidity conditions and do not expose to the sun.	
處 理 Handling	・避免碰撞、撕裂。 ・Avoid crushing or tearing.	
儲存堆積 Stacking	・木箱：4 層 / 紙箱：2 層 / 紙桶：2 層 ・Wooden Box：4 layers / Paper Carton：2 layers / Paper Box ：2 layers	

7. 合片 Assembly

7.1 合片前的準備伸展與裁切 Preparation: Stretching and Cutting

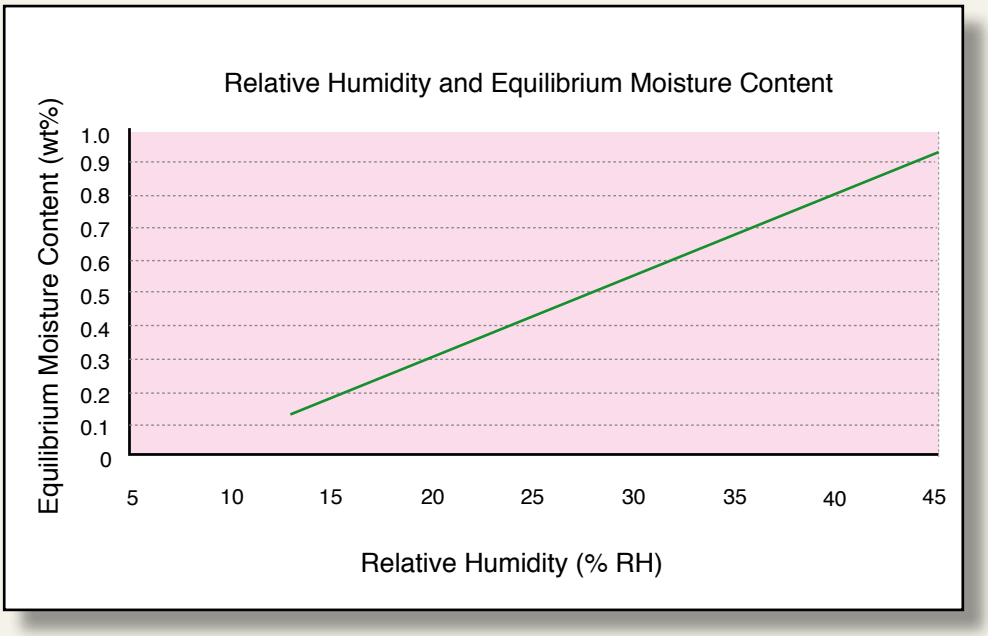
在進行合片程序之前，PVB膜必須先進行裁切。而為了防止PVB膜在夾層過程中產生收縮現象，PVB膜之裁切尺寸必須比玻璃略大。

倘若是應用於汽車擋風玻璃，PVB膜還必須在裁切前先進行伸展，一般是以加熱方式使PVB膜變成扇形。不過，為了避免殘存應力導致PVB膜在伸展後有收縮現象產生，建議展膜後之中間膜貯存溫度條件應在25℃以下。

Considering the deformation of the PVB sheet during the laminating process, it should be cut a little larger than the glass area.

In the case of windshield glass, after stretching by heating the PVB sheet, PVB sheet is suggested to be stored below 25℃ to prevent residual stress causing shrinkage.

7.2 相對溼度與平衡含水率 Relative Humidity and Equilibrium Moisture Content



相對濕度與平衡含水率的關係圖

PVB膜含水率對夾層玻璃的接著及耐貫穿性有決定性的影響。為了保有適宜的接著力及良好的耐貫穿性，理想的含水率控制範圍應為0.3~0.6wt%。但是含水率易受外在環境所影響，其與相對溼度之關係圖如上圖所示。

為了讓含水率保持在理想的0.45%左右，對於貯存及合片過程之環境條件，建議如下:

- 溫度Temperature: 20℃
- 相對濕度Relative Humidity: 23%

A key factor affecting the adhesion and penetration resistance of laminated glass is the moisture content of PVB sheet. It shall be controlled in the range of 0.3~0.6wt %, but it changes easily by environment. The above figure shows the equilibrium moisture content from different relative humidity ranges.

When the PVB sheet is stored and assembly in a controlled condition of 20℃ and relative humidity 23% , it will reach an equilibrium and ideal moisture of 0.45%.

8. 預壓合 Pre-pressing

預壓合程序主要有二種工法：壓輪法與真空法。目的為：

- ◆ 將玻璃和PVB膜之間的空氣排出。
- ◆ 保持玻璃與PVB膜間的密著性。
- ◆ 將夾層玻璃的邊緣密封，以避免在正壓合程序中，空氣浸入夾層玻璃內。

Main methods for pre-pressing are nip roll system and vacuum system. The main purposes are,

- ◆ De-airing between glass and PVB sheet.
- ◆ Maintaining the adhesion of the PVB sheet to the glass surface.
- ◆ Sealing the edge of laminated glass to avoid penetration of air during autoclave process.

8.1 壓輪法 Nip Roll Process

	第一壓輪 First Nip Roller		第二壓輪 Second Nip Roller	
程序條件 Condition	範 圍 Range	目標值 Typical Value	範 圍 Range	目標值 Typical Value
玻璃表面溫度 (℃) Surface Temperature of Glass	室溫 Room Temp.	~	65~80	70
壓輪壓力 (kg/cm^2) Pressure of Nip Roller	2~5	3	3~10	6
目的 Purpose	消除空氣 De-airing		黏著Sticking / 密封Sealing	

8.2 真空法 Vacuum Process

程序條件 Condition	範圍 Range	目標值 Typical Value
初始玻璃表面溫度/真空條或真空袋溫度 Initial Temperature of Glass Surface /Temperature of Ring or Bag	20~30	25
加熱前抽真空時間 Vacuum before heating	＞5	＞5
真空度 (mm Hg) Vacuum Level	600~700	650
玻璃表面溫度 (℃) Tacking Temperature of Glass Surface	90~110	100

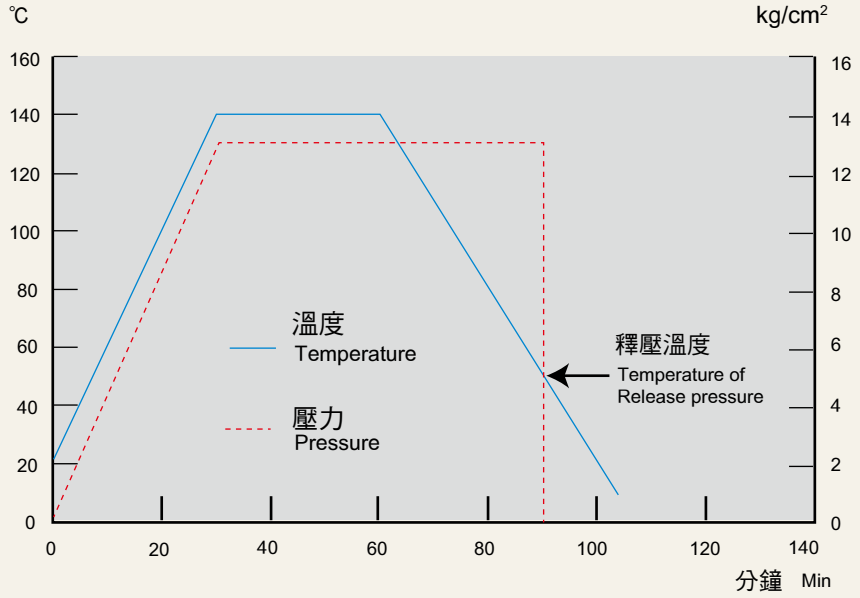
9. 正壓合 Autoclave

正壓合一般有氣壓式與油壓式高壓釜。單層PVB膜之夾層條件，請參考下表與溫度(壓力)-時間關係圖。

In general, the air type or oil type autoclave is used in the process.

The following condition is provided for reference in the processing of single layer laminated glass.

	範圍 Range	目標值 Typical Value
溫度 (℃) Maximum Temperature	120~150	135
壓力 (kg/cm^2) Maximum Pressure	10~15	13
溫度、壓力保持時間 (分) Holding Time at Maximum Temperature /Pressure（minutes）	＞20	30
釋壓溫度 (℃) Temperature of Release Pressure	＜50	35



註：

1. 愈多層夾膠玻璃為達平衡溫度/壓力，最高溫度/壓力之保持時間需愈長。
2. 釋壓溫度需低於50℃，否則易產生氣泡。
3. 升壓及升溫之速率應相近。
4. 理想的升壓及升溫速率， 需視高壓釜熱傳及壓傳能力而定。

Remark：

1. Multi-layer laminated glass requires longer hold time to reach equilibrium of temperature and pressure.
2. Pressure must not be released until the temperature is below 50℃, or else bubbles will occur.
3. Heating and pressurization must occur simultaneously.
4. The actual time depends on heating and pressurization capacity of equipment in the autoclave.

10. 各項認證 Certifications

使用WINLITE®製成之夾層玻璃，具有充分的安全性，可通過各項對夾層玻璃之認證測試，例如美國標準ANSI Z97.1: 2009、日本標準 JIS R3205: 2005、中國國家標準GB15763-2009、台灣標準CNS1184等。

The laminated glass with WINLITE® PVB sheet can achieve various standards for safety glass such as, ANSI Z97.1: 2009, JIS R3205: 2005, GB15763.3-2009 and CNS1184.

建築安全玻璃規範
Standards for Laminated Safety Glass in Buildings

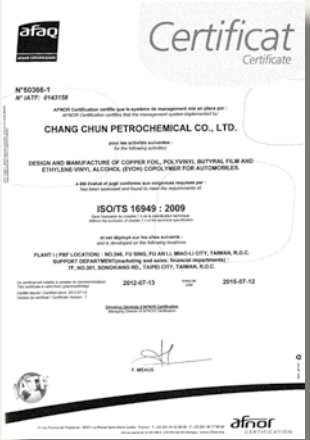
美國 American	ANSI Z97.1-2009
日本 Japan	JIS R3205-2005
中國 China	GB15763.3-2009
台灣 Taiwan	CNS1184

汽車安全玻璃規範
Standards for Laminated Safety Glass in Automobile

中國 China	GB9656-2003

防彈玻璃規範
Standards for Bulletproof Safety Glass

中國 China	GA165-1997



ISO 9001 BSMI 認可登錄 REGISTERED

ISO 14001 BSMI 認可登錄 REGISTERED

OHSAS 18001 BSMI 認可登錄 REGISTERED

CNAS 檢測 CNAS L0690

IATF ISO/TS 16949 : 2009