VE

VE INTERLAYER EVA FILM FOR ARCHITECTURAL SAFETY LAMINATED GLASS (HIGH TRANSPARENT)

建筑工程安全夹层玻璃
专用VE型功能中间膜（超高透明）

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建筑工程安全夹层玻璃专用VE型功能中间膜性能简介
VE Interlayer EVA Film For Architectural Safety Laminated Glass

作为专业从事EVA夹层玻璃中间膜研发、生产的胶片科技公司，依恩推出了一系列广泛应用于户外建筑工程、汽车玻璃等安全夹层玻璃中间膜产品，满足了市场对安全玻璃的迅速增长及新标准在改进玻璃的安全性、耐久性、美观性等方面的需求。依恩公司提供的产品、技术及最终评估系统由于有效地满足了上述要求，从而促进了EVA功能中间膜在整个安全玻璃行业的发展。

As a professional EVA interlayer film manufacturer, E&N company has successfully developed variety of EVA film for outdoor building glass, automobile glass etc safety glass, and come to meet the needs of market and the requirment of the new standard--safety, durability and artistic etc. Sequentially has promoted EVA Film's development in the whole safety glass industrial.

依恩（VE）功能中间膜在过去7年间经过不断改进，已成为EVA功能中间膜在安全夹层玻璃中的首选材料，为夹层玻璃提供了众多优点：安全、防盗防爆、降低噪音、节能及阳光控制、防止室内有色材料的褪色、美观性等。

After 7years' development and improvement, VE series Film has became customer's first choice for making safety laminated glass because of following advantages: safety, anti-explosion, reducing noise,saving energe, controling the sunlight, and color fading-resistance, etc.

1.依恩(VE-H)型功能中间膜是依恩公司基于VE型产品新近研发，具有重大革新技术的夹层玻璃中间膜。VE-H型超越了现有技术，大大拓展了夹层玻璃性能。VE-H型的硬度是普通EVA的5倍，VE+的高强度、高透明、耐久性、节能及优越阳光控制体系使其能轻易地适应当今建筑市场的最新最严格要求。相对普通EVA夹层玻璃，VE+夹层玻璃可提高防弹、抗冲击性能，并可在一定程度上减小夹层玻璃厚度。

VE-H Film is the highest film based on the VE series. It surpass the existing technology and make the laminated glass more stronger, more transparent, and more durable. The hardness of VE-H is 5 times to the ordinary EVA film. And the excellent energy-saving and sunlight-control property make it meet the needs of construction market more better. Compared to ordinary EVA film, the laminated glass with VE-H could enhance the bullet-proof and shock resistance, and also can save the cost by reducing the thickness of laminated glass.

2.VE+H是专门为满足当今建筑业的需要所设计的，它和现行的VE类产品具有相同的破碎安全性和碎片保持能力，但能大大地提高安全玻璃的抗冲撞性能，防盗防爆性能及抗灾害性能，要想使玻璃在框架中保持完整可使用更破，更结实的VE+中间膜，它适合于天棚、幕墙、汽车等户外型建筑安全玻璃，因其在使用中及破碎后安全性方面有更苛刻的强度和挠度要求，当夹层玻璃温度升高后，它具有更稳定、更长的使用寿命，同时具有优异的耐候性和边部稳定性。

VE-H film is specially developed to meet today's construction demands. Excepting the same broken safety and fragments remaining as the existing VE series film, and the more important is can highly enhance the resistance to collision and anti-explosion. Because of the stronger tensile strength and flexivity, it can be used widely in canopy, curtain wall,automobile etc ourdoor architectural safety laminated glass. It will be more popular because of the better stability, longer useful time and excellent weather-resistance.

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目前，依恩用于建筑工程安全夹层玻璃中间膜的产品规格主要有以下几种:
Main products for architecture safety laminated glass:

产品规格 VE PRODUCT SPECIFICATION

产品Product	产品包装Packaging	型号ITEM CODE	厚度 x宽度x长度 （mm x mm x m）
VE- H/A	木箱Poly wood case	VE80H/A	0.80*2300*50
		VE50H/A	0.50*2300*80
		VE40H/A	0.40*2300*100
		VE25H/A	0.25*2300*150
VE- B	纸皮Paper Skin	VE76B	0.76*2300*50
		VE50B	0.50*2300*80
		VE38B	0.38*2300*100
		VE25B	0.25*2300*150
EN- H	纸皮Paper Skin	EN76H	0.76*2300*50
		EN50H	0.50*2300*80
		EN38H	0.38*2300*100
		EN25H	0.25*2300*150

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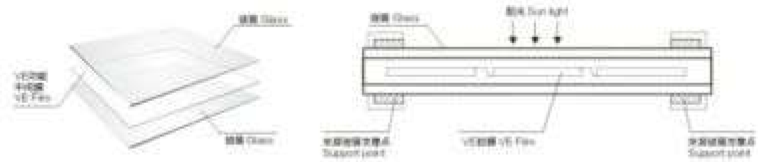
VE功能中间膜的作用
FUNCTION

粘合玻璃，及其他材料为一个整体，并且保护夹层玻璃及夹层材料受到湿气、冲击以及外部气候的损害。

Bonding glass and other materials together, and protecting the laminated glass and interlayers from the damage by humidity, impact and weather exposure.



VE功能中间膜的技术要求
TECHNOLOGY

□高透明性，保持夹层玻璃设置空间的自然清晰。
High transparence make laminated glass clear as origin.

□完美和稳定的阳光控制体系，在UV照射下，低降解，能防止室内有色材料的褪色保持美观性等。
Perfect sunlight control system, stop UV rays incoming and prevent color fade.

□对玻璃及其他材料有良好的粘接力，具有很高的破碎安全性和碎片保持能力。
Excellent adhesion with materials not only glass, keep the fragments hold together when shattered.

□有足够的强度和耐候性能，能够维持和延长夹层玻璃材料的使用寿命。
The outstanding strength and weather durability can maintain and lengthen useful time of the laminated glass.

VE功能中间膜的特性
PROPERTIES

□高强度 High tensile strength
□高透明度 Super high transmittance
□高粘接强度 Excellent adhesion strength
□高耐候性 Excellent weather durability
□高晶点控制 Low Crystal

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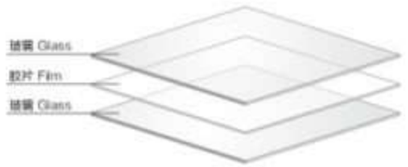
VE功能中间膜的加工方法
PROCESSING METHOD



1 **玻璃合片**
Clean and overlapping
将洁净过的玻璃与切好的VE+H胶膜合片时，为防止胶膜位置移动，可使用铜热胶带固定四边四点。
Clean the glass and sandwich VE-H film between two glasses. Then fix the edges of overlapped glasses with heat-resistance tape in order to avoid displacement

2 **真空常温**
Vacuum
玻璃四周置放便于真空排气沙网，在真空值达到0.095Mpa常温下冷抽5分钟，排空硅胶袋内空气。
Place the gauze around the glass for better vacuum. Keep 5 minutes when the vacuum value reach to 0.095Mpa.

3 **加热保持**
Second heating section
一般加热到玻璃表面温度达50℃-60℃，保持时间20-30分钟；然后继续加热到玻璃表面温度达130℃-135℃，保持时间45-60分钟，胶膜厚度或合成层数增加，可适当延长保温时间。
First section, heating till the glass temparature reach to 50℃-60℃, keep it for 20-30mins;Second section, heating again, till 130℃-135℃ for 45-60mins.For thicker film or more layers, raise the temperature and time accordingly.

4 **冷却**
Cooling
在冷却降温阶段，真空须保持，可使用风机降温。
During cool period, don't stop vacuum pump. Fan can be used help to cool.

5 **取出**
Taking out
为防止夹层错位及夹层玻璃定型，玻璃温度降到60℃以下再取出。
To provent laminate malposed, taking out the laminated glass till the temperature below 60℃

VE功能中间膜性能参数表PERFORMANCE PARAMETERS

测试项目TEST ITEM	方法TEST METHOD	VE-H	VE-A/B	EN-H
抗拉强度 Tensile Strength	E&N LAB METHOD	23MPA	17.8MPA	18.6MPA
邵氏硬度A Shore hardness A	E&N LAB METHOD	80.2HA	75.6HA	79HA
与玻璃粘结力（180° 剥离，速度300mm/min） Adhesion with glass(180℃ peeling speed：300mm/min)	E&N LAB METHOD	>95N/cm	>95N/cm	>95N/cm
透光率 Light Transmittance(390nm-900nm)	E&N LAB METHOD	>90.4%	>90.5%	>90.1%
雾度 Haze	E&N LAB METHOD	<0.25%	<0.25%	<0.3%
阻断UV的波段 Blocked UV wavelength	E&N LAB METHOD	390nm	390nm	360nm
UV阻隔率 UV blocked rate 4mm+0.4mm+4mm	E&N LAB METHOD	>99%	>99%	>80%
断裂伸长率 Elongation	E&N LAB METHOD	700%	635%	660%
吸水率 Water Absorption	ASTMD570	≤0.1%	≤0.1%	≤0.1%
耐热性 Heat Resistance 水煮2小时 2hrs in the 100℃ water	GB-15763.3-2009	无渗水、气泡、脱胶现象 No water penetration\ bubbles\and de-lamination	无渗水、气泡、脱胶现象 No water penetration\ bubbles\and de-lamination	无渗水、气泡、脱胶现象 No water penetration\ bubbles\and de-lamination
耐湿热实验 I Humidity Resistance I 温度60℃，湿度97%，400小时 60℃，97%RH,400hrs	E&N LAB METHOD	无渗水、气泡、脱胶、雾变现象 No water penetration\bubbles/ de-lamination, and No Haze appearance	无渗水、气泡、脱胶、雾变现象 No water penetration\bubbles/ de-lamination, and No Haze appearance	无渗水、气泡、脱胶、雾变现象 No water penetration\bubbles/ de-lamination, and No Haze appearance
耐湿热实验 II Humidity Resistance II 温度85℃，湿度85%，1000小时 85℃ 85%RH 1000hrs	E&N LAB METHOD	从玻璃边缘往里3.5cm呈雾变状，其余未发现气泡、脱胶等现象 Haze appeared just at 3.5cm from the edge with no bubbles and de-lamination	从玻璃边缘往里3.5cm呈雾变状，其余未发现气泡、脱胶等现象 Haze appeared just at 3.5cm from the edge with no bubbles and de-lamination	———
抗UV加速老化试验 UVA340灯管 Anti-aging Lamb tube UVA 340	E&N LAB METHOD	黄变指数 Yellow change△YI：<0.7	黄变指数 Yellow change△YI：<0.7	黄变指数 Yellow change△YI：<1.5
温度50℃，湿度65%，辐射2000小时 50℃ 65%RH Radiation 2000hrs		透光率下降Light transmittance decrease：0.5%	透光率下降Light transmittance decrease：0.5%	透光率下降Light transmittance decrease：1%
冷热冲击 Heat & Cold shock	E&N LAB METHOD	黄变指数 Yellow changee△YI：<0.7	黄变指数 Yellow change△YI：<0.7	黄变指数 Yellow change△YI：<0.7
低温-40℃30分钟，高温80℃30分钟，循环50次 Cold-40℃30min, Heat80℃30min, 50circles		透光率下降Light transmittance decrease：<0.5%	透光率下降Light transmittance decrease：<0.5%	透光率下降Light transmittance decrease：<0.5%
散弹袋冲击性能 Impact Resistance Against Shot-Bag	GB-15763.3-2009	合格Qualified	合格Qualified	合格Qualified
落球冲击剥离性能 Ball Impact Peeling Resistance	GB-15763.3-2009	合格Qualified	合格Qualified	合格Qualified

注：上述数据在实验室条件下测得，仅供参考。 Remark:The above data measured in the laboratory conditions, just for reference.

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作为夹层玻璃中间膜，依恩推出的VE型产品无论从实验室到实践应用中，由于能有效地满足了安全夹层玻璃各方面更严格、更苛刻的性能需求，VE必将成为一种迅速崛起的新材料、新能源，从而促进了EVA中间膜在整个安全玻璃行业的发展。

As a kind of interlayer film for safety laminated glass, VE eva film meets higher requirements of today's architectural market. It has become the best and sole selection for the safety laminated glass as new energy and material, and has been resulting in the new development for the safety laminated glass industry.

1 VE功能中间膜拉伸强度 Tensile Strength
VE功能中间膜硬度 Hardness

中间膜物性Physical Properties

项目Item	单位Unit	VE-H	VE-A/B	PVB	A竞品 A Competitor's	B竞品 B Competitor's
拉伸强度 Tensile Strength	MPa	23	17.8	20	11	17.2
硬度A Hardness A	HA	80.2	75.8	/	64	74

※EVA膜厚度Thickness: 0.40mm

图1.中间膜强度
FIG1.Tensile Strength

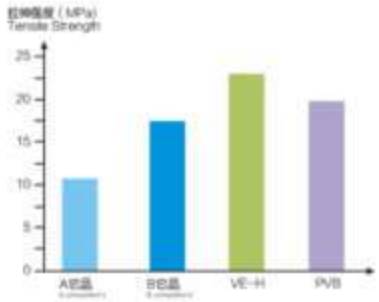
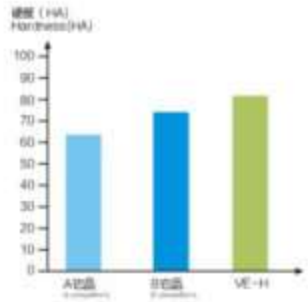


图2.中间膜硬度
FIG2.Hardness



VE-H同竞争牌号强度对比图 Intensity comparation chart

■ VE-H是高弹性材料，具有较高的撕裂强度。
VE-H is viscous-elastic material with high tearing strength.

■ 在同等条件下与PVB具有同等强度，较其他EVA竞争牌号更强、更硬，提高了的硬度和胶膜强度提供了高品性能。
VE-H has same intensity as PVB film in the same condition, but more higher and stronger than other brand EVA films.

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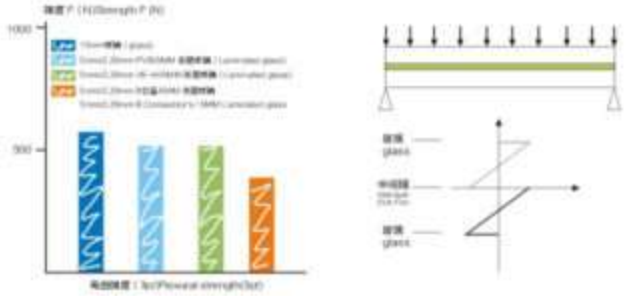
图3.强度特性
FIG.3.Strength Properties



■VE-H夹层玻璃与PVB夹层玻璃具有同等强度，比竞争牌号EVA夹层玻璃更坚硬
VE-H laminated glass has same strength as PVB laminated glass, and harder than other brand's.
■VE-H夹层玻璃接近同样厚度的单片玻璃的弯曲强度
The flexural strength of VE-H laminated glass is nearly same as single glass

图4.相对强度
FIG.4，Relative Strength

温度=23℃ 1.52mm中间膜 夹层玻璃尺寸=2m
T=23℃ 1.52mm film glass size=2m

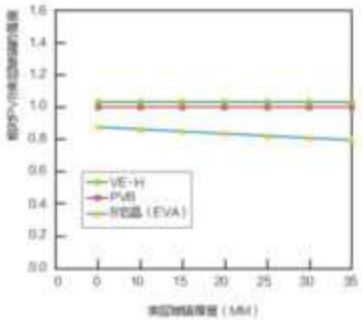
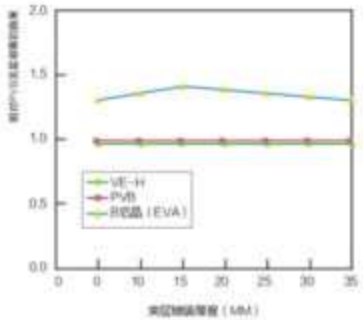


图5.相对挠度
FIG.5，Relative Deflection Ratio

温度=23℃ 1.52mm中间膜 夹层玻璃尺寸=2m
T=23℃ 1.52mm film glass size=2m



同其他中间膜夹层玻璃相比，VE-H夹层玻璃会有更高的强度性能，可有效减少于玻璃厚度，尤其对撑的夹层玻璃，特别有过于点式支撑玻璃。

同其它中间膜夹层玻璃相比，VE-H 夹层玻璃会有更高的韧性，有利于减小玻璃厚度。

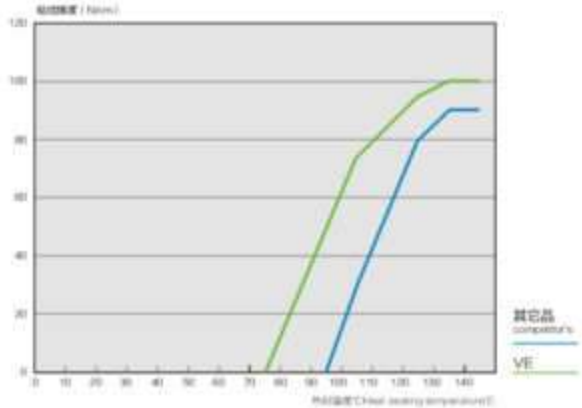
Compared to other brand eva films, VE-H is more stronger, can help to save cost by reducing glass thickness. It is recommended to be use in point-support glass curtain wall.

2 VE功能中间膜粘接强度
Adhesion Strength

中间膜物性Physical Properties

项目Item	单位Unit	VE-H	VE-AB	A竞品A competitor's	B竞品B competitor's
粘结强度 Adhesion Strength	N/cm	95	95	70	80

图6.粘结强度
FIG.6，Adhesion Strength



VE同竞争牌号粘结强度对比图
Adhesion strength comparison chart

■同竞争牌号比，VE粘结度更强更优实
VE film has stronger adhesion strength than other brand eva films.
■胶膜的粘结强度与热封温度成正比
The Adhesion strength of eva film is in proportion to the temperature.
■VE中间膜在100℃时依然发挥优秀的粘结性能
VE film will play a very strong adhesive performance at 100℃
■粘结度越高，玻璃破碎后保持力增强，安全钢印性能越高
The more stronger adhesion strength is, the more safer laminated glass will be.

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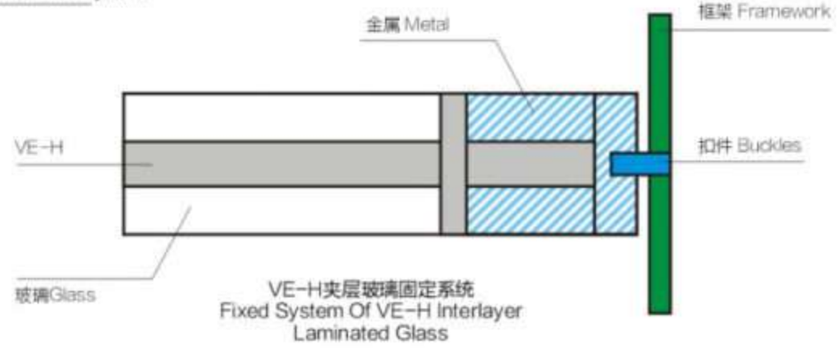
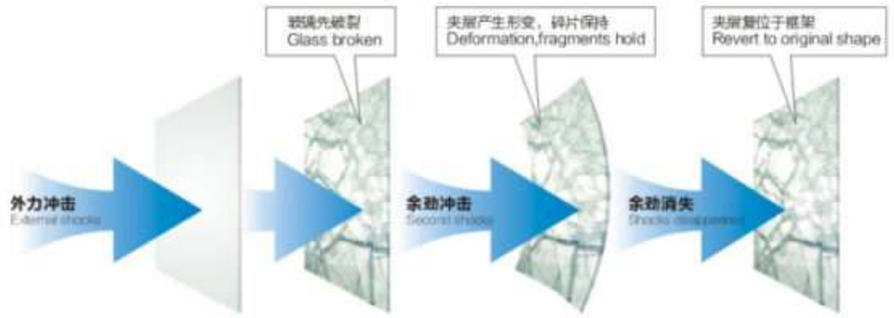
图7.固定系统
FIG.7，Fixed System



VE-H夹层玻璃固定系统
Fixed System Of VE-H Interlayer
Laminated Glass

■ VE-H和金属的粘结度较高，如铝
Stronger adhesion with metal , like Aluminum
■ 提高玻璃在破碎后的性能
设计的多样性和美观性在整个系统中，中间层成为基本的结构单元
The laminated glass become the basic structure unit because of the diversity and artistic design.

图8.爆炸测试
FIG.8,Explosion Testing



VE-H夹层玻璃抗爆性能 Anti-explosion property

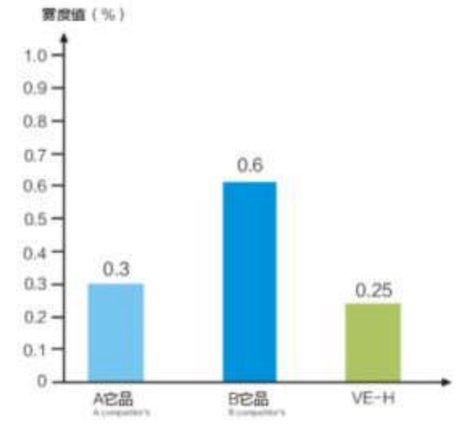
■ VE-H夹层玻璃满足夹层玻璃抗冲撞，防盗防爆及抗灾害性能要求
■ 具有极强破碎安全性和碎片保持能力
VE- H laminated glass meets all the requirments about impact, anti-theft,explosion-proof and disasters-resistance.
■ VE- H胶膜层数增加，强度更大
The strength is in proportion to the film thickness.
■ 试验表明，胶片的抗撕裂能量是判断其抗冲击性能的重要指标
Test indicates that anti-tearing energy is a important index to judge the impact-resistance property.
■ 胶片脱落势必关系到胶片的拉伸及能量的消失
The tensile strength and energy disappearance will lead to the laminated glass degumming.
■ 玻璃破碎后的性能表现是由破碎后的夹层玻璃受到胶大胶片模量影响所产生平面上的位移所决定的
The glass's properties after broken, is determined by the film's displacement owing to film modulus.
■ 提高了的硬度和撕裂强度提供了高级性能
The more advanced properties are available owing to the higher hardness and tearing strength.

3 透光率 / 雾度 / UV阻隔率
Transmittance/haze/UV blocked rate

中间膜物性Physical Properties

项目Item	单位Unit	VE-H	VE-A/B	A它品A competitor's	B它品B competitor's
透光率（390nm-900nm） Light Transmittance（390nm-900nm）	%	90.4	90.5	90.4	90.1
雾度 Haze	%	0.25	0.25	0.3	0.6
阻隔UV的波段 Blocked UV wavelength	nm	390	390	360	380
UV阻隔率 UV blocked rate	%	>99	>99	80	98.8

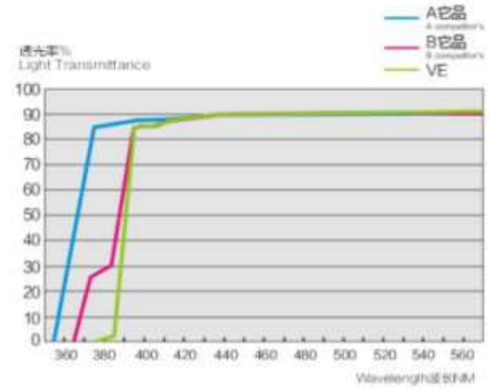
图9.雾度
FIG8.Haze



VE同竞争牌号的雾度对比图
Haze comparison chart

■ 在同等条件下VE比竞争牌号的清晰度更高
VE is more clear.

图10.透光率/UV阻隔率
FIG10.Light Transmittace
UV blocked rate



VE同竞争牌号的透光率和UV阻隔率对比图
Transmittance and UV blocking comparison chart

■ 在同等条件下VE比竞争牌号的透光率更高
UV阻隔的波段更宽
■ UV阻隔率更强更完全
VE has higher transmittance, and UV blocking is more stronger and completely.

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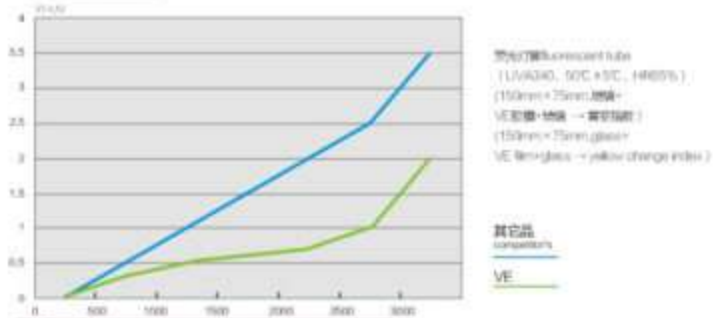
图11.美观性能及阳光控制
FIG11.Artistic and sunlight control

- VE夹层玻璃的效果还原夹层玻璃应营造的自然和通明
  Super high transparence make laminated glass clear as origin.
- 完美的阳光控制体系，有效地控制阳光对人体及室内物品的伤害
  The perfect sunlight control system can effectively protect furniture indoor from the damage owing to UV rays.
- 多样化的VE夹层方式和选择，改善了空间的美观性和欣赏性
  Diversified designs make the room more artistic and beautiful.

3 环境模拟试验 Simulation Test

图12.抗UV测试
FIG12. UV blocking test

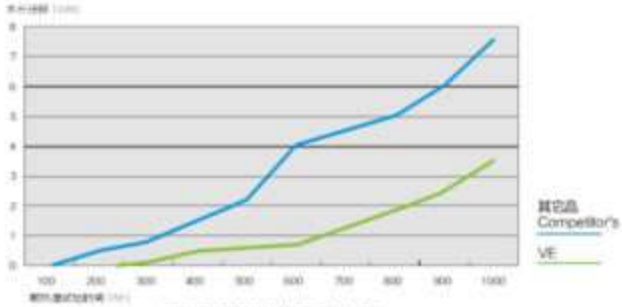


VE同竞争牌号抗UV测试曲线图

- VE产品比竞争牌号具有更完善更稳定的阳光控制体系
  VE film has more perfect sunlight control system
- 在UV辐照下，品质降幅，比竞争牌号具有更好更强的耐候性
  VE film has stronger weather durability than other brand films owing to low degradation in the UV radiation.
- 优异的抗老化性能能够维持和延长夹层玻璃膜片的使用寿命的重要指标
  The excellent aging-resistance property can maintain and extend the film's useful life.

图13.耐热湿测试 I
FIG.13.Heat&humidity resistance test I

温度85℃，相对湿度85%，150mm×200mm,玻璃+VE胶膜+玻璃 → 水份迁移
85℃,85%RH,150mm*200mm glass+VE film+glass → water migration



VE同竞争牌号耐热湿测试曲线图

- 在更严格更苛刻的恶劣的“双85”环境模拟试验下，VE产品具有竞争牌号所无法比拟和超越的耐候性及边部稳定性。
  Under the more bad conditions (85℃,85%RH), VE film has the outstanding weather durability and stability.
- 在苛刻的环境条件下，VE产品在颜色和原来上未有明显的变化及边部缺陷，具有其它竞争牌号无法克服的超强的耐热湿性能。
  VE laminated glass has no obvious changes and edge defects.
- VE产品在抗水分能力，耐抗恶劣环境的侵蚀能力等方面具有明显的耐热湿性能，这是直接关系和决定夹层玻璃能够维持和延长在户外环境条件下的使用寿命的关键因素。
  The excellent water-resistance ability /heat&humidity resistance ability and weather durability is the critical factor that decide the laminated glass can be used in outdoor for a long time.

图14.耐热湿测试 II
FIG.14.Heat&humidity resistance test II

温度85℃，相对湿度85%，1000h Conditions: 85° C 85%RH, 1000hrs

“双85”耐热湿试验对比图
Heat&Humidity resistance test

- 试验结果在苛刻的环境条件下，其它竞争牌号EVA夹层玻璃水份从边部已完全迁移整块成雾，水份弯起，黄变严重，四周出现气泡，开裂状；
  Test results: The laminated glass with competitor's eva film became haze completely, the water migrated from edges into the center. And bubbles, de-lamination and yellow changes were observed.
- VE夹层玻璃从边部往里3.5cm呈雾状，其余未发现异常。
  VE laminated glass just become haze within the scope of 3.5cm from the edges. And no other unusual phenomenon.
- 试验表明VE夹层玻璃比其它竞争牌号EVA夹层玻璃具有更强更稳定的耐候性和边部稳定性。
  Test indicates that VE laminated glass has more excellent weather-resistance and stability against competitors' eva film.

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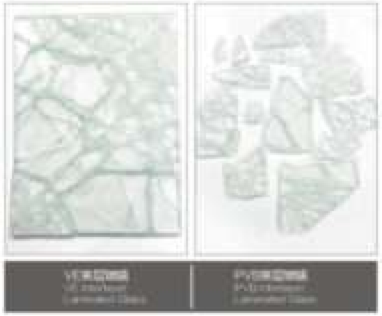
图15.耐热湿性能Ⅱ
FIG.15, Heat&humidity resistance test Ⅱ

► 按层压工艺制备好两块VE夹层玻璃和PVB夹层玻璃;
Specimen: Two VE laminated glasses and One PVB laminated glass;
► 在温度为23℃±2℃，相对湿度50%±5%条件下放置至少40h后，将VE夹层玻璃和PVB夹层玻璃置于平面上用锤头将其分别均匀敲碎，但仍保持碎片紧密粘连于中间膜;
Exposed the specimens in the condition of 23° C±2° C, 50%RH±5% for 40hrs,Break the laminated glass but keep the fragments still stick on the interlayer film;
► 将敲碎的两块试样浸泡于装有恒温加热装置的水箱;
Put the broken specimens into a thermostatic water tank;
► 使水箱加热至沸腾状态持续2h后取出冷却;
Quickly heating to boiling, 2hrs later, take out the specimens , and cool;
► 待两块试样在常温下完全冷却后观察夹层玻璃碎片保持状况。
Observe three specimens.



VE夹层玻璃与PVB夹层玻璃耐湿热对比图

■ 试验结果PVB夹层玻璃四分五裂，且碎片与PVB胶膜用手轻拍即完全脱落;
VE夹层玻璃完好无损，且碎片与VE胶膜粘合强度依然如初。
Test results: PVB laminated glass was broken completely. And the fragments dropped from the PVB interlayer film.VE laminated glass still same as before . And the fragments still stick on the VE interlayer film and keep good adhesion force.
■ 试验表明VE夹层玻璃比PVB夹层玻璃具有更强的耐湿热性能和粘结性能。
Test indicates that VE laminated glass has stronger heat&humidity-resistance and adhesion against PVB laminated glass.

图16.抗风化性能
FIG.16.Aging-resistance property
1.5m×2m VE夹层玻璃
1.5m×2m VE Laminated glass

■ 大范围的耐候性测试
自然暴晒于佛山市建国户外试验场3年以上进行光照抗老化实验。
Weather resistance test in a large range Exposed in Foshan E&N outdoor test site for 3years.
■ 试验表明，VE夹层玻璃没有其它竞争牌号夹层玻璃有时候出现的边部缺陷。
■ Test indicates that no defects were observed
VE夹层玻璃颜色和雾度没有变化。
No yellow changes and haze in the VE laminated glass.

VE夹层玻璃抗风化试验
Transmittance and UV blocking comparison chart

APPLICATION AND DEVELOPMENT PROSPECT
VE胶膜应用领域及发展前景

VE胶膜（尤其是VE-H）是专门为满足当今建筑业的需要而设计的，由于其具有优越满足了安全夹层玻璃各方面使用性，要求的性能需求，现正被广泛应用于户外建筑工程安全夹层玻璃，天棚，幕墙，汽车挡风玻璃等领域。
VE eva film (particular VE-H) is specially developed to meet the requirment of today's architecture industry. It is widely used in outdoor like curtain wall, skylight, Canopy, automobile windshield,act owing to its excellent properties.

鉴于此，及其更佳的成本效益，VE必将在机遇中，成为一种夹层玻璃中间膜的新材料，新能源，从而促进了EVA中间膜在整个安全玻璃行业的发展。
Compared to the other films, VE eva film as a new material and new energy, will become the best and sole selection because of the cost efficiency for the safety laminated glass. And also will resulting in the new development for the safety laminated glass industry.

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