Architecture of ETFE

The Next Generation of Architecture

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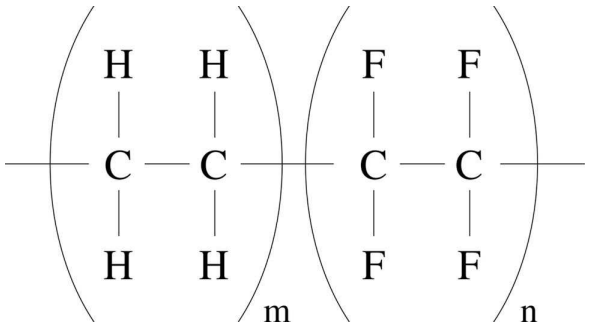
ETFE FILM



- ETFE – Ethylene-Tetra-Flouro-Ethylene
- The new generation material which goes beyond glass
- ETFE film is an extruded section made from flouro-polymer resin
- ETFE is commonly used as a electrical conduit cover
- Today is used as a single skin, double, or triple foil pillow

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Characteristics

1. **Super Lightweight**...350g/㎡	More Quakeproof (light and flexible) More Economical (Large span, Installation characteristic)
2. **Super Durability**...Over 20 years	Maintains transparency (will not cloud) Maintains strength (Little deterioration)
3. **Safety**	Fire retardant (self extinguishing) Shatterproof (no sharp shards.)

Performance

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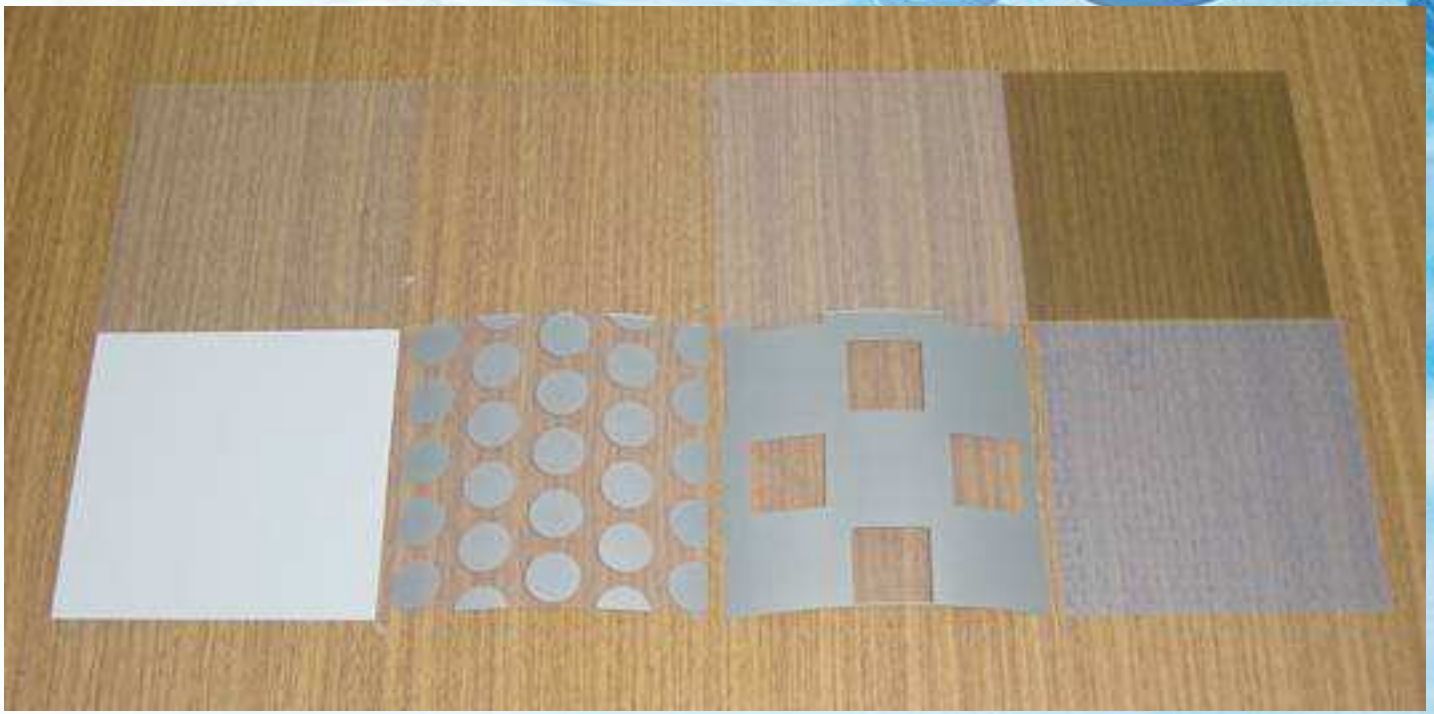
ETFE Film Variations

Diffused

Transparent

UV Cut (ultraviolet)

IR absorption (infrared)



White

Silver Polka-dotted

Silver Checkered

Blue Polka-dotted

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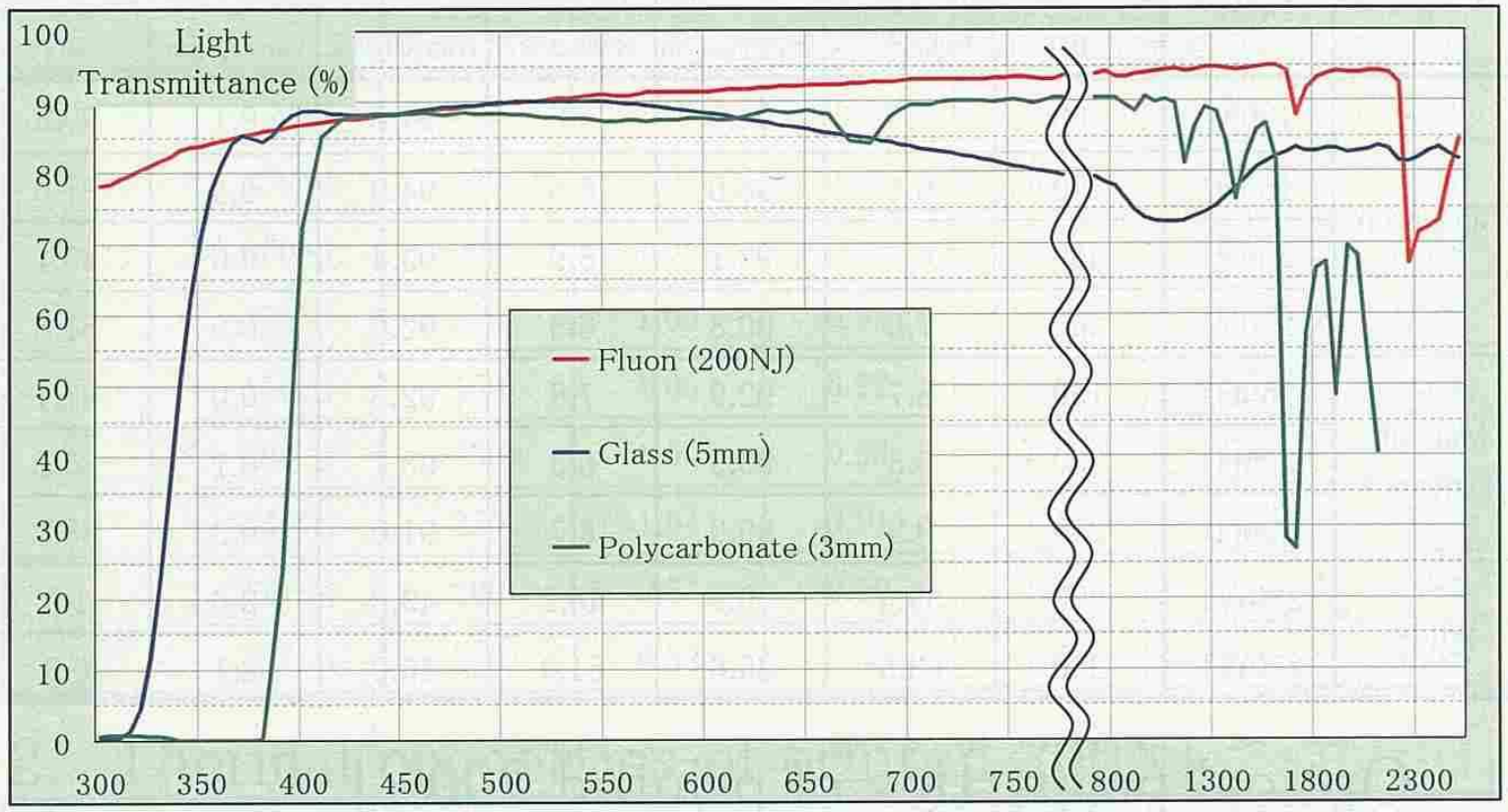
Light transparency of ETFE films

1. Light Transmittance chart by wave length

(Comparison with other materials)



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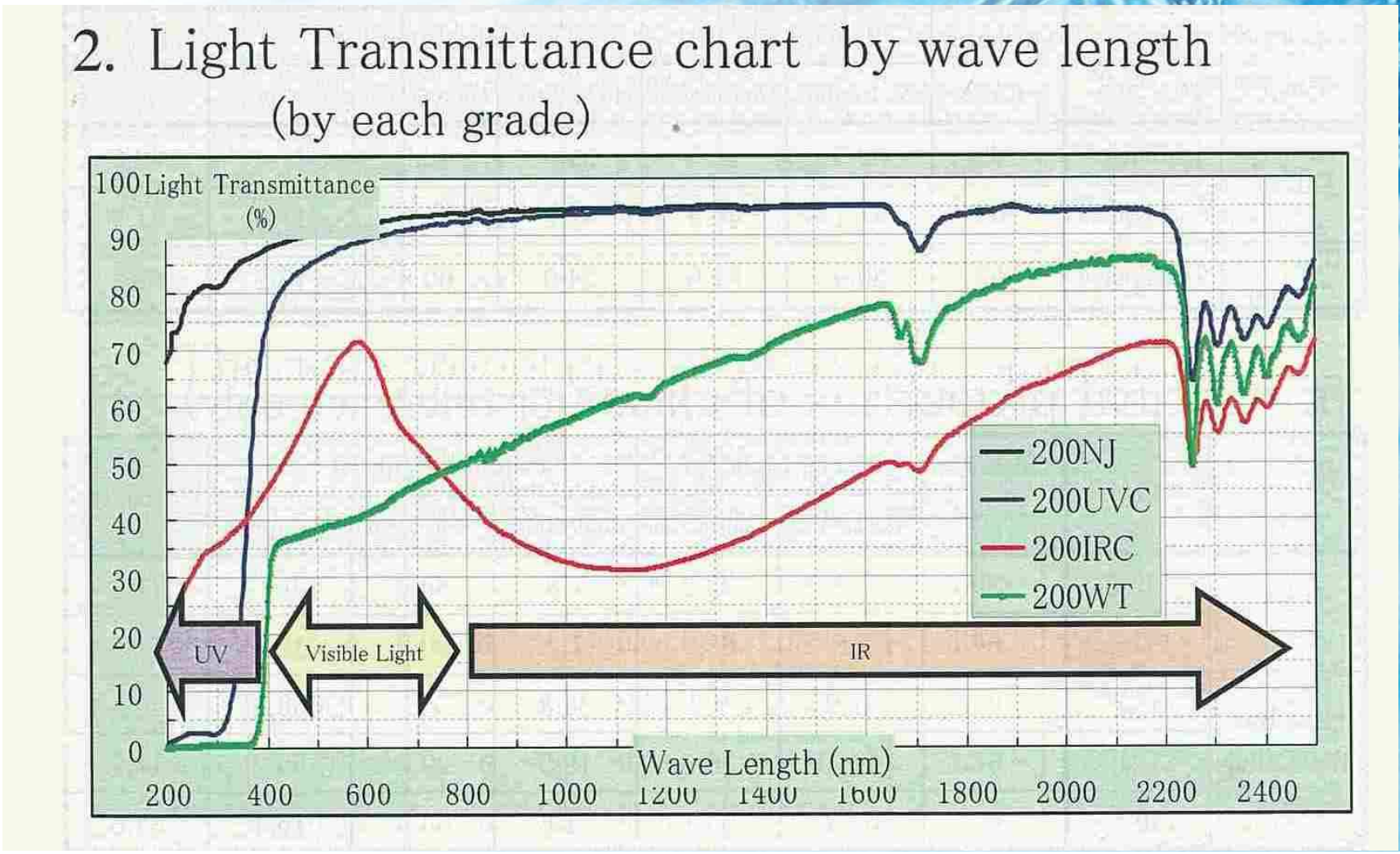
Light transparency of ETFE films



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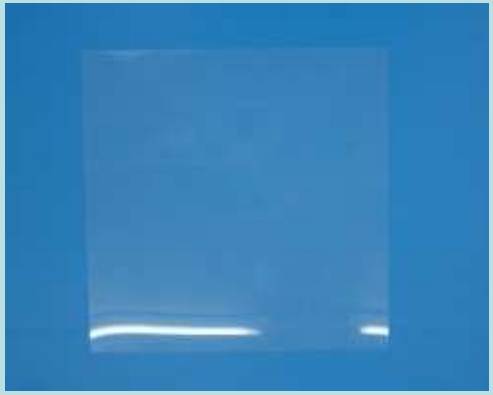
Solar Transmittance



Transparent 92%

White 50%

Checkered 45%

Polka-dotted 66%

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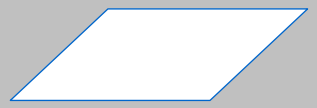
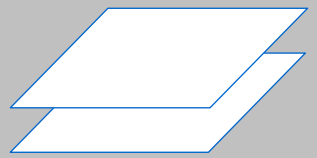
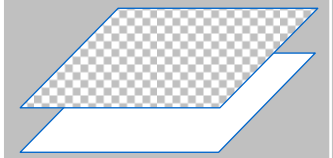
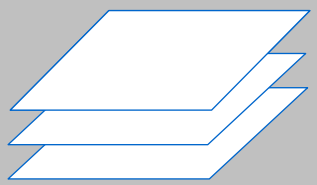
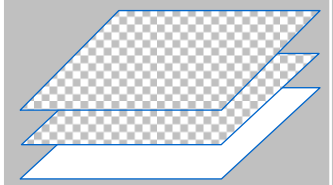
Thermal Insulation Performance

Transparent	Thermal transmittance 熱貫流率 U(W/㎡K)	Solar shading coefficients 日射遮蔽係数	**Silver Checkered**	Thermal transmittance 熱貫流率 U(W/㎡K)	Solar shading coefficients 日射遮蔽係数
	5.8 (glass 5.9)	1.06 (glass 0.95)		5.2	0.56
	2.6 (glass 3.3)	0.98 (glass 0.83)		2.3	0.52
	1.7	0.92		1.5	0.33

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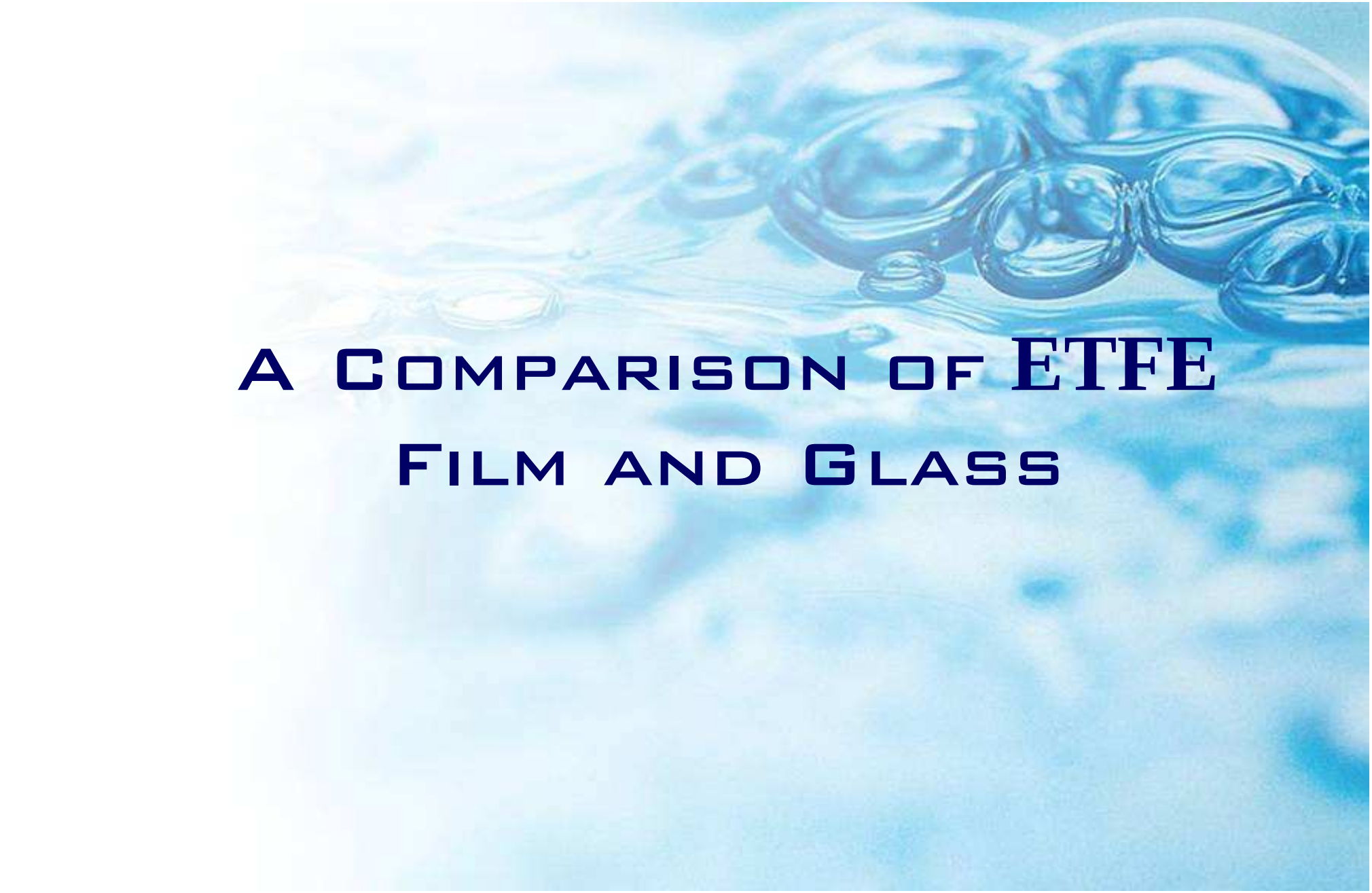

A Comparison of ETFE Film and Glass

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Characteristics

	ETFE FILM	Float glass
Thickness	100 ~ 250 micron	3 ~ 19 mm
Specific gravity	1.75	2.5
Weight	0.175 ~ 0.438 kg/m^2	7.5 ~ 47.5 kg/m^2
Transmittance	~ 93%	~ 88%
Tensile strength, Tensile elongation	Tensile strength (23℃): ≧ 45Mpa Tensile elongation (23℃): ≧400%	
Temperature range	-80~150℃ (Melting point: 270℃)	(Melting point: 720℃)
Flame proof	Class B-1 [DIN 4102] V-0 (250NJ) [UL94] Flame retardant 1st grade [JIS A 1322] material	Non-combustible material

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Material Types

Glass	transparent plate・template glass・wire glass・heat ray absorption glass・heat ray reflection glass・high performance heat ray reflection glass・multiple glass・surface coated glass
ETFE Film	transparent (NJ)・colored (WT)・Ultraviolet Cutting (UVC)・Infrared Ray Cutting (IRC)・multi-tiered・printing (SL)・diffusion (matted HJ)

Some multifunctional products made of ETFE film have become ready-made articles.

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WEIGHT

Glass (SG2.5)	Float Glass 3mm～19mm
	Approx. 7.5～47.5kg/㎡
ETFE Film (SG1.75)	100～250 μ m
	Approx. 0.175～0.438kg/㎡

Lightweight properties of ETFE Film is outstanding.

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Conformation Latitude

Glass	Flat plate, and also having some constraints for Outline shape.
ETFE Film	Convex shape is available. (Convex curved surface, HP curved surface,etc.)

ETFE Film is excellent in design.

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Thermal Properties

Thermal Transmission

Glass	Single plate 6mm	5.9w/㎡k
	2 tiers（6mm＋A12mm＋6mm）	3.3w/㎡k
	2 tiers（Low－E6＋A12＋Low－E6）	1.8w/㎡k
ETFE Film	Single film 200μm	5.8w/㎡k
	2 tiers（200μm＋A300mm＋200）	2.6w/㎡k
	3 tiers（200＋A300＋200＋A300＋200）	1.7w/㎡k

Heat transmission rate are homogeneous dimension for any ETFE materials.

Shading Co-Efficient

Glass	Single plate6mm	0.95w/㎡k
	2 tiers（6mm＋A12mm＋6mm）	0.83w/㎡k
	3 tiers（Low－E6＋A12＋Low－E6）	0.65w/㎡k
ETFE Film	Single film 200μm	1.06w/㎡k
	Single W film 200μm	0.58w/㎡k
	Single printing film 200μm	0.56w/㎡k
	2 tiers（200μm＋A300mm＋200）	0.98w/㎡k
	3 tiers（200＋A300＋200＋A300＋200）	0.92w/㎡k
	2 tiers（200IRC＋A300＋200）	0.59w/㎡k

Equivalent effectiveness can be achieved.

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Acoustic Properties

■**Focused on Sound Transmission Loss from the standpoint of NR Sound Insulation.**
(large Sound Transmission loss＝high Sound Insulation)

	Hz	10	20	50	80	100	160	200	400	500
Glass	single plate 6mm	17.7	23.2	30.9	33.7	34.3	32.2	26.8	34.8	37.3
	2 tiers（6mm＋A12mm＋6mm）	20.0	16.8	32.3	37.4	39.2	37.2	31.8	39.1	41.0
ETFE Film	single film 200μm	3.0	3.0	6.9	10.4	12.0	15.5	17.1	22.2	23.9
	2 tiers（200μm＋A300mm＋200）	4.6	3.5	8.3	11.8	12.4	17.2	20.2	29.4	33.0

Less Sound Insulation compared to glass.

Due to it’s light mass/volume ratio, the acoustic performance of an ETFE covering is a great advance against other type of covers. An ETFE roof with a mass of less than 1 kg/sqm is acoustically ‘transparent’; loud crowd noises are not reflected back. This means that the internal environment is considerable more comfortable with lower reverberation times than if the cladding had been constructed from an acoustically hard material. This is particularly evident on spherical domes or other structures where the focus effect of hard acoustic cladding can make speech almost unintelligible.

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A Comparison of ETFE Film and Fabric

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Characteristics

	ETFE film	PTFE-glass fiber fabric (SF-Ⅱ)	PVC-polyester fabric (SCC200-H)
Thickness (μm)	250	800	730
Weight (kg/㎡)	0.438	1.3	0.9
Tensile strength (N/3㎝)	375	4500×3600	1962×1962
Tensile elongation (%)	400	10×15	28.5×33.9
Transmittance (%)	90	10.6	11.4
Temperature range (℃) (Maximum use)	150	260	60
Flame retardancy	Good	Excellent	Fair

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Printing on ETFE Film

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Printing Process

Type	Gravure Roll Printing	Screen Printing	Digital Printing
Specification	Corona discharge treating ＋ fluorocarbon resin＋ Aluminum flake powder	Corona discharge treating ＋ fluorocarbon resin＋ Aluminum flake powder	Corona discharge treating ＋ UV hardening type ink （Radical type）
Thickness	Coating thickness 3～5 μ m	Coating thickness9 μ m	–
Design	Design repeating	Simple design is available	Design, various colors
Process	Available to fabricate for long length	Cannot fabricate for long length （up to around 4m）	Up to around 50m
Durability	–	Unconfirmed the endurance yet	Unconfirmed the endurance yet

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ETFE Extrusion and Applications

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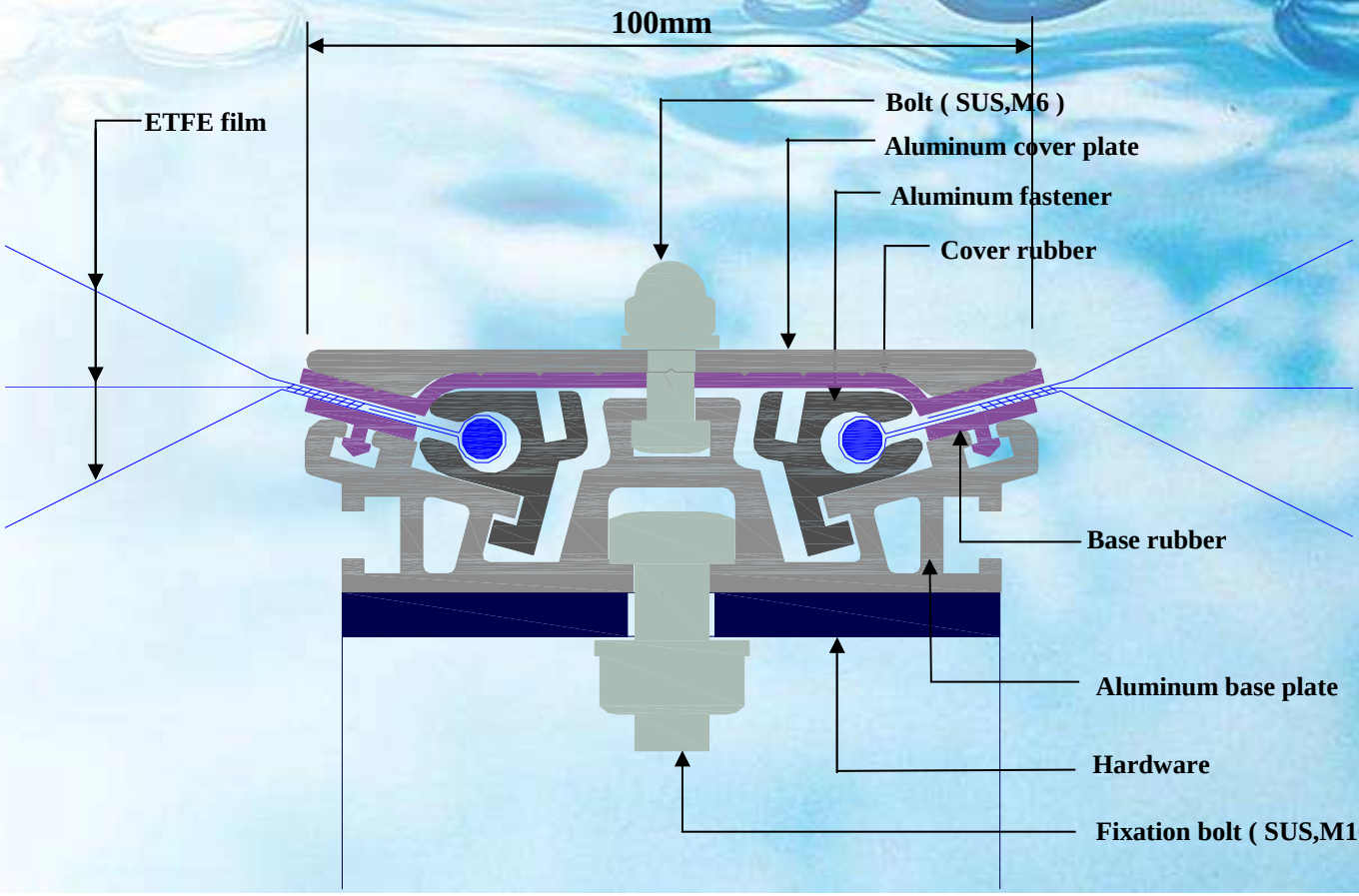
Installation process of the ETFE extrusion clamping detail

Divisional clamping of the fastener (cushion panel)



Pneumatic System (Air Supply)

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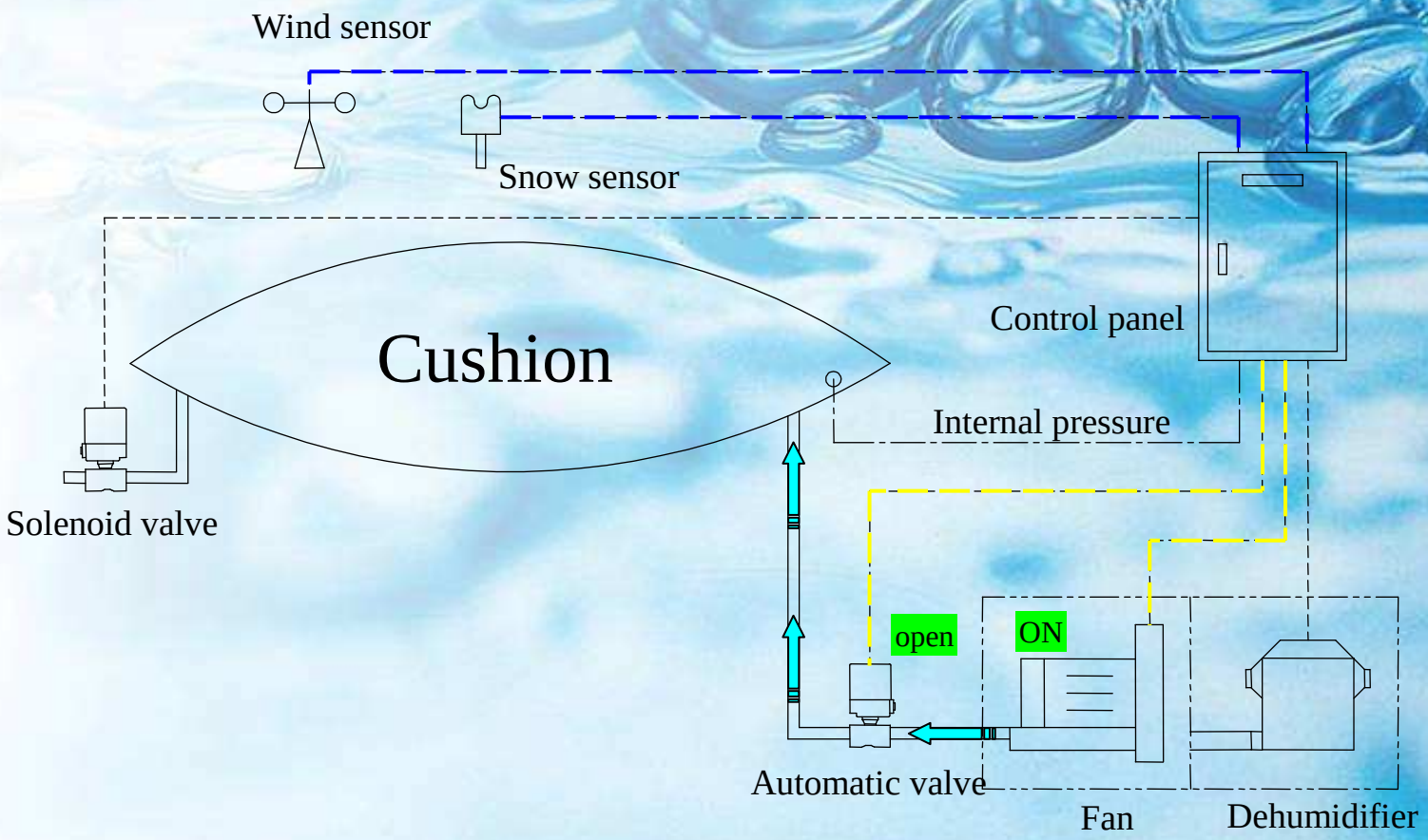
Internal Pressure Control System



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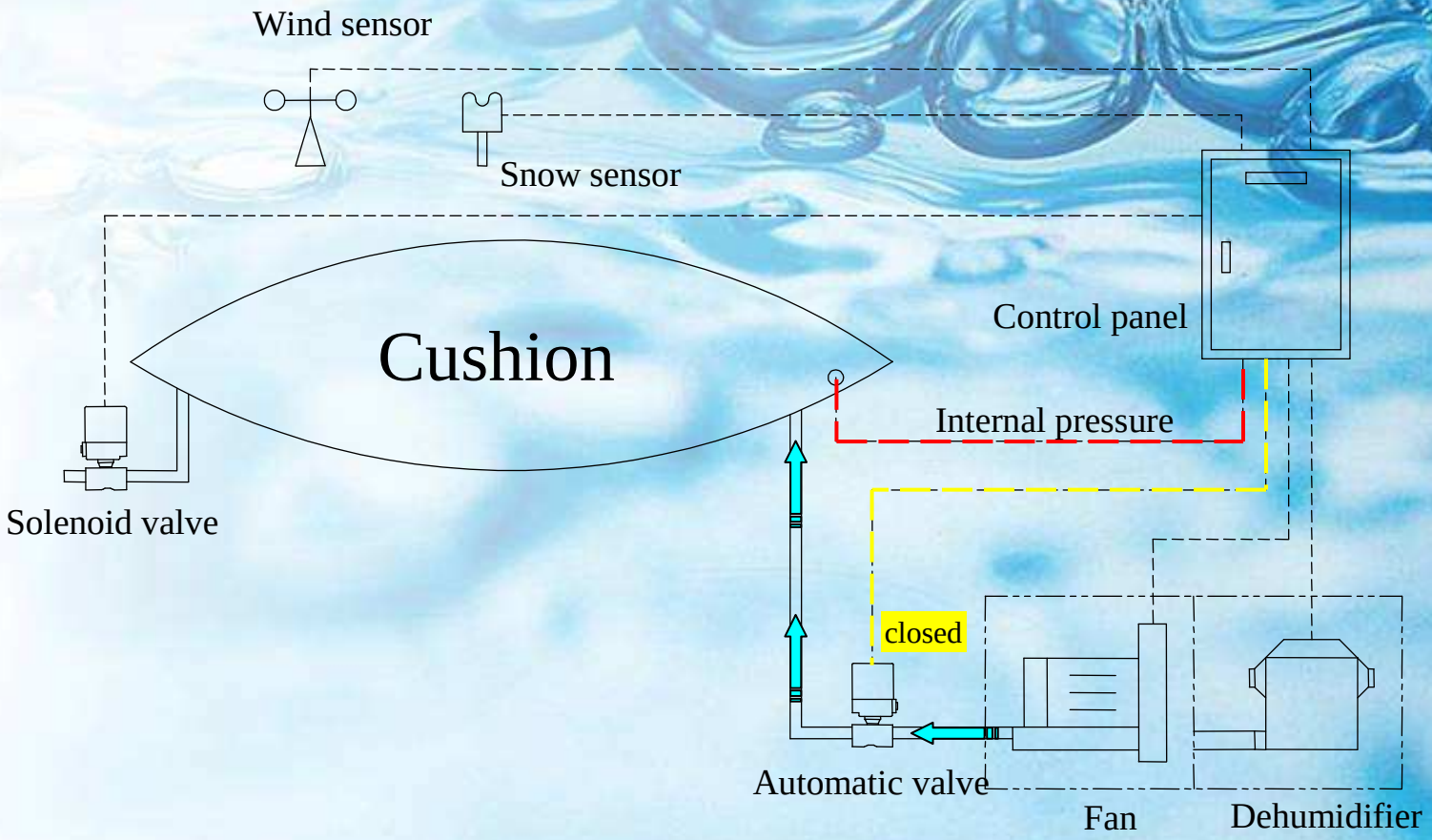
Internal Pressure Control System



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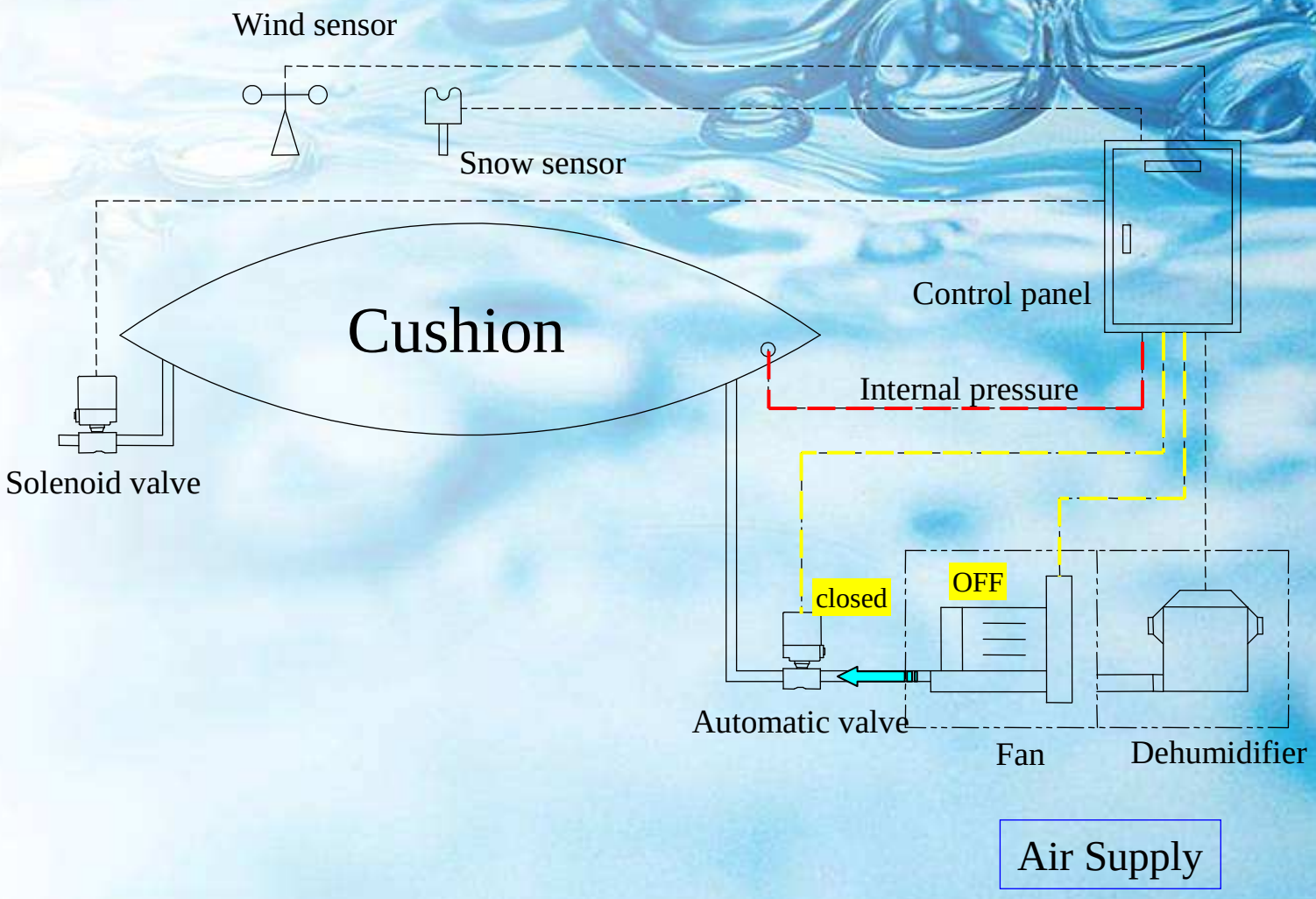
Internal Pressure Control System



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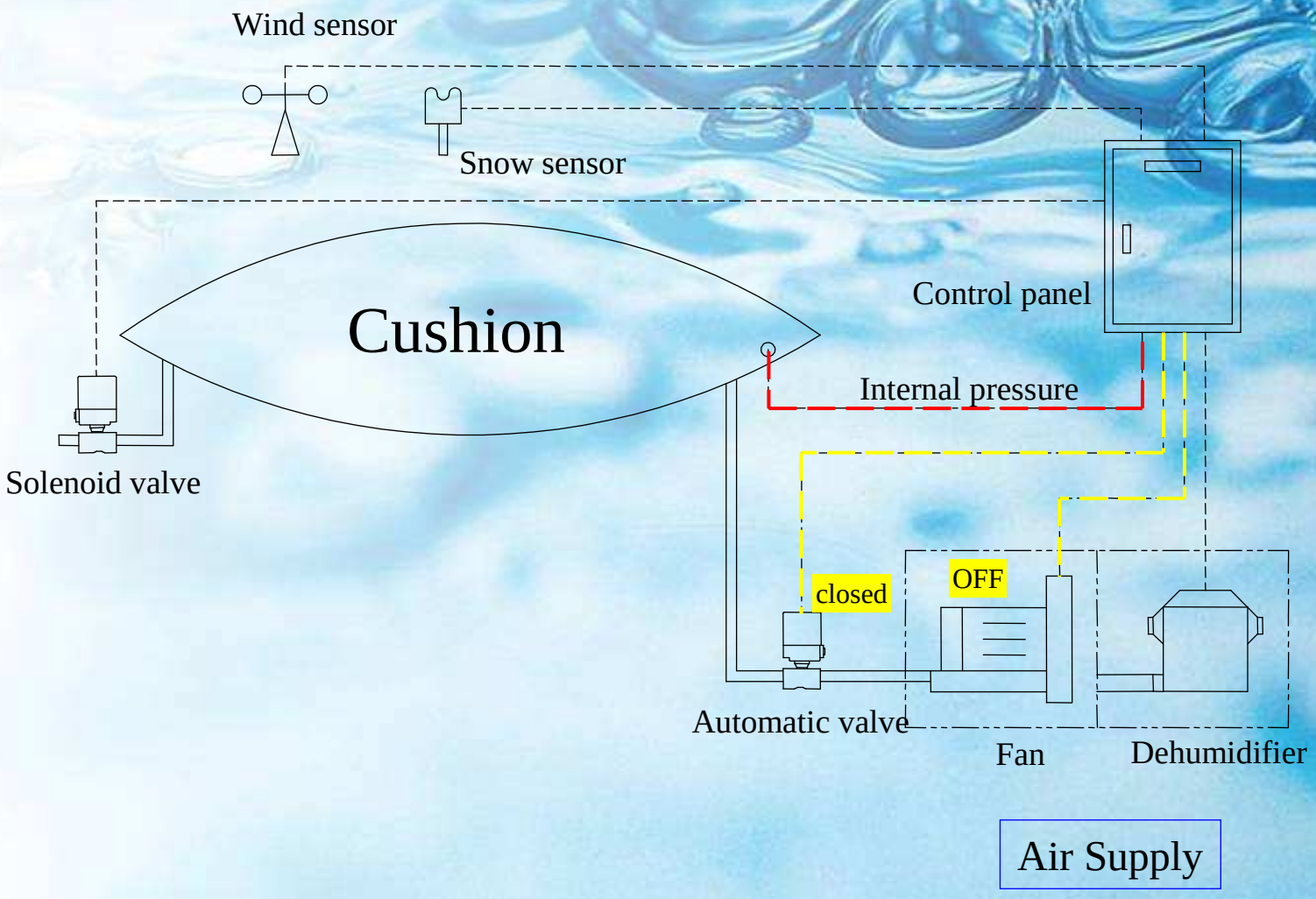
Internal Pressure Control System



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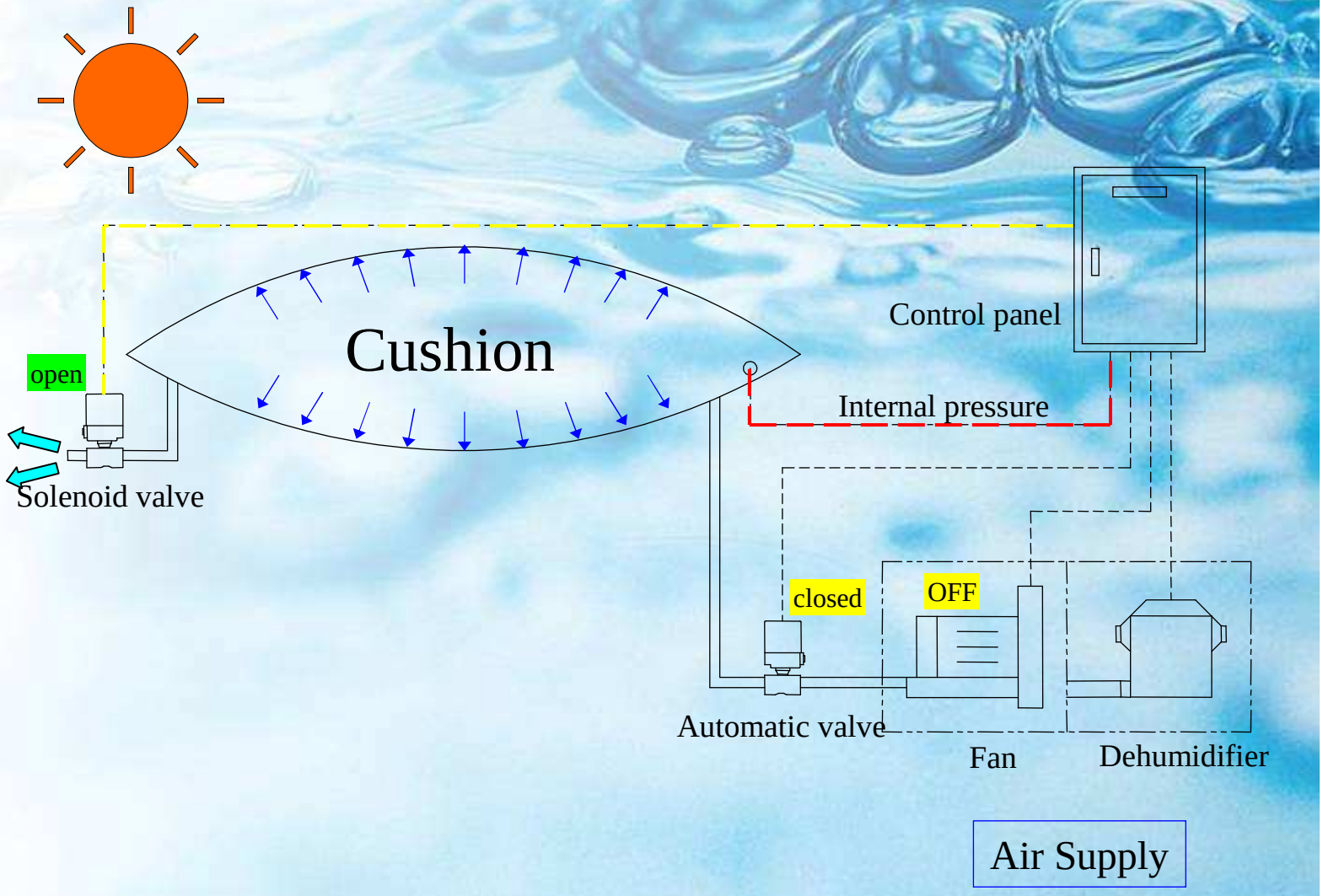
Internal Pressure Control System



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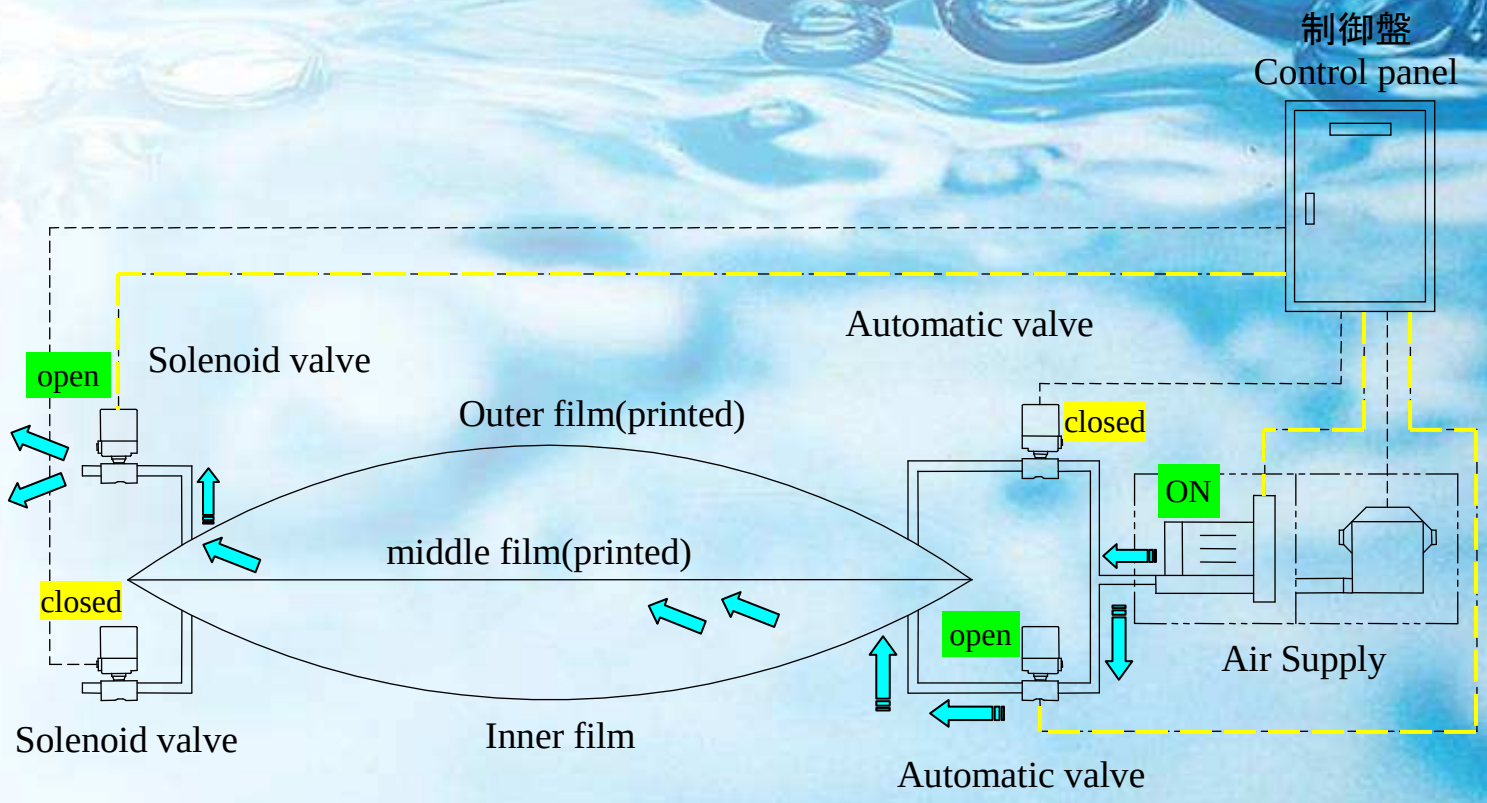
Sunlight Control System



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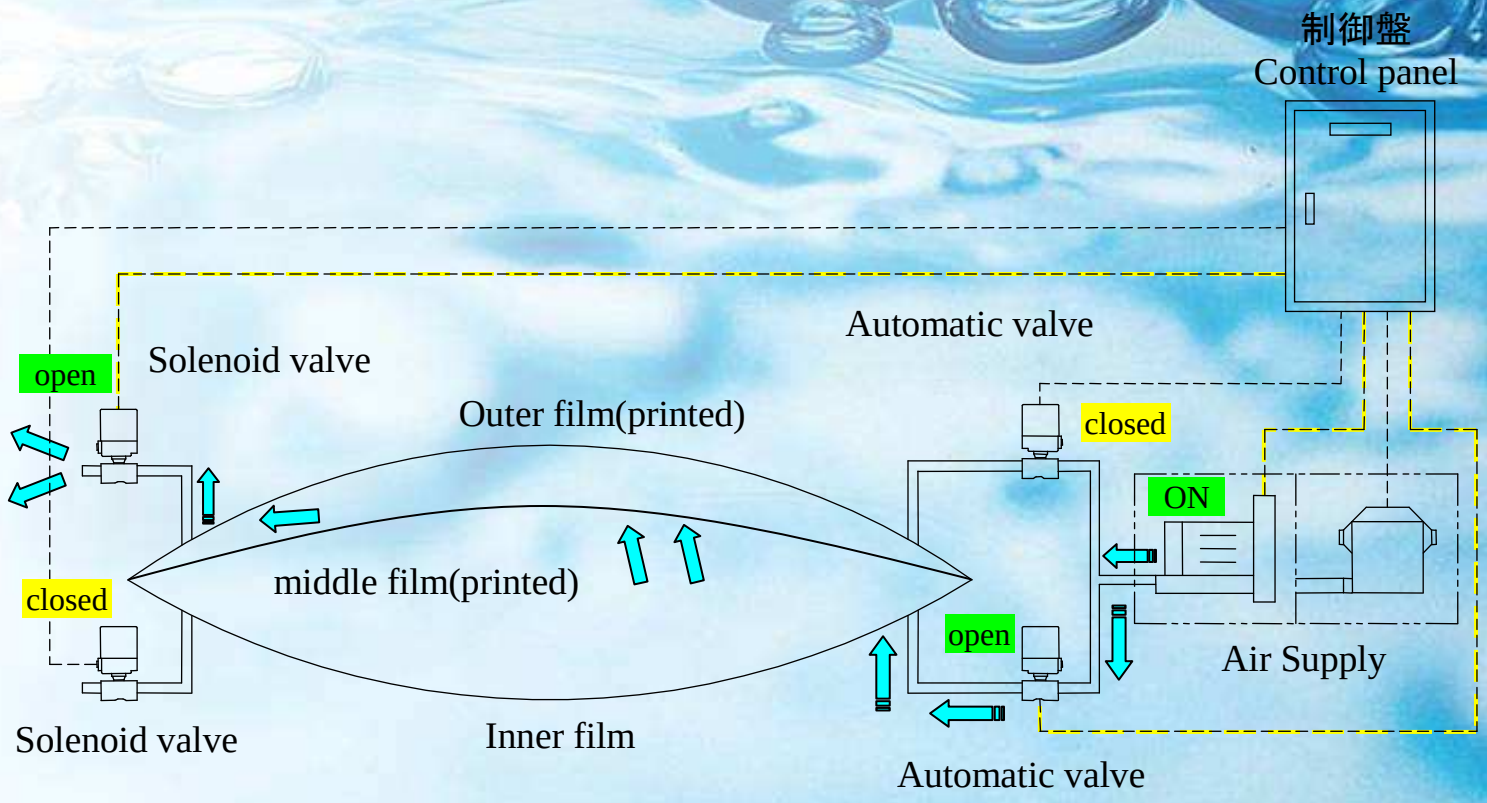
Sunlight Control System



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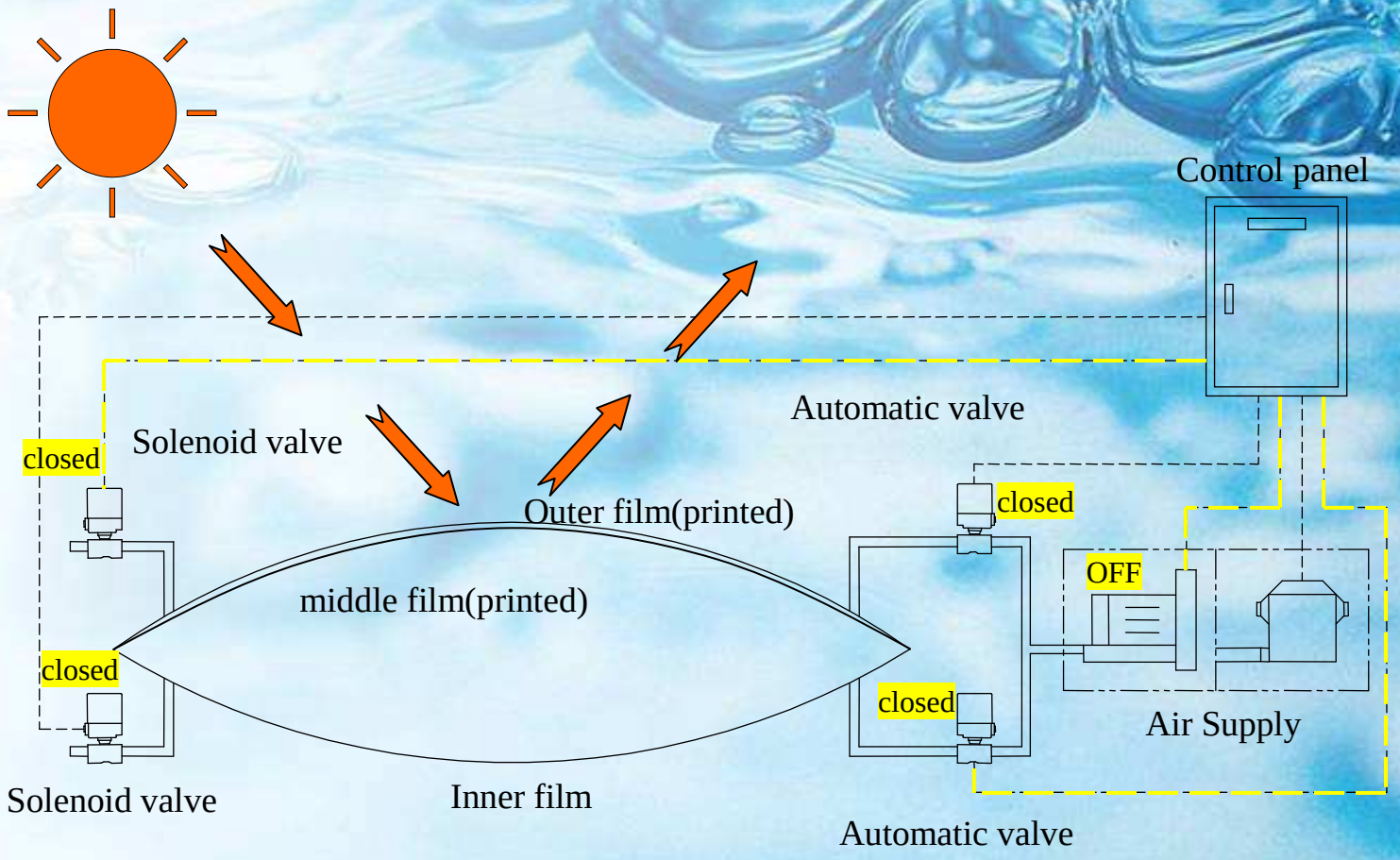
Sunlight Control System



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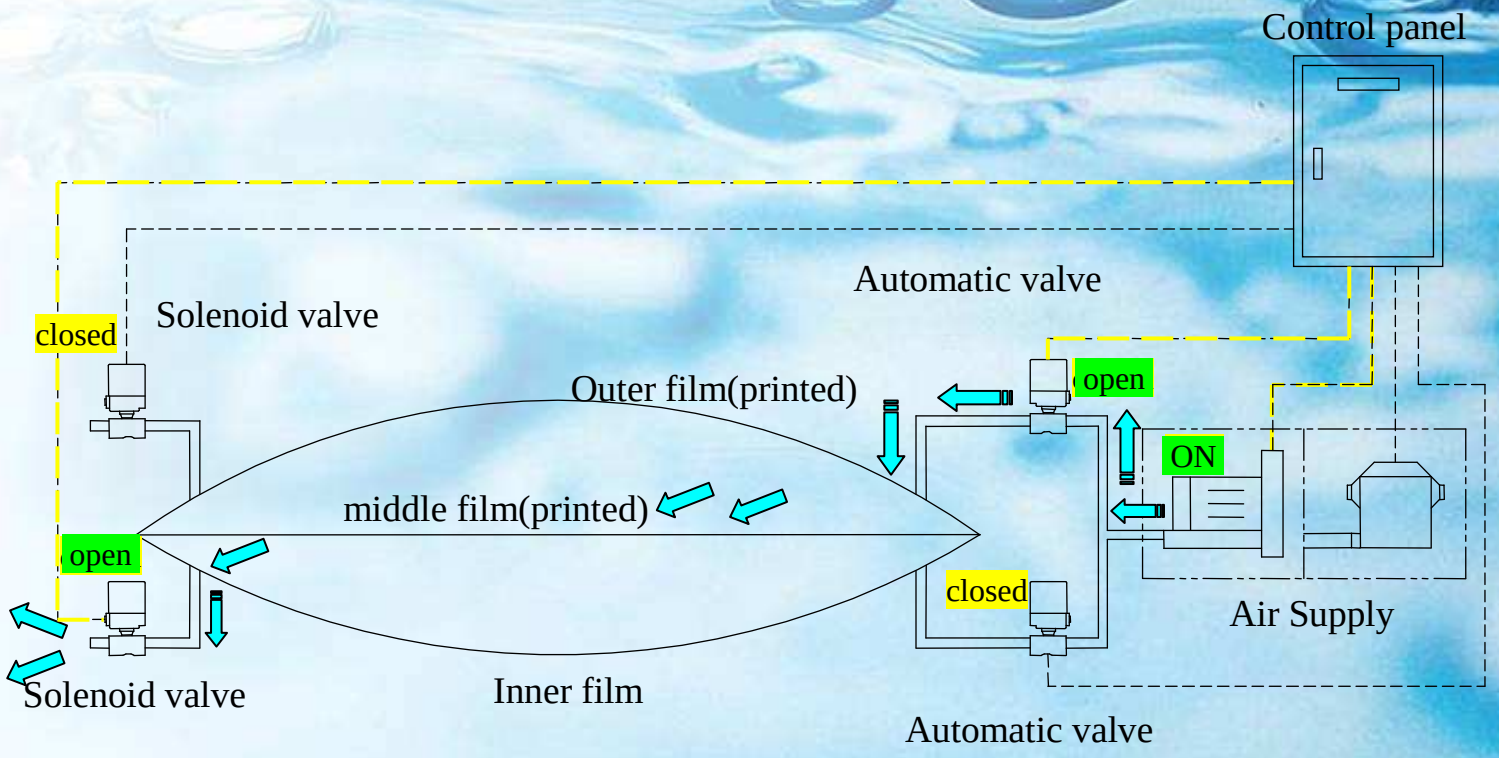
Sunlight Control System



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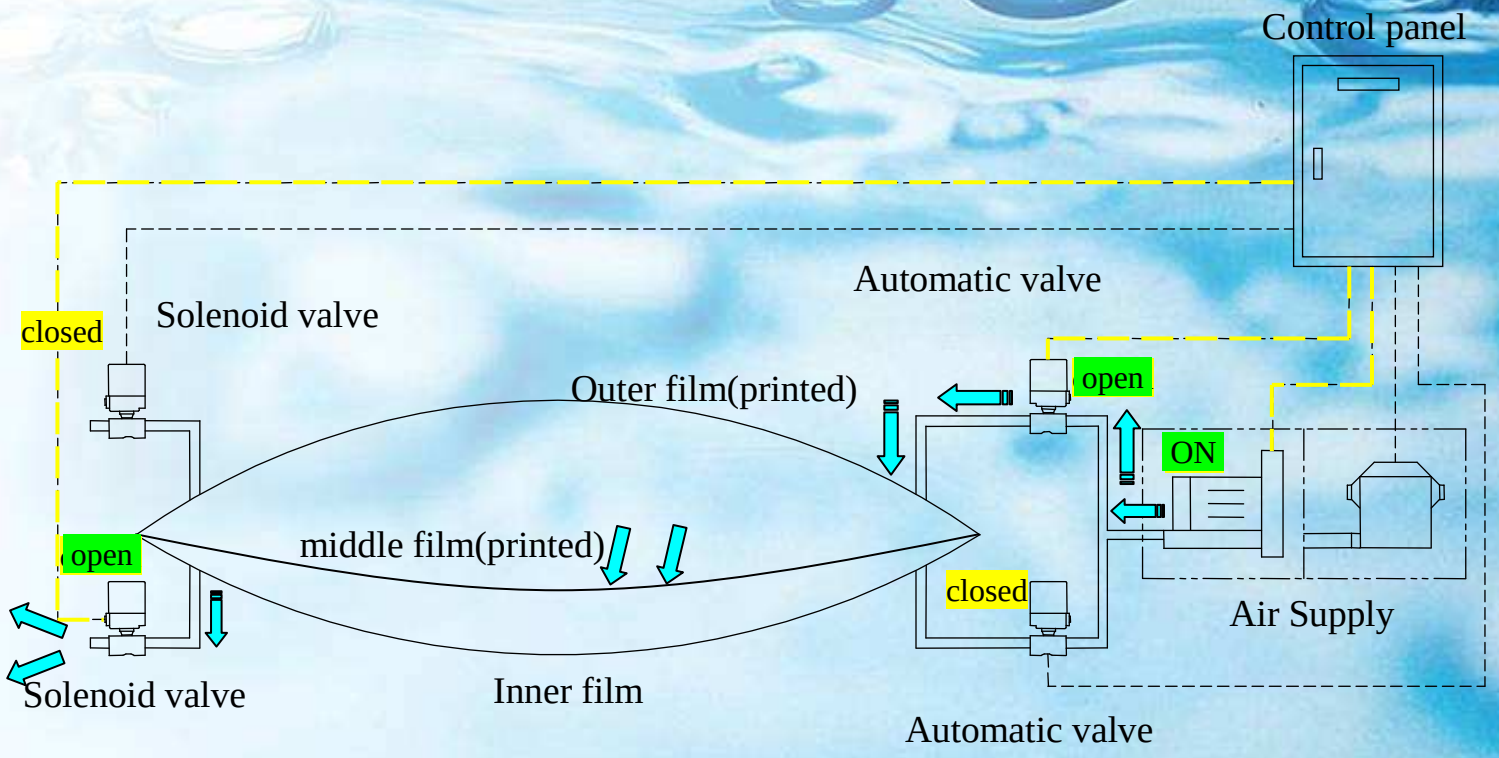
Sunlight Control System



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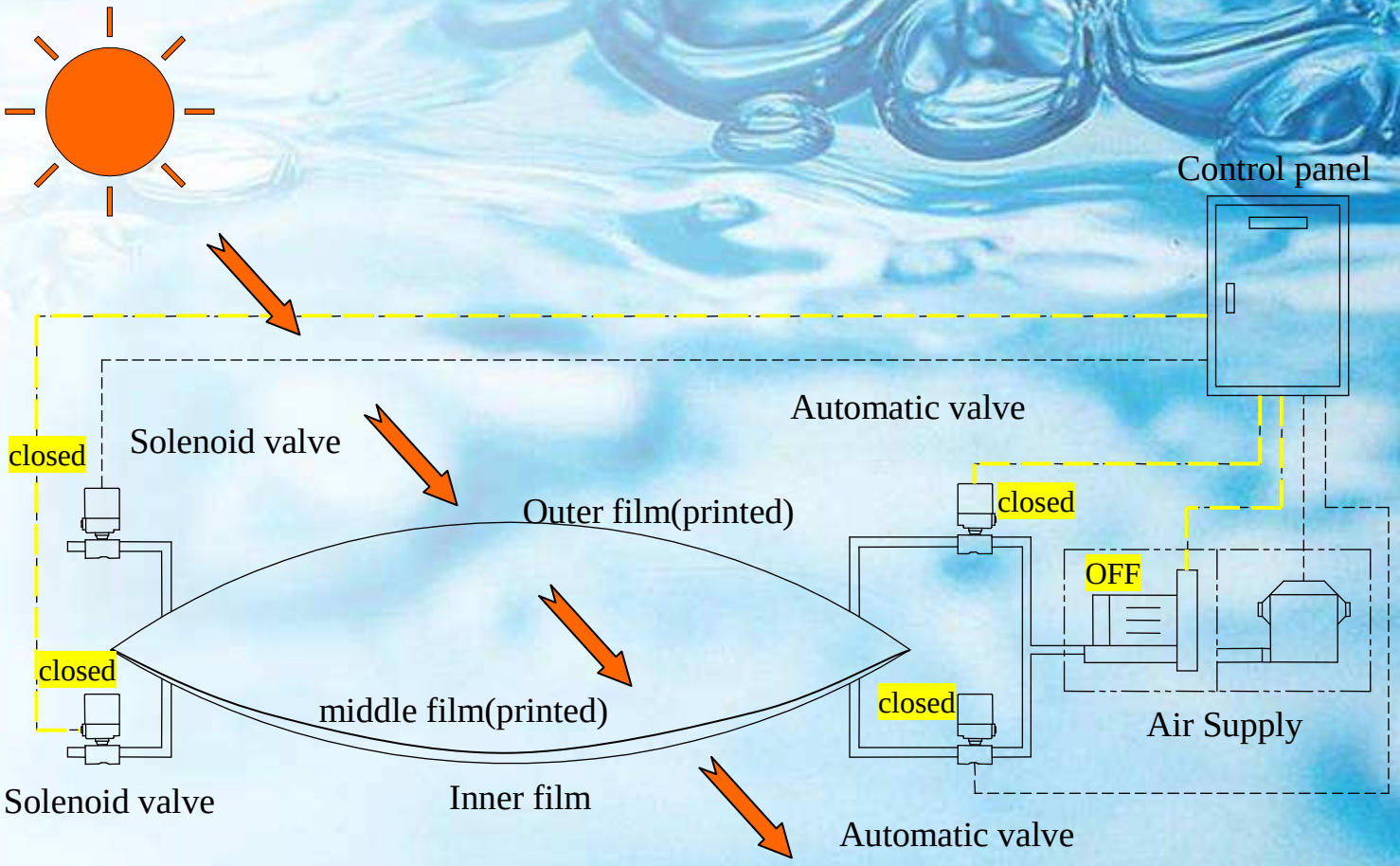
Sunlight Control System



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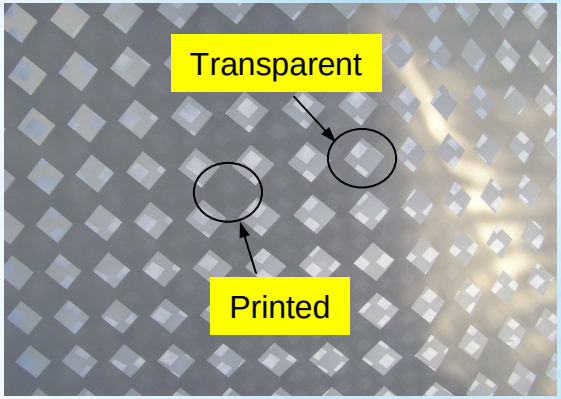
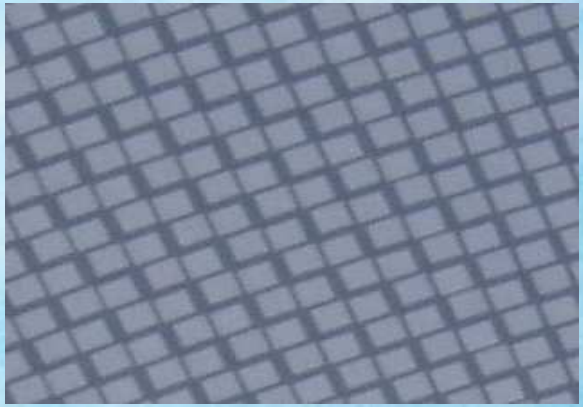
Inspection of Sun Control System

Sunlight control



Light penetration



Light shading

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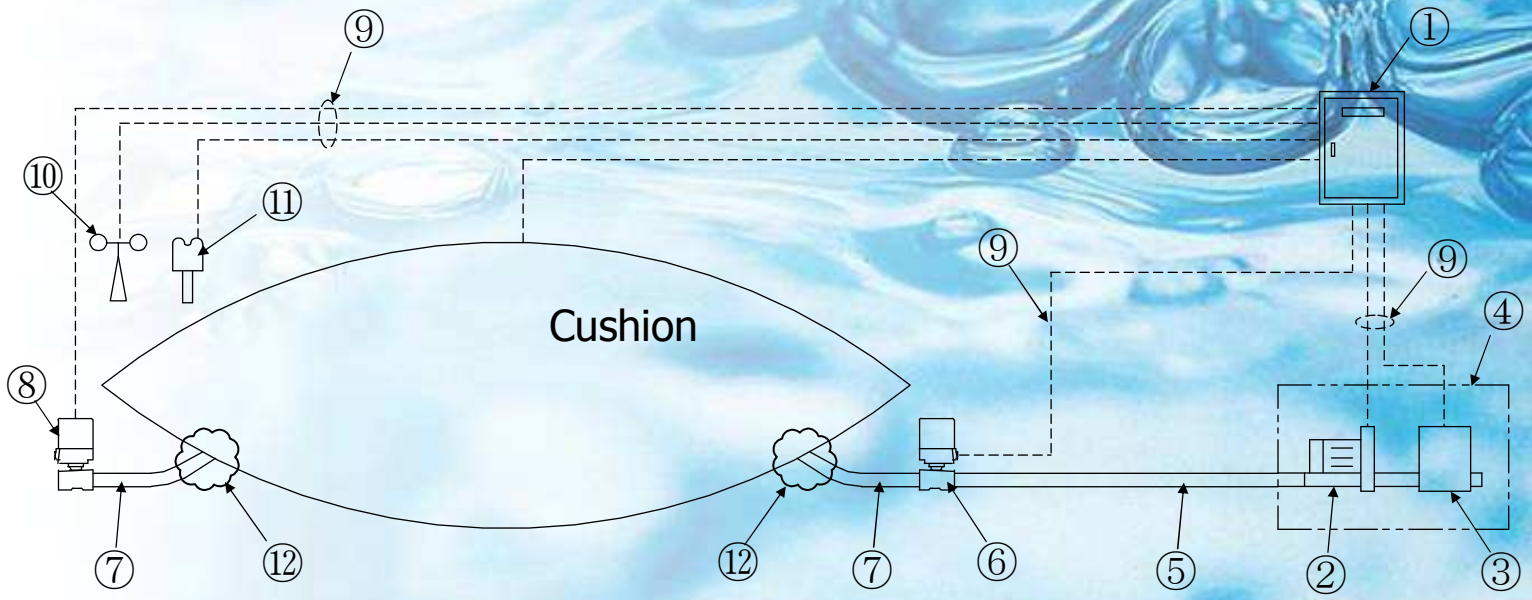
Glossary of Items



①Control box
②Air blower
③Dehumidifier
④Chamber box
⑤Duct

⑥Air-supply valve（motor valve）
⑦Flexible hose
⑧Air exhaust valve（solenoid valve）
⑨Control cable
⑩Anemometer

⑪Snow Gauge
⑫Air inlet and outlet
⑬Pressure detecting tube

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Control Unit and Blower

①Control console

The console controls the on-off of the air blower and the opening and closing of the valve using PLC (Programmable Controller), on receipt of signals from disturbance detectors such as anemometers, snow detectors, and from pressure sensors.

Pressure sensor

PLC

②Air blower

A device for sending air into the cushion

③Dry dehumidifier

A machine for dehumidifying the air sent into the cushion.

It is used to prevent the condensation from occurring inside the cushion in a high-humidity environment.

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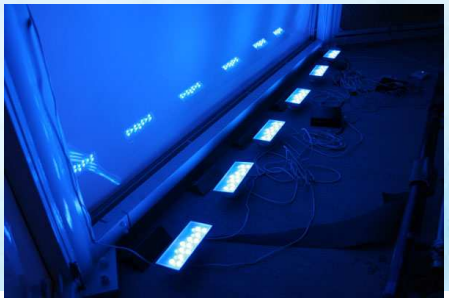
LED Lighting additions









LED light

Indoor

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Projection of Image on Inside Pillow

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ETFE Project List

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Sea Side Farm

TAIYOKOGYO CORPORATION
Location: Osaka, Japan
Surface area: Approx. 100 sqm
Form: Single layer
Completion: 2005.02

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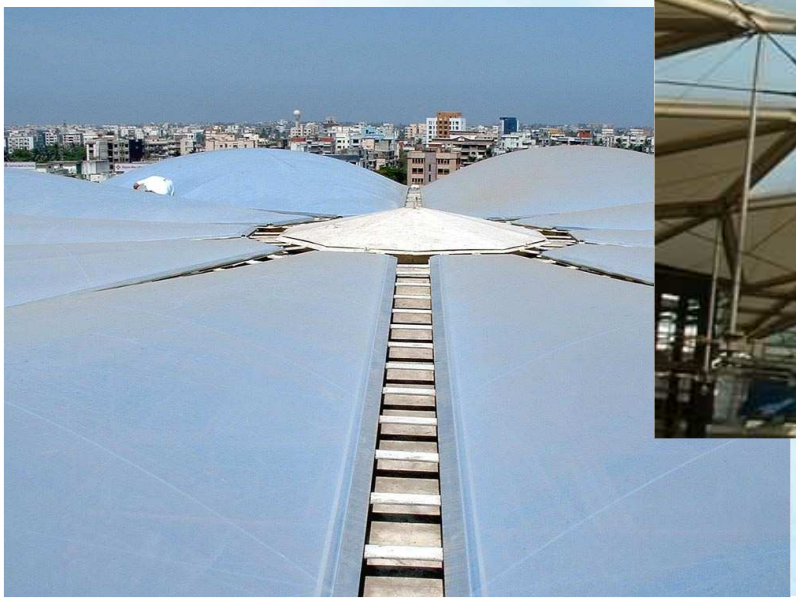
Sahara Star

TAIYOKOGYO CORPORATION
Location: Mumbai, India
Surface area: Approx. 1200 sq.m
Form: Air cushion 3 layers
Completion: 2005.10



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Yuanda Factory Entry

TAIYOKOGYOCORPORATION
Location: Shenyang, China
Surface area: Approx. 700 sq.m
Form: Single layer (cable net)
Completion: 2007

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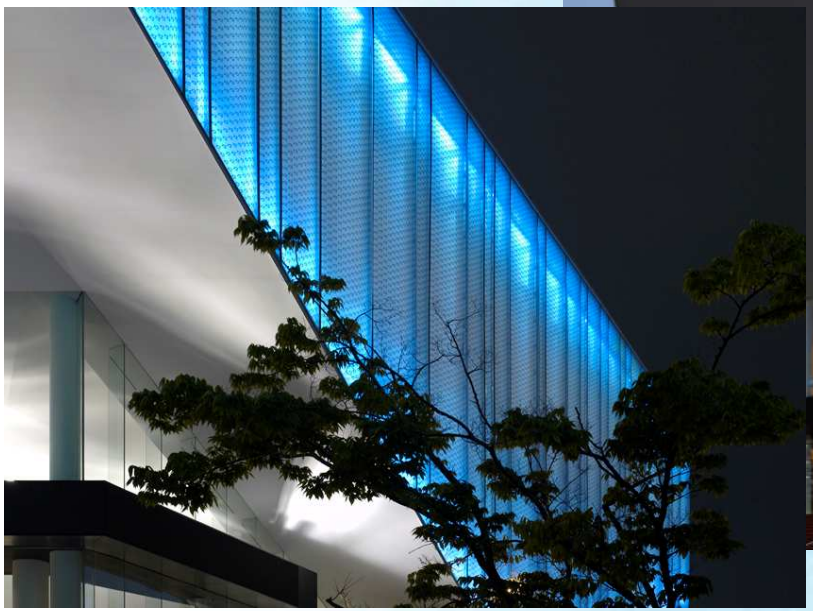
GS Xi Model House

TAIYOKOGYO CORPORATION
Location: Busan, Korea
Surface area: Approx. 2500 sq.m
Form: Air cushion 2 layers
Completion: 2007.07



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GS Xi Model House

TAIYOKOGYO CORPORATION
Location: Busan, Korea
Surface area: Approx. 2500 sq.m
Form: Air cushion 2 layers
Completion: 2007.07

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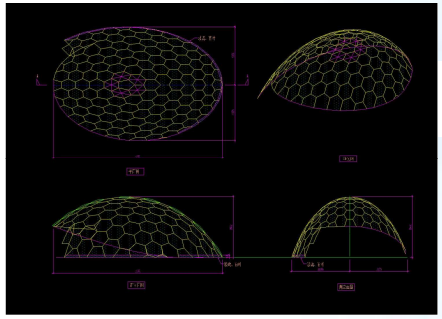
Nan-Tong Exhibition

TAIYOKOGYO CORPORATION
Location: Nan Tong, China
Surface area: Approx. 1600 sq.m
Form: Air cushion 3 layers
Completion: 2007.09



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ETFE Under Construction

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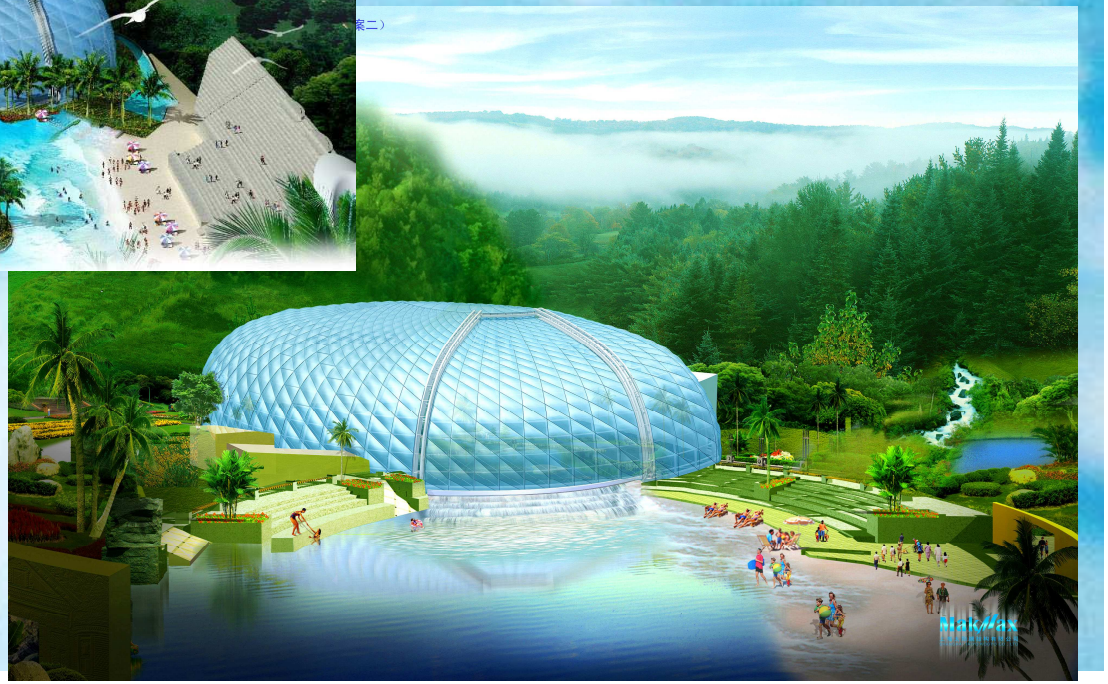
Shenzhen Water Park

TAIYOKOGYO CORPORATION
Location: Shenzhen, China
Surface area: Approx. 8000 sq.m
Form: Air cushion 3 layers
Completion: 2008.04



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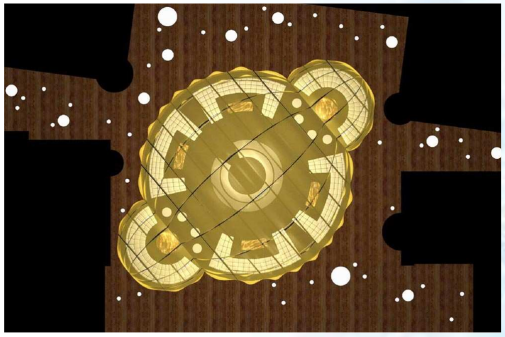
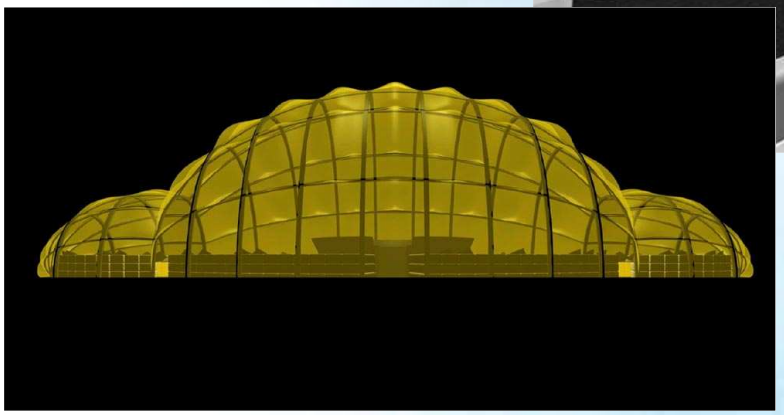
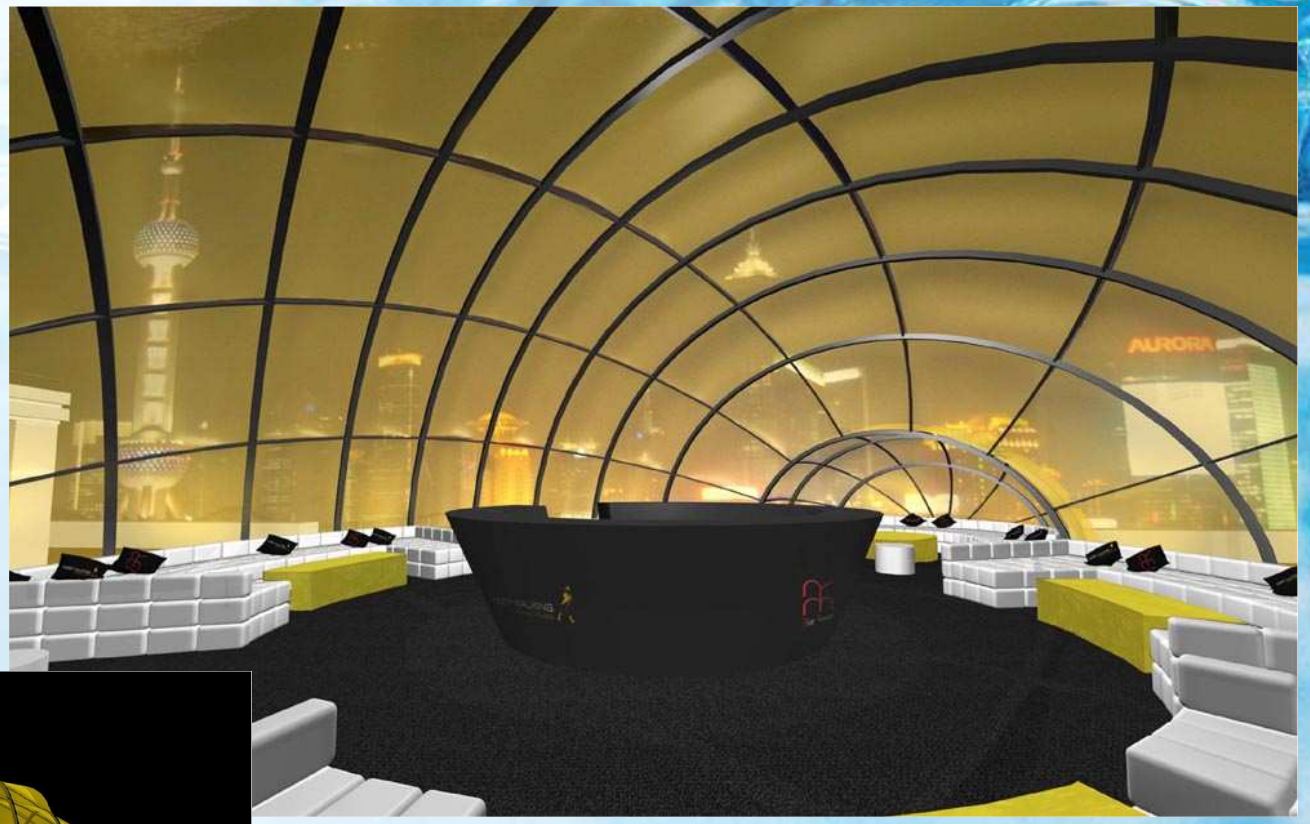
Waiten Number 18 Bar

TAIYOKOGYO CORPORATION
Location: Shanghai, China
Surface area: Approx. 400 sq.m
Form: Air cushion 2 layers
Completion: 2008







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