ภาคผนวกที่ 7

เอกสารประกอบมาตรการ

7.1 เอกสารรับรองค่าสะท้อนกระจกของอาคารโครงการ

โครงการ อาคารสำนักงานใหญ่เมืองไทยลิสซิ่ง

ประมาณค่า OTTV

มุมอะซิมุท = 45 (ตะวันออกเฉียงเหนือ)													
ผนัง	ชนิดผนัง	A_w (Sq.m.)	U_w (W/Sq.m. °C)	DSH (kJ/cu.m.)	Solar Absorbtance	Td_{eq} (°C)	A_F (Sq.m.)	U_F (W/Sq.m. °C)	T diff. (°C)	SHGC	SC	ESR (W/Sq.m.)	Q (Watt)
ผนัง 1	ทึบ	-	2.84	122.14	0.50	13.97	-	-	-	-	-	-	-
ผนัง 2	ทึบ	160.5	3.20	119.71	0.30	10.14	-	-	-	-	-	-	5,217.121
ผนัง 3	ทึบ	380.98	0.70	67.15	0.30	14.96	-	-	-	-	-	-	3,971.728
กระจก 1	โปร่ง	-	-	-	-	-	-	1.69	5	0.280	0.320	215.840	-
กระจก 2	โปร่ง	-	-	-	-	-	627.24	4.98	5	0.360	0.420	215.840	36,088.258
ค่าความร้อนรวม													45,277.107
พื้นที่ผนังทึบ													541.50
พื้นที่ผนังโปร่ง													627.24
พื้นที่รวม (ตร.ม.)													1,168.74
OTTV (Watt/Sq.m.)													38.740

มุมอะซิมุท = 135 (ตะวันออกเฉียงใต้)													
ผนัง	ชนิดผนัง	A_w (Sq.m.)	U_w (W/Sq.m. °C)	DSH (kJ/cu.m.)	Solar Absorbtance	Td_{eq} (°C)	A_F (Sq.m.)	U_F (W/Sq.m. °C)	T diff. (°C)	SHGC	SC	ESR (W/Sq.m.)	Q (Watt)
ผนัง 1	ทึบ	8.0	2.84	122.14	0.50	15.50	-	-	-	-	-	-	352.419
ผนัง 2	ทึบ	131.8	3.20	119.71	0.30	11.02	-	-	-	-	-	-	4,655.647
ผนัง 3	ทึบ	218.60	0.70	67.15	0.30	16.62	-	-	-	-	-	-	2,532.704
กระจก 1	โปร่ง	-	-	-	-	-	-	1.69	5	0.280	0.320	263.140	-
กระจก 2	โปร่ง	-	-	-	-	-	260.93	4.98	5	0.360	0.420	263.140	16,878.718
ค่าความร้อนรวม													24,419.489
พื้นที่ผนังทึบ													358.43
พื้นที่ผนังโปร่ง													260.93
พื้นที่รวม (ตร.ม.)													619.36
OTTV (Watt/Sq.m.)													[redacted]

โครงการ อาคารสำนักงานใหญ่เมืองไทยลิสซิ่ง

ประมาณค่า OTTV

มุมอะซิมุท = 225 (ตะวันตกเฉียงใต้)													
ผนัง	ชนิดผนัง	A_w (Sq.m.)	U_w (W/Sq.m. °C)	DSH (kJ/cu.m.)	Solar Absorbtance	Td_{eq} (°C)	A_F (Sq.m.)	U_F (W/Sq.m. °C)	T diff. (°C)	SHGC	SC	ESR (W/Sq.m.)	Q (Watt)
ผนัง 1	ทึบ	-	2.84	122.14	0.50	14.48	-	-	-	-	-	-	-
ผนัง 2	ทึบ	155.9	3.20	119.71	0.30	10.41	-	-	-	-	-	-	5,196.335
ผนัง 3	ทึบ	401.85	0.70	67.15	0.30	15.75	-	-	-	-	-	-	4,411.745
กระจก 1	โปร่ง	-	-	-	-	-	576.26	1.69	5	0.280	0.320	256.820	18,129.757
กระจก 2	โปร่ง	-	-	-	-	-	131.68	4.98	5	0.360	0.420	256.820	8,392.122
ค่าความร้อนรวม													36,129.959
พื้นที่ผนังทึบ													557.72
พื้นที่ผนังโปร่ง													707.94
พื้นที่รวม (ตร.ม.)													1,265.66
OTTV (Watt/Sq.m.)													28.546

มุมอะซิมุท = 315 (ตะวันตกเฉียงเหนือ)													
ผนัง	ชนิดผนัง	A_w (Sq.m.)	U_w (W/Sq.m. °C)	DSH (kJ/cu.m.)	Solar Absorbtance	Td_{eq} (°C)	A_F (Sq.m.)	U_F (W/Sq.m. °C)	T diff. (°C)	SHGC	SC	ESR (W/Sq.m.)	Q (Watt)
ผนัง 1	ทึบ	9.6	2.84	122.14	0.50	12.63	-	-	-	-	-	-	343.738
ผนัง 2	ทึบ	137.2	3.20	119.71	0.30	9.32	-	-	-	-	-	-	4,098.427
ผนัง 3	ทึบ	654.85	0.70	67.15	0.30	13.92	-	-	-	-	-	-	6,353.421
กระจก 1	โปร่ง	-	-	-	-	-	984.68	1.69	5	0.280	0.320	234.580	29,016.913
กระจก 2	โปร่ง	-	-	-	-	-	174.79	4.98	5	0.360	0.420	234.580	10,551.809
ค่าความร้อนรวม													50,364.308
พื้นที่ผนังทึบ													801.64
พื้นที่ผนังโปร่ง													1,159.47
พื้นที่รวม (ตร.ม.)													1,961.11
OTTV (Watt/Sq.m.)													25.682
OTTV รวมทั้งอาคาร (Watt/Sq.m.)													31.146

โครงการ อาคารสำนักงานใหญ่เมืองไทยลิสซิ่ง

ประมาณค่า RTTV

มุมอะซิมุท = 0													
ผนัง	ชนิดผนัง	A_w (Sq.m.)	U_w (W/Sq.m. °C)	DSH (kJ/cu.m.)	Solar Absorbtance	Td_{eq} (°C)	A_F (Sq.m.)	U_F (W/Sq.m. °C)	T diff. (°C)	SHGC	SC	ESR (W/Sq.m.)	Q (Watt)
หลังคาพร้อมฉนวน	ทึบ	962.00	0.466	746.176	0.5	11.546	-	-	-	-	-	-	5,175.979
ค่าความร้อนรวม													5,175.979
พื้นที่ผนังทึบ													962
พื้นที่ผนังโปร่ง													-
พื้นที่รวม (ตร.ม.)													962
RTTV (Watt/Sq.m.)													5.38

RTTV รวมทั้งอาคาร (Watt/Sq.m.)	5.38

โครงการ อาคารสำนักงานใหญ่เมืองไทยลิสซิ่ง

รหัส	ชั้นที่	วัสดุ	ความหนา (mm)	ความหนาแน่น (kg/m³)	k (W/m-°C)	Cp (kJ/kg °C)	R (m²-°C/W)	DSH (kJ/m².°C)	ลักษณะและสีผิวภายนอก		
Wall-1	1	ฟิล์มอากาศภายนอก	-	-	-	-	0.04400	-	Alpha	0.3	STANDARD
ALUMINIUM	2	อลูมิเนียม	25.0	2,672	211.000	0.896	0.00012	59.853			คาดการ
	3	ช่องว่างอากาศ (แผ่รังสีสูง)	50.0	-	-	-	0.14800	-			คาดการ
	4	อลูมิเนียม	25.0	2,672	211.000	0.896	0.00012	59.853			คาดการ
	5	ฟิล์มอากาศภายใน	-	-	-	-	0.12000	-			STANDARD
			100.0		รวม	1.792	0.31224	119.706	3.203	W/m²-°C	
Roof-2	1	ฟิล์มอากาศภายนอก	-	-	-	-	0.05500	-	Alpha	0.7	
	2	หลังคาคอนกรีต	250.0	2,400	1.442	0.920	0.17337	552.000			
	3	ฉนวนใยแก้ว	50.0	24	0.035	0.960	1.42857	1.152			
	4	ช่องว่างอากาศ	100.0	-	-	-	0.45800	-			
	5	แผ่นยิปซัม	9.0	800	0.282	1.090	0.03191	7.848			
	6	ฟิล์มอากาศภายใน	-	-	-		0.16200	-			
			409.0		รวม	2.970	2.30886	561.000	0.433	W/m²-°C	
Wall-5	1	ฟิล์มอากาศภายนอก	-	-	-	-	0.04400	-	Alpha	0.5	STANDARD
WALL	2	ปูนฉาบสำหรับคอนกรีตมวลเบา	15.0	1,860	0.720	0.840	0.02083	23.436			ควาหนาจาก t
	3	คอนกรีตมวลเบามวลเบา	70.0	1,280	0.476	0.840	0.14706	75.264			ควาหนาจาก t
	4	ปูนฉาบสำหรับคอนกรีตมวลเบา	15.0	1,860	0.720	0.840	0.02083	23.436			ควาหนาจาก t
	5	ฟิล์มอากาศภายใน	-	-	-	-	0.12000	-			STANDARD
			100.0		รวม	2.520	0.35273	122.136	2.835	W/m²-°C	
Wall-2	1	ฟิล์มอากาศภายนอก	-	-	-	-	0.04400	-	Alpha	0.3	STANDARD
BACK PAN	2	LAMINATED GLASS	30.0	2,500	0.048	0.880	0.62500	66.000	1.600		ข้อมูลกระจกจ
SPANDREL	3	ฉนวนใยแก้ว	20.0	60	0.031	0.960	0.64516	1.152			ดูจากกรุงศรี
	4	ฟิล์มอากาศภายใน	-	-	-	-	0.12000	-			STANDARD
			50.0		รวม	1.840	1.43416	67.152	0.697	W/m²-°C	
Wall-4.1	1	ฟิล์มอากาศภายนอก	-	-	-	-	0.04400	-	Alpha	0.3	
GRILL	2	อลูมิเนียม	100.0	2,672	211.000	0.896	0.00047	239.411			
	5	ฟิล์มอากาศภายใน	-	-	-	-	0.12000	-			
			100.0		รวม	0.896	0.16447	239.411	6.080	W/m²-°C	
Roof-1	1	ฟิล์มอากาศภายนอก	-	-	-	-	0.05500	-	Alpha	0.3	
	2	หลังคาคอนกรีต	250.0	2,400	1.442	0.920	0.17337	552.000			
	3	ฉนวนPU	40.0	24	0.023	1.530	1.73913	1.469			
	4	ฟิล์มอากาศภายใน	-	-	-	-	0.16200	-			
			290.0		รวม	2.450	2.12950	553.469	0.470	W/m²-°C	

MATERIALS OF GLASS

TYPE	NO.	MATERIAL	THICKNESS (mm.)	DENSITY (kg/m³)	k (W/m-°C)	U (W/m²-°C)	SHGC
G-1	1	P50	30.76	-	-	1.590	0.305

March 28, 2018 Prepared for P&T
By NUALANONG M.(BO)
nmethapipatkul@guardian.com +66 81 8624304

MTLS REV2

Make-up Name	Make-up Icon	Transmittance		Reflectance			Absorptance	U-Value		Shading Coefficient (sc)	Solar Heat Gain Coefficient (SHGC)	Light to Solar Gain (LSG)	Thermal Stress (COG) °F/C	Color Rendering Index (R_a)
		Visible (τ_v %)	Solar (τ_e %)	Visible		Solar	Solar (α_e %)	Winter Night (W/m²·K)	Summer Day (W/m²·K)					
				ρ_v % out	ρ_v % in	ρ_e % out								
5CL/1.52PVB/5RB40/12AIR/5CL		37	21	24	23	21	58	1.71	1.69	0.32	0.28	1.33	Caution	93.9
5RB20/1.52PVB/5CL		23	18	20	26	18	64	5.47	4.98	0.42	0.36	0.63	Go	96.8
6CL/1.52PVB/6RB40/12AIR/5CL		37	20	24	23	20	60	1.70	1.69	0.32	0.28	1.33	Stop	93.4
6RB20/1.52PVB/6CL		23	17	20	26	18	65	5.40	4.93	0.42	0.36	0.62	Go	96.9

Calculation Standard: NFRC 2010

5CL/1.52PVB/5RB40/12AIR/5CL

Outdoors

			Thermal Stress Guidance (COG) (°C)
GLASS 1	Clear (Middle East) Thickness = 5mm	#1 ----- #2 -----	Caution 70.0
INTERLAYER 1	0.060" (1.52mm) Saflex® R Clear PVB		
GLASS 2	Clear (Middle East) Thickness = 5mm	#3 ----- #4 SunGuard® HP Royal Blue 40 (Middle East)	Caution 72.6
GAP 1	100% Air, 12mm (.472")		
GLASS 3	Clear (Asia Pacific) Thickness = 5mm	#5 ----- #6 -----	Go 38.2

Total Unit (Nominal) = 1 3/32 in / 28.524 mm Slope = 90° Window Height = 1 meter

Estimated Nominal Glazing Weight: 37.24 kg/m²

Indoors

ใช้กระจกความหนา 5 มม.

5RB20/1.52PVB/5CL

Outdoors

			Thermal Stress Guidance (COG) (°C)
GLASS 1	Clear (Middle East) Thickness = 5mm	#1 ----- #2 SunGuard® Solar Royal Blue 20 (Middle East)	Go 58.2
INTERLAYER 1	0.060" (1.52mm) Saflex® R Clear PVB		
GLASS 2	Clear (Asia Pacific) Thickness = 5mm	#3 ----- #4 -----	Go 54.9

Total Unit (Nominal) = 7/16 in / 11.524 mm Slope = 90° Window Height = 1 meter

Estimated Nominal Glazing Weight: 25.37 kg/m²

Indoors

6CL/1.52PVB/6RB40/12AIR/5CL

Outdoors

			Thermal Stress Guidance (COG) (°C)
GLASS 1	Clear (Middle East) Thickness = 6mm	#1 ----- #2 -----	Caution 71.2
INTERLAYER 1	0.060" (1.52mm) Saflex® R Clear PVB		
GLASS 2	Clear (Middle East) Thickness = 1/4" = 6mm	#3 ----- #4 SunGuard® HP Royal Blue 40 (Middle East)	Stop 73.9
GAP 1	100% Air, 12mm (.472")		
GLASS 3	Clear (Asia Pacific) Thickness = 5mm	#5 ----- #6 -----	Go 38.4

Total Unit (Nominal) = 1 3/16 in / 30.524 mm Slope = 90° Window Height = 1 meter

Estimated Nominal Glazing Weight: 41.9 kg/m²

Indoors

6RB20/1.52PVB/6CL

Outdoors

			Thermal Stress Guidance (COG) (°C)
GLASS 1	Clear (Middle East) Thickness = 6mm	#1 ----- #2 SunGuard® Solar Royal Blue 20 (Middle East)	Go 58.8
INTERLAYER 1	0.060" (1.52mm) Saflex® R Clear PVB		
GLASS 2	Clear (Asia Pacific) Thickness = 1/4" = 6mm	#3 ----- #4 -----	Go 55.2

Total Unit (Nominal) = 17/32 in / 13.524 mm Slope = 90° Window Height = 1 meter

Estimated Nominal Glazing Weight: 30.03 kg/m²

Indoors

Important Notes

The performance values shown above represent NOMINAL VALUES for the center of glass with no spacer system or framing. Slight variations may occur due to manufacturing tolerances, point of manufacture, and type of instrumentation used to measure the optical properties. For configurations that include non-specular (diffuse) components, performance results cannot be verified and should only be used as a general indication of performance. For configurations which include ceramic frit coating, the actual values may

vary significantly based upon the thickness and composition of the frit. For configurations with coatings laminated facing the PVB, there may be a noticeable color change. Guardian recommends a full size mock-up be approved. Calculations and terms in this report are based on NFRC 2010.

Please note that the THERMAL STRESS GUIDELINE is only a rough reference to the thermal safety of a glazing. Other factors such as the size of glass areas, shapes and patterns, glass thickness, glass damaged during shipping, handling or installation, orientation of the building, exterior shading, overhangs/fins that reduce wind speed, and areas with high daily temperature fluctuations can all increase the probability of thermal breakage. The results shown are not for any specific glazing installation and do not constitute a warranty against glass breakage.

Explanation of Terms

% Transmittance Visible or Light Transmittance (τ_v %) is the percentage of visible light at normal incidence (90° to surface) that is transmitted by the glass.

% Ultraviolet (UV) Transmittance (τ_{uv} %) is the percentage of ultraviolet light at normal incidence directly transmitted by the glass. Ultraviolet Light is defined as radiant energy from the sun having a wavelength range of 300 nm to 380 nm.

% Solar Energy Direct Transmittance (τ_e %) is the percentage of solar energy at normal incidence directly transmitted by the glass. Solar Energy is the radiant energy from the sun having a wavelength range of 300 nm to 2500 nm.

% Reflectance Visible Outdoors or Light Reflectance Out (ρ_v % out) is the percentage of visible light at normal incidence directly reflected by the glass back outdoors.

% Reflectance Visible Indoors or Light Reflectance In (ρ_v % in) is the percentage of visible light at normal incidence directly reflected by the glass back indoors.

% Solar Energy Reflected Outdoors or Solar Direct Reflectance Out (ρ_e % out) is the percentage of solar energy at normal incidence directly reflected by the glass back outdoors.

% Solar Energy Reflected Indoors or Solar Direct Reflectance In (ρ_e % in) is the percentage of solar energy at normal incidence directly reflected by the glass back indoors.

Absorptance (α_e %) (Solar, Visible or UV) is defined as a process in which a range of radiation is retained by a substance and converted into heat energy. The creation of heat energy also causes the substance to emit its own radiation.

U-Factor or U-Value (U_G) is the air-to-air thermal conductance of 39" high glazing and associated air films. US Standard units are Btu/hr.ft².F. and SI / Metric units are W/m²K. Winter night values are 12.3 mph wind at -0.4°F outdoors and 69.8°F still indoor air. Summer values are 0 sun, 6.15 mph wind at 89.6°F outdoors and 75.2°F still indoor air.

Relative Heat Gain (RHG) is the total net heat gain to the indoors due to both the air-to-air thermal conductance and the solar heat gain. Imperial units are Btu/hr.ft². RHG = [(Summer U-Value)(89.6°F - 75.2°F) + (Shading Coefficient)(200 Btu/hr-ft²)]. Metric units are W/m². RHG = [(Summer U-Value)(32°C - 24°C) + (Shading Coef.)(631 W/m²)]

Shading Coefficient (SC) is the fraction of solar heat, direct (300 to 2500 nm) plus indirect (5 to 40 μm), transferred indoors through the glass. For reference, 1/8" (3.1 mm) clear glass has a value of 1.00 (SC is an older term being replaced by the SHGC).

Solar Heat Gain Coefficient (SHGC) is the fraction of solar energy incident on the glazing that is transferred indoors both directly and indirectly through the glazing. The direct gain portion equals the direct solar transmittance, while the indirect is the fraction of the solar energy absorbed to the energy reradiated and convected indoors. No heat gain from warmer outdoor air is included. SHGC = (Direct Solar Trans) + {[(Indirect Solar Heat Gain) - (Summer U-Value)(89.6°F - 75.2°F)] / (248.209 Btu/hr-ft²)}

Light-to-Solar Gain (LSG) is the ratio of visible light gain to solar gain. LSG = (Visible Transmittance) / (SHGC)

Color Rendering Index in transmission, D65 (R_a) is the change in color of an object as a result of the light being transmitted by the glass.

Weighted Sound Reduction Index (Rw) is a single-number quantity which characterizes the airborne sound insulation of a material or building element over a range of frequencies.

Sound Transmission Class (STC) is a single-number quantity which characterizes the airborne sound insulation of a material or building element over a range of frequencies.

Disclaimer

This performance analysis is provided for the limited purpose of assisting the user in evaluating the performance of the glass products identified on this report. Spectral data for products manufactured by Guardian reflect nominal values derived from typical production samples. Spectral data for products not manufactured by Guardian were derived from the LBNL International Glazing Database and have not been independently verified by Guardian. The values calculated by this tool are generated according to established engineering practices and applicable calculation standards. Many factors may affect glass performance, including glass size, building orientation, shading, wind speed, type of installation, and others. The applicability and results of the analysis are directly related to user inputs and any changes in actual conditions can have a significant effect on the results. It is possible to create many different glazing types and glass make-ups using this tool. Guardian makes no guarantee that any glazing modeled by the tool is available from Guardian or any other manufacturer. The user has the responsibility to check with the manufacturer regarding availability of any glass type or make-up. While Guardian has made a good faith effort to verify the reliability of this tool, it may contain unknown programming errors that could result in incorrect results. The user assumes all risk relating to the results provided by the tool and is solely responsible for selection of appropriate products for the user's application. GUARDIAN MAKES NO EXPRESS OR IMPLIED WARRANTY OF ANY KIND WITH RESPECT TO THE PERFORMANCE CALCULATOR. THERE ARE NO WARRANTIES OF MERCHANTABILITY, NON-INFRINGEMENT OR FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO THE PERFORMANCE CALCULATOR AND NO WARRANTY SHALL BE IMPLIED BY OPERATION OF LAW OR OTHERWISE. IN NO EVENT SHALL GUARDIAN BE LIABLE FOR DIRECT, INDIRECT, SPECIAL, CONSEQUENTIAL OR INCIDENTAL DAMAGES OF ANY KIND RELATING TO OR RESULTING FROM USE OF THE PERFORMANCE CALCULATOR.

Program Version: 4.1.0.5124
Database Version: 20170505

PRODUCT PERFORMANCE DATA OF THE CSG HOLDING CO.LTD.

GREEN ENERGY INDUSTRIAL ZONE OF CSG IN DONGGUAN,GUANGDONG, PR.CHINA.

Date: 24th JAN 2019
Project name:MTC
Customer: AAG

Calculated programme：W6.3
External condition：ASHRAE

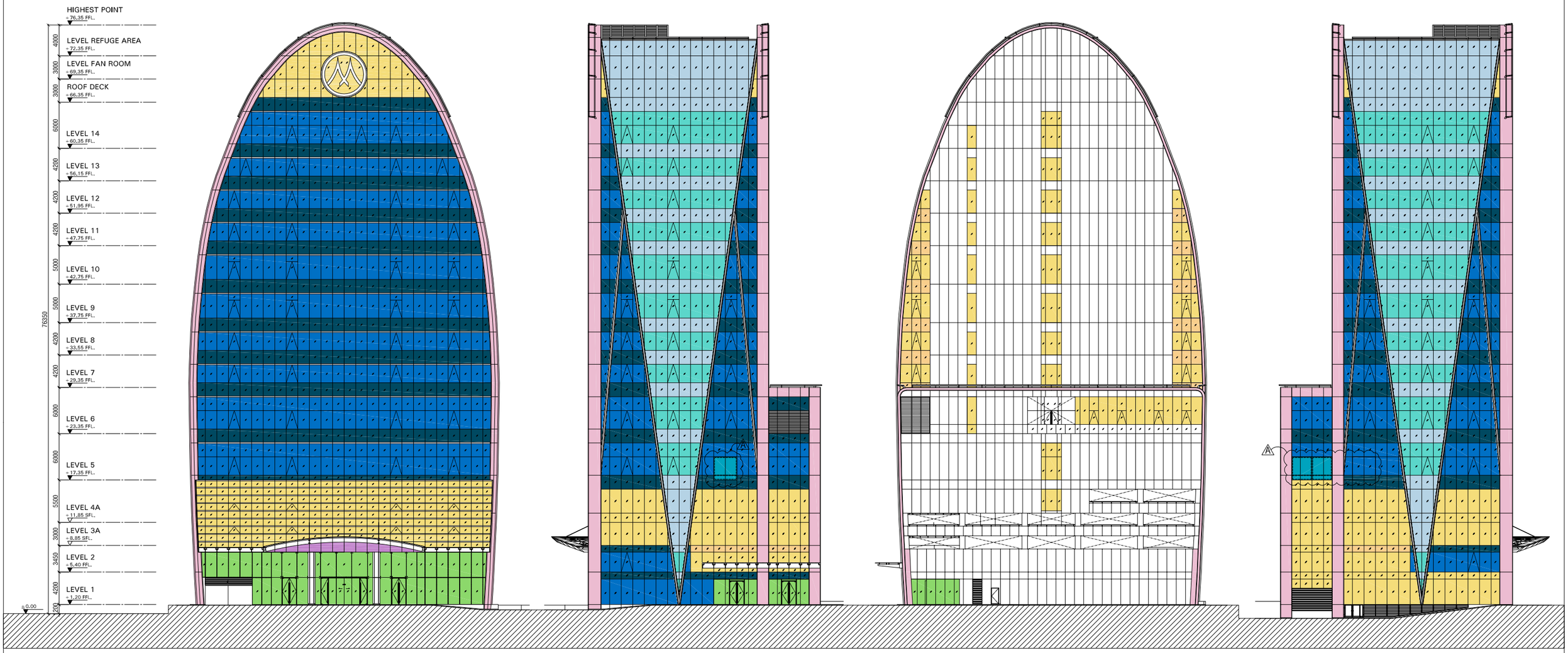
	No.	DESCRIPTION OF SAMPLE	Visible Light(%)			Solar Energy(%)		U-value(W/m2·K)		Shading Coefficient	SHGC
			Trans	Refl Out	Refl In	Trans	Refl	Winter night	Summer day		
	Guardian	5C/1.52PVB/5RB40+12A+5C	37	24	23	21	21	1.69	1.71	0.32	0.28
TYPE A VISION	CSG	6C/1.52pvb/6C CEN15-45D(#4)+12A+6C	39	18	13	16	25	1.66	1.62	0.26	0.23
	Guardian	5RB20/1.52PVB/5C	23	20	26	18	18	4.98	5.47	0.42	0.36
TYPE A Spandrel TYPE C	CSG	6CSN140(#2)/1.52PVB/6C	33	16	17	22	14	5.54	5.03	0.49	0.43
	Guardian	5C/1.52pvb/5C NP50(#4)+12A+5C	47	24	20	25	25	1.64	1.60	0.35	0.31
TYPE B VISION	CSG	6C/1.52pvb/6C BJ13-51D(#4)+12A+6C	47	26	17	19	31	1.64	1.60	0.29	0.25
	Guardian	5LB52(#2)/1.52PVB/5C	53	15	11	42	12	5.47	4.90	0.64	0.55
TYPE B Spandrel	CSG	6CST145(#2)/1.52PVB/6C	42	29	20	36	22	5.54	5.03	0.57	0.50
	Guardian	6N70(#2)/1.52PVB/6C	70	9	9	46	16	5.40	4.93	0.66	0.57
TYPE D	CSG	6CST165(#2)/1.52PVB/6C	65	18	12	56	15	5.54	5.03	0.75	0.66

Remark:

1. The data provided for your reference.

2. The actual performance data of products may slightly differ from the data listed.

3. Note: A-Air space; Ar: Argon filled;



Aluminium & Glazing General specification

- TYPE A : INSULATING LAMINATED GLASS — Vision glass
- TYPE A : LAMINATED GLASS — Spandrel glass with back pan
- TYPE B : INSULATING LAMINATED GLASS — Vision glass
- TYPE B : LAMINATED GLASS — Spandrel glass with back pan
- TYPE C : LAMINATED GLASS — Vision glass
- TYPE C : LAMINATED GLASS — Spandrel glass with back pan
- TYPE D : LAMINATED GLASS — Vision glass
- TYPE A : ALUMINIUM COMPOSITE CLADDING — ALPOLIC®/fr : Champagne Metalic # M9177-G30
- TYPE B : ALUMINIUM COMPOSITE CLADDING — ALPOLIC®/fr : Prismatic Sky # ME017-G80
- A — TYPE C : ALUMINIUM COMPOSITE CLADDING — COLOR JOTUN RAL5024 (MATCH TO GLASS TYPE "A")

NOTE : GLASS SPECIFICATION REF. TO SD7-301 AND TECHNICAL SPECIFICATION

DESIGN INTENT DRAWING ONLY
CONTRACTOR IS RESPONSIBLE FOR DESIGN AND SHOP DRAWING/CALCULATION SUBMISSION
MATERIAL SIZES/THICKNESS INDICATIVE

FOR CONSTRUCTION

Palmer & Turner (Thailand) Ltd.
231/9 Bangkok Cable Building II
3rd Floor Soi Sarasin Rajadamri Road
Lumpini, Patumwan Bangkok 10330
Tel : 662-651-9180 (10 Lines)
Fax : 662-651-9170

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SCALE 1:500

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JOB NO. B5353

DRAWING NO. SD7-102

REVISION REV.A

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CSG HOLDINGS.

South Asia Edition.

China Southern Glass

ENERGY EFFICIENT ARCHITECTURAL GLASS

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"The bitterness of poor quality

remains forever once the sweeetness

of low price is forgotten".

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Established in 1984, China Southern Glass Holding Co., ltd, is one of the leading Enterprises in the Chinese glass industry. In 1992, CSG became public by Issuing both A and B shares at the Shenzhen Stock Exchange. By the year 2017, CSG's total assets have exceeded 3 Billion USD primarily engaged in manufacturing of float glass, architectural glass, display glass & photo-voltaic products.

CSG has eight major production bases in China, located at Shenzhen, Tianjin, Dongguan, Wujiang, Chengdu, Xianning, Langfang & Yichang respectively.

CSG can manufacture & supply all categories of architectural glass products including Low iron float glass, clear float glass, tinted float glass, Low E glass, solar reflective glass, insulating glass, laminated glass, enameled glass, tempered glass, curved tempered glass, as well as composite glass products.

The glass coating lines with over 55 cathodes can handle size as large as 3300 X 6000 or longer.

CSG Architectural Glass Co., Ltd., Administration Building at Shekou, Shenzhen.

CSG is the largest Low-E glass producer in Asia

The glass production lines & processing equipment of CSG are supplied by world famous facility manufactures. The current manufacturing facilities include:

•11 float glass production lines with an annual output capacity of over 2.4 million tons. the facilities supplied by Raute Precision (Finland), Stein Beurty (France) & Saco Inc. (USA)

•14 Low-E & solar reflective glass coating lines with an annual production capacity of over 50 million Sq/m. the coating line facilities supplied by Leybold (Germany) & BOC (USA).

•Over 50 insulating glass processing lines with an annual production capacity of 15 million Sq/m. the line facilities supplied by Lisec (Austria).

•Many other facilities like tempering lines, ceramic frit glass & laminated glass lines.

Dongguan CSG Architectural Glass Co., Ltd., Area : 500,000 Sq/m

Sichuan CSG Energy conservation Glass Co., Ltd. vArea : 460,000 Sq/m

Tianjin CSG Architectural Glass Co., Ltd., Area : 250,000 Sq/m

Xianning CSG Architectural Glass Co., Ltd., Area : 650,000 Sq/m

Wujiang CSG Architectural Glass Co., Ltd., Area : 260,000 Sq/m

Float Glass

Quality glass originates from quality raw materials, as a leading enterprise in Chinese glass industry, CSG has its own raw material bases in Sichuan Jiangyou & Guangdong Yinde with outstanding quartz resource, and has established 5 float glass production bases in Dongguan Chengdu, Wujiang, Hebei & Xianning respectively. CSG has eleven float glass lines of the latest technology with an annual output of 2.4 million tons of high quality float glass of various color and thickness, which are widely used in architecture, automobile, furniture, optics, information technology & microelectronics etc.

Chengdu CSG Glass Co., Ltd, with a total capital of 1.3 billion RMB, 3 float glass production lines, An annual output of 680,000 tons of high quality float glass and special glass.

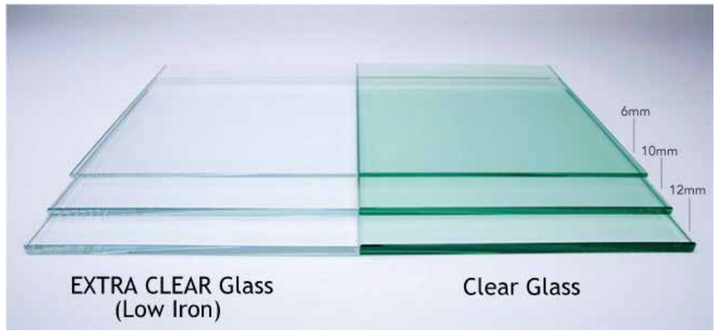
Wujiang CSG Glass Co., Ltd, with a total capital of 1 billion RMB, 2 float glass production lines, An annual output of 480,000 tons of high quality float glass and special glass.

Hebei CSG Glass Co., Ltd, with a total capital of 1.1 billion RMB, 2float glass production lines, An annual output of 490,000 tons of high quality float glass and special glass.

Xianning CSG Glass Co., Ltd, with a total capital of 0.8 billion RMB 2 two float glass production lines, An annual output of 450,000 tons of high quality float glass & special glass.

Features

High transmittance of visible light –
The transmittance is the highest among domestic products of the same category.
Outstanding evenness and uniformity –
Small deformation after re-processing, low distortion of reflected image.
High precision control –
On-line digital scanner can detect defects larger than 0.1mm.



Specifications

Standard dimension (mm)		
914 x 1220	2140 x 3300	3300 x 6000
1160 x 1600	2140 x 3660	3300 x 10,000
1500 x 2000	2400 x 3300	3660 x 4200
1545 x 2440	2440 x 3050	
1650 x 2140	2440 x 3660	
	2800 x 3660	

Standard Thickness (mm)
2, 2.1, 2.3, 2.5, 3.0, 3.2, 4, 5, 6, 8, 10, 12, 15, 19.

Quality Standards confirming to

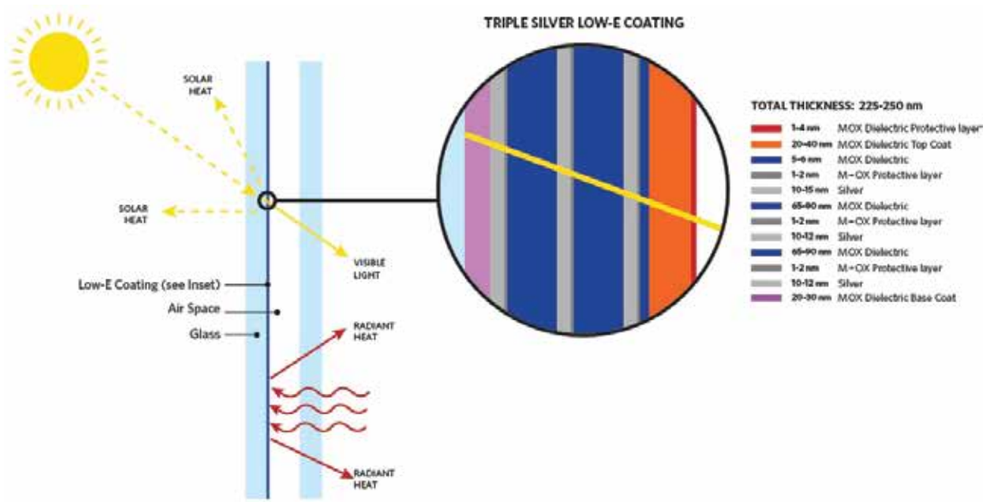
BS952 (British)

ASTMC 1036-5 (American)

JISR3202 (Japanese)

AS2208 (Australia)

Striking a balance between aesthetics and thermal performance of a glass facade involves careful selection of the low-e coatings, the glass, and the materials that compose the façade structure. In pursuit of glass facades with optimal thermal performance and visual clarity, one must often seek out the latest coating technologies available. Using Analysis tools to quantitatively determine thermal performance and optical qualities of the glass facades. We at CSG can evaluate the existing highest thermal performance with highest visible light transmittance possible in low-e coating technology.



Modern low-e coatings on glass are composed of 12+ layers of metals and ceramics in a 300 nanometer (0.0003 mm) thick coating, with some layers measuring only one nanometer. These coatings are applied by specialized coaters inside vacuum chambers. The latest low-e coating technology available incorporates three silver layers and multiple ceramic layers. These coatings are referred to as "triple silver" low-e coatings, and can offer as much as 65% visible light transparency and 30% better thermal performance compared to "double silver" low-e coatings.

The thickness and composition of the layers is specifically designed to result in a highly tuned optical filter that passes only visible light, while reflecting near infrared (solar heat) and far infrared (radiant heat).

Infrared Screening Glass (Triple Silver Low E)

In a building, about 50% of the energy is gained/lost through windows. Improving energy efficiency of window glass can contribute a lot in optimizing the electricity consumed for HVAC (Heating, ventilation, and air conditioning). Application of high performance energy efficient glass plays a key role in green building development and energy saving for the society. As the leading energy efficient glass manufacturer in China, CSG Holding Co., Ltd. (CSG) developed a brand new series of glass products, namely infrared screening glass, with the latest coating technology, outstanding performance and a range of amazing colors, providing architects with exceptional options to meet the developing trend of architectures.

The remarkable energy efficient infrared screening glass has the following specials:
>Direct solar infrared transmittance below 2%, extraordinarily cool in summer
>Emissivity approaching zero, about 0.02, low thermal transmittance;
>Higher visible light transmittance, better daylight.

The best energy efficient glass for the South Asia.
>Advantages of Infrared Screening Glass In the solar radiation,
> about 47% is visible light and 51% is infrared radiation (IR).

The incoming solar IR through window glass causes heat accumulation and temperature rise, which is the major heat source of cooling load.

Comparison of differet glass products with the same visible light transmittance
Transmission sprectra with the same VT

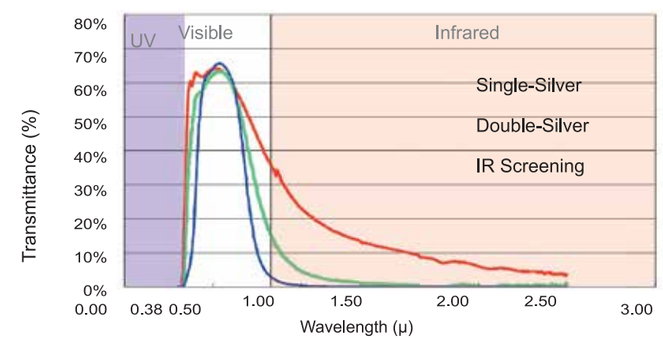


Figure 1

The figure 1 shows transmission spectra of single silver low-e, double silver low-e and infrared screening glass with the same visible light transmittance.
Within the infrared region (780nm - 2500nm), the area under the transmission curve reflects direct solar IR transmittance. The overall transmittance in the solar IR region is the sum of direct solar IR transmittance plus secondary transfer, defined as total solar IR transmittance (SIR) which quantitatively describes glass characteristics against solar IR. Much better than single and double silver low-e glass as shown,

All infrared screening glass products of CSG have a direct solar IR. Transmittance below 2%, and a total solar IR transmittance around 3%, which indicates an extraordinary performance in reducing cooling load and creating comfortable working and living environment in a hot climate.

Comparison of differet glass products with the same Shading Coefficient Transmission sprectra with the same SC

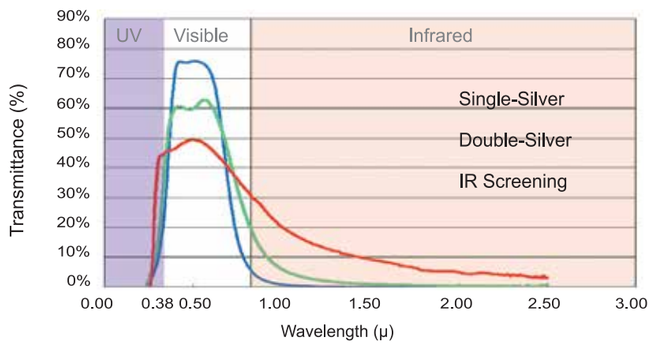


Figure 2

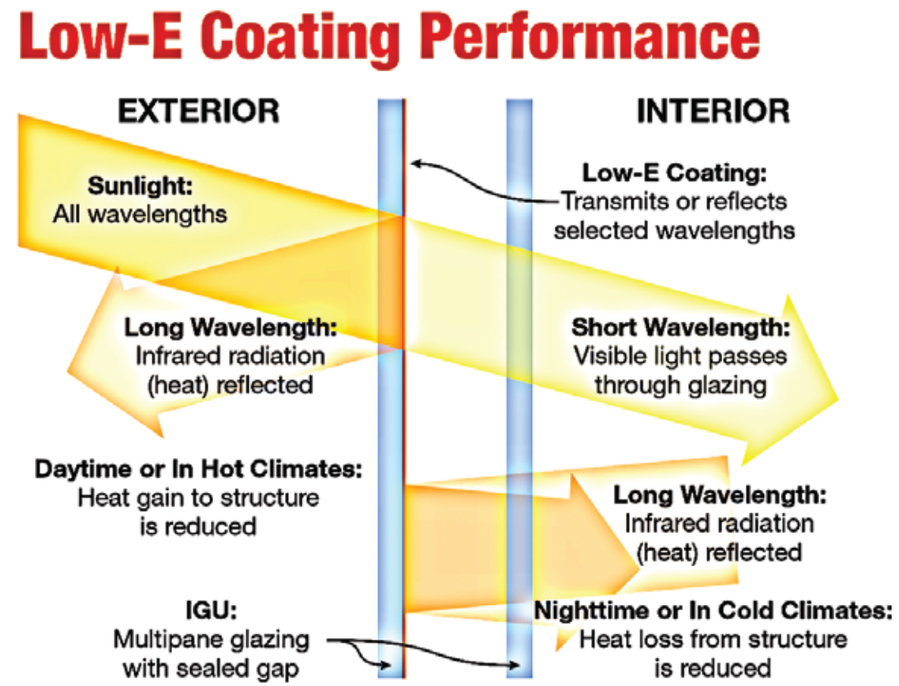
Shading coefficient (SC) is determined by integration over the whole solar spectra from 300nm to 2500nm, oftenly used to evaluate glass performance against solar heat in design practice and building codes. As a matter of fact, visible light acts differently from solar infrared radiation in energy efficiency of buildings. The figure 2 shows a comparison of different glass products with the same SC. Obviously, infrared screening glass has the lowest solar IR transmittance & in eturn the best performance against solar IR and in reduction of cooling load. In view of all IR screening glass products having a direct solar IR transmittance below 2%, the selection process shall follow visible light transmittance & aesthetic appearance requirements rather than shading coefficient SC to optimize energy efficiency of buildings.

Various options the infrared screening glass products have a wide range of VLT (from around 45% to 70%), different brightness (reflectivity about 10% to 30%), and various colors (neutral light grey, silver grey, silver, light blue, blue grey etc.). Exhibiting crystal clear look of satisfied colors at different viewing angles, the IR screening glass products are incredible combinations of best performance and outstanding aesthetic effect, providing architects with idea options for various design concepts.

Double Silver Low E

While maintaining the same visible light transmittance, double silver Low-E glass has much lower total solar IR transmittance, SIR, than single silver Low-E glass. In other words, double silver Low-E glass filters the sunshine as a cool lighting source to a larger extent and provides a better solution to energy efficiency of buildings, especially in hot climate zones.

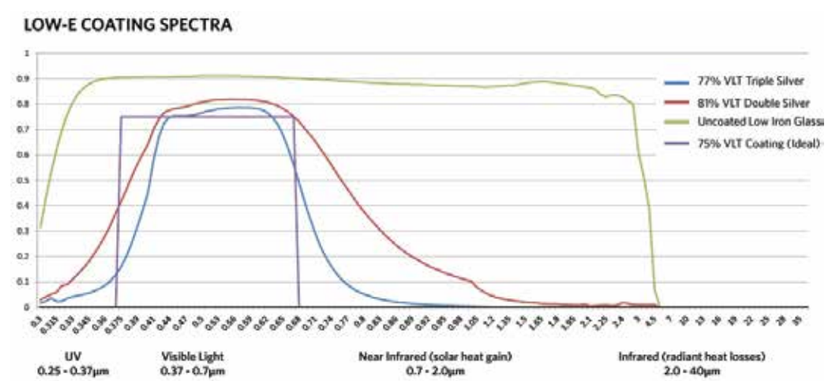
Features
A wide range of visible light transmittance - meet various daylight requirements;
A variety of crisp colors - sound options for different aesthetic effects; Low total solar IR transmittance, SIR - more comfortable and effectively reducing cooling load.



Single Silver Low E

Within the coating structure of single silver Low-E glass, there is one silver layer. Single Silver Low-E glass has been widely used in various buildings at different locations worldwide.

Features
Visible light transmittance - adequate indoor natural day lighting.
Solar energy transmittance - a wide range of shading coefficient SC available, for different geological locations.
High far infrared reflectance - low U-value, reduced thermal transfer due to temperature difference.



Photometric Data (Pre-Temperable Low-E)

The MSVD (offline) coating on the glass is applied **after** tempering the glass, Comparing to a post temperable glass, a pre temperable glass is recommended for it can ensure the photometric properties & thermal performances as per the standards.

LBNL Optics6

ASHRAE

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Triple Silver Low Emissivity Glass (6 + 12A + 6)

Shade	Coating Code	Visual Light Transmission %	External Reflection %	Internal Reflection %	Solar Factor (SHGC)	Shading Coefficient	U-Value (W/sqm-K)
Neutral	CET13-65XD	62	12	15	0.29	0.33	1.63
Neutral Grey	BJ36SD	31	18	11	0.17	0.19	1.63
	LB48SD	42	26	22	0.20	0.23	1.63
	BJ46SD	41	26	18	0.20	0.23	1.63
	BJ52S	52	20	16	0.26	0.30	1.58
Light Grey	BJ45SD	41	18	12	0.21	0.24	1.63
	BJ56SD	49	18	15	0.23	0.27	1.63
	SJ52S	50	15	11	0.24	0.28	1.61
Grey	SJ65S	62	12	13	0.28	0.32	1.58
	SJ50S	50	9	15	0.26	0.30	1.64
	SJ35S	35	14	12	0.19	0.22	1.65
Cool Grey	BJ52SD	48	18	18	0.22	0.25	1.60
Blue Grey	LB49S	47	9	17	0.24	0.28	1.61
	LB61S	58	16	15	0.28	0.32	1.61
	LB42SD	40	19	13	0.20	0.23	1.63
Blue	LB56SD	49	17	16	0.23	0.26	1.63

Fully Automatic Insulating glass line

Double Silver Low Emissivity Glass (6 + 12A + 6)

Shade	Coating Code	Visual Light Transmission %	External Reflection %	Internal Reflection %	Solar Factor (SHGC)	Shading Coefficient	U-Value (W/sqm-K)
Neutral	CED12-78D	67	11	12	0.38	0.44	1.63
	CED12-67D	61	11	12	0.36	0.41	1.66
	SJ79	70	11	12	0.44	0.50	1.64
Neutral Grey	LB51	46	27	16	0.24	0.28	1.61
	LB13-48D	43	25	15	0.23	0.26	1.63
	CEN13-38D	40	20	15	0.23	0.26	1.66
	BJ13-51D	47	26	17	0.25	0.29	1.63
	CEN13-39D	40	20	19	0.27	0.31	1.66
Light Grey	CED12-52D	47	14	11	0.28	0.32	1.63
	TCEN12-57D	52	14	11	0.30	0.34	1.66
Grey	SJ66	62	12	12	0.37	0.42	1.62
	SJ60	54	15	12	0.30	0.35	1.61
	SJ55	47	12	12	0.30	0.35	1.67
	SJ48	43	16	13	0.26	0.30	1.66
	SJ42	42	8	12	0.26	0.30	1.63
Cool Grey	SJ12-53D	47	15	12	0.28	0.32	1.63
	CEN13-55D	50	19	19	0.28	0.32	1.66
	CEN13-46D	40	19	20	0.27	0.31	1.66
	LB13-45D	40	20	13	0.23	0.26	1.66
	CEN13-56D	50	19	21	0.33	0.38	1.74
Blue Grey L	LB60	54	16	12	0.30	0.34	1.61
Blue Grey	LB63	57	21	16	0.30	0.34	1.63
Blue	LB45	40	19	13	0.23	0.26	1.63
	SJ12-68D	61	13	14	0.36	0.41	1.69

Single Silver Low Emissivity Glass (6 + 12A + 6)

Shade	Coating Code	Visual Light Transmission %	External Reflection %	Internal Reflection %	Solar Factor (SHGC)	Shading Coefficient	U-Value (W/sqm-K)
Neutral	CES11-80N	72	12	13	0.57	0.65	1.90
Neutral Grey	CEF16-50	46	30	15	0.34	0.39	1.77
	CER15-46TS	42	34	16	0.31	0.36	1.77
Grey	CEB12-45	44	15	13	0.34	0.39	1.79
Blue Grey	CEB13-60	52	21	12	0.40	0.46	1.84
	CEF13-46	43	20	15	0.32	0.37	1.77
Blue	CEY14-60	55	19	11	0.42	0.48	1.79

Remarks:
1. The data is provided for your reference.
2. The glass performance is estimated with the OPTICS & can be different with the test results.
3. Note: A—Air space; C—Clear Glass.

Post Temperable Low E Glass

The post-temperable Low-E glass products are suitable for long way transportation, and can be easily stored and processed. The secondary glass processing companies must comply with the standards to ensure there is no lensing effect upon the coated glass once these are tempered in the autoclave. CSG provides a clear methodolgy for the secondary glass manufacturers.

Photometric Data (Post-Temperable Low-E)

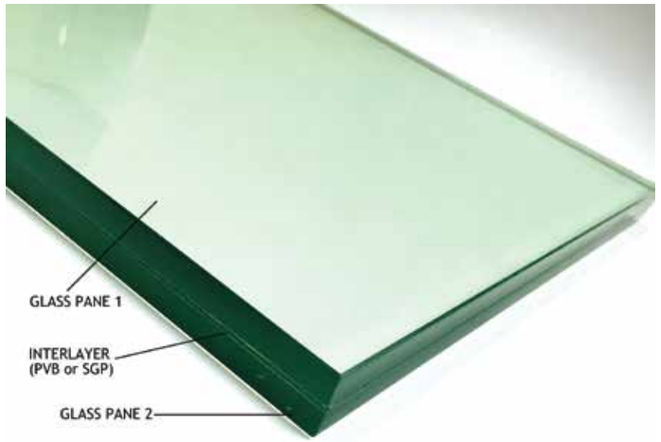
Type of Coating	Shade	Coating Code	Visual Light Transmission %	External Reflection %	Internal Reflection %	Solar Factor (SHGC)	Shading Coefficient	U-Value (W/sqm-K)
Triple	Neutral	TT65	62	13	15	0.29	0.33	1.63
Double	Neutral	Super D2	53	10	12	0.32	0.37	1.71
	Blue Gray	Super D3	42	31	29	0.23	0.26	1.69
Single	Neutral	Super N1	77	12	12	0.60	0.69	1.86
	Cool Gray	Super SE III	53	21	11	0.43	0.49	1.86
	Light Gray	Super N3	54	14	11	0.42	0.48	1.86
	Neutral Gray	Super N5	44	29	12	0.35	0.40	1.74
Solar Reflective	Neutral	CST165	66	18	12	0.73	0.84	5.34
	Cool Gray	CST159	58	22	22	0.68	0.78	5.40
	Cool Gray	CST154	56	16	13	0.63	0.72	5.18
	Neutral Gray	CST145	44	29	21	0.55	0.63	5.30
	Light Gray	CST143	43	13	19	0.52	0.60	4.70

Remarks:
1. The data is provided for your reference.
2. The glass performance is estimated with the OPTICS, & can be different with the actual.
3. Note: A—Air space; C—Clear Glass.

Laminated Glass

Laminated glass is made by adding an interlayer membrane between two glass panes (Sandwiching) followed by heat treatment in autoclave.

These interlayers could be a soft polyvinyl butyl **PVB** or high strength sentry **SGP**



Features of a laminated glass.

Noise reduction performance:
PVB membrane has good sound wave hindering property and thus, laminated glass may effectively reduce transmission of noise.

UV Protection
Laminated glass can substantially ward off ultraviolet (as much as over 99%), thus it helps to reduce the effect of ultraviolet on costly furniture, curtains, exhibits and other articles.

Security: installed laminated glass may not be easily broken. Therefore, laminated glass provides effective defense against malicious destroy, pilferage and violent invasion. Prevention against hurricane and earthquake: for the reason that fragments of broken glass still retain in its original position, laminated glass is suitable for regions subject to hurricane and earthquake. The glass retain in its frame even if broken.

Specification Product categories
Ordinary clear, colored, coated laminated glass, laminated tempered glass, laminated heat-strengthened glass, curved laminated glass, aquarium glass, & bulletproof glass etc

Production Capacity

Maximum dimension(mm): 3000 x12000** (12 Meters Long)
Color of PVB membrane: clear, milky white, gray, blue,pink etc.
Thickness of PVB membrane (mm): 0.38~3.04

Quality

Conforming to ASTMC,

ASTM INTERNATIONAL

Conforming to AS/NZ2208:1996

STANDARDS Australia

Anti-Reflective Glass

Anti Reflective glass also known as the anti reflection coating is mainly used to reduce or eliminate the reflected light of the glass surface and improving its transmittance.

The mentioned coating process has the glass coated with multiple layers of optical films that makes the reflected light interfered or eliminated, then the glas will be chracterized with excellent visual perpective effect, when people observe objects through glass, eliminating the influence from reflected glare will make the observer to view the objects clearly. The early applications of the anti reflective glass was subjected to camera lenses and microscopes while at present the range has been more wide, such as high class showcases, museum display, cabinets, airport control towers, see sighting halls, picture frames etc

PHOTOMETRIC DATA FOR ANTI REFLECTIVE GLASS

Glass Thickness	Transmittance (380nm~780nm)	Reflectence (380nm~780nm)	CRI	Optical Linear
6 mm AR Glass	>= 94%	>= 4.0%	98.75	W
6 mm AR + 1.52 PVB + 6mm AR Glass	>= 97%	>= 1.0%	98.91	W

Image observed from a Glass **without** Anti-Reflective coating

Image observed from a Glass **with** Anti-Reflective coating.

Production Processing Range:

Conventional processing size : 3600 X 3300 mm.
Processing Thickness : 1.3 ~19 mm.

Quality Standard

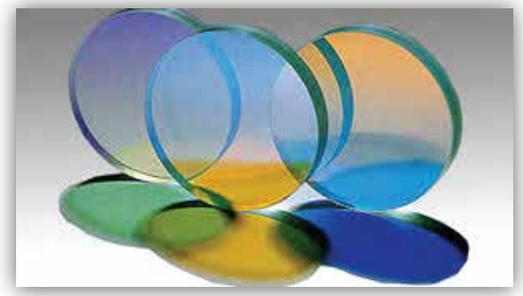
Low Iron/Extra Clear Glasses : JC/T2028 in “Low Iron Glass”
Tempered Glasses : GB 15763.2 in Architectural Safety Glass Section II Tempered Glass”
Heat strengthened Glasses : GB/T 17841 in “Heat Strengthened Glass”
Laminated Glasses : GB 15763.30 in Ärchitectural Safety Glass Section III Laminated Glass”
Anti-Reflection films : Q/CSG 003-2016 in Anti Reflection Glass.

Dichroic Glass

Dichroic glass is glass which displays two different colors by undergoing a color change in certain lighting conditions. The coated layers form a sequential series of reflective cavities that resonate with the desired wavelengths.
Other wavelengths cancel or reflect as the peaks and troughs of the waves overlap.

One dichroic material is a modern composite non-translucent glass that is produced by stacking layers of glass and micro-layers of metals or oxides which give the glass shifting colors depending on the angle of view, causing an array of colors to be displayed as an example of thin-film optics.

At CSG, we offer dichroic coatings on the glasses with guaranteed performance.



In projects, the coating incorporates dichroic glass into the exterior of its high-rise building, reflecting light into various colors that depend on the time of the day.

Scratch Ressistance Glass

Even though glass is a kind of very stable material, being able to meet the requirement for long-term usage in many common conditions, when its surface contacts with or has friction with other solid materials(such as glass, cream and solid metals) frequently, it is easy to get destroyed for its surface; when its surface is exposed to chemical corrosive environment, or contacts with some inorganic or organic solvent(such as aqueous alkali, acid rain, or other hard water), it often makes glass surface degraded and spotted, generating non-removable and visible defects. These visible scratches, erosive marks effect the glass appearance directly. Therefore, it is of great meaning to improve the scratch resistance and erosion resistance.

Physical damages on glass

Natural damages on glass

Developed by CSG Research Institute, scratch resistance glass is a kind of functional glass products with leading technology in China.
CSG scratch resistance glass applies to the fields like commercial building glass, household glass and automotive glass etc., it can stand up to the harm brought by ubiquitous abrasion, spot and erosion within itself, making the glass products in new condition & permanently like a diamond.

Specification (6mm)	Haze	Transmittance			Reflectance on Clear Surface			Reflectance on Coated Surface		
		Tvis	Ta*	Tb*	Rvis	Ra*	Rb*	Rvis	Ra*	Rb*
Clear Glass	<0.4%	89.5	-1.3	0.11	8.22	-0.6	-0.9	8.26	-0.6	-0.8
Scratch Resistant Glass	<0.4%	87.8	-1.2	1.14	7.71	-0.5	0.12	8.26	-0.6	-1.4

The transmittance of scratch resistance glass decreases 1.5% roughly compared with uncoated clear glass in the same specification, for example

Test on Scratch Resistant

Taking the load as much as 10N, tungsten steel drill rubs glass surface back and forth along single track, as shown in the picture: load 10N

The drill rubbing the glass sample for appox 10,000 times.

Scratch resistance glass after cycling friction movement

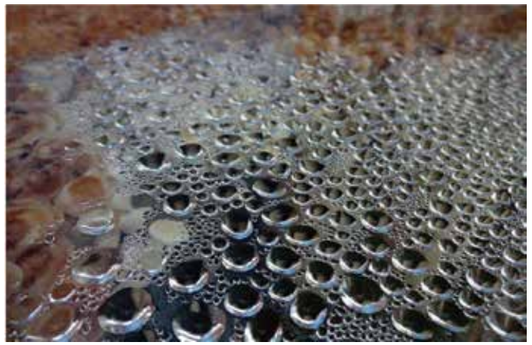
Common glass after cycling friction movement

De Fog & Frost Glass

"Defrost and defogging coated glass" is made of transparent conductive on the surface of single float glass.

The film layer is then sandwiched with another float glass, and the conductive heating film layer is located in the clip. The inner surface of the layer of glass is led out of the electrode. Current generates heat in the heated film layer, making the glass temperature is raised to 20~40 °C, which can be used for defrost and defogging of glass buildings.

The power supply voltage used for defrosting and defogging coated glass can be AC according to different usage conditions 36~220V voltage, the product adopts unique safety design and adds temperature control switch. Autonomous constant temperature control, safe and reliable.



Defrost and defogging coated glass properties	
Working voltage	AC 36~220 V
Heating temperature	20~40 °C
Power per unit area	2~4 W/dm2
Control method	Fully automated temperature control
Maximum size	2400mm*3300mm

Jade Glass is an inorganic material forged at high temperature. Anti radiating & aging. Suitable for exterior and interior decoration.

According to different environmental request.Jade Glass can be covered with safety explosion film in front and back side or compound into laminated glass to improve Jade Glass' intensity.

Even if Jade Glass broken via unexpected shocks,the Jade Glass fragments will still stick together as a whole unit making it safe.

It is a patented product available with CSG.

Installation

1. When installing on the flat surfaces,it needs to have round 3- 5mm gap between both Jade Glass and Jade Glass with the wall. For the gap,it needs to use glass composition glue (or elasticity binder) to fill it. So that it will not crash when Jade Glass expanding because it will have the flexible space for the material.

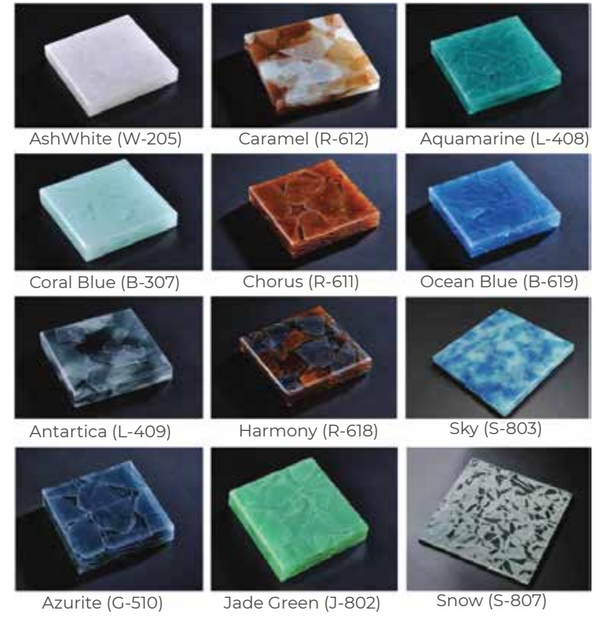
2. When laying glass, use glass composition glue to stick the backside of Jade Glass. It is very importation that can not use any cement to stick Jade Glass, because it will be easy crash after use cement. The reason is cement will be solidified. And when pull Jade Glass, it will be crash.

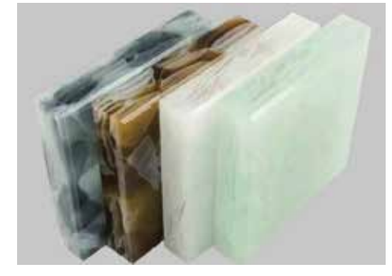
3. For countertops, it needs to use the plates which up to 15mm thickness to put under Jade Glass. The plates should be flat. And when put in under Jade Glass, must make sure of the carrying capability, can not let Jade Glass overhead. Avoid the heat source above 90°C touching Jade Glass directly for long time.

JADE Glass Dimensions (standard)	
Thickness	20mm & 30mm
Max. Slab Size	1400mm X 3000mm

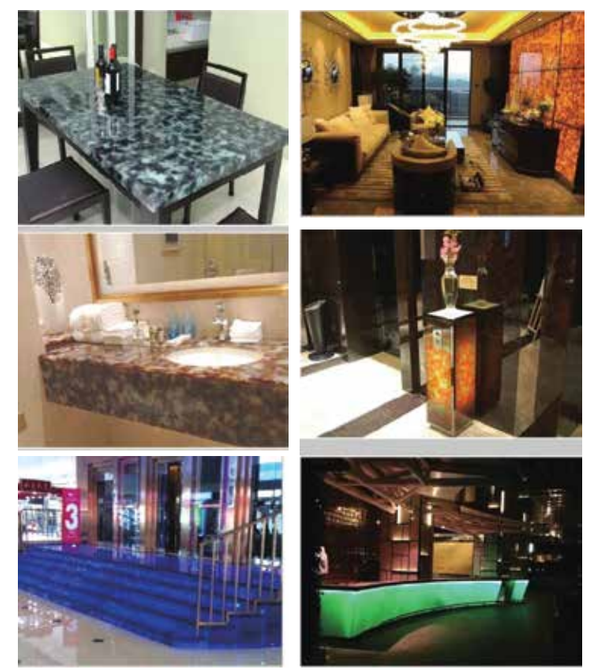
SNOW Glass Dimensions (Standard)	
Thickness	15mm & 20mm
Max. Slab Size	1200mm X 1200mm

Varities to choose from.





Various Decorative Applications



PV (Photovoltic modules)

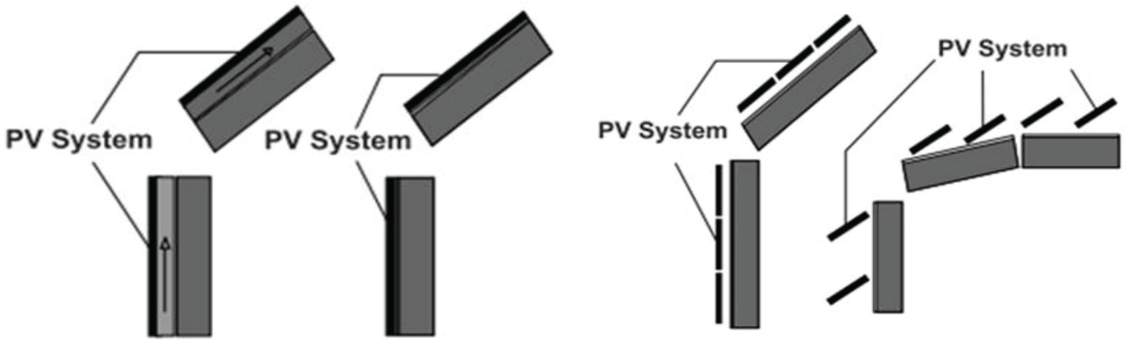
A photovoltaic system is constructed by assembling a number of individual collectors called modules electrically and mechanically into an array.

BIPV`

BIPV (Building Integrated Photovoltaic systems) are solar cells integrated into the envelope elements, such as construction materials as roof tiles and ceramic or glass facades. The solar contribution reduces energy costs for the building owner while the exported `solar electricity helps support the utility grid during the time of its greatest demand.

BAPV

BAPV (Building Applied Photovoltaic systems) are regular solar cell systems that are generally installed on top of roofs.

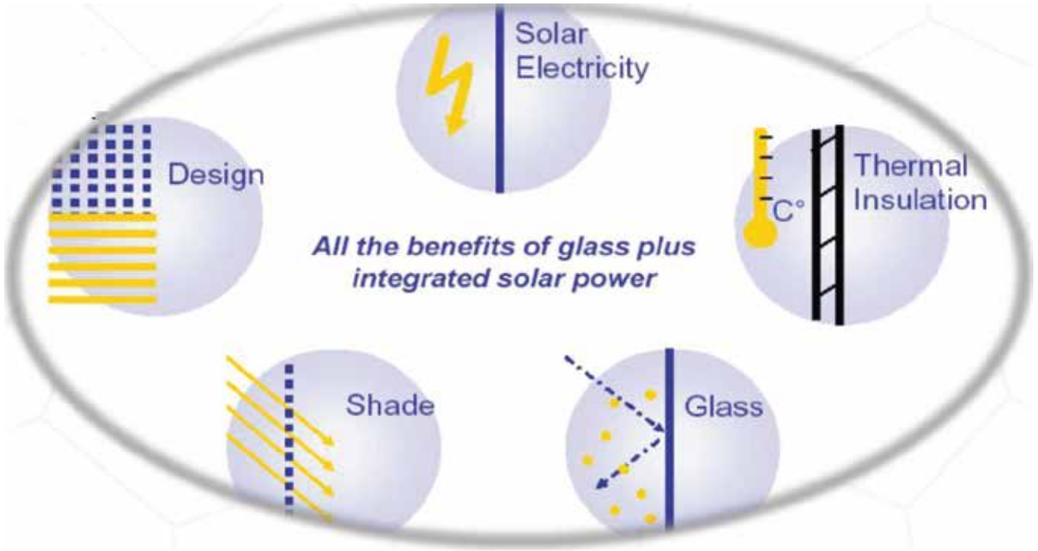


BIPV`

BAPV

BIPV: Function and Aesthetics.

As for the development of solar product application, the architecture solar glass module were born. Energy generation construction material could be made by solar cells integrated together with normal building glass.

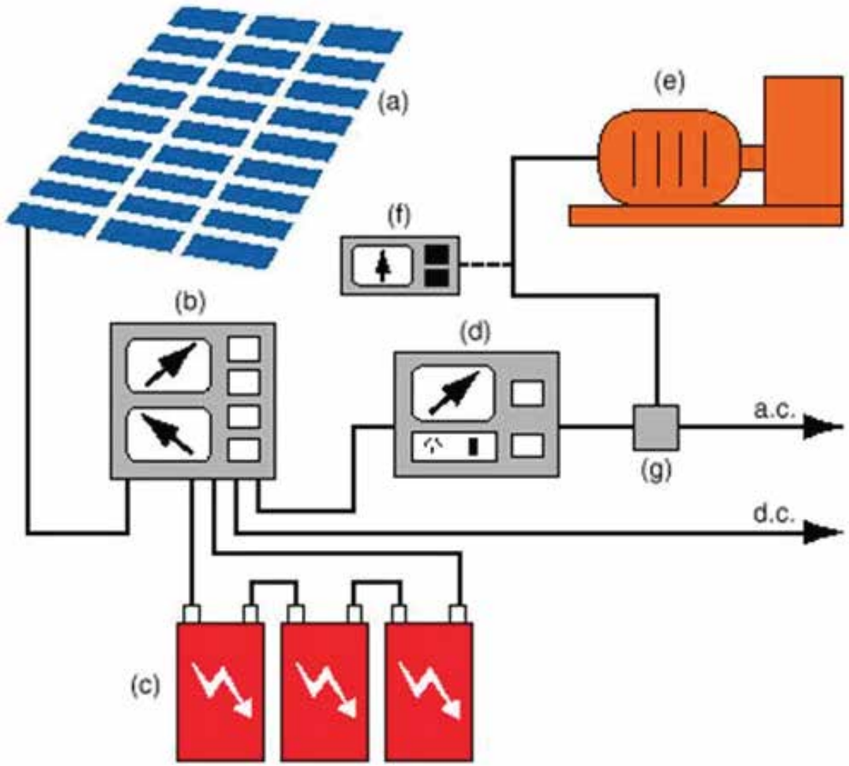


· Glass Modules for facades and glass roofs are multifunctional for the shell of the building. In addition to energy generation, they offer a large number of functions which fulfil the demands of a modern solar architecture：

· · Energy Generation
· · Design
· · Glare protection / light guidance
· · Shade and transparency
· · Protection against the sun and heat
· · Roof and facade skin；`

BIPV Module

Building Integrated Photovoltaics (BIPV) is the integration of photovoltaics (PV) into the building envelope. The PV modules serve the dual function of the building skin replacing conventional building envelope materials—and power generator.
By avoiding the cost of conventional materials, the incremental cost of photovoltaics is reduced and its life-cycle cost is improved. That is, BIPV systems often have lower overall costs than PV systems requiring separate, dedicated, mounting systems.



A complete BIPV system includes:

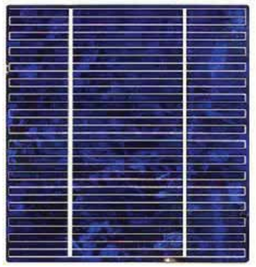
a. The PV modules (which might be thin-film or crystalline, transparent, semi-transparent, or opaque);
b. A charge controller, to regulate the power into and out of the battery storage bank (in stand-alone systems);
c. A power storage system, generally comprised of the utility grid in utility-interactive systems or, a number of batteries in stand-alone systems;
d. Power conversion equipment including an inverter to convert the PV modules' DC output to AC compatible with the utility grid;
e. Backup power supplies such as diesel generators (optional-typically employed in stand-alone systems); and
f. Appropriate support and mounting hardware, wiring, and safety disconnects.

PV Cells

Monosilicon cell

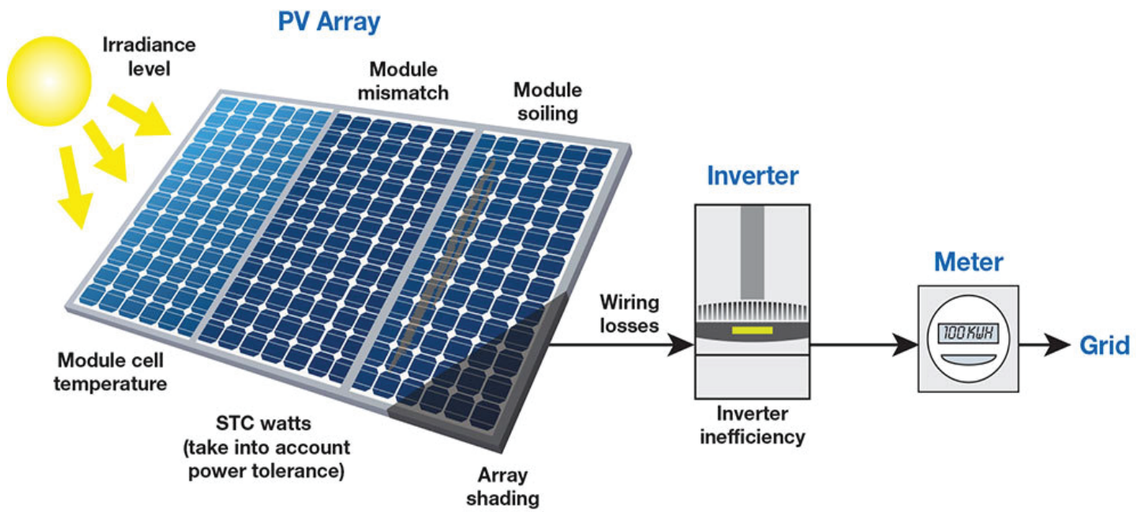
Polysilicon cell

Amorphous silicon cell



CdTe (Cadium Telluride) cell

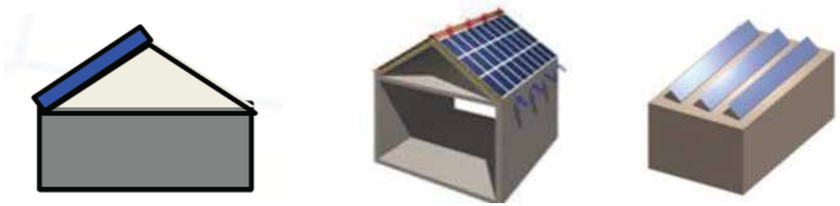
CIGS (Copper Indium Galium Selenide) cell



Main types of BIPV system

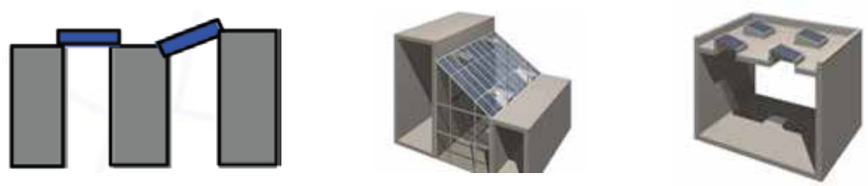
PV roof

installed on the roof as construction components



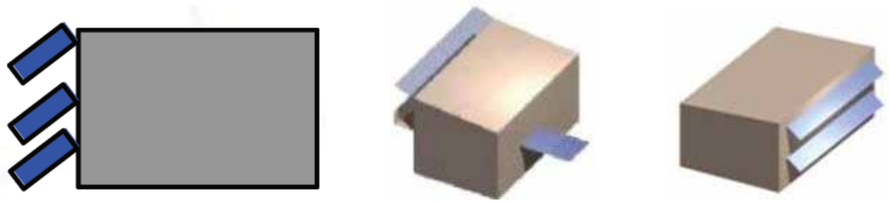
PV window and sunroof

·installed on the skylight as construction components



PV canopy and sunshield

installed on the building as sunshiled



PV curtain

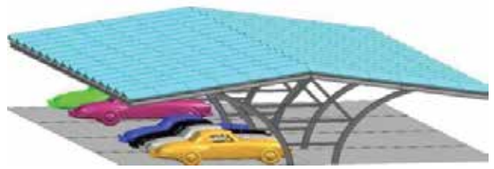
installed on the wall as curtain glass

Flexible PV plant

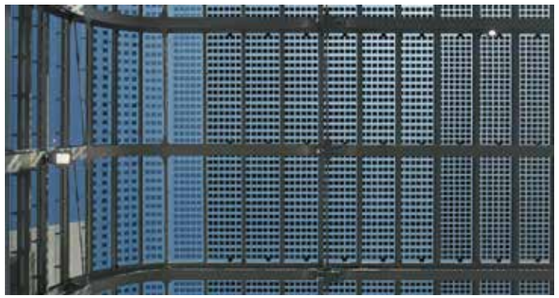
installed on the roof as construction components

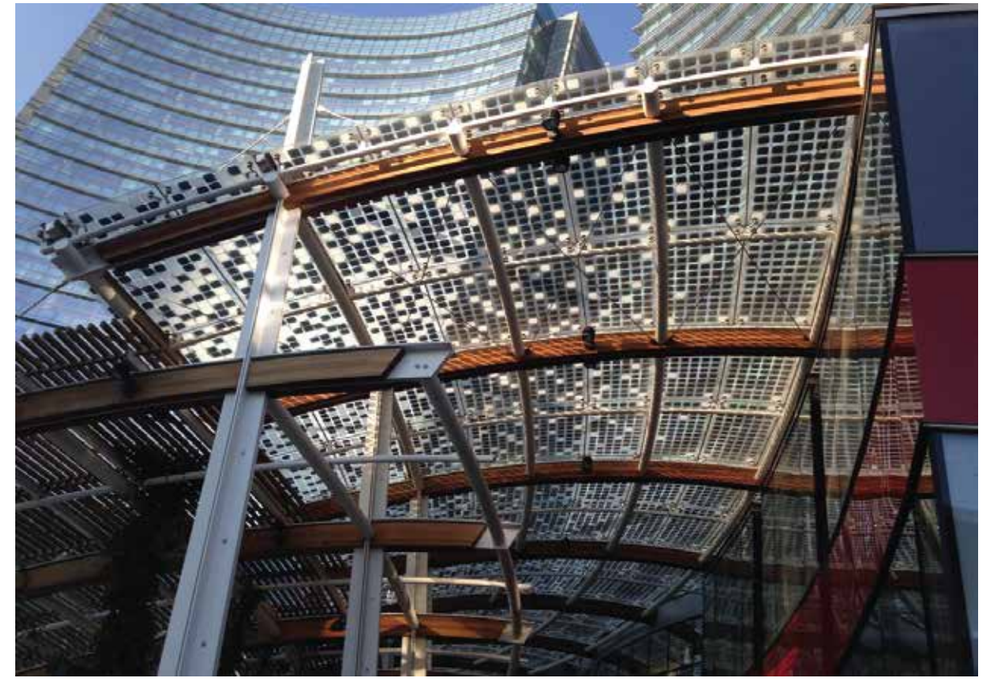
Car Shed PV plant

installed on steel structure as construction components



PV LED flaring building





Project Name : Chhatrapati Shivaji International Airport (MIAL).
Developed by : GVK India.
Design Office : Skidmore Owings & Merrill LLP (U.S.A).
Location : Mumbai, India.
Supplied Area : 120,000 sq/meters.

Project Name : Dhirubhai Ambani International Convention & Exhibtion Center (DAICEC).
Developed by : Reliance Industries , India.
Design Office : Ar Hafeez Contractor (India).
Location : Mumbai, India.
Supplied Area : 90,000 sq/meters.

Project Name : Omkar 1973
Developed by : Omkar Realtors, India.
Design Office : Kohn Pedersen Fox (U.S.A).
Location : Mumbai, India.
Supplied Area : 15,000 sq/meters.

Project Name : Oberoi 360 Worli
Developed by : Oberoi Realty, India.
Design Office : Kohn Pedersen Fox (U.S.A).
Location : Mumbai, India.
Supplied Area : 40,000 sq/meters.

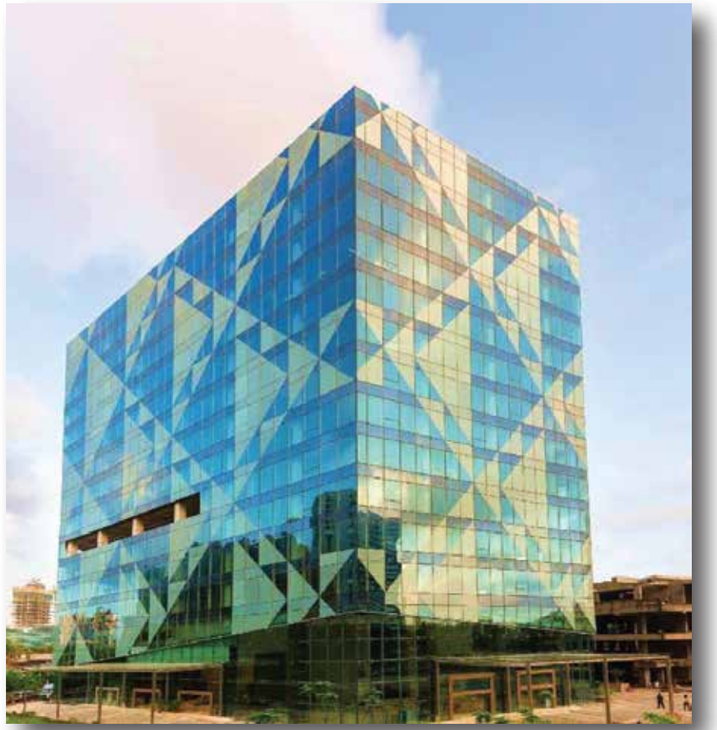
Project Name : Colombo City Center (C3)
Developed by : Sanken Constructions (Sri Lanka).
Design Office : Aedas (Singapore).
Location : Colombo, Sri Lanka.
Supplied Area : 20,000 sq/meters.

Project Name : Reliance Twin Tower
Developed by : Reliance Industries, India.
Design Office : Ar Hafeez Contractor (India).
Location : Mumbai, India.
Supplied Area : 3,000 sq/meters.

Project Name : Amazon India Headquarters.
Developed by : Amazon India.
Design Office : Ar CRN, Chennai (India).
Location : Hyderabad, India.
Supplied Area : 30,000 sq/meters.

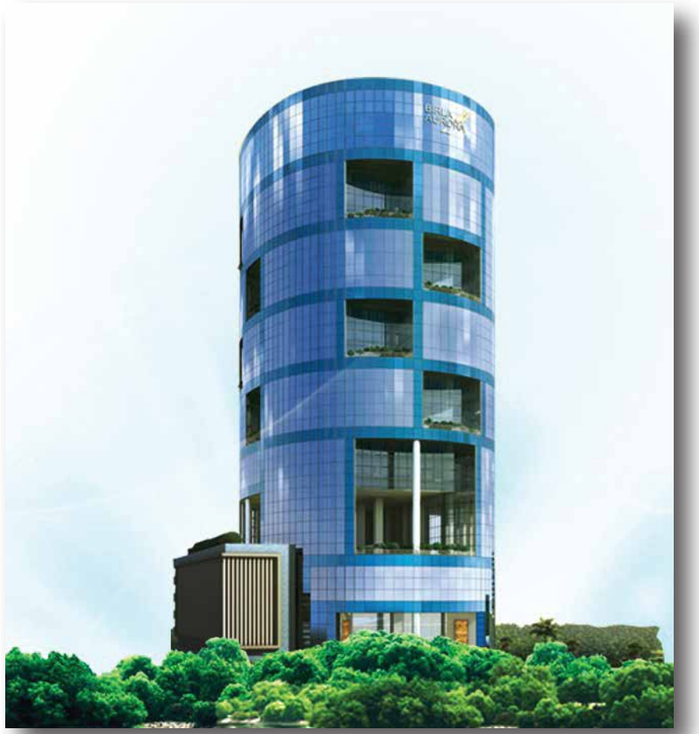
Project Name : ICICI Bank, Headquarters.
Developed by : ICICI India.
Design Office : Ar Hafeez Contractor, (India).
Location : Hyderabad, India.
Supplied Area : 15,000 sq/meters.

Project Name : Godrej One
Developed by : Godrej, India.
Design Office : Pelli Clarke Pelli (U.S.A).
Location : Mumbai, India.
Supplied Area : 25,000 sq/meters.



Project Name : Century Mill
Developed by : CENTURY, India.
Design Office : RSP (India).
Location : Mumbai, India.
Supplied Area : 15,000 sq/meters.

Project Name : Century Mill
Developed by : CENTURY, India.
Design Office : Ar Hafeez Co. (India).
Location : Mumbai, India.
Supplied Area : 10,000 sq/meters.



Project Name : New Cuff Parade
Developed by : Lodha, India.
Design Office : WOHA (Singapore).
Location : Mumbai, India.
Supplied Area : 20,000 sq/meters.

Project Name : Ritz Carlton.
Developed by : Nitesh Developers.
Design Office : Ar Hafeez Contractor, (India).
Location : Bangalore, India.
Supplied Area : 8,000 sq/meters.

Project Name :Vrindavan Tech Park (VTP).
Developed by : Assetz Property.
Design Office : Thomas Associates, (India).
Location : Bangalore, India.
Supplied Area : 40,000 sq/meters.

Project Name : Hotel Park Plaza
Developed by : Park Plaza India.
Design Office : UGA & Ostraca, (India).
Location : Bangalore, India.
Supplied Area : 5,000 sq/meters.

Project Name : IBC Knowledge Park.
Developed by : India Builders Co.
Design Office : Ar Hafeez Contractor, (India).
Location : Bangalore, India.
Supplied Area : 16,000 sq/meters.

Project Name : Prestige Tech Park .
Developed by : Prestige developers
Design Office : RSP, (India).
Location : Bangalore, India.
Supplied Area : 16,000 sq/meters.

Project Name : Computer Associates .
Developed by : CA.
Design Office : CRN, Chennai, (India).
Location : Bangalore, India.
Supplied Area : 5,000 sq/meters.

Project Name : Microsoft .
Developed by : Microsoft India
Design Office : RSP, (India).
Location : Hyderabad, India.
Supplied Area : 17,000 sq/meters.

Project Name : Ascendas Tech Park .
Developed by : Ascendas.
Design Office : RSP, (India).
Location : Bangalore, India.
Supplied Area : 3,000 sq/meters.

Project Name : JPMC .
Developed by : JPMC
Design Office : RSP, (India).
Location : Bangalore, India.
Supplied Area : 3,000 sq/meters.

Project Name : The Park hotel.
Developed by : Park Hotel & Resorts.
Design Office : Skidmore Owings & Merrill LLP (U.S.A).
Location : Hyderabad, India.
Supplied Area : 15,000 sq/meters.

Project Name : Rajiv Gandhi International Airport (HIAL).
Developed by : GMR India.
Design Office : Integrated Design Associates. (Singapore).
Location : Hyderabad, India.
Supplied Area : 30,000 sq/meters.

Project Name : Indira Gandhi International Airport T3 (DIAL).
Developed by : GMR India.
Design Office : Integrated Design Associates. (Singapore).
Location : New Delhi, India.
Supplied Area : 1,60,000 sq/meters.

Project Name : Crown Plaza.
Developed by : KGA, Kochi, India
Design Office : Edifice Architects, (Bengaluru).
Location : Kochi, India.
Supplied Area : 8,000 sq/meters.

Project Name : SUN TV Headquarters.
Developed by : Sun Tv, India
Design Office : CRN Chennai.
Location : Chennai, India.
Supplied Area : 4,000 sq/meters.

Project Name : Cnergy IT Park.
Developed by : Sheth Developers, India
Design Office : SAW , (Mumbai).
Location : Mumbai, India.
Supplied Area : 8,000 sq/meters.

Project Name : Holiday Inn hotel.
Developed by : JAS Orchids, India
Design Office : RKA.
Location : Amritsar, India.
Supplied Area : 4,000 sq/meters.

Project Name : EON.
Developed by : Panchshil Realty, India
Design Office : SAA Architecture LLC, (USA).
Location : Pune, India.
Supplied Area : 8,000 sq/meters.

Project Name : ICC .
Developed by : Panchshil Realty, India
Design Office : SAA Architecture LLC, (USA).
Location : Pune, India.
Supplied Area : 5,000 sq/meters.

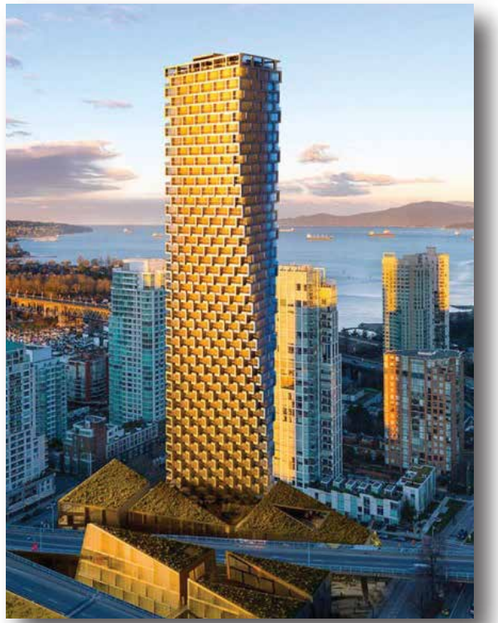
Project Name : Hyatt Regency Hotel.
Developed by : Panchshil Realty, India
Design Office : Gensler, (USA).
Location : Pune, India.
Supplied Area : 10,000 sq/meters.

Project Name : Courtyard Marriot.
Developed by : Panchshil Realty, India
Design Office : SAA Architecture LLC, (USA).
Location : Pune, India.
Supplied Area : 5,000 sq/meters.

Project Name : 30 Madison Avenue, USA
Supplied Area : 17,000 sq/meters.

Project Name : Millennium Park, USA
Supplied Area : 30,000 sq/meters.

Project Name : Clear Spirit, Canada
Supplied Area : 12,000 sq/meters.



Project Name : Vancouver House, Canada
Supplied Area : 16,000 sq/meters.

Project Name : 626 First Avenue
(American Copper Building) USA
Supplied Area : 30,000 sq/meters.

Project Name : Optima Kierland
Center, USA
Supplied Area : 30,000 sq/meters.

Project Name : River Side B1, 400 West
61st Street - RCB1 USA
Supplied Area : 30,000 sq/meters.

Project Name : Metropolis Phase 2B , USA
Supplied Area : 40,000 sq/meters.

Project Name : Hadid Tower Milan, Italy
Supplied Area : 23,000 sq/meters.

Project Name : Farr Apartment, UK
Supplied Area : 33,000 sq/meters.

Project Name : Harbour Central, London, UK
Supplied Area : 46,000 sq/meters.

Project Name : Newington butts (London) UK
Supplied Area : 25,000 sq/meters.

Project Name : BLVD Heights, UAE
Supplied Area : 25,000 sq/meters.

Project Name : Parsons Headquarters, UAE
Supplied Area : 10,000 sq/meters.

Project Name : Dubai Arena, UAE
Supplied Area : 13,000 sq/meters.

Project Name : Dubai Expo 2020, UAE
Supplied Area : 13,000 sq/meters.

Project Name : Royal Atlantis Hotel, UAE
Supplied Area : 100,000 sq/mts.

Project Name : Rolex Towers, UAE
Supplied Area : 110,000 sq/meters.

Project Name : Sky Towers, UAE
Supplied Area : 260,000 sq/meters.

Project Name : Abu Dhabi Fin. Center UAE
Supplied Area : 100,000 sq/meters.

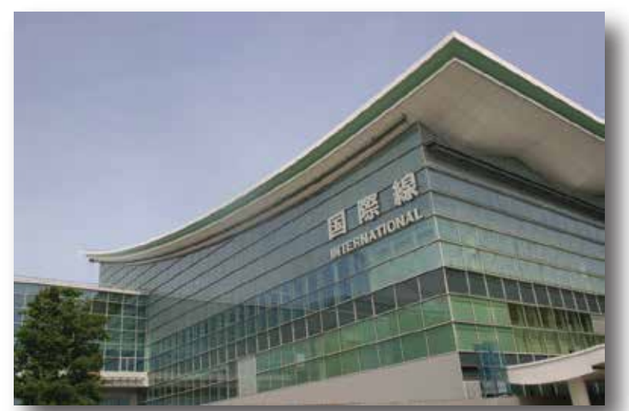
Project Name : Midtown, Japan
Supplied Area : 45,000 sq/meters.

Project Name : Marunouchi, Japan
Supplied Area : 21,000 sq/meters.

Project Name : Toranomon, Japan
Supplied Area : 45,000 sq/meters.

Project Name : Marunouchi, Japan
Supplied Area : 21,000 sq/meters.

Project Name : TGMM, Japan
Supplied Area : 35,000 sq/meters.



Project Name : Tokyo International Airport, Japan
Supplied Area : 30,000 sq/meters.

Project Name : Dream tower
South Korea
Supplied Area : 66,000 sq/mts.

Project Name : Busan LCT
South Korea
Supplied Area : 210,000 sq/mts.

Project Name : Gongpeondong
Office Bldg South Korea
Supplied Area : 66,000 sq/mts.

Project Name : CJ only one
R&D Center, South Korea
Supplied Area : 210,000 sq/mts.

Project Name : Goldin Financial Centre, Hong Kong
Supplied Area : 30,000 sq/meters.

Project Name : Hyson Place, Hong Kong
Supplied Area : 28,000 sq/meters.

Project Name : MGM Grand, Macau
Supplied Area : 40,000 sq/meters.

Project Name : TCTL 38, Hong Kong
Supplied Area : 30,000 sq/meters.

Project Name : West Kowloon Station, Hong Kong
Supplied Area : 20,000 sq/meters.

Project Name : Hong Kong Science Park, Hong Kong
Supplied Area : 30,000 sq/meters.

Project Name : Galaxy Phase I & II Macau
Supplied Area : 60,000 sq/meters.

Project Name : MGM Cotai, Macau
Supplied Area : 85,000 sq/meters.

Project Name : New World Center, Hong Kong
Supplied Area : 66,000 sq/meters.

Project Name : Lohas Park 5, Hong Kong
Supplied Area : 33,000 sq/meters.

Project Name : Merdeka PNB, Malaysia
Supplied Area : 110,000 sq/meters.

Project Name : Menara J Land, Malaysia
Supplied Area : 25,000 sq/meters.

Project Name : KL ECO CITY, Malaysia
Supplied Area : 95,000 sq/meters collectively for towers OT2, BO, SO, OT3.

Project Name : KL Trillion, Malaysia
Supplied Area : 20,000 sq/meters.

Project Name : St Regis, Malaysia
Supplied Area : 25,000 sq/meters.

Project Name : Grand Hyatt, Malaysia
Supplied Area : 30,000 sq/meters.

Project Name : Felda & Naza Tower, Malaysia
Supplied Area : 70,000 sq/meters.

Project Name : South Beach, Singapore
Supplied Area : 55,000 sq/meters.

Project Name : CPF Southernwood, Singapore
Supplied Area : 30,000 sq/meters.

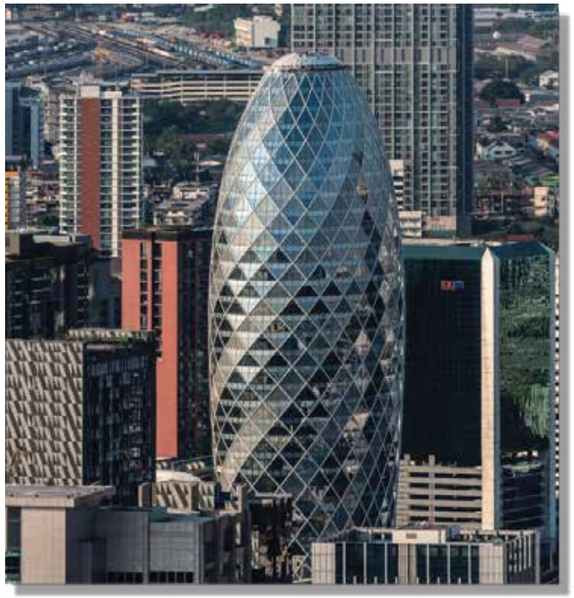
Project Name : MBC2, Singapore
Supplied Area : 40,000 sq/meters.

Project Name : Lao Pa Sat Market Street Singapore
Supplied Area : 20,000 sq/meters.

Project Name : Orchard Ion, Singapore
Supplied Area : 40,000 sq/meters.

Project Name : Marina One., Singapore
Supplied Area : 140,000 sq/meters.

Project Name : 9 Penang Road, Singapore
Supplied Area : 30,000 sq/meters.



Project Name : Pearl Bangkok, Thailand
Supplied Area : 30,000 sq/meters.

Project Name : FYI Center, Thailand
Supplied Area : 26,000 sq/meters.

Project Name : T1 Office, Thailand
Supplied Area : 22,000 sq/meters.

Project Name : Singha Complex, Thailand
Supplied Area : 30,000 sq/meters.

Project Name : Rosewood Hotel, Thailand
Supplied Area : 25,000 sq/meters.

Project Name : G Land Tower, Thailand
Supplied Area : 39,000 sq/meters.

Project Name : The Tower, Indonesia
Supplied Area : 38,000 sq/meters.

Project Name : Menara Astra, Indonesia
Supplied Area : 50,000 sq/meters.

Project Name : Sequis Tower, Indonesia
Supplied Area : 45,000 sq/meters.

Project Name : WTC II & III, Indonesia
Supplied Area : 70,000 sq/meters.

Project Name : Gama Tower, Indonesia
Supplied Area : 40,000 sq/meters.

Project Name : Thamrin Nine, Indonesia
Supplied Area : 65,000 sq/meters.

Project Name : St Regis Hotel & Residences Indonesia
Supplied Area : 65,000 sq/meters.

Project Name : International Financial Center 2 Indonesia
Supplied Area : 35,000 sq/meters.

Project Name : Trump Tower, Phillipines
Supplied Area : 25,000 sq/meters.

Project Name : The Curve, Phillipines
Supplied Area : 15,000 sq/meters.

Project Name : Shangri La, Phillipines
Supplied Area : 45,000 sq/meters.

Project Name : Ayala Garden Diamond, Phillipines
Supplied Area : 63,000 sq/meters.

Project Name :Times Square Saigon, Vietnam
Supplied Area : 15,000 sq/meters.

Project Name :Sun Wah Pearl, Vietnam

Supplied Area : 40,000 sq/meters.

Project Name :Alpha Towers Alpha 2, Alpha 3 & Alpha 4 Vietnam

Supplied Area : Collectvely 100,000 sq/meters.

Project Name :Estella Heights Phase I & II Vietnam

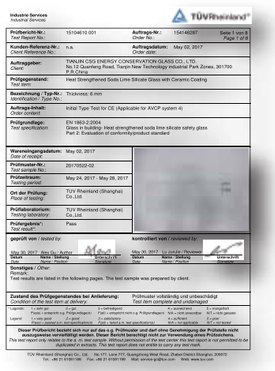
Supplied Area : 20,000 sq/meters.

Certifcates & Honours

BSI Certificate for
Insulating Glass Units

IGCC Certificate

Standardsmark Licence of
Australian Standard



CE Test Report

EN 14179
Heat Soak Certificate

EN 1279
Test Report

BSI Kitemark
Certificate

ISO 9001:2008 Certificate

SGCC Certificate

UKAS Certificate

Terminology

Visible Light Transmittance
The percentage of visible light (380-780nm) that is transmitted through the glass.

Visible Light Reflectance
The percentage of visible light that is reflected from the glass surface(s).

Solar Transmittance:
The percentage of ultraviolet, visible and near infrared energy (300-2500nm) that is transmitted through the glass.

Solar Reflectance:
The percentage of solar energy that is reflected from the glass surface(s).

Shading Coefficient (SC):
The solar factor (total transmittance) of a glass relative to that of 3mm clear float glass (0.87) and is used as a performance comparison. The lower the shading coefficient number, the lower the amount of solar heat transmitted.

U-value:
A measure of heat gain or heat loss through glass due to the differences between indoor and outdoor temperatures.
It is expressed as Watts per square meter, per degree Kelvin, W/m2.K.

Solar Factor (g):(SHGC)
the percentage of total soar radiant heat energy transmitted through glazing (the sum of energy transmitted directly and energy absorbed and re-emitted to the interior).

Total Solar IR Transmittance (SIR):
The total solar IR transmittance is the fraction of incident solar infrared transmitted by the glass to the interior, including direct solar IR transmittance and secondary transfer.

Hong Kong Southern Glass Trading Co., Ltd.
Add: #3806 Singga Commercial Centre 144-151 Connaught Road West, Hong Kong.
Contact: Ms. Amy Qiu, Email: qiuxl@csgholding.com , Mobile: +86-13802453952

CSG (HK) South Asia Office. (India, Sri Lanka, Nepal & Bangaldesh)
Add: Hiranandani Gardens, Mumbai, India.
Contact: Ms. Pamela, Email: pany@csgholding.com, Mobile: +91 7738136301

CSG Middle East.
Add: Office 3109 , Jumeriah Bay X3,Dubai , UAE.
Contact: Mr. Ali Xu, Email: xucq@csgholding.com, Mobile: +971 562986919

CSG Australia.
Add: Suite 13, 13-25 Church Street Hawthorn, VIC 3122 Australia.
Contact person: Mr. Bin Ma Email: mabq@csgholding.com, Mobile: +61398527095

CSG (HK) Japan & Taiwan.
301 Sakamotoya Building, 1—18—12, Yotsuya, Shinjuku—ku, Tokyo, Japan, 1600004
Contact: Ms. Michiko Wang, Email: wangsr@csgholding.com,
Mobile: +81-80-3643-8866 +86-136-0300-8457, TEL: +81-3-6274-8292, +81-3-6274-8291

CSG (HK) Thailand.
Add: Center Ramma 9, Khwaeng Huai Khwang, Krung Thep Maha Nakhon 10310
Contact: Mr. Robin Jiang, Email: jiangzb@csgholding.com , Mobile: +66 0971364070

CSG(HK) Malaysia.
Add: 28/F Central Plaza, 34 Jalan Sultan Ismail, 50250 Kuala Lumpur, Malaysia
Contact: Ms. Celia Deng, Email: dengq@csgholding.com, Mobile: +60 03 2149 0901

CSG(HK) Indonesia & Myanmar.
Add: Taman Anggrek, 1-19G J1. Letjend. S. Parman Kay. 21 Jakarta Barat 11470 Indonesia
Contact: Mr. Fu Pei, Email: fup@csgholding.com, Mobile: +62 858-8336-6155
Mr. Young, Email: wuzy@csgholding.com, Mobile: +62 0812-8693-0432

CSG (HK) Korea .
Add: Charmant officetel, Kwanyang-dong, 1598, Dongan-gu, Gyeonggi-Do, Korea. 14066
Contact: Mr. Sam Yang, Email: yangqj@csgholding.com, Mobile: +82 10 5620 5858

CSG (HK) Philippines.
Add: 30th street corner 2nd avenue Bonifacio Global City, Taguig City 1634 Phippines.
Contact: Ms. Emma Lin, Email: linwq@csgholding.com, Mobile: +63 9566972058

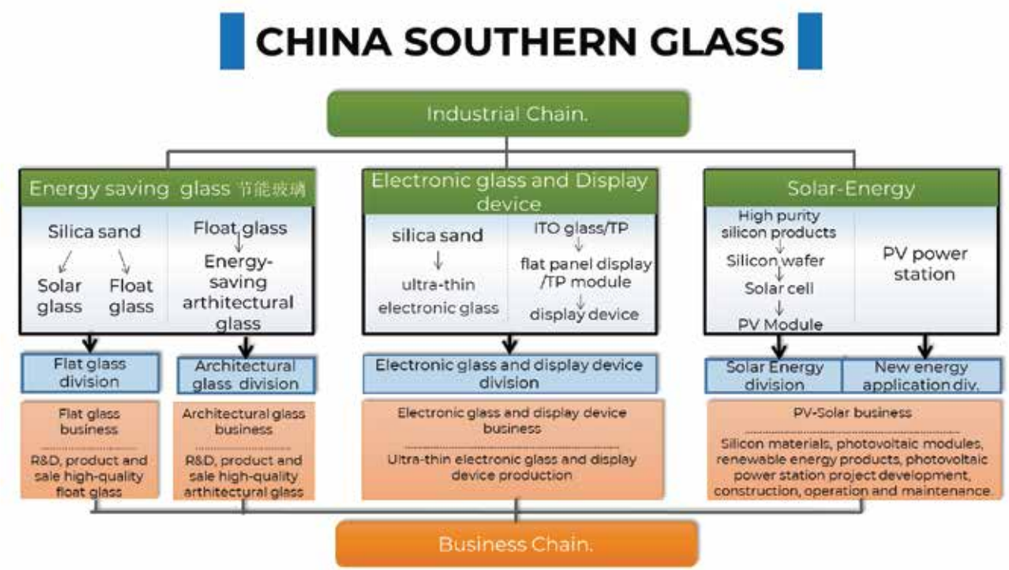
CSG (HK) Vietnam & Cambodia.
Add: Sunrise City,27 Nguyen Huu Tho, Tan Hung,Quan 7,HCM.
Contact: Ms. Gao Ya, Email: gaoy@csgholding.com, Mobile: +84 01293766150

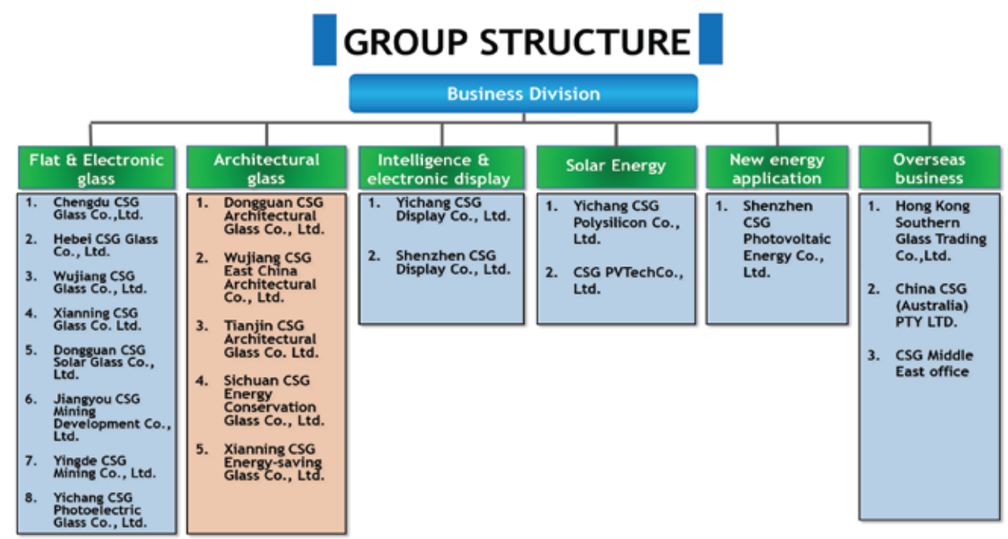
CSG (HK) North America & Central Asia
Add: A211 CSG Building, 6th Industry Road, Shekou, Nanshan, Shenzhen.
Contact: Ms. Tonia Zhou, Email: zhoujing®csgholding.com,
Mobile: +86 15816862876. Tel: +86-755-26860660/26860666 ext. 8016

Other Regions/Countries:

Ms. Angel Chow.
Email: angel@csgholding.com.
Mobile: +852-9631-5337 (HK) / +86-13825202150 (China)

Mr. Alex Wong.
E-mail: alex@csgholding.com.
Mobile: +66 970201790 (Thailand),+86-13826521151 (China).





7.2 ตัวอย่างเอกสารตรวจสอบเครื่องใช้ไฟฟ้าและเครื่องจักรของโครงการ (เครื่องปรับอากาศ)

Roof

แบบฟอร์มตรวจเช็คและบำรุงรักษา เครื่องปรับอากาศ

บริษัท เมืองไทยแคปปิตอล สำนักงานใหญ่

Date. 2../..1../.....69.....

ลำดับ	รายการที่ตรวจเช็ค	FCU - LMR - 01			FCU - LMR - 02			FCU			FCU			FCU		
		✓	×	หมายเหตุ	✓	×	หมายเหตุ	✓	×	หมายเหตุ	✓	×	หมายเหตุ	✓	×	หมายเหตุ
1	ทำความสะอาด AIR FILTER	/			/											
2	ตรวจสอบ BEARING เพื่อตรวจเติมจารบี/ขันน็อต	–			–											
3	ตรวจสอบลูกปืน BEARING	–			–											
4	ตรวจสอบความตึงของสายพาน	–			–											
5	ตรวจสอบการเสื่อมสภาพของสายพาน	–			–											
6	ตรวจสอบ ALIGNMENT มอเตอร์	/			/											
7	ตรวจสอบอุปกรณ์ THERMOSTAT	/			/											
8	ตรวจสอบการทำงานของ CONTROL VALVE	/			/											
9	ตรวจเช็คแรงดัน (V) / กระแสฟ้า (A)	/	220V / 0.88 A		/	220V / 0.83A										
10	ตรวจสอบถาดรองน้ำทิ้ง (ตันไหม)	/			/											
11	ตรวจเช็คท่อน้ำเย็น (เข้า/ออก)	/			/											
12	ตรวจเช็คสายไฟฟ้า ตำแหน่งขั้วยึดหัวสาย	/			/											
13	ตรวจเช็คพัดลมว่ามีการแตกหักหรือไม่	/			/											

ลำดับ	รายการที่ตรวจเช็ค	FCU			FCU			FCU			FCU			FCU		
		✓	×	หมายเหตุ	✓	×	หมายเหตุ	✓	×	หมายเหตุ	✓	×	หมายเหตุ	✓	×	หมายเหตุ
1	ทำความสะอาด AIR FILTER															
2	ตรวจสอบ BEARING เพื่อตรวจเติมจารบี/ขันน็อต															
3	ตรวจสอบลูกปืน BEARING															
4	ตรวจสอบความตึงของสายพาน															
5	ตรวจสอบการเสื่อมสภาพของสายพาน															
6	ตรวจสอบ ALIGNMENT มอเตอร์															
7	ตรวจสอบอุปกรณ์ THERMOSTAT															
8	ตรวจสอบการทำงานของ CONTROL VALVE															
9	ตรวจเช็คแรงดัน (V) / กระแสฟ้า (A)															
10	ตรวจสอบถาดรองน้ำทิ้ง (ตันไหม)															
11	ตรวจเช็คท่อน้ำเย็น (เข้า/ออก)															
12	ตรวจเช็คสายไฟฟ้า ตำแหน่งขั้วยึดหัวสาย															
13	ตรวจเช็คพัดลมว่ามีการแตกหักหรือไม่															

[redacted]

FL.11

แบบฟอร์มตรวจเช็คและบำรุงรักษา เครื่องปรับอากาศ

บริษัท เมืองไทยแคปปิตอล สำนักงานใหญ่

Date 24/1/69

ลำดับ	รายการที่ตรวจเช็ค	FCU 11-01		FCU 11-02		FCU 11-03		FCU 11-04		FCU 11-05	
		✓ ✗	หมายเหตุ	✓ ✗	หมายเหตุ	✓ ✗	หมายเหตุ	✓ ✗	หมายเหตุ	✓ ✗	หมายเหตุ
1	ทำความสะอาด AIR FILTER	/		/		/		/		/	
2	ตรวจสอบ BEARING เพื่อตรวจเติมจารบี/ขันน็อต	/		/		/		/		/	
3	ตรวจสอบลูกปืน BEARING	/		/		/		/		/	
4	ตรวจสอบความตึงของสายพาน	/		/		/		/		/	
5	ตรวจสอบการเสื่อมสภาพของสายพาน	/		/		/		/		/	
6	ตรวจสอบ ALIGNMENT มอเตอร์	/		/		/		/		/	
7	ตรวจสอบอุปกรณ์ THERMOSTAT	/		/		/		/		/	
8	ตรวจสอบการทำงานของ CONTROL VALVE	/		/		/		/		/	
9	ตรวจเช็คแรงดัน (V) / กระแสฟ้า (A)	/	226V	/		/		/		/	
10	ตรวจสอบถาดรองน้ำทิ้ง (ตันไหม)	/		/		/		/		/	
11	ตรวจเช็คท่อน้ำเย็น (เข้า/ออก)	/		/		/		/		/	
12	ตรวจเช็คสายไฟฟ้า ตำแหน่งขั้วยึดหัวสาย	/		/		/		/		/	
13	ตรวจเช็คพัดลมว่ามีการแตกหักหรือไม่	/		/		/		/		/	

ลำดับ	รายการที่ตรวจเช็ค	FCU 11-07		FCU 11-08		FCU		FCU		FCU	
		✓ ✗	หมายเหตุ	✓ ✗	หมายเหตุ	✓ ✗	หมายเหตุ	✓ ✗	หมายเหตุ	✓ ✗	หมายเหตุ
1	ทำความสะอาด AIR FILTER	/		/							
2	ตรวจสอบ BEARING เพื่อตรวจเติมจารบี/ขันน็อต	/		/							
3	ตรวจสอบลูกปืน BEARING	/		/							
4	ตรวจสอบความตึงของสายพาน	/		/							
5	ตรวจสอบการเสื่อมสภาพของสายพาน	/		/							
6	ตรวจสอบ ALIGNMENT มอเตอร์	/		/							
7	ตรวจสอบอุปกรณ์ THERMOSTAT	/		/							
8	ตรวจสอบการทำงานของ CONTROL VALVE	/		/							
9	ตรวจเช็คแรงดัน (V) / กระแสฟ้า (A)	/		/							
10	ตรวจสอบถาดรองน้ำทิ้ง (ตันไหม)	/		/							
11	ตรวจเช็คท่อน้ำเย็น (เข้า/ออก)	/		/							
12	ตรวจเช็คสายไฟฟ้า ตำแหน่งขั้วยึดหัวสาย	/		/							
13	ตรวจเช็คพัดลมว่ามีการแตกหักหรือไม่	/		/							

[redacted]

แบบฟอร์มตรวจเช็คและบำรุงรักษา เครื่องปรับอากาศ

FL.10

บริษัท เมืองไทยแคปปิตอล สำนักงานใหญ่

Date 8/8/69

ลำดับ	รายการที่ตรวจเช็ค	FCU 10-05		FCU 10-04		FCU 10-08		FCU 10-09		FCU 10-01	
		✓ | ×	หมายเหตุ	✓ | ×	หมายเหตุ	✓ | ×	หมายเหตุ	✓ | ×	หมายเหตุ	✓ | ×	หมายเหตุ
1	ทำความสะอาด AIR FILTER	/		/		/		/		/	
2	ตรวจสอบ BEARING เพื่อตรวจเติมจารบี/ขันน็อต	/		/		/		/		/	
3	ตรวจสอบลูกปืน BEARING	/		/		/		/		/	
4	ตรวจสอบความตึงของสายพาน	/		/		/		/		/	
5	ตรวจสอบการเสื่อมสภาพของสายพาน	/		/		/		/		/	
6	ตรวจสอบ ALIGNMENT มอเตอร์	/		/		/		/		/	
7	ตรวจสอบอุปกรณ์ THERMOSTAT	/		/		/		/		/	
8	ตรวจสอบการทำงานของ CONTROL VALVE	/		/		/		/		/	
9	ตรวจเช็คแรงดัน (V) / กระแสฟ้า (A)	/	230.6V / 0.63A	/	228.8V / 0.82A	/	227V / 0.69A	/	223V / 0.58A	/	221V / 1.78A
10	ตรวจสอบถาดรองน้ำทิ้ง (ตันไหม)	/		/		/		/		/	
11	ตรวจเช็คท่อน้ำเย็น (เข้า/ออก)	/		/		/		/		/	
12	ตรวจเช็คสายไฟฟ้า ตำแหน่งขั้วยึดหัวสาย	/		/		/		/		/	
13	ตรวจเช็คพัดลมว่ามีการแตกหักหรือไม่	/		/		/		/		/	

ลำดับ	รายการที่ตรวจเช็ค	FCU 10-10		FCU 10-11		FCU 10-06		FCU		FCU	
		✓ | ×	หมายเหตุ	✓ | ×	หมายเหตุ	✓ | ×	หมายเหตุ	✓ | ×	หมายเหตุ	✓ | ×	หมายเหตุ
1	ทำความสะอาด AIR FILTER	/		/		/					
2	ตรวจสอบ BEARING เพื่อตรวจเติมจารบี/ขันน็อต	/		/		/					
3	ตรวจสอบลูกปืน BEARING	/		/		/					
4	ตรวจสอบความตึงของสายพาน	/		/		/					
5	ตรวจสอบการเสื่อมสภาพของสายพาน	/		/		/					
6	ตรวจสอบ ALIGNMENT มอเตอร์	/		/		/					
7	ตรวจสอบอุปกรณ์ THERMOSTAT	/		/		/					
8	ตรวจสอบการทำงานของ CONTROL VALVE	/		/		/					
9	ตรวจเช็คแรงดัน (V) / กระแสฟ้า (A)	/	223V / 1.85A	/	221V / 1.73A	/	220V / 0.71A				
10	ตรวจสอบถาดรองน้ำทิ้ง (ตันไหม)	/		/		/					
11	ตรวจเช็คท่อน้ำเย็น (เข้า/ออก)	/		/		/					
12	ตรวจเช็คสายไฟฟ้า ตำแหน่งขั้วยึดหัวสาย	/		/		/					
13	ตรวจเช็คพัดลมว่ามีการแตกหักหรือไม่	/		/		/					

[redacted]

FL.12

แบบฟอร์มตรวจเช็คและบำรุงรักษา เครื่องปรับอากาศ

บริษัท เมืองไทยแคปปิตอล สำนักงานใหญ่

Date 14/2/69

ลำดับ	รายการที่ตรวจเช็ค	FCU 9-10		FCU 9-05		FCU 9-03		FCU 9-04		FCU 9-06	
		✓ | ×	หมายเหตุ	✓ | ×	หมายเหตุ	✓ | ×	หมายเหตุ	✓ | ×	หมายเหตุ	✓ | ×	หมายเหตุ
1	ทำความสะอาด AIR FILTER	/		/		/		/		/	
2	ตรวจสอบ BEARING เพื่อตรวจเติมจารบี/ขันน็อต	/		/		/		/		/	
3	ตรวจสอบลูกปืน BEARING	/		/		/		/		/	
4	ตรวจสอบความตึงของสายพาน	/		/		/		/		/	
5	ตรวจสอบการเสื่อมสภาพของสายพาน	/		/		/		/		/	
6	ตรวจสอบ ALIGNMENT มอเตอร์	/		/		/		/		/	
7	ตรวจสอบอุปกรณ์ THERMOSTAT	/		/		/		/		/	
8	ตรวจสอบการทำงานของ CONTROL VALVE	/		/		/		/		/	
9	ตรวจเช็คแรงดัน (V) / กระแสฟ้า (A)	/		/		/		/		/	
10	ตรวจสอบถาดรองน้ำทิ้ง (ตันไหม)	/		/		/		/		/	
11	ตรวจเช็คท่อน้ำเย็น (เข้า/ออก)	/		/		/		/		/	
12	ตรวจเช็คสายไฟฟ้า ตำแหน่งขั้วยึดหัวสาย	/		/		/		/		/	
13	ตรวจเช็คพัดลมว่ามีการแตกหักหรือไม่	/		/		/		/		/	

ลำดับ	รายการที่ตรวจเช็ค	FCU 9-07		FCU 9-09		FCU 9-13		FCU 9-12		FCU 9-05	
		✓ | ×	หมายเหตุ	✓ | ×	หมายเหตุ	✓ | ×	หมายเหตุ	✓ | ×	หมายเหตุ	✓ | ×	หมายเหตุ
1	ทำความสะอาด AIR FILTER	/		/		/		/		/	
2	ตรวจสอบ BEARING เพื่อตรวจเติมจารบี/ขันน็อต	/		/		/		/		/	
3	ตรวจสอบลูกปืน BEARING	/		/		/		/		/	
4	ตรวจสอบความตึงของสายพาน	/		/		/		/		/	
5	ตรวจสอบการเสื่อมสภาพของสายพาน	/		/		/		/		/	
6	ตรวจสอบ ALIGNMENT มอเตอร์	/		/		/		/		/	
7	ตรวจสอบอุปกรณ์ THERMOSTAT	/		/		/		/		/	
8	ตรวจสอบการทำงานของ CONTROL VALVE	/		/		/		/		/	
9	ตรวจเช็คแรงดัน (V) / กระแสฟ้า (A)	/		/		/		/		/	
10	ตรวจสอบถาดรองน้ำทิ้ง (ตันไหม)	/		/		/		/		/	
11	ตรวจเช็คท่อน้ำเย็น (เข้า/ออก)	/		/		/		/		/	
12	ตรวจเช็คสายไฟฟ้า ตำแหน่งขั้วยึดหัวสาย	/		/		/		/		/	
13	ตรวจเช็คพัดลมว่ามีการแตกหักหรือไม่	/		/		/		/		/	

[redacted]

FL. 8

แบบฟอร์มตรวจเช็คและบำรุงรักษา เครื่องปรับอากาศ

บริษัท เมืองไทยแคปปิตอล สำนักงานใหญ่

Date. 22 / 2 / 69

ลำดับ	รายการที่ตรวจเช็ค	FCU 8-09		FCU 8-03		FCU 8-04		FCU 8-08		FCU 8-06	
		✓ ✗	หมายเหตุ	✓ ✗	หมายเหตุ	✓ ✗	หมายเหตุ	✓ ✗	หมายเหตุ	✓ ✗	หมายเหตุ
1	ทำความสะอาด AIR FILTER	✓		✓		✓		✓		✓	
2	ตรวจสอบ BEARING เพื่อตรวจเติมจารบี/ขันน็อต	✓		✓		✓		✓		✓	
3	ตรวจสอบลูกปืน BEARING	✓		✓		✓		✓		✓	
4	ตรวจสอบความตึงของสายพาน	✓		✓		✓		✓		✓	
5	ตรวจสอบการเสื่อมสภาพของสายพาน	✓		✓		✓		✓		✓	
6	ตรวจสอบ ALIGNMENT มอเตอร์	✓		✓		✓		✓		✓	
7	ตรวจสอบอุปกรณ์ THERMOSTAT	✓		✓		✓		✓		✓	
8	ตรวจสอบการทำงานของ CONTROL VALVE	✓		✓		✓		✓		✓	
9	ตรวจเช็คแรงดัน (V) / กระแสฟ้า (A)	✓		✓		✓		✓		✓	
10	ตรวจสอบถาดรองน้ำทิ้ง (ตันไหม)	✓		✓		✓		✓		✓	
11	ตรวจเช็คท่อน้ำเย็น (เข้า/ออก)	✓		✓		✓		✓		✓	
12	ตรวจเช็คสายไฟฟ้า ตำแหน่งขั้วยึดหัวสาย	✓		✓		✓		✓		✓	
13	ตรวจเช็คพัดลมว่ามีการแตกหักหรือไม่	✓		✓		✓		✓		✓	

ลำดับ	รายการที่ตรวจเช็ค	FCU 8-07		FCU		FCU		FCU		FCU	
		✓ ✗	หมายเหตุ	✓ ✗	หมายเหตุ	✓ ✗	หมายเหตุ	✓ ✗	หมายเหตุ	✓ ✗	หมายเหตุ
1	ทำความสะอาด AIR FILTER	✓									
2	ตรวจสอบ BEARING เพื่อตรวจเติมจารบี/ขันน็อต	✓									
3	ตรวจสอบลูกปืน BEARING	✓									
4	ตรวจสอบความตึงของสายพาน	✓									
5	ตรวจสอบการเสื่อมสภาพของสายพาน	✓									
6	ตรวจสอบ ALIGNMENT มอเตอร์	✓									
7	ตรวจสอบอุปกรณ์ THERMOSTAT	✓									
8	ตรวจสอบการทำงานของ CONTROL VALVE	✓									
9	ตรวจเช็คแรงดัน (V) / กระแสฟ้า (A)	✓									
10	ตรวจสอบถาดรองน้ำทิ้ง (ตันไหม)	✓									
11	ตรวจเช็คท่อน้ำเย็น (เข้า/ออก)	✓									
12	ตรวจเช็คสายไฟฟ้า ตำแหน่งขั้วยึดหัวสาย	✓									
13	ตรวจเช็คพัดลมว่ามีการแตกหักหรือไม่	✓									

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แบบฟอร์มตรวจเช็คและบำรุงรักษา เครื่องปรับอากาศ

บริษัท เมืองไทยแคปปิตอล สำนักงานใหญ่

Date 6/6/2569

ลำดับ	รายการที่ตรวจเช็ค	FCU 12-02		FCU 12-04		FCU 12-03		FCU 12-05		FCU 12-07	
		✓ | ×	หมายเหตุ	✓ | ×	หมายเหตุ	✓ | ×	หมายเหตุ	✓ | ×	หมายเหตุ	✓ | ×	หมายเหตุ
1	ทำความสะอาด AIR FILTER	✓		✓		✓		✓		✓	
2	ตรวจสอบ BEARING เพื่อตรวจเติมจารบี/ขันน็อต	✓		✓		✓		✓		✓	
3	ตรวจสอบลูกปืน BEARING	✓		✓		✓		✓		✓	
4	ตรวจสอบความตึงของสายพาน	✓		✓		✓		✓		✗	สายพานขาด
5	ตรวจสอบการเสื่อมสภาพของสายพาน	✓		✓		✓		✓		✗	ขาด
6	ตรวจสอบ ALIGNMENT มอเตอร์	✓		✓		✓		✓		✓	
7	ตรวจสอบอุปกรณ์ THERMOSTAT	✓		✓		✓		✓		✓	
8	ตรวจสอบการทำงานของ CONTROL VALVE	✓		✓		✓		✓		✓	
9	ตรวจเช็คแรงดัน (V) / กระแสฟ้า (A)	✓		✓		✓		✓		✓	
10	ตรวจสอบถาดรองน้ำทิ้ง (ตันไหม)	✓		✓		✓		✓		✓	
11	ตรวจเช็คท่อน้ำเย็น (เข้า/ออก)	✓		✓		✓		✓		✓	
12	ตรวจเช็คสายไฟฟ้า ตำแหน่งขั้วยึดหัวสาย	✓		✓		✓		✓		✓	
13	ตรวจเช็คพัดลมว่ามีการแตกหักหรือไม่	✓		✓		✓		✓		✓	

ลำดับ	รายการที่ตรวจเช็ค	FCU 12-08		FCU		FCU		FCU		FCU	
		✓ | ×	หมายเหตุ	✓ | ×	หมายเหตุ	✓ | ×	หมายเหตุ	✓ | ×	หมายเหตุ	✓ | ×	หมายเหตุ
1	ทำความสะอาด AIR FILTER	✓									
2	ตรวจสอบ BEARING เพื่อตรวจเติมจารบี/ขันน็อต	✓									
3	ตรวจสอบลูกปืน BEARING	✓									
4	ตรวจสอบความตึงของสายพาน	✓									
5	ตรวจสอบการเสื่อมสภาพของสายพาน	✓									
6	ตรวจสอบ ALIGNMENT มอเตอร์	✓									
7	ตรวจสอบอุปกรณ์ THERMOSTAT	✓									
8	ตรวจสอบการทำงานของ CONTROL VALVE	✓									
9	ตรวจเช็คแรงดัน (V) / กระแสฟ้า (A)	✓	403/405/403 V. /21A								
10	ตรวจสอบถาดรองน้ำทิ้ง (ตันไหม)	✓									
11	ตรวจเช็คท่อน้ำเย็น (เข้า/ออก)	✓									
12	ตรวจเช็คสายไฟฟ้า ตำแหน่งขั้วยึดหัวสาย	✓									
13	ตรวจเช็คพัดลมว่ามีการแตกหักหรือไม่	✓									

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