

## ภาคผนวกที่ 7

เอกสารประกอบมาตรการ

## **7.1 เอกสารรับรองค่าสะท้อนกระจกของอาคารโครงการ**

โครงการ อาคารสำนักงานใหญ่เมืองไทยลิซซิ่ง  
ประมาณค่า OTTV

มุมอะซิมุท = 45 (ตะวันออกเฉียงเหนือ)													
ผนัง	ชนิดผนัง	A <sub>w</sub> (Sq.m.)	U <sub>w</sub> (W/Sq.m. °C)	DSH (kJ/cu.m.)	Solar Absorbance	Td <sub>eq</sub> (°C)	A <sub>F</sub> (Sq.m.)	U <sub>F</sub> (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 <sub>w</sub> (Sq.m.)	U <sub>w</sub> (W/Sq.m. °C)	DSH (kJ/cu.m.)	Solar Absorbance	Td <sub>eq</sub> (°C)	A <sub>F</sub> (Sq.m.)	U <sub>F</sub> (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.)		39.427											

โครงการ อาคารสำนักงานใหญ่เมืองไทยลิซซิ่ง  
ประมาณค่า OTTV

มุมอะซิมุต = 225 (ตะวันตกเฉียงใต้)													
ผนัง	ชนิดผนัง	A <sub>w</sub> (Sq.m.)	U <sub>w</sub> (W/Sq.m. °C)	DSH (kJ/cu.m.)	Solar Absorbance	Td <sub>eq</sub> (°C)	A <sub>F</sub> (Sq.m.)	U <sub>F</sub> (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											

มุมอะซิมุต = 315 (ตะวันตกเฉียงเหนือ)													
ผนัง	ชนิดผนัง	A <sub>w</sub> (Sq.m.)	U <sub>w</sub> (W/Sq.m. °C)	DSH (kJ/cu.m.)	Solar Absorbance	Td <sub>eq</sub> (°C)	A <sub>F</sub> (Sq.m.)	U <sub>F</sub> (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 <sub>w</sub> (Sq.m.)	U <sub>w</sub> (W/Sq.m. °C)	DSH (kJ/cu.m.)	Solar Absorbance	Td <sub>eq</sub> (°C)	A <sub>F</sub> (Sq.m.)	U <sub>F</sub> (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 อาคารสำนักงานในกรุงเทพมหานคร

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
ALUMINIUM	1	ฟิล์มจากพลาสติก	-	-	-	-	0.04400	-	Alpha
	2	อลูมิเนียม	35.0	2,672	211.000	0.896	0.00012	59.853	
	3	ช่องว่างอากาศ (ในรังสีสูง)	30.0	-	-	-	0.14800	-	
	4	อลูมิเนียม	35.0	2,672	211.000	0.896	0.00012	59.853	
	5	ฟิล์มจากพลาสติก	-	-	-	-	0.12000	-	
Roof-2			100.0		รวม	1.792	0.31224	119.706	3.203 W/m²-°C
	1	ฟิล์มจากพลาสติก	-	-	-	-	0.05500	-	Alpha
	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	แผ่นฉนวน	9.0	800	0.282	1.090	0.03191	7.848	
	6	ฟิล์มจากพลาสติก	-	-	-	-	0.16200	-	
			409.0		รวม	2.970	2.30886	561.000	0.433 W/m²-°C
Wall-5	1	ฟิล์มจากพลาสติก	-	-	-	-	0.04400	-	Alpha
	2	ฉนวนสำหรับคอนกรีตมวลเบา	15.0	1,860	0.720	0.840	0.02083	23.436	
	3	คอนกรีตมวลเบา	70.0	1,386	0.476	0.840	0.14706	75.264	
	4	ฉนวนสำหรับคอนกรีตมวลเบา	15.0	1,860	0.720	0.840	0.02083	23.436	
	5	ฟิล์มจากพลาสติก	-	-	-	-	0.12000	-	
			100.0		รวม	2.520	0.35273	122.136	2.835 W/m²-°C
Wall-2 BACK PAN SPANDREL	1	ฟิล์มจากพลาสติก	-	-	-	-	0.04400	-	Alpha
	2	LAMINATED GLASS	30.0	2,500	0.048	0.880	0.62500	66.000	
	3	ฉนวนใยแก้ว	20.0	60	0.031	0.960	0.64516	1.152	
	4	ฟิล์มจากพลาสติก	-	-	-	-	0.12000	-	0.697 W/m²-°C
			50.0		รวม	1.840	1.43416	67.152	
Wall-4,1 GRILL	1	ฟิล์มจากพลาสติก	-	-	-	-	0.04400	-	Alpha
	2	อลูมิเนียม	30.0	2,672	211.000	0.896	0.00047	239.411	
	5	ฟิล์มจากพลาสติก	100.0	-	รวม	0.896	0.16447	239.411	
Roof-1	1	ฟิล์มจากพลาสติก	-	-	-	-	0.05500	-	Alpha
	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	ฟิล์มจากพลาสติก	-	-	-	-	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

STANDARD  
ค่าตัว  
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STANDARD

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STANDARD

MTLS REV2

Make-up Name	Make-up Icon	Transmittance		Reflectance		Absorp tance	U-Value		Shadin g Coeffici ent (sc)	Solar Heat Gain Coeffici ent (SHGC)	Light to Solar Gain (LSG)	Thermal Stress (COG) °F/C	Color Rendering Index (Ra)	
		Visible (τ <sub>v</sub> %)	Solar (τ <sub>e</sub> %)	Visible	Solar		Winter Night (W/m².K)	Summer Day (W/m².K)						
5CL/1.52PVB/5R B40/12AIR/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/6R B40/12AIR/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

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

Total Unit (Nominal) = 7/16 in / 11.524 mm  
 Estimated Nominal Glazing Weight: 25.37 kg/m²

### Indoors

## 6CL1.52PVB/6RB40/12AIR/5CL

Thermal  
Stress  
Guidance  
(COG)

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

Total Unit (Nominal) = 1 3/16 in / 30.524 mm  
 Estimated Nominal Glazing Weight: 41.9 kg/m²

### Indoors

## 6RB20/1.52PVB/6CL

Thermal  
Stress  
Guidance  
(COG)

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

Total Unit (Nominal) = 17/32 in / 13.524 mm  
 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 ( $\tau_v$  %)** is the percentage of visible light at normal incidence (90° to surface) that is transmitted by the glass.

**% Ultraviolet (UV) Transmittance ( $\tau_{uv}$  %)** 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 ( $\tau_e$  %)** 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 ( $\rho_v$  % out)** is the percentage of visible light at normal incidence directly reflected by the glass back outdoors.

**% Reflectance Visible Indoors or Light Reflectance In ( $\rho_v$  % 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 ( $\rho_e$  % 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 ( $\rho_e$  % in)** is the percentage of solar energy at normal incidence directly reflected by the glass back indoors.

**Absorbance ( $\alpha_e$  %)** (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.ft<sup>2</sup>.F. and SI / Metric units are W/m<sup>2</sup>K. 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.ft<sup>2</sup>. RHG = [(Summer U-Value)(89.6°F - 75.2°F) + (Shading Coefficient)(200 Btu/hr.ft<sup>2</sup>)]. Metric units are W/m<sup>2</sup>. RHG = [(Summer U-Value)(32°C - 24°C) + (Shading Coef.)(631 W/m<sup>2</sup>)]

**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.ft<sup>2</sup>)

**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 ( $R_w$ )** 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, P.R.CHINA.**

Date: 24th JAN 2019

Project name: MTC

Customer: AAG

Calculated programme: W6.3

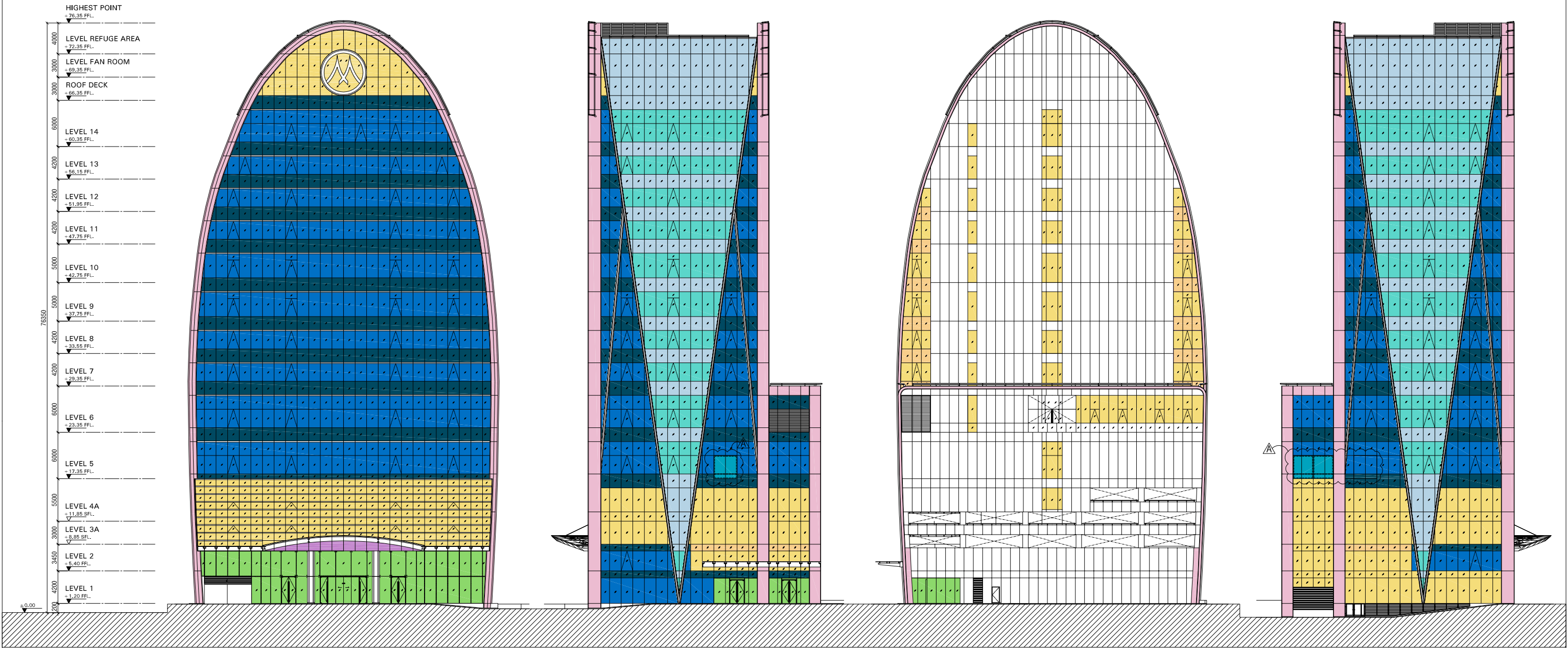
External condition: ASHRAE

No.	DESCRIPTION OF SAMPLE	Visible Light(%)			Solar Energy(%)		U-value(W/m <sup>2</sup> ·K)		Shading Coefficient	SHGC
		Trans	Refl		Trans	Refl	Winter night	Summer day		
			Out	In						
Guardian	5C/1.52PVB/5RB40+12A+5C	37	24	23	21	21	1.69	1.71	0.32	0.28
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
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
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
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
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 C : LAMINATED GLASS  
Vision glass
- TYPE A : ALUMINIUM COMPOSITE CLADDING  
ALPOLIC®/fr : Champagne Metallic # M9177-G30
- TYPE A : LAMINATED GLASS  
Spandrel glass with back pan
- TYPE C : LAMINATED GLASS  
Spandrel glass with back pan
- TYPE B : ALUMINIUM COMPOSITE CLADDING  
ALPOLIC®/fr : Prismatic Sky # ME017-G80
- TYPE B : INSULATING LAMINATED GLASS  
Vision glass
- TYPE D : LAMINATED GLASS  
Vision glass
- TYPE C : ALUMINIUM COMPOSITE CLADDING  
COLOR JOTUN RAL5024 (MATCH TO GLASS TYPE "A")
- TYPE B : LAMINATED GLASS  
Spandrel glass with back pan

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

REV.	DESCRIPTION	DATE
A	-GENERAL REVISION	06.02.19

PROJECT: <b>MUANGTHAI CAPITAL HEADQUARTER</b>
DRAWING TITLE: <b>ALUMINIUM &amp; GLAZING GENERAL SPECIFICATION</b>

SCALE 1:500	DRAWING NO. SD7-102
DATE NOV. 2018	REVISION REV.A
JOB NO. B5353	

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

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





“The **bitterness** of poor quality  
remains forever once the sweetness  
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.



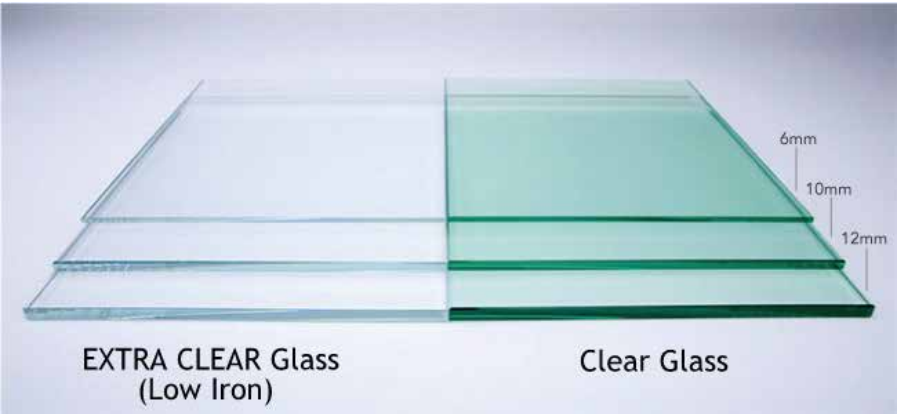
Hebei CSG Glass Co., Ltd, with a total capital of 1.1 billion RMB, 2 float glass production lines, An annual output of 490,000 tons of high quality float glass and special glass.



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)

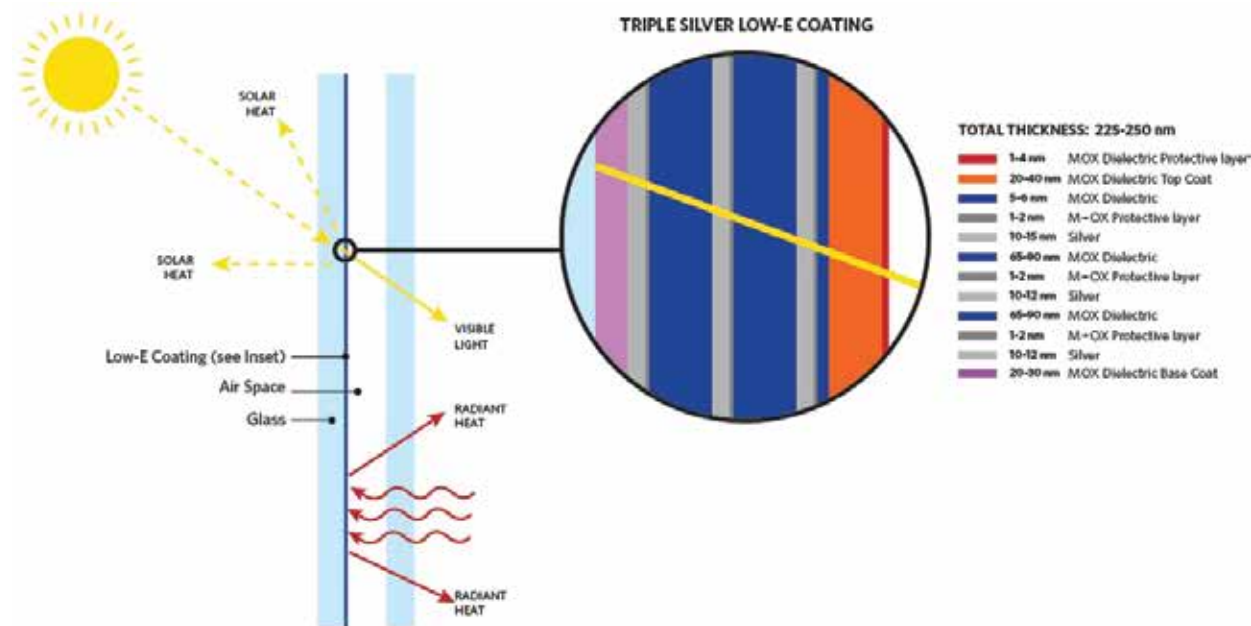


JISR3202  
(Japanese)

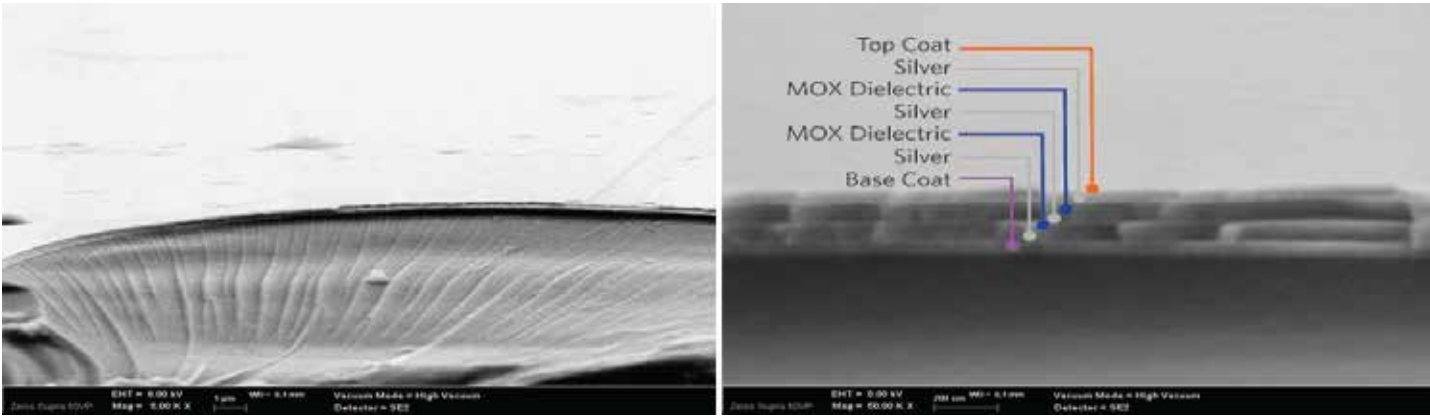


AS2208  
(Australia)

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 spectra with the same VT

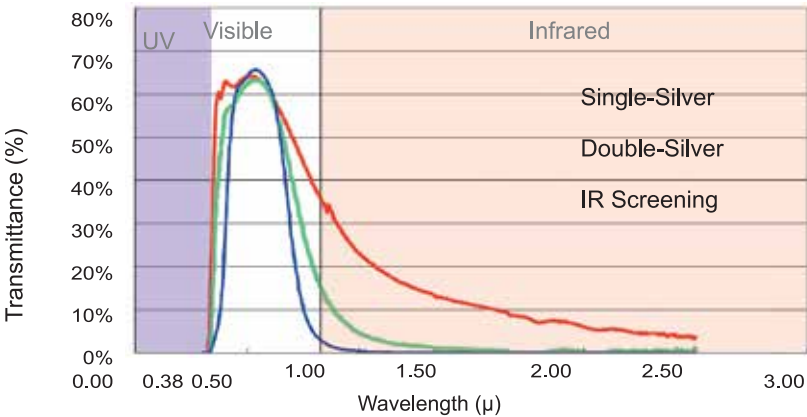


Figure 1

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

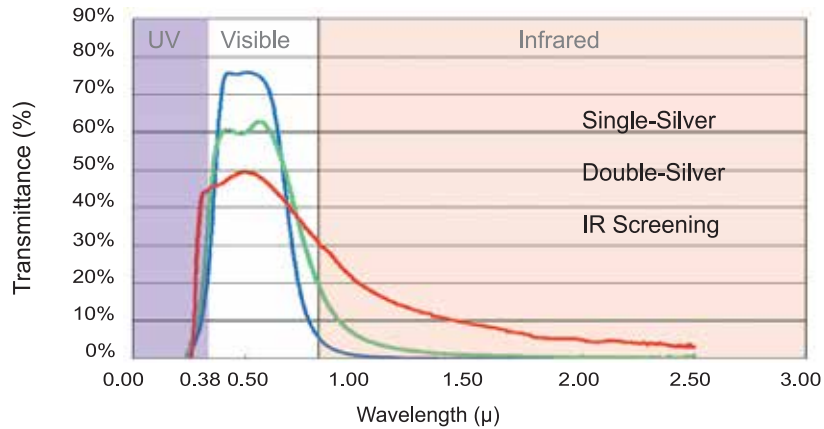


Figure 2

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 return 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.

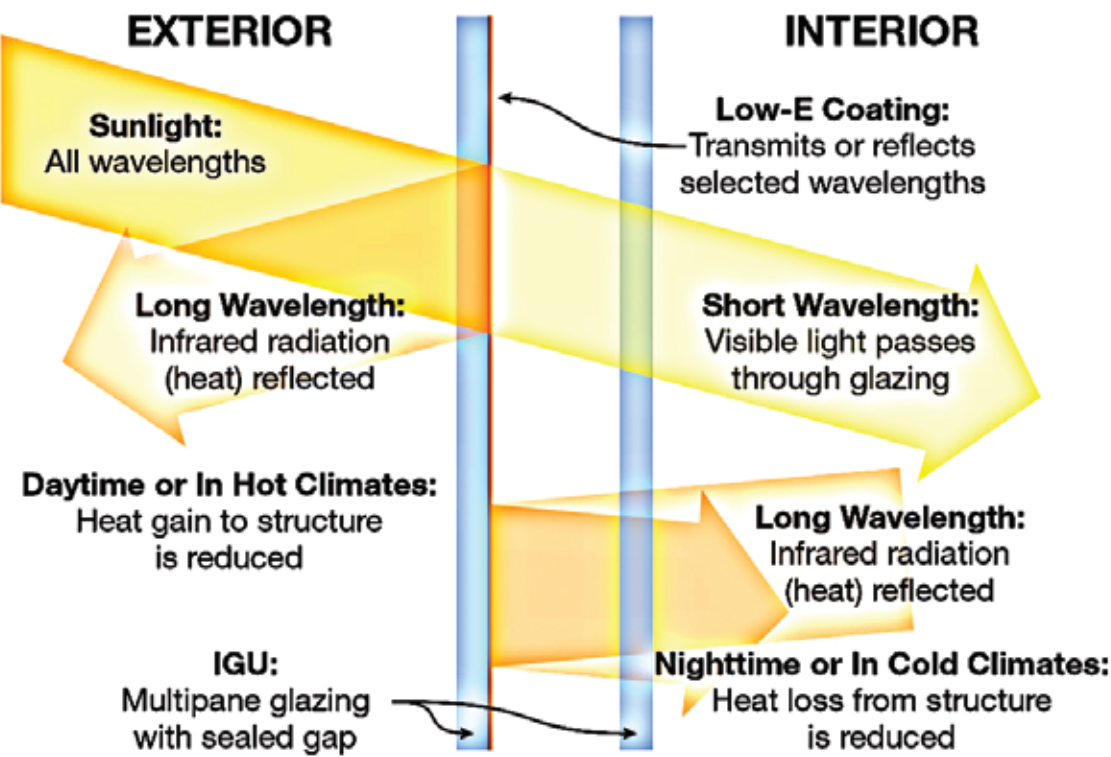
Double Silver Low E

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.

Low-E Coating Performance

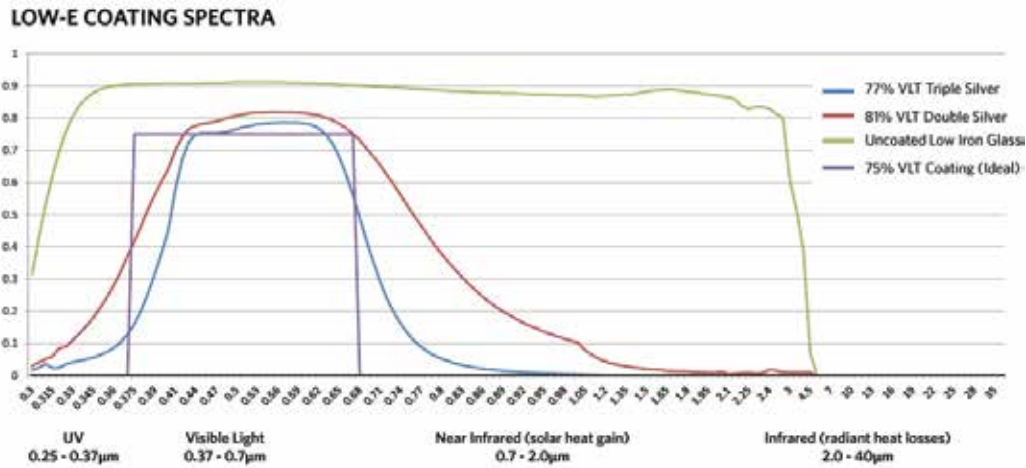


Single Silver Low E

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.



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
Blue Grey L	CEN13-56D	50	19	21	0.33	0.38	1.74
	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	CEF16-50	46	30	15	0.34	0.39	1.77
Grey	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.



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 methodology for the secondary glass manufacturers.

Photometric Data (Post-Temperable Low-E)

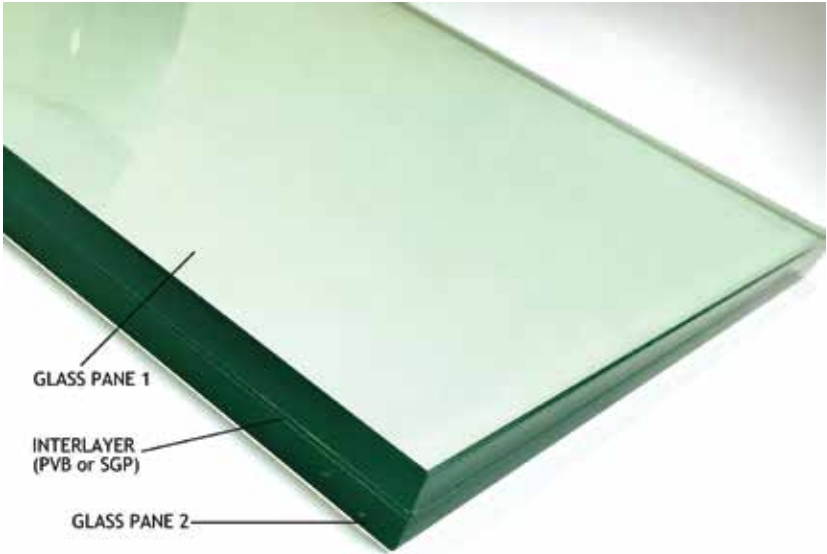
Type of Coating	Shade	Coating Code	Visual Light Transmission %	External Reflection %	Internal Reflection %	Solar Factor (SHGC)	Shading Coefficient t	U-Value (W/sqm-K)
Triple	Neutral	TT65	62	13	15	0.29	0.33	1.63
Double	Neutral	Super D2	53	10	12	0.32	0.37	1.71
	Blue Gray	Super D3	42	31	29	0.23	0.26	1.69
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	CSTI65	66	18	12	0.73	0.84	5.34
	Cool Gray	CSTI59	58	22	22	0.68	0.78	5.40
	Cool Gray	CSTI54	56	16	13	0.63	0.72	5.18
	Neutral Gray	CSTI45	44	29	21	0.55	0.63	5.30
	Light Gray	CSTI43	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,



Conforming to AS/NZ2208:1996





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 perspective 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.

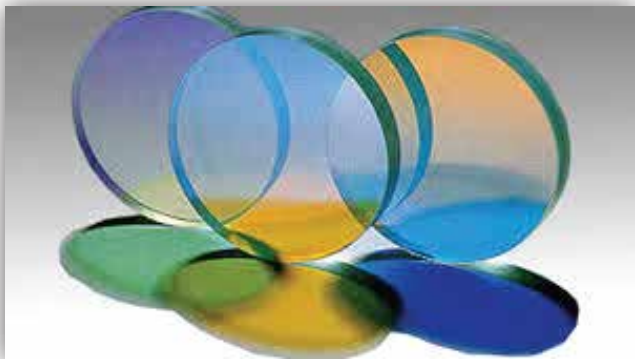
Quality Standard

- 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 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.





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

"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.



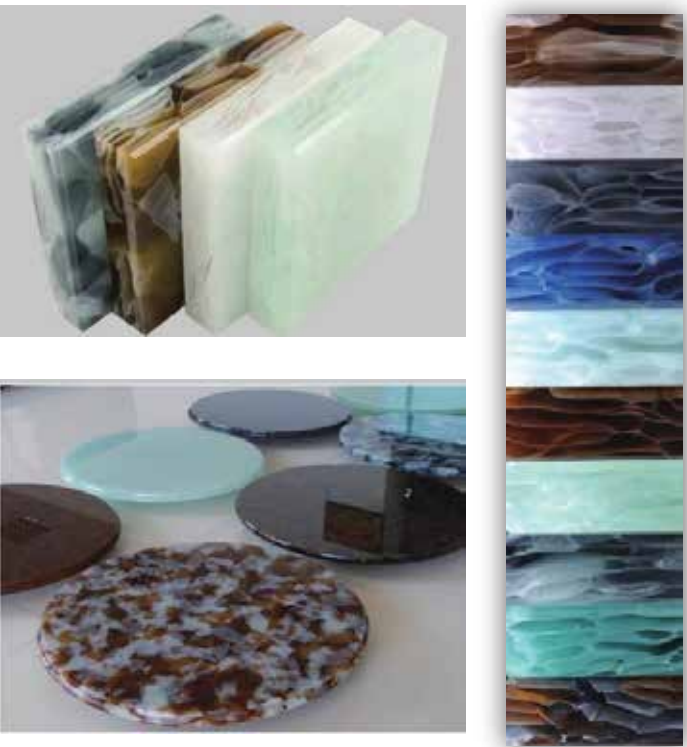
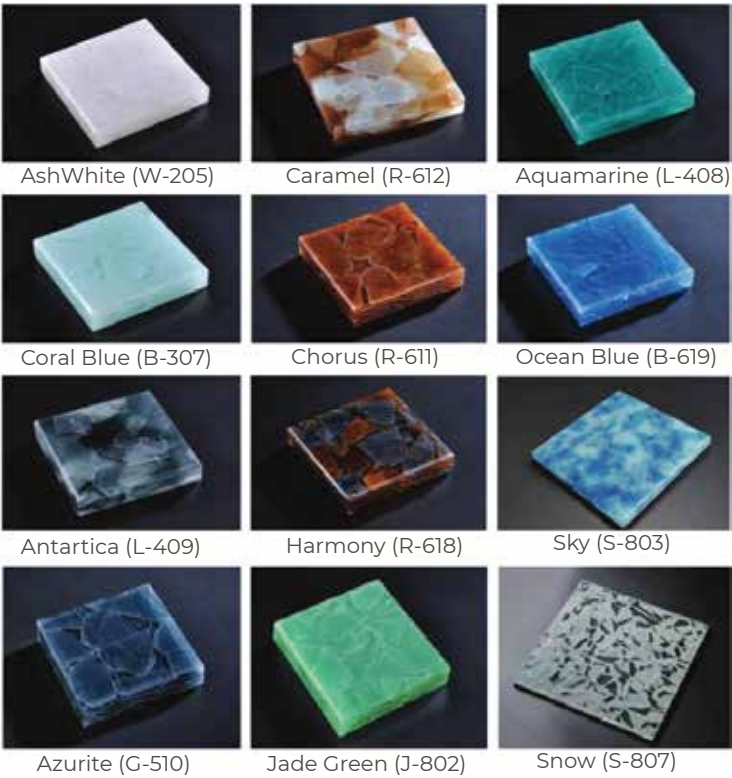
Installation

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.

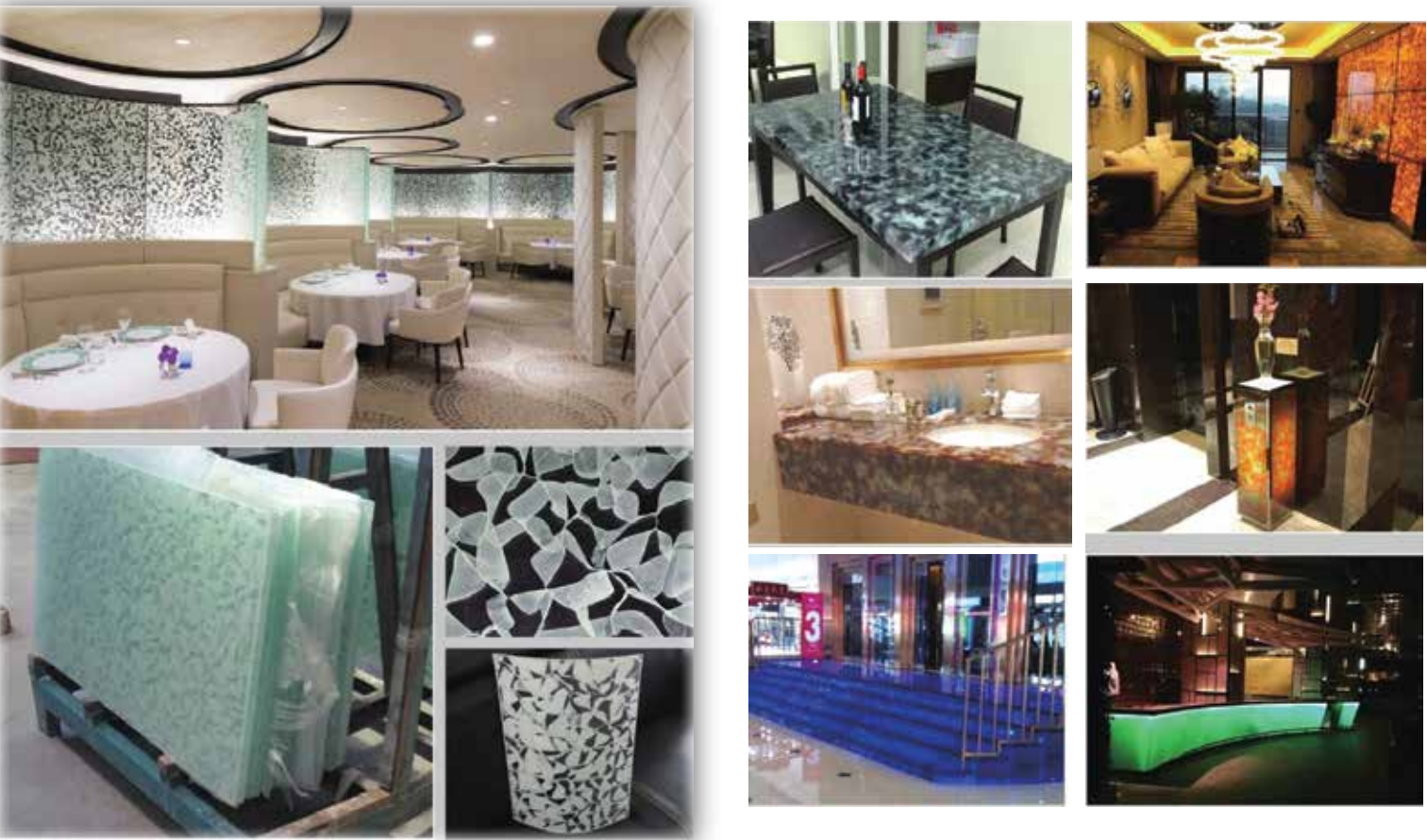
JADE Glass Dimensions (standard)	
Thickness	20mm & 30mm
Max. Slab Size	1400mm X 3000mm

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

Varities to choose from.



Various Decorative Applications





PV (Photovoltaic modules)

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

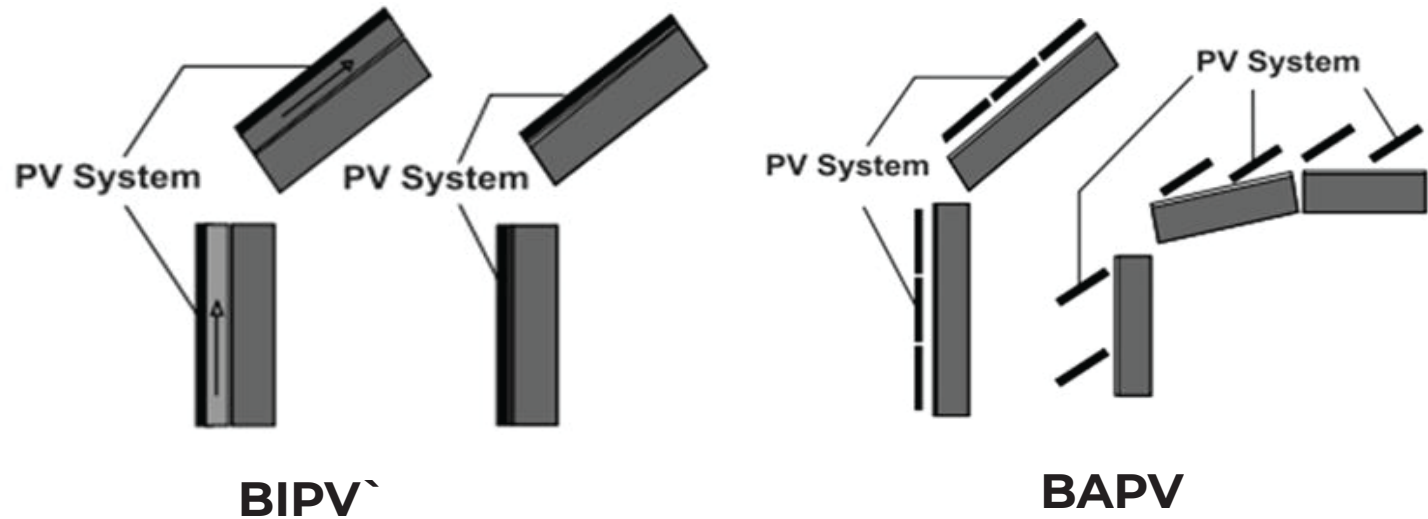


BIPV`

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.

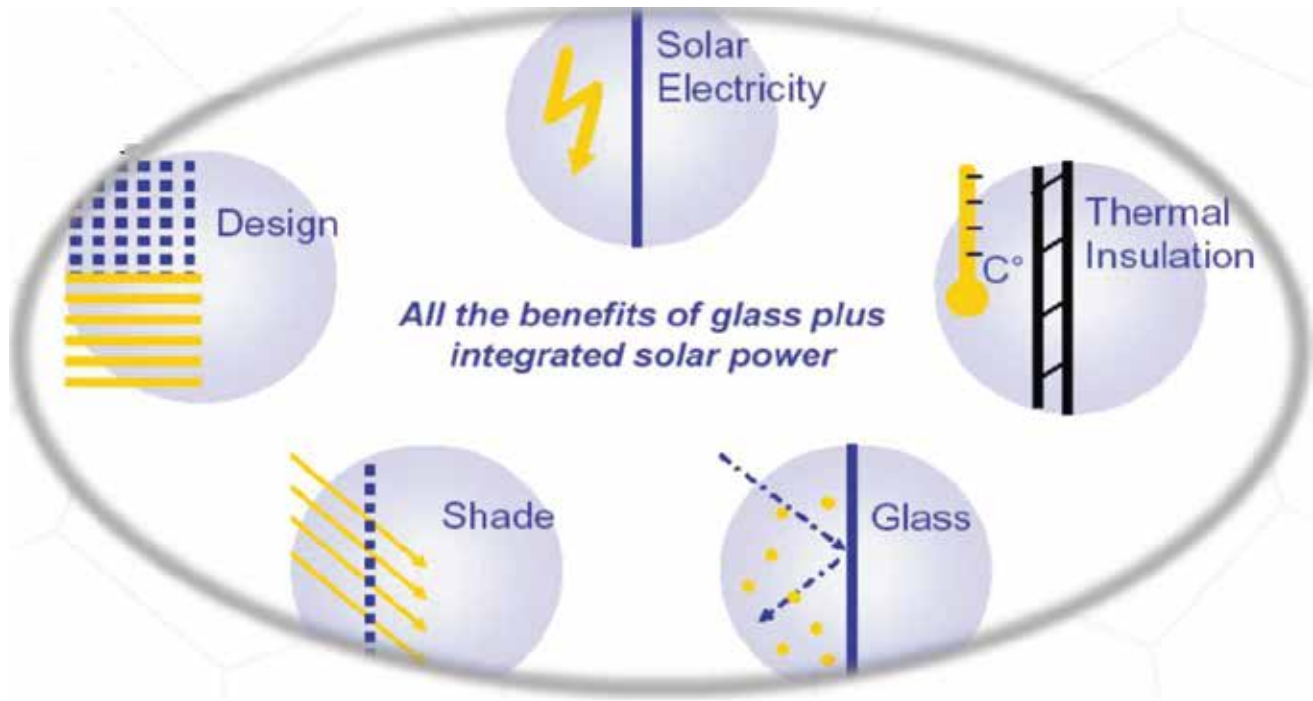
BAPV

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



BIPV: 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:

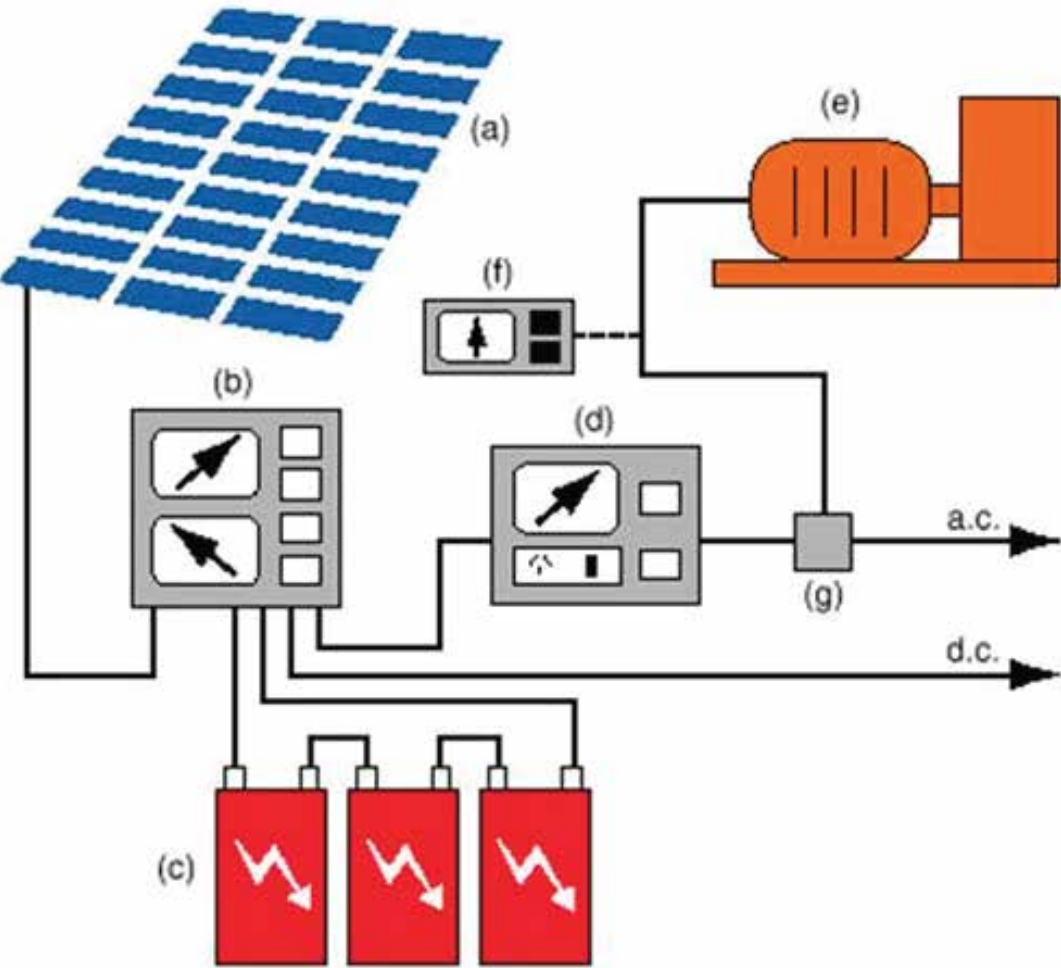
- • Energy Generation
- • Design
- • Glare protection / light guidance
- • Shade and transparency
- • Protection against the sun and heat
- • Roof and facade skin;`





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

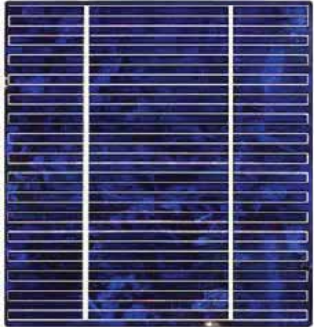
Monosilicon cell



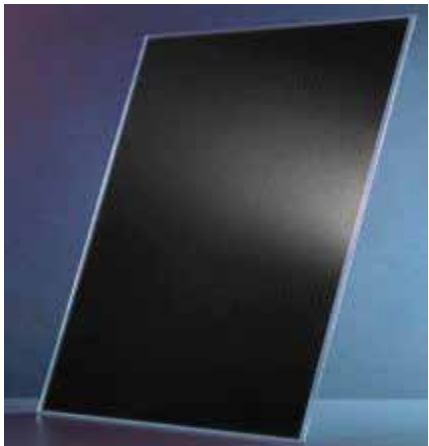
Polysilicon cell



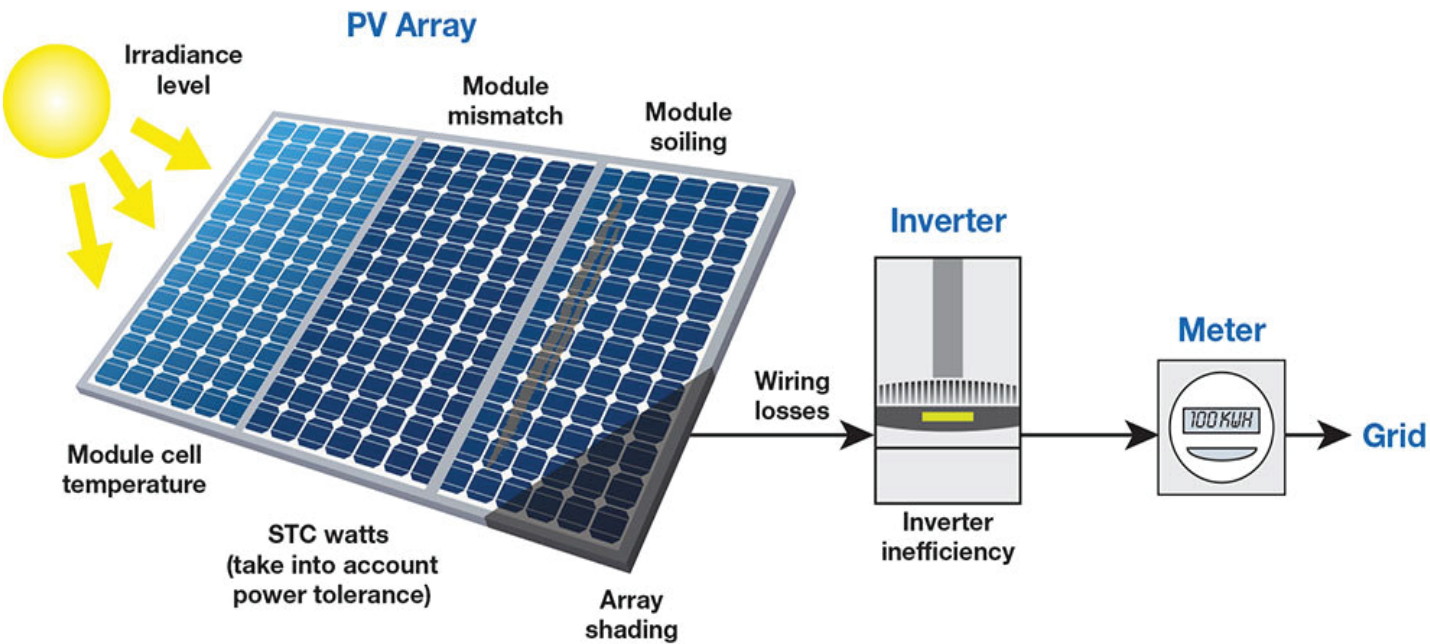
Amorphous silicon cell



CdTe (Cadium Telluride) cell



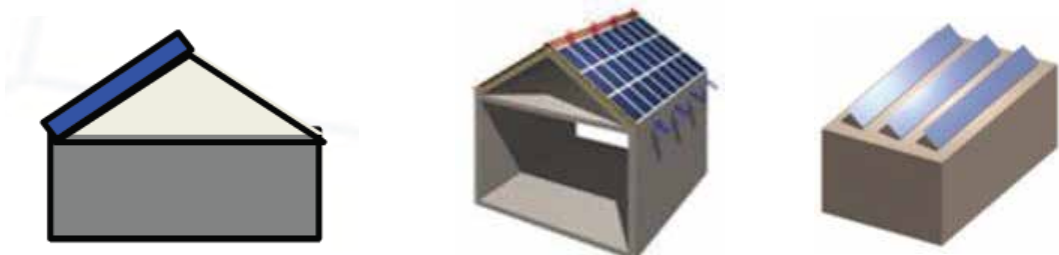
CIGS (Copper Indium Galium Selenide) cell



Main types of BIPV system

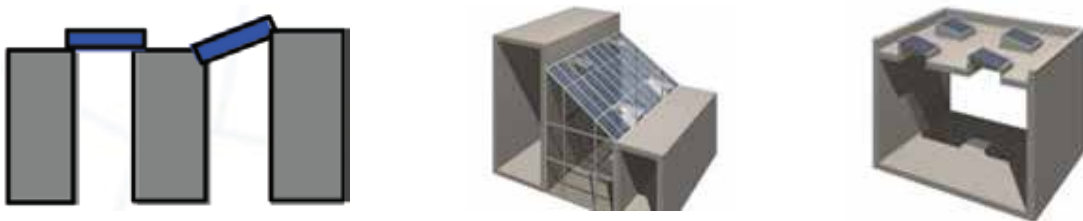
PV roof

installed on the roof as construction components



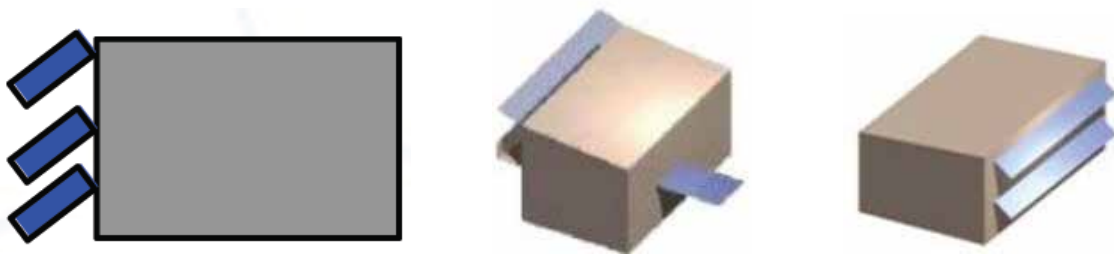
PV window and sunroof

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



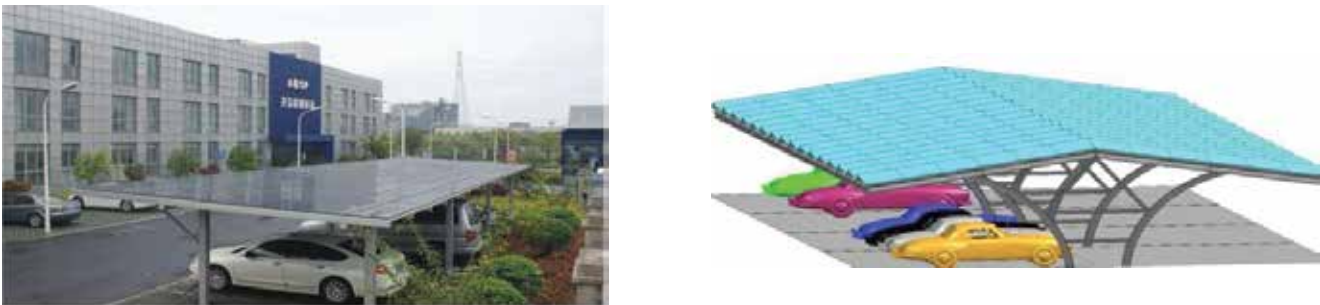
Flexible PV plant

installed on the roof as construction components



Car Shed PV plant

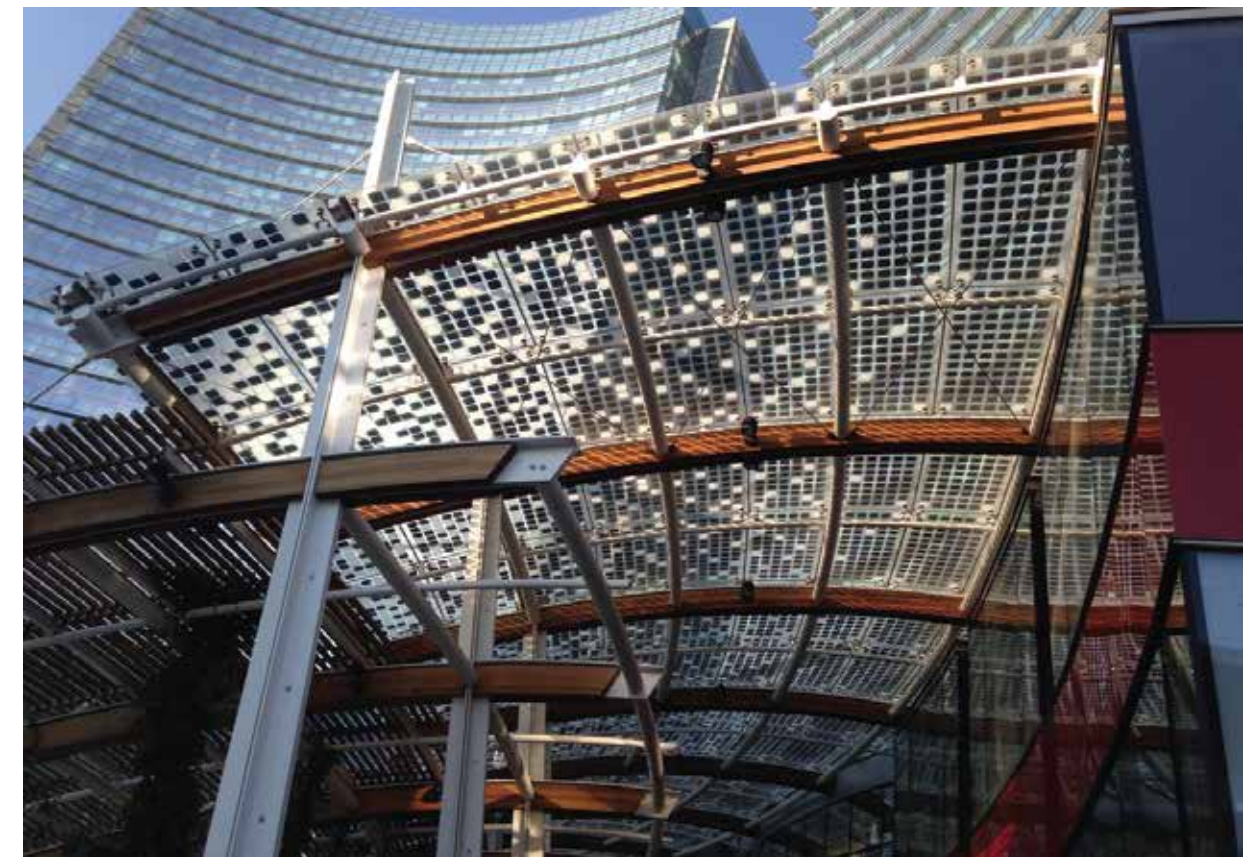
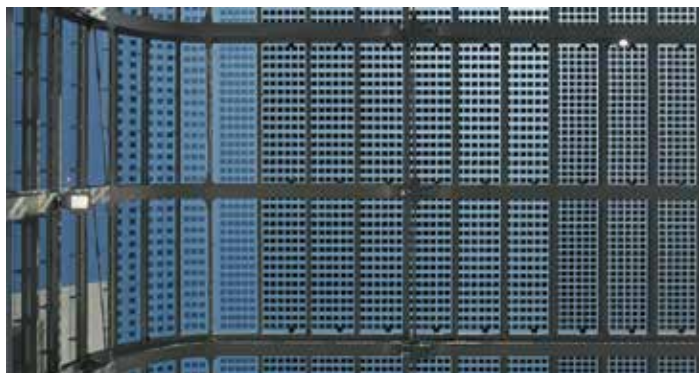
installed on steel structure as construction components



PV LED flaring building











Project Name : Chhatrapati Shivaji International Airport (CIAL).  
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 & Exhibition 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 : Amazon India Headquarters.  
Developed by : Amazon India.  
Design Office : Ar CRN, Chennai (India).  
Location : Hyderabad, India.  
Supplied Area : 30,000 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 : 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.







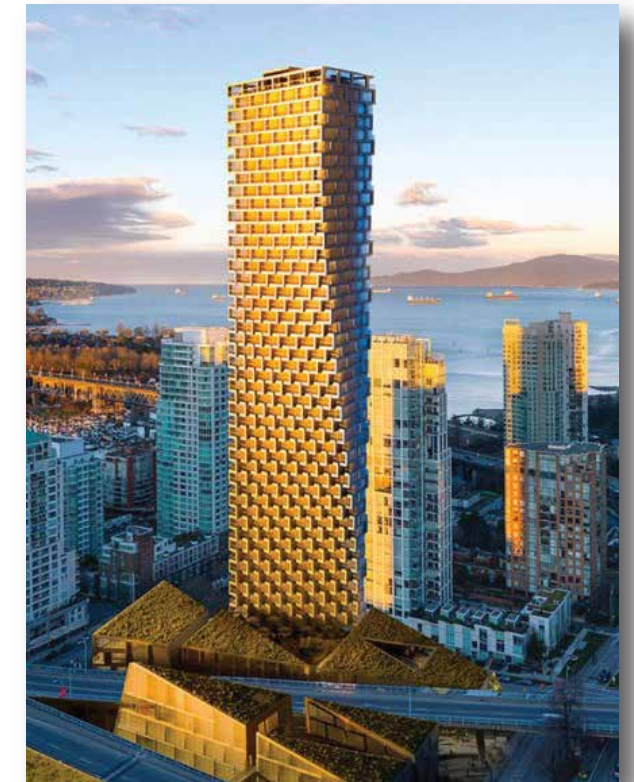
Project Name : 30 Madison Avenue, USA  
Supplied Area : 17,000 sq/meters.



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

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



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



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



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



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

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





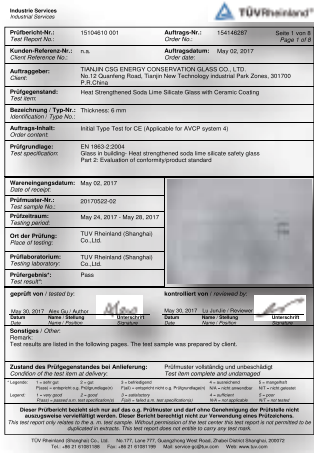
BSI Certificate for Insulating Glass Units



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 Jl. 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

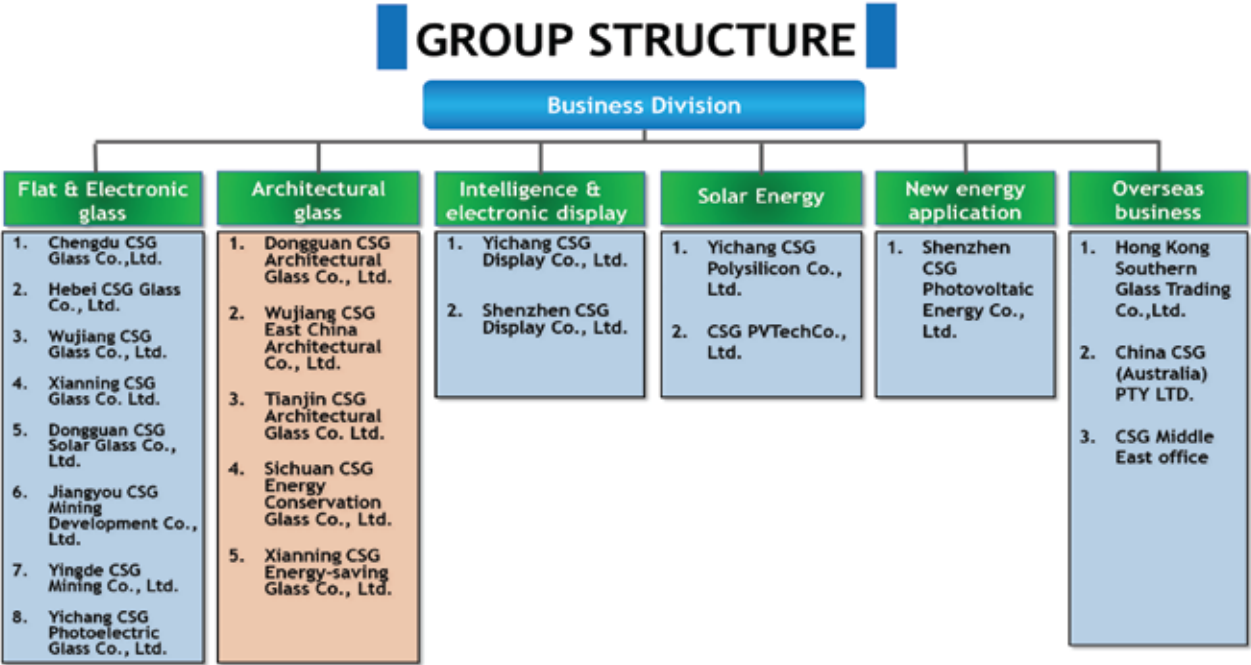
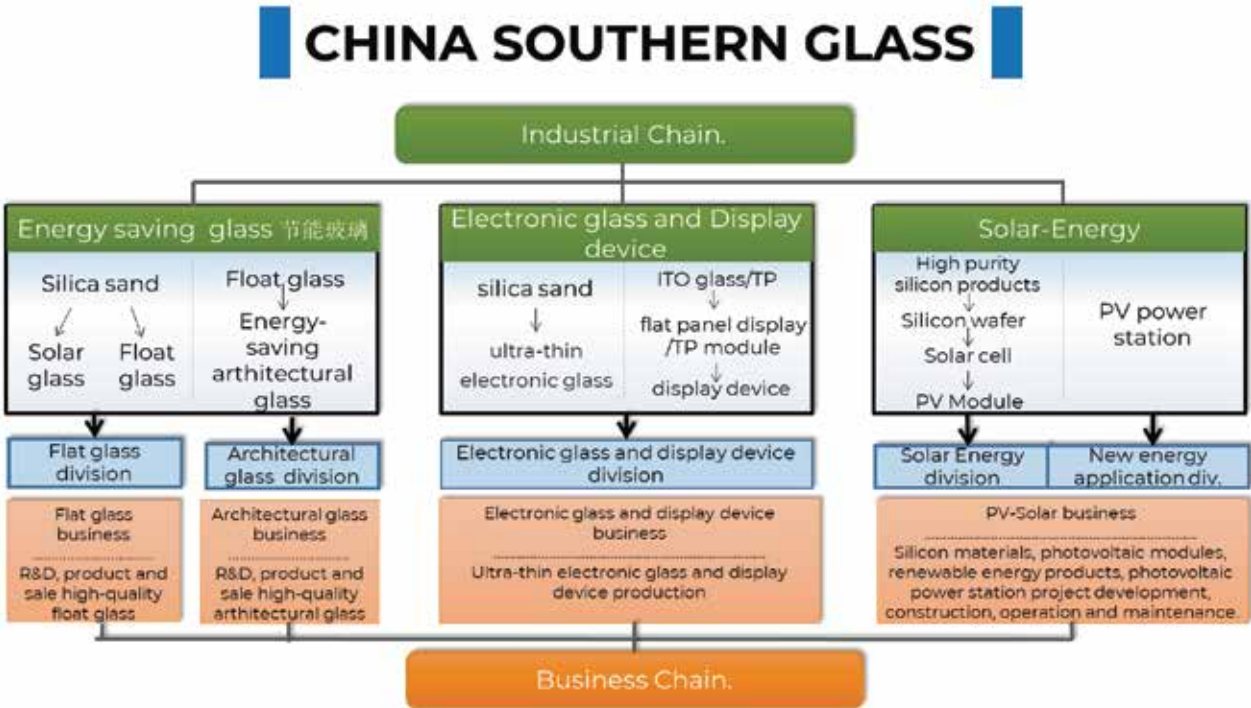
**CSG (HK) North America & Central Asia**

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:**

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Email: angel@csgholding.com.  
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## **7.2 ตัวอย่างเอกสารตรวจสอบเครื่องใช้ไฟฟ้าและเครื่องจักรของโครงการ (เครื่องปรับอากาศ)**



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# PREVENTIVE MAINTENANCE WATER COOLED CHILLER

BRAND



TRANE



Carrier



Haier



DB



Tasaki

2064

SERVICE DATE: 23/02/65  
CUSTOMER: MUANG THAI CAPITAL  
CHILLER MODEL: CGMPDPWNI  
COMPRESSOR MODEL: \_\_\_\_\_  
COMPRESSOR MODEL: \_\_\_\_\_

JOB NO: USC-20-100  
LOCATION: \_\_\_\_\_  
SERIAL NO. AA55661M00BA54000  
SERIAL NO. \_\_\_\_\_  
SERIAL NO. \_\_\_\_\_

SERVICE VISIT NO. \_\_\_\_\_  
UNIT NO. 2  
OIL TYPE: \_\_\_\_\_  
REFRIGERANT: R136A  
OPERATING HRS: 1202  
START COUNT: \_\_\_\_\_  
OPERATING HRS: 1202  
START COUNT: \_\_\_\_\_

- ☐ CENTRIFUGAL ☐ RECIPROCATING ☐ STAR-DELTA ☐ VSD ☐ OTHERS  
☐ SCREW ☐ SCROLL ☐ SOLID STATE STARTER ☐ AUTO-TRANS

## MOTOR INFORMATION

## DESIGN CONDITIONS

MOTOR MODEL:	SERIAL NO.		P.D.	T.D.
MOTOR BRAND:	VOLT/PHASE/Hz:	COOLER		
MOTOR HP:	FLA :	CONDENSER		
MOTOR RPM:	LRA :			

## OIL SUMP

## Units

## MOTOR

## Units

OIL LEVEL :	<input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/>	% FLA: (FLA _____)	<u>30</u>	<u>0</u>	Amps
OIL PRESSURE		Kpad / Psid	INPUT POWER :		Kw
OIL PRESSURE (LOP)		Kpa / Psig	PHASE A VOLTAGE	<u>396</u>	Volts
OIL PRESSURE (HOP)		Kpa / Psig	PHASE B VOLTAGE	<u>396</u>	Volts
OIL SUMP TEMPERATURE		°C / °F	PHASE C VOLTAGE	<u>396</u>	Volts
OIL PUMP DRIVE FREQUENCY		Hz	PHASE A CURRENT	<u>61.3</u>	Amps
STANBY OIL PRESSURE		Ena/ Dis	PHASE B CURRENT	<u>64.2</u>	Amps
			PHASE C CURRENT	<u>88.6</u>	Amps

## COMPRESSOR

## Units

## OUTPUT FREQUENCY

SUCTION TEMPERATURE	<u>45.6</u>	°C / °F	OUTPUT VOLTAGE		Volts
DISCHARGE TEMPERATURE	<u>96.7</u>	°C / °F	DC BUS VOLTAGE		Volts
DISCHARGE SUPPERHEAT		°C / °F	INVERTER LINK CURRENT		Amps
PROTECTION VANE		%	INTERNAL AMBIENT TEMPERATURE	<u>42.3</u>	°C / °F
VANE POSITION		%	CONVERTER HEATSINK TEMPERATURE	<u>42.2</u>	°C / °F
SLIDE VALVE POSITION (YS/YR)		%	PHASE A (SCR & HEATSING) TEMPERATURE		°C / °F
PROXIMITY POS./REF (YK)		Mill	PHASE B (SCR & HEATSING) TEMPERATURE		°C / °F
TOTAL VGD COUNT (YK)		Nos	PHASE C (SCR & HEATSING) TEMPERATURE		°C / °F
TOTAL SURGE COUNT		Nos			

## CONDENSER

## Units

DELTA-P (Condenser - Evaporator / Evaporator)		Kpad / Psid	CONDENSER PRESSURE	<u>89.0</u>	<u>80.4</u>	Kpa / Psid
EVAPORATOR		Units	CONDENSER SATURATION TEMPERATURE			°C / °F
REFRIG	EVAPORATOR PRESSURE	<u>23.7</u>	DROP LEG REFRIGERANT TEMPERATURE			°C / °F
	EVAPORATURE SATURATION TEMP	<u>41.6</u>	SUB COOLING TEMPERATURE			°C / °F
	EVAPORATURE REFRIGERANT TEMP		REFRIGERANT LEVEL SETING			%
LIQUID	SET POINT TEMPERATURE	<u>29.0</u>	REFRIGERANT LEVEL POSITION			%
	LEAVING CHILLED WATER TEMP	<u>46.9</u>	LEAVING CONDENSER TEMPERATURE	<u>50.9</u>		°C / °F
	ENTERING CHILLED WATER TEMP	<u>48.3</u>	ENTERING CONDENSER TEMPERATURE	<u>46.9</u>		°C / °F
	SMALL TEMPERATURE DIFFERENCE		SMALL TEMPERATURE DIFFERENCE			°C / °F
	INLET PRESSURE	<u>90</u>	INLET PRESSURE	<u>86</u>		Kpa / Psid
	OUTLET PRESSURE	<u>5</u>	OUTLET PRESSURE	<u>80</u>		Kpa / Psid
	FLOW RATE		FLOW RATE			GPM

## INSPECTION CHECK LIST

## COMMENT

<input checked="" type="checkbox"/> System Operation	Desired Speed	<u>17211</u>	<u>17211</u>	<u>17211</u>	r/min
<input type="checkbox"/> Protection Device	Actual Speed	<u>17211</u>	<u>0</u>	<u>0</u>	r/min
Refrigerant level	Surge Speed	<u>17211</u>	<u>3695</u>	<u>3695</u>	r/min
<input type="checkbox"/> Oil level & Colour	Crack Speed	<u>23068</u>	<u>10510</u>	<u>10510</u>	r/min
<input type="checkbox"/> Oil Return Operation	IBV Opening	<u>110.0</u>	<u>110.0</u>	<u>110.0</u>	°C
<input type="checkbox"/> Purge Unit Operation (YT)	Refrigerant Power	<u>20.1</u>	<u>0.0</u>	<u>0.0</u>	kW
<input type="checkbox"/> Oil Cooler	Actual Power	<u>20.1</u>	<u>0.0</u>	<u>0.0</u>	kW
<input type="checkbox"/> Oil Filter	IBV Opening	<u>26.7</u>	<u>0.0</u>	<u>0.0</u>	°C
<input checked="" type="checkbox"/> Sign of Leakage	Liquid level	<u>5.1</u>	<u>25</u>	<u>25</u>	°C
<input type="checkbox"/> Machine Noise level					
<input type="checkbox"/> Check Control and Safety Cutout					
<input type="checkbox"/> Check for part deteriortion and					
Touch-up rusty part					
<input checked="" type="checkbox"/> Clean machine					

## SERVICE & WARRANTY INFORMATION

<input checked="" type="checkbox"/> SERVICE PERIOD <u>3</u> YEAR(S)					
<input type="checkbox"/> 6 TIMES / YEAR					
<input type="checkbox"/> 12 TIMES / YEAR					
<input checked="" type="checkbox"/> OTHERS <u>2 Y</u>					

## SCOPE OF WORK

## SATISFACTION OF THE CLIENT & COMMENTS

<input type="checkbox"/> INCLUDED ANNUAL OIL CHANGE	<input type="checkbox"/> Excellent	<input type="checkbox"/> Very Good	<input type="checkbox"/> Good	<input type="checkbox"/> Fair	<input type="checkbox"/> Improve
<input type="checkbox"/> INCLUDED CONDENSER TUBE					
<input type="checkbox"/> INCLUDED CHANGE COOLANT					
<input type="checkbox"/> INCLUDED OIL ANALYSIS					





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BRAND



YORK



TRANE



Carrier



Haier



DB



Tasaki

# PREVENTIVE MAINTENANCE WATER COOLED CHILLER

2069

SERVICE DATE: 22/02/65  
CUSTOMER: MOBANG THAI CAPITAL  
CHILLER MODEL: CG110FWNI  
COMPRESSOR MODEL: \_\_\_\_\_  
COMPRESSOR MODEL: \_\_\_\_\_

JOB NO: USG-90-100  
LOCATION: \_\_\_\_\_  
SERIAL NO. AA920EE1M00BAK0001  
SERIAL NO. \_\_\_\_\_  
SERIAL NO. \_\_\_\_\_

SERVICE VISIT NO. \_\_\_\_\_  
UNIT NO. \_\_\_\_\_  
OIL TYPE: \_\_\_\_\_  
REFRIGERANT: R134A  
OPERATING HRS: 1292  
START COUNT: \_\_\_\_\_  
OPERATING HRS: 1292  
START COUNT: \_\_\_\_\_

- ☒ CENTRIFUGAL ☐ RECIPROCATING ☐ STAR-DELTA ☒ VSD ☐ OTHERS  
☐ SCREW ☐ SCROLL ☐ SOLID STATE STARTER ☐ AUTO-TRANS

## MOTOR INFORMATION

## DESIGN CONDITIONS

MOTOR MODEL:	SERIAL NO.		P.D.	T.D.
MOTOR BRAND:	VOLT/PHASE/Hz:	COOLER		
MOTOR HP:	FLA :	CONDENSER		
MOTOR RPM:	LRA :			

OIL SUMP			Units	MOTOR			Units
OIL LEVEL :	<u>00</u>	<u>00</u>		% FLA: (FLA _____)	<u>0</u>	<u>52.3</u>	Amps
OIL PRESSURE			Kpad / Psid	INPUT POWER :		<u>14.5</u>	Kw
OIL PRESSURE (LOP)			Kpa / Psig	PHASE A VOLTAGE		<u>396</u>	Volts
OIL PRESSURE (HOP)			Kpa / Psig	PHASE B VOLTAGE		<u>393</u>	Volts
OIL SUMP TEMPERATURE			°C / °F	PHASE C VOLTAGE		<u>396</u>	Volts
OIL PUMP DRIVE FREQUENCY			Hz	PHASE A CURRENT	<u>2</u>	<u>70.1</u>	Amps
STANDBY OIL PRESSURE			Ena / Dis	PHASE B CURRENT	<u>0</u>	<u>40.3</u>	Amps
				PHASE C CURRENT	<u>0</u>	<u>41.4</u>	Amps

COMPRESSOR			Units	CONDENSER			Units
SUCTION TEMPERATURE	<u>30.0</u>	<u>45.6</u>	°C / °F	OUTPUT VOLTAGE			Volts
DISCHARGE TEMPERATURE	<u>32.3</u>	<u>95.6</u>	°C / °F	DC BUS VOLTAGE			Volts
DISCHARGE SUPPERHEAT			°C / °F	INVERTER LINK CURRENT			Amps
PR. ION VANE	<u>EXV Opening</u>	<u>0.0</u>	%	INTERNAL AMBIENT TEMPERATURE	<u>Inverter Temp</u>	<u>39.9</u>	°C / °F
VANE POSITION		<u>30.0</u>	%	CONVERTER HEATSINK TEMPERATURE	<u>Soft Start Temp</u>	<u>106.3</u>	°C / °F
SLIDE VALVE POSITION (YS/YR)			%	PHASE A (SCR & HEATSING) TEMPERATURE			°C / °F
PROXIMITY POS./REF (YK)			Mill	PHASE B (SCR & HEATSING) TEMPERATURE			°C / °F
TOTAL VGD COUNT (YK)			Nos	PHASE C (SCR & HEATSING) TEMPERATURE			°C / °F
TOTAL SURGE COUNT			Nos				
DELTA-P (Condenser - Evaporator / Evaporator)			Kpad / Psid				

EVAPORATOR			Units	REFRIG			Units
REFRIG	EVAPORATOR PRESSURE	<u>46.9</u>	Kpa / Psig	REFRIG	CONDENSER PRESSURE	<u>83.0</u>	Kpa / Psi
	EVAPORATURE SATURATION TEMP		°C / °F		CONDENSER SATURATION TEMPERATURE		°C / °F
	EVAPORATURE REFRIGERANT TEMP		°C / °F		DROP LEG REFRIGERANT TEMPERATURE		°C / °F
	SET POINT TEMPERATURE	<u>49.0</u>	°C / °F		SUB COOLING TEMPERATURE		°C / °F
	LEAVING CHILLED WATER TEMP	<u>14.0</u>	°C / °F		REFRIGERANT LEVEL SETING		%
	ENTERING CHILLED WATER TEMP	<u>15.0</u>	°C / °F		REFRIGERANT LEVEL POSITION	<u>83.2</u>	%
	SMALL TEMPERATURE DIFFERENCE		°C / °F		LEAVING CONDENSER TEMPERATURE	<u>48.9</u>	°C / °F
	INLET PRESSURE	<u>90</u>	Kpa / Psig		ENTERING CONDENSER TEMPERATURE		°C / °F
	OUTLET PRESSURE	<u>84</u>	Kpa / Psig		SMALL TEMPERATURE DIFFERENCE		°C / °F
	FLOW RATE		GPM		INLET PRESSURE	<u>86</u>	Kpa / Psi
					OUTLET PRESSURE	<u>80</u>	Kpa / Psi
					FLOW RATE		GPM

INSPECTION CHECK LIST			COMMENT		
<input checked="" type="checkbox"/>	System Operation		Desired speed	<u>60rpm</u>	<u>60rpm</u>
<input checked="" type="checkbox"/>	Protection Device		Actual speed	<u>0</u>	<u>2122</u>
<input checked="" type="checkbox"/>	Refrigerant level		Surge speed	<u>3692</u>	<u>19126</u>
<input type="checkbox"/>	Oil level & Colour		Chock speed	<u>10506</u>	<u>23487</u>
<input type="checkbox"/>	Oil Return Operation		IGV Opening	<u>110.0</u>	<u>110.0</u>
<input type="checkbox"/>	Purge Unit Operation (YT)		Requested Power	<u>0</u>	<u>44.4</u>
<input type="checkbox"/>	Oil Cooler		Actual Power	<u>0</u>	<u>44.0</u>
<input type="checkbox"/>	Oil Filter		Liquid level	<u>46</u>	<u>49</u>
<input checked="" type="checkbox"/>	Sign of Leakage				
<input type="checkbox"/>	Machine Noise level				
<input type="checkbox"/>	Check Control and Safety Cutout				
<input type="checkbox"/>	Check for part deteriortion and				
<input type="checkbox"/>	Touch-up rusty part				
<input checked="" type="checkbox"/>	Clean machine				

## SERVICE & WARRANTY INFORMATION

- ☐ SERVICE PERIOD 5 YEAR(S)  
☐ 6 TIMES / YEAR  
☐ 12 TIMES / YEAR  
☒ OTHERS 4/14

## SCOPE OF WORK

## SATISFACTION OF THE CLIENT & COMMENTS

- ☐ INCLUDED ANNUAL OIL CHANGE ☐ Excellent ☐ Very Good ☐ Good ☐ Fair ☐ Improve  
☐ INCLUDED CONDENSER TUBE  
☐ INCLUDED CHANGE COOLANT  
☐ INCLUDED OIL ANAYLYSIS





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BRAND



3312

# PREVENTIVE MAINTENANCE WATER COOLED CHILLER

SERVICE DATE: 15/7/51/65 JOB NO: VSC-80-100 SERVICE VISIT NO. 1  
CUSTOMER: 14037nd LOCATION: AA880611M00079K020001 UNIT NO. 1  
CHILLER MODEL: CC1100PWN1 SERIAL NO. OIL TYPE: REFRIGERANT: R132  
COMPRESSOR MODEL: SERIAL NO. OPERATING HRS: 1510 START COUNT:  
COMPRESSOR MODEL: SERIAL NO. OPERATING HRS: 1510 START COUNT:

- ☒ CENTRIFUGAL ☐ RECIPROCATING ☐ STAR-DELTA ☒ VSD ☐ OTHERS  
☐ SCREW ☐ SCROLL ☐ SOLID STATE STARTER ☐ AUTO-TRANS

## MOTOR INFORMATION

## DESIGN CONDITIONS

MOTOR MODEL:	SERIAL NO.	COOLER	P.D.	T.D.
MOTOR BRAND:	VOLT/PHASE/Hz: 380V/3/50	CONDENSER		
MOTOR HP:	FLA:			
MOTOR RPM:	LRA:			

## OIL SUMP

## Units

## MOTOR

## Units

OIL LEVEL:		% FLA: (FLA _____)		Amps
OIL PRESSURE	Kpad / Psid	INPUT POWER:		Kw
OIL PRESSURE (LOP)	Kpa / Psig	PHASE A VOLTAGE		Volts
OIL PRESSURE (HOP)	Kpa / Psig	PHASE B VOLTAGE	403	393
OIL SUMP TEMPERATURE	°C / °F	PHASE C VOLTAGE		Volts
OIL PUMP DRIVE FREQUENCY	Hz	PHASE A CURRENT		Amps
STANBY OIL PRESSURE	Ena/ Dis	PHASE B CURRENT		Amps
		PHASE C CURRENT		Amps

## COMPRESSOR

## Units

## OUTPUT FREQUENCY

SUCTION TEMPERATURE	80	111	°C / °F	OUTPUT VOLTAGE		Volts
DISCHARGE TEMPERATURE	83	111	°C / °F	DC BUS VOLTAGE		Volts
DISCHARGE SUPERHEAT			°C / °F	INVERTER LINK CURRENT		Amps
PRE-ROTATION VANE Inverter Temp	88.2	110.4	%	INTERNAL AMBIENT TEMPERATURE		°C / °F
VANE POSITION Soft Star Temp	106.1	131.8	%	CONVERTER HEATSINK TEMPERATURE		°C / °F
SLIDE VALVE POSITION (YS/YR)			%	PHASE A (SCR & HEATSINK) TEMPERATURE		°C / °F
PROXIMITY POS./REF (YK)			Mill	PHASE B (SCR & HEATSINK) TEMPERATURE		°C / °F
TOTAL VGD COUNT (YK)			Nos	PHASE C (SCR & HEATSINK) TEMPERATURE		°C / °F
TOTAL SURGE COUNT			Nos			

DELTA-P (Condenser - Evaporator / Evaporator)	Kpad / Psid	CONDENSER	Units
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## EVAPORATOR

## Units

REFRIG	EVAPORATOR PRESSURE	44	32	Kpa / Psig	REFRIG	CONDENSER PRESSURE	103	113	Kpa / Psi
	EVAPORATURE SATURATION TEMP			°C / °F		CONDENSER SATURATION TEMPERATURE			°C / °F
	EVAPORATURE REFRIGERANT TEMP			°C / °F		DROP LEG REFRIGERANT TEMPERATURE			°C / °F
	SET POINT TEMPERATURE		18.0	°C / °F		SUB COOLING TEMPERATURE			°C / °F
	LEAVING CHILLED WATER TEMP	11.5		°C / °F		REFRIGERANT LEVEL SETING			%
	ENTERING CHILLED WATER TEMP	14.8		°C / °F		REFRIGERANT LEVEL POSITION			%
	SMALL TEMPERATURE DIFFERENCE		3.6	°C / °F		LEAVING CONDENSER TEMPERATURE	43.1		°C / °F
	INLET PRESSURE	90		Kpa / Psig		ENTERING CONDENSER TEMPERATURE	34.0		°C / °F
	OUTLET PRESSURE	84		Kpa / Psig		SMALL TEMPERATURE DIFFERENCE		1.0	°C / °F
	FLOW RATE			GPM		INLET PRESSURE	86		Kpa / Psi
						OUTLET PRESSURE	80		Kpa / Psi
						FLOW RATE			GPM

## INSPECTION CHECK LIST

## COMMENT

<input type="checkbox"/> System Operation	Desired Speed	0	15A21
<input type="checkbox"/> Protection Device	Actual Speed	0	12989
<input type="checkbox"/> Refrigerant level	Surge Speed	3695	21328
<input type="checkbox"/> Oil level & Colour	choke Speed	10508	25A69
<input type="checkbox"/> Oil Return Operation	1kv. Opening	110.0	110.0
<input type="checkbox"/> Purge Unit Operation (YT)	Requested Power	0.0	86.1
<input type="checkbox"/> Oil Cooler	Actual Power	0.0	87.0
<input type="checkbox"/> Oil Filter			
<input type="checkbox"/> Sign of Leakage			
<input type="checkbox"/> Machine Noise level			
<input type="checkbox"/> Check Control and Safety Cutout			
<input type="checkbox"/> Check for part deteriorion and			
<input type="checkbox"/> Touch-up rusty part			
<input type="checkbox"/> Clean machine			

## SERVICE & WARRANTY INFORMATION

<input type="checkbox"/> SERVICE PERIOD YEAR(S)	1kv Opening	0.0	11.0
<input type="checkbox"/> 6 TIMES / YEAR	Liquid Level	55	50
<input type="checkbox"/> 12 TIMES / YEAR			
<input type="checkbox"/> OTHERS			

## SCOPE OF WORK

## SATISFACTION OF THE CLIENT & COMMENTS

<input type="checkbox"/> INCLUDED ANNUAL OIL CHANGE	<input type="checkbox"/> Excellent	<input type="checkbox"/> Very Good	<input type="checkbox"/> Good	<input type="checkbox"/> Fair	<input type="checkbox"/> Improve
<input type="checkbox"/> INCLUDED CONDENSER TUBE					
<input type="checkbox"/> INCLUDED CHANGE COOLANT					



# PREVENTIVE MAINTENANCE WATER COOLED CHILLER

BRAND



2070

SERVICE DATE: 24 / 5 / 65  
CUSTOMER: Wasthu  
CHILLER MODEL: CCH100PHW1  
COMPRESSOR MODEL:  
COMPRESSOR MODEL:

JOB NO: USC-20-100  
LOCATION: A88A06EIM0059KSH0001  
SERIAL NO.:  
SERIAL NO.:  
SERIAL NO.:

SERVICE VISIT NO.:  
UNIT NO.: 8  
OIL TYPE: -  
REFRIGERANT: R132  
OPERATING HRS: 1440  
START COUNT:  
OPERATING HRS: 1442  
START COUNT:

- ☒ CENTRIFUGAL ☐ RECIPROCATING ☐ STAR-DELTA ☒ VSD ☐ OTHERS  
☐ SCREW ☐ SCROLL ☐ SOLID STATE STARTER ☐ AUTO-TRANS

## MOTOR INFORMATION

## DESIGN CONDITIONS

MOTOR MODEL:	SERIAL NO.		P.D.	T.D.
MOTOR BRAND:	VOLT/PHASE/Hz: 380 / 3 / 60	COOLER		
MOTOR HP:	FLA :	CONDENSER		
MOTOR RPM:	LRA :			

OIL SUMP	Units	MOTOR	Units
OIL LEVEL :	○ ○ ○ ○	% FLA: (FLA _____)	48 48 Amps
OIL PRESSURE	Kpad / Psid	INPUT POWER :	58 55 Kw
OIL PRESSURE (LOP)	Kpa / Psig	PHASE A VOLTAGE	
OIL PRESSURE (HOP)	Kpa / Psig	PHASE B VOLTAGE	388 488 Volts
OIL SUMP TEMPERATURE	°C / °F	PHASE C VOLTAGE	
OIL PUMP DRIVE FREQUENCY	Hz	PHASE A CURRENT	
STANBY OIL PRESSURE	Ena / Dis	PHASE B CURRENT	98 98 Amps
		PHASE C CURRENT	

COMPRESSOR	Units	CONDENSER	Units
SUCTION TEMPERATURE	46 46 °C / °F	OUTPUT FREQUENCY	
DISCHARGE TEMPERATURE	110 108 °C / °F	OUTPUT VOLTAGE	
DISCHARGE SUPPERHEAT	°C / °F	DC BUS VOLTAGE	
PRELIMINARY VANE	108.8 105.8 %	INVERTER LINK CURRENT	
VANE POSITION	117.6 117.3 %	INTERNAL AMBIENT TEMPERATURE	
SLIDE VALVE POSITION (YS/YR)	%	CONVERTER HEATSINK TEMPERATURE	
PROXIMITY POS./REF (YK)	Mill	PHASE A (SCR & HEATSING) TEMPERATURE	
TOTAL VGD COUNT (YK)	Nos	PHASE B (SCR & HEATSING) TEMPERATURE	
TOTAL SURGE COUNT	Nos	PHASE C (SCR & HEATSING) TEMPERATURE	
DELTA-P (Condenser - Evaporator / Evaporator)	Kpad / Psid		

EVAPORATOR	Units	CONDENSER	Units
REFRIG		REFRIG	
EVAPORATOR PRESSURE	86 38 Kpa / Psig	CONDENSER PRESSURE	116 115 Kpa / Psig
EVAPORATURE SATURATION TEMP	°C / °F	CONDENSER SATURATION TEMPERATURE	°C / °F
EVAPORATURE REFRIGERANT TEMP	°C / °F	DROP LEG REFRIGERANT TEMPERATURE	°C / °F
SET POINT TEMPERATURE	48.0 °C / °F	SUB COOLING TEMPERATURE	°C / °F
LEAVING CHILLED WATER TEMP	22.4 °C / °F	REFRIGERANT LEVEL SETING	%
ENTERING CHILLED WATER TEMP	51.8 °C / °F	REFRIGERANT LEVEL POSITION	%
SMALL TEMPERATURE DIFFERENCE	2.0 °C / °F	LEAVING CONDENSER TEMPERATURE	46.5 °C / °F
INLET PRESSURE	Kpa / Psig	ENTERING CONDENSER TEMPERATURE	88.2 °C / °F
OUTLET PRESSURE	Kpa / Psig	SMALL TEMPERATURE DIFFERENCE	0.2 °C / °F
FLOW RATE	GPM	INLET PRESSURE	88 Kpa / Psig
		OUTLET PRESSURE	80 Kpa / Psig
		FLOW RATE	GPM

## INSPECTION CHECK LIST

## COMMENT

<input type="checkbox"/> System Operation	
<input type="checkbox"/> Protection Device	Desired speed 22405 22715
<input checked="" type="checkbox"/> Refrigerant level	
<input type="checkbox"/> Oil level & Colour	Actual Speed 21683 21182
<input type="checkbox"/> Oil Return Operation	
<input type="checkbox"/> Purge Unit Operation (YT)	Surge Speed 21595 20866
<input type="checkbox"/> Oil Cooler	
<input type="checkbox"/> Oil Filter	choke Speed 25512 25092
<input type="checkbox"/> Sign of Leakage	
<input type="checkbox"/> Machine Noise level	IGV Opening 110.0 110.0
<input type="checkbox"/> Check Control and Safety Cutout	
<input type="checkbox"/> Check for part deteriortion and	requested Power 52.0 55.5
Touch-up rusty part	
<input type="checkbox"/> Clean machine	Actual Power 52.5 55.6
SERVICE & WARRANTY INFORMATION	
<input type="checkbox"/> SERVICE PERIOD YEAR(S)	Low Opening 25.3 25.5
<input type="checkbox"/> 6 TIMES / YEAR	
<input type="checkbox"/> 12 TIMES / YEAR	Liavly Level 24 50
<input type="checkbox"/> OTHERS	

## SCOPE OF WORK

## SATISFACTION OF THE CLIENT & COMMENTS

<input type="checkbox"/> INCLUDED ANNUAL OIL CHANGE	<input type="checkbox"/> Excellent	<input type="checkbox"/> Very Good	<input type="checkbox"/> Good	<input type="checkbox"/> Fair	<input type="checkbox"/> Improve
<input type="checkbox"/> INCLUDED CONDENSER TUBE					
<input type="checkbox"/> INCLUDED CHANGE COOLANT					
<input type="checkbox"/> INCLUDED OIL ANAYLYSIS					



### 7.3 เอกสารรับรองสารทำความเย็นในระบบปรับอากาศของโครงการ





# MAGNETIC BEARING CENTRIFUGAL CHILLER



- 007 Features
- 017 Water-cooled Magnetic Bearing Centrifugal Chiller
- 029 Air-cooled Magnetic Bearing Centrifugal Chiller
- 037 Modular Water-cooled Magnetic Bearing Centrifugal Chiller

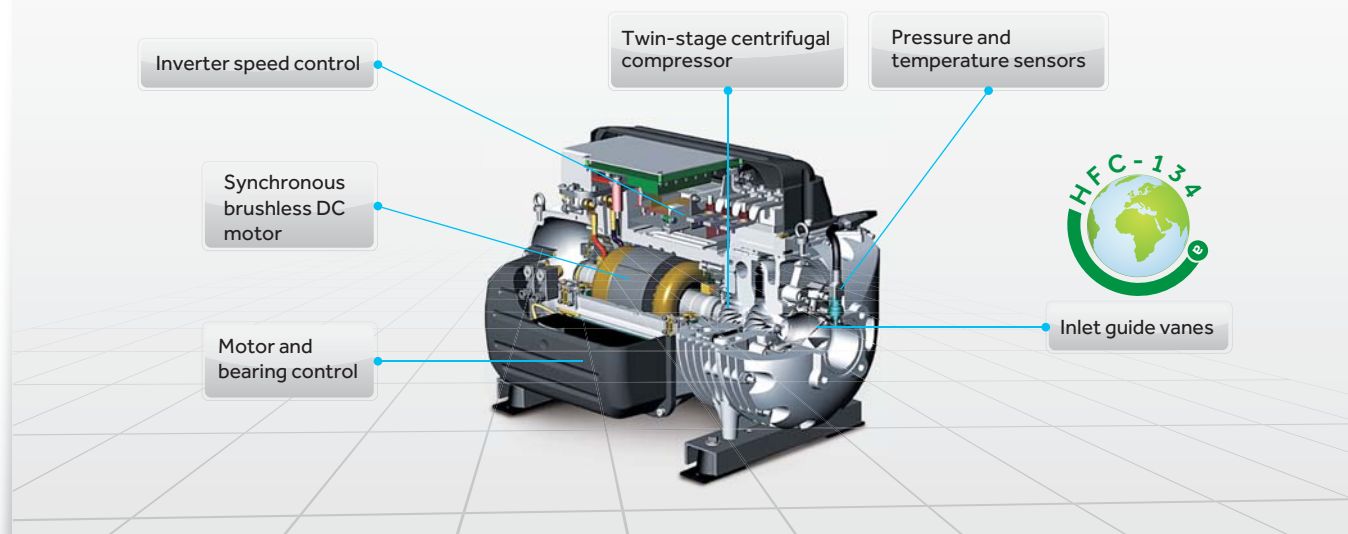


## Advanced Technology

### Compressor technology

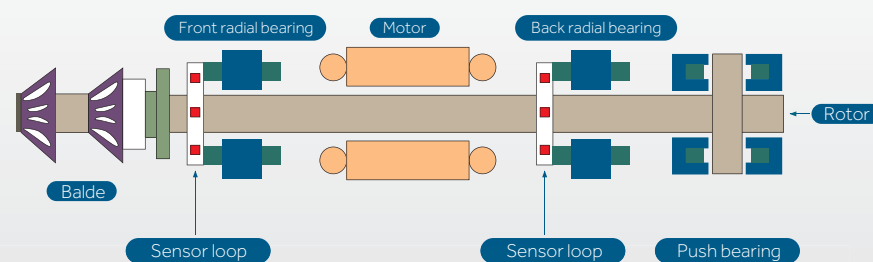
#### • Turbocor compressor technology

The chillers either water-cooled or air-cooled, are designed to optimize the performance of the high efficient Danfoss Turbocor oil-free centrifugal compressor technology.



#### • Magnetic bearing technology

Magnetic bearing and orientation sensor: Two radial bearings and one axial bearing compose the digital magnetic bearing system. The movement parts are made of permanent magnet and electric magnet will suspend on the magnet and move without friction. The orientation sensor will confirm the precise position of the rotor at max.6,000,000 times per minute.



#### • Permanent-magnet motor and Landing bearing

The compressor motor is magnetic permanently, which is supplied voltage by PWM (pulse width management) to realize variable speed running. The landing bearing will go upward before the unit starts up, which will keep a certain distance automatically and ensure no friction.

The radial bearing is to bear the axis after the compressor is powered down, to avoid the touch between the axis and the other metal surface.



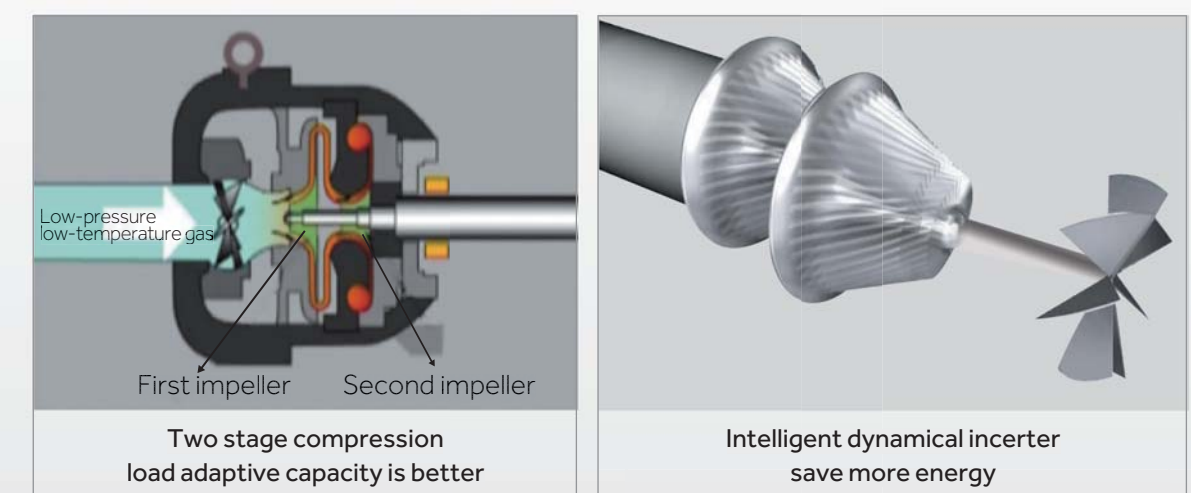
## Advanced Technology

### Compressor Technology

#### • Inverter driving

The inverter centrifugal compressor adopts the integrated driving module. on the condition of condensing temperature decreasing or load reducing, lower the compressor revolution, then optimum the compressor energy efficiency with 5%-100% of rated load.

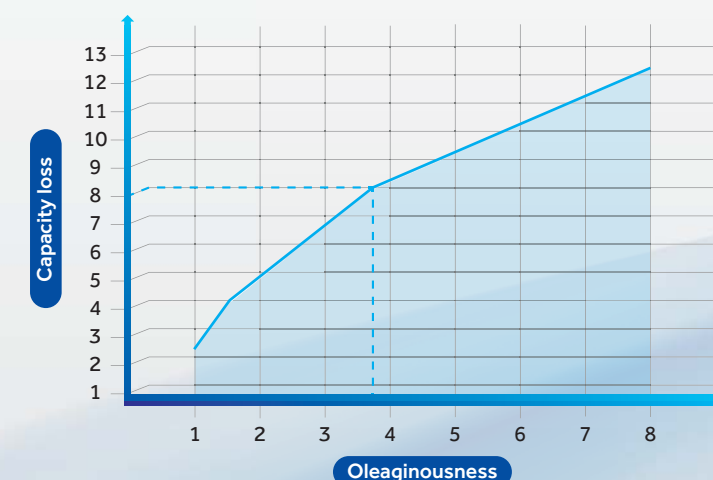
Optional: digital load balancing valve, compressor even can work normally even when the load almost closes to 0.



#### • Frictionless system

The movement parts of magnetic bearing system centrifugal compressor are composed of two radial magnetic bearings and one axial magnetic bearing. So the digital magnetic bearing system will be suspended when compressor is running. The movement parts do not need oil, which avoid that oil film in the heat exchanger lays on the pipe to reduce the heat exchanging efficiency. Thus it will ensure the product has the consistent excellent performance in its operation period.

The oil content of old type chiller is 9% on average, which will reduce the efficiency up to 15% to 20%. Haier's magnetic bearing system inverter centrifugal chiller can enhance efficiency over 15% because of oil-free lubrication system.



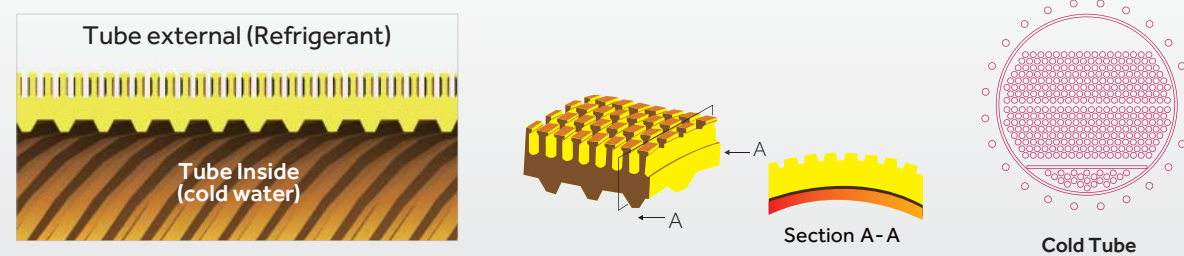


# Features

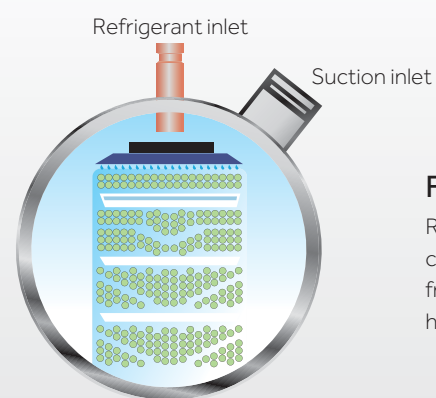
## Advanced Technology

### High efficiency heat exchanger

The water-cooled and air-cooled magnetic bearing centrifugal chillers adopt shell and tube flooded evaporator and shell and tube condenser. The heat exchange tube adopts special layout make refrigerant flow improvement in the evaporator and the condenser to increase efficiency.



The modular water-cooled magnetic bearing centrifugal chillers adopt falling film evaporator to reduce the refrigerant charge by 40% and increase the heat exchange efficiency by 10%.

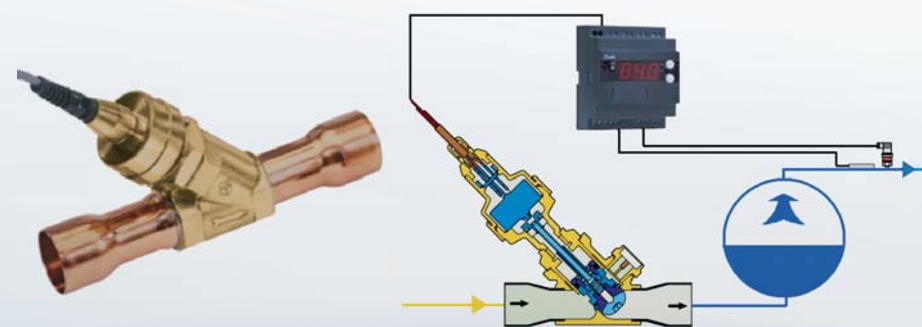


#### Fall film type

Refrigerant liquid film lays on copper evenly, air is separated from liquid perfectly to increase heat exchange efficiency greatly.

### EEV design

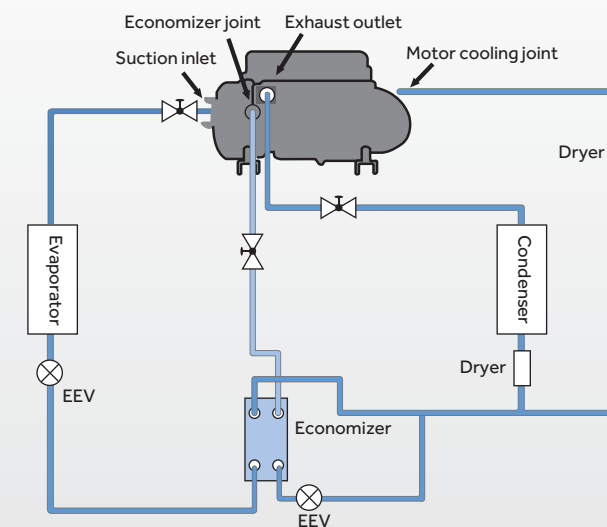
The unit adopts electronic expansion valve to control the volume of liquid refrigerant spraying into the evaporator precisely. By controlling the stepping motor operation due to the different load, the special electronic expansion valve driving module can adjust open degree of valve to control refrigerant flow volume, reaching the optimum efficiency.



## Advanced Technology

### Economizer

The chillers are added with the economizer, which can improve degree of supercooling greatly, increasing efficiency by 10%.



### Intelligent control

#### Cloud services center

Haier magnetic bearing centrifugal chiller with built-in smart network communication module, just by an Internet cable Internet the user can upload unit operation parameters, the fault information to the client end and Haier smart cloud services system. Enjoy the 24-hour butler service provided by Haier's smart cloud service system.

Long-distance detection: detect each parameters of unit operation on real time, and accumulate the data and make it in diagram. Improve the work efficiency of checking and recording personnel in the air-conditioner room, reduce the workload of the management personnel in the air-conditioner room, to achieve the goal of simplifying air-conditioner room or unattended air-conditioner room.

Default warning: the system can monitor the unit operation conditions constantly, and send alarming informations to the cloud services system or mobile terminals with relevant authorities, notify the administrative staff of the air-conditioner room to quickly check and maintain it. Avoid the failure of the unit and reduce the failure rate of the unit.

Energy saving service: record and analyze the energy consumption data of unit and system, to provide optimized energy saving strategies and using methods for users.





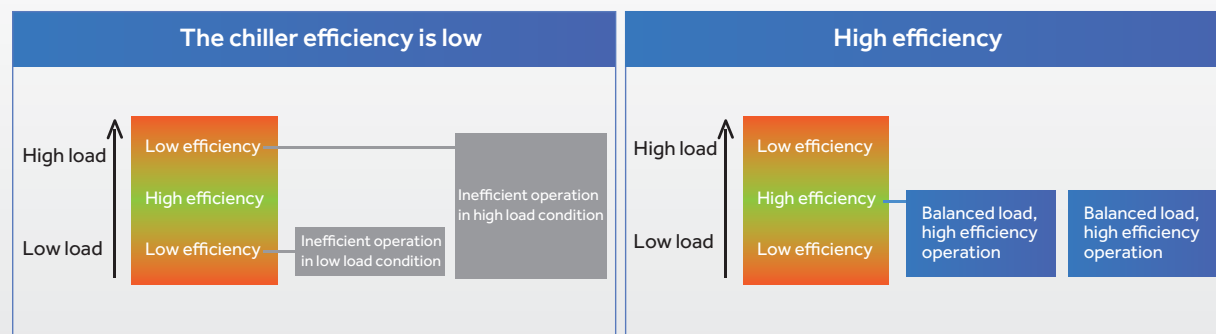
# Features

## Advanced Technology

### Intelligent control

#### Load sharing strategies in multi-condenser refrigeration system

The control technology of load sharing strategies in multi-condenser refrigeration system can make every condenser operate in equilibrium load value, by which the unit can keep the optimal operation performance.



## High Efficiency

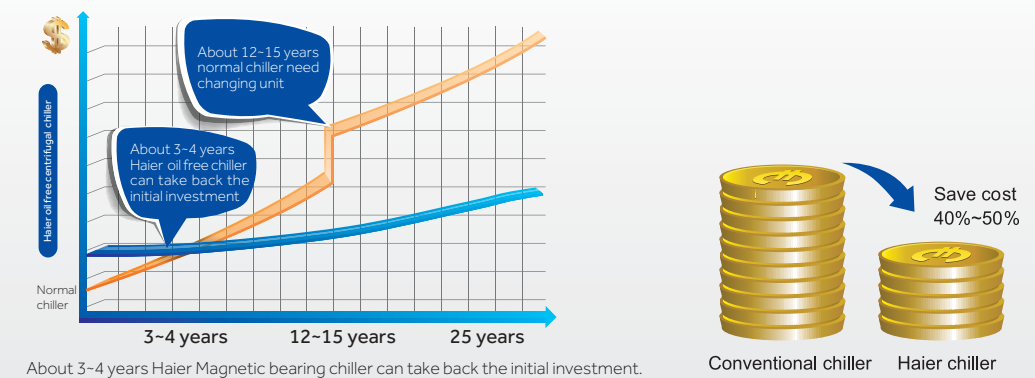
The unit adopts the turbo inverter compressor technology and frictionless technology, which will enhance the energy efficiency greatly. Water cooled series IPLV (integrated part-load value AHRI standards) can be 11.98 (Air-cooled series IPLV is 6.0). Comparing with conventional chiller, Haier magnetic bearing centrifugal chiller IPLV is 50% higher.



## Low Cost

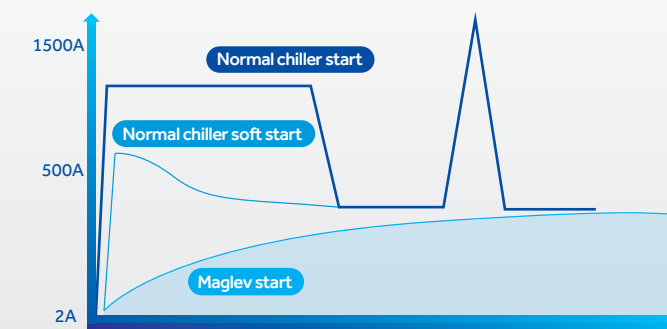
### Low operation cost

Comparing with conventional chillers, Haier magnetic bearing centrifugal chillers can save cost up to 40%-50%.



### Low installation cost

Because of magnetic bearing system technology, when the system starts up, only 2A current is necessary to suspend the axis, low starting torque, which results in low interference for electricity net. The conventional chiller start current can reach 1500A. Because the unit adopts low start current, the installed don't need soft starter which will save US 80,000 costs.



The unit adopts 380V power supply, then 10KV power supply is not required. It will be much safer since the examination and approval process are not required either.



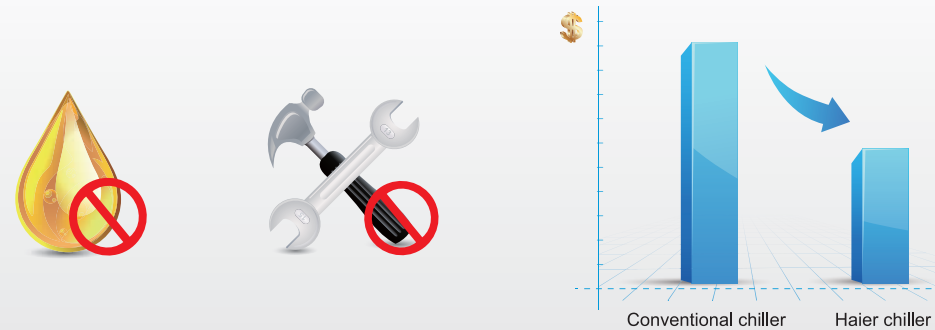


# Features

## Low Cost

### Low maintenance cost

The unit adopts no oil in the chiller means no oil contamination over time, so design efficiency is maintained effortlessly. This design can save as much as US 60,000 maintenance costs during the life cycle.



## High Reliability

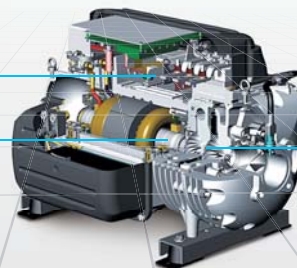
### Longevity 30+ years

Compressor is made from the aerial class aluminum mold and the high strength thermal plastic electronic case, which can keep the compressor long-time and high efficient running.

**Aerospace materials and technology, ensure 30 years reliable efficient operation.**

The moving parts adopt aviation alloy material, which ensure unit reliability and the life above 30 years.

Aerospace equipment Intelligent multilevel reliability control which ensure unit can automatic processing the problems in the operation in any case, such as the case of power failure etc...

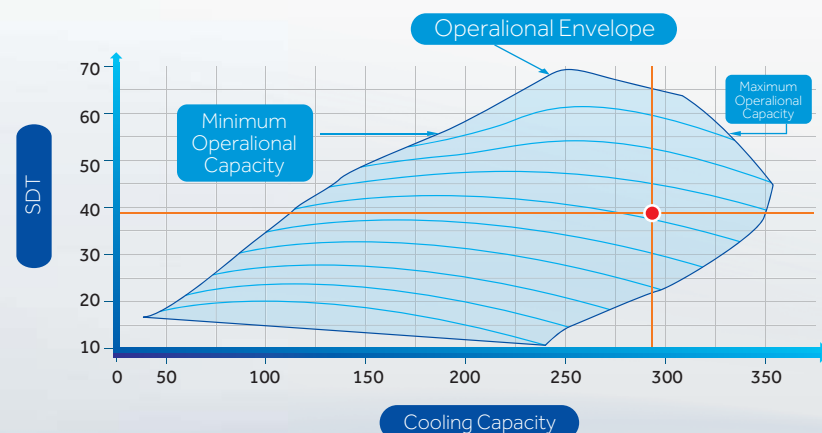


Aeroengine turbine design technology.



### Compressor safe operation

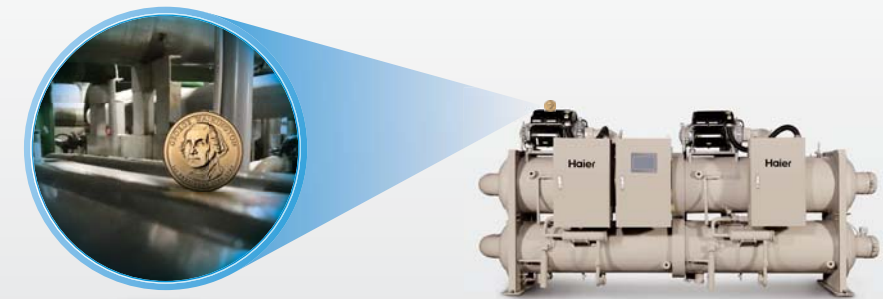
Compressor control module will supply the performance curves and according to the curves, adjust the running speed in time to ensure the compressor running safely.



## Comfort

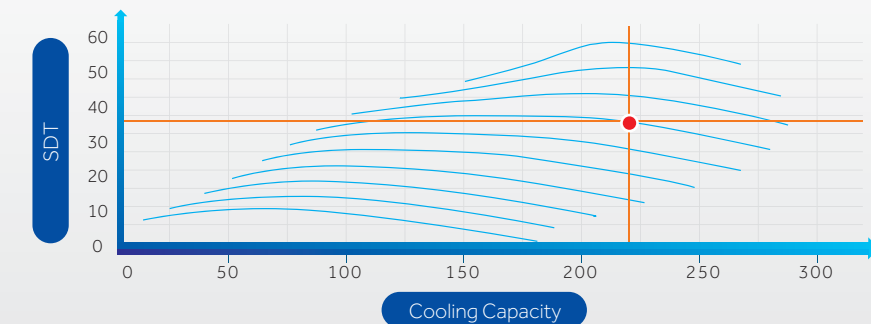
### Low noise and less vibration

Because of fully frictionless operation, the device vibration is close to zero. So Haier magnetic bearing centrifugal chiller doesn't need the anti-vibration parts and water-cooled chiller's running noise is lower than 70 dB(A), while the conventional chiller is higher than 85dB(A).



### Flexible capacity adjustment

When condensing temperature goes down or the heat load is decreased, the compressor speed will be slower. The system controls the refrigerant output from 5%-100% of the rated load freely, optimizing the compressor efficiency.



## Convenience

### Friendly operation screen

Big LCD touch screen. Chinese and English are selectable  
Calendar / Fault inquires / Water system equipment interlocking / Remote control / Unit operation parameters quick inquiry





## Renovation Solution

### Dismantling the wall

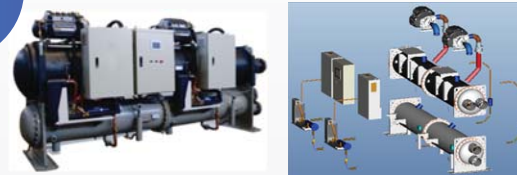
Long renovation period.  
The normal operating of the building will be affected.  
The large-scale equipment is required, which needs high cost.



Conventional solution

### Disassembling the unit

The period is long.  
The reliability of the unit is poor.  
The manufacturer needs to dispatch professionals for disassembly and assembly on the site.



Based on the above, the market needs a product with high efficiency, small size and light weight, which can be easily transformed without dismantling the wall. Haier modular water-cooled magnetic bearing centrifugal chillers were born at the right moment.



- **High efficiency**

With the adoption of the turbo inverter compressor technology, Haier modular magnetic bearing centrifugal chiller increases efficiency by 50% compared to the conventional unit.

- **Environmentally friendly**

The units adopt falling film evaporator to reduce the refrigerant charge by 40% and increase the heat exchange efficiency by 10%.

- **Small footprint, easy to transport**

The modular magnetic bearing centrifugal chiller is compact, which can save 45% installation space than conventional chiller. So it is easy to transport by the elevator.



## Renovation Solution

- **Convenient assembly**

The specialized crane and other large-scale equipment are not needed for the disassembly after unit arrives at the work site. Only the forklift is needed to save installation time and cost.





# Water-cooled Magnetic Bearing Centrifugal Chiller

Water cooled/Cooling only  
Cooling capacity range from 440kW up to 7034kW



## Options/Accessories

Accessories		Standard	Optional
Power supply		3/380V/50Hz	3/380V/60Hz; 3/400V/50hz; 3/460V/60Hz
Communication protocol		Modbus	BACnet
Active power filter		X	√
Surge suppressors		X	√
Economizer	≤800RT	√	/
	>800RT	X	√
Water inlet/outlet connection type	≤800RT	Victaulic	Flange
	>800RT	Flange	/
Thermal insulation thickness		30mm	25mm/40mm
Water side working pressure		1.0Mpa	1.6Mpa/2.5Mpa
ASME pressure vessel		X	√
Chilled water flowmeter		X	√
Automatic online rubber ball cleaning device		X	√
Channel steel base		X	√
Refrigeration cycle system	≤800RT	Modular refrigeration cycle system	Incorporative refrigeration cycle system
	>800RT	Incorporative refrigeration cycle system	/
Heat recovery		X	Partial heat recovery(Hot water outlet temperature is no more than 40°C, heat recovery efficiency is about 10%)

# Specification

MODEL		CC0440PWNI	CC0530PWNI	CC0740PWNI
Cooling capacity	Ton	125	150	205
	kW	440	528	721
Power input	kW	74.7	87.9	121.0
EER	kW/kW	5.89	6.01	5.96
Starting current	A	2	2	2
Max. running current	A	176	188	225
Safe protection		High/low pressure protection, safety protection, short of water relay protection, anti-freezed protection, motor overload, phase sequence and lack of phase protection		
Compressor	Type	Magnetic bearing compressor		
	Starting mode	Soft start		
Power supply		3N/380V/50Hz		
Refrigerant throttle type		Electronic expansion valve		
Capacity control		5%-100%		
Controller type		PLC control		
Refrigerant	Type	R134a		
	Charge	kg	210	250
Evaporator	Type	Flood type		
	Water inlet/outlet temp	12°C/7°C		
	Inlet/outlet pipe	DN	150	150
	Rated water flow	m³/h	91	124
	Water dirt coefficient	m²·°C/kW	0.0176	
	Standard pressure	MPa	1.0	
Condenser	Pass	4	2	
	Water side resistance	kPa	83	44
	Type	Shell & Tube heat exchanger		
	Water inlet/outlet temp	30°C/35°C		
	Inlet/outlet pipe	DN	150	150
	Rated water flow	m³/h	106	145
External dimension	Water dirt coefficient	m³/h	0.044	
	Standard pressure	m²·°C/kW	1.0	
	Pass	MPa	4	2
	Water side resistance	kPa	77	55
	Unit length	mm	2500	2800
	Unit width	mm	1200	1200
Package dimension	Unit height	mm	2100	2100
	Unit length	mm	2600	2900
	Unit width	mm	1300	1300
Weight	Unit height	mm	2200	2200
	Net weight	Kg	2370	2550
	Gross weight	Kg	2410	2590
Operation weight		Kg	2670	2900

MODEL		CC0880PWNI	CC1100PWNI	CC1330PWNI
Cooling capacity	Ton	250	300	375
	kW	879	1055	1319
Power input	kW	146.5	174.7	217.6
EER	kW/kW	6.00	6.04	6.06
Starting current	A	2	2	2
Max. running current	A	352	376	528
Safe protection		High/low pressure protection, safety protection, short of water relay protection, anti-freezed protection, motor overload, phase sequence and lack of phase protection		
Compressor	Type	Magnetic bearing compressor		
	Starting mode	Soft start		
Power supply		3N/380V/50Hz		
Refrigerant throttle type		Electronic expansion valve		
Capacity control		5%-100%		
Controller type		PLC control		
Refrigerant	Type	R134a		
	Charge	kg	400	600
Evaporator	Type	Flood type		
	Water inlet/outlet temp	12°C/7°C		
	Inlet/outlet pipe	DN	200	250
	Rated water flow	m³/h	189	227
	Water dirt coefficient	m²·°C/kW	0.0176	
	Standard pressure	MPa	1.0	
Condenser	Pass	2	1	
	Water side resistance	kPa	75	36
	Type	Shell & Tube heat exchanger		
	Water inlet/outlet temp	30°C/35°C		
	Inlet/outlet pipe	DN	200	250
	Rated water flow	m³/h	212	264
External dimension	Water dirt coefficient	m³/h	0.044	
	Standard pressure	m²·°C/kW	1.0	
	Pass	MPa	2	1
	Water side resistance	kPa	72	33
	Unit length	mm	4400	6520
	Unit width	mm	1200	1200
Package dimension	Unit height	mm	2100	2100
	Unit length	mm	4500	6620
	Unit width	mm	1300	1300
Weight	Unit height	mm	2200	2200
	Net weight	Kg	3800	6130
	Gross weight	Kg	3850	6200
Operation weight		Kg	4300	6880

Note: 1. Above parameters are based on the standard products;  
2. Above products standard pressure is 1.0Mpa. Contact with haier technology engineer, if you need the pressure higher than 1.0Mpa.  
3. Except above standard models, haier also can be customized products according to customer's requirements;  
4. Due to our policy of innovation some specifications may be changed without notification;  
5. Model CC1330PWNI-CC2810PWNI is split type chiller, the installer need to combine the chiller on site.  
6. CC1330PWNI, CC1400PWNI, CC1580PWNI can be customizent with 2 passes.

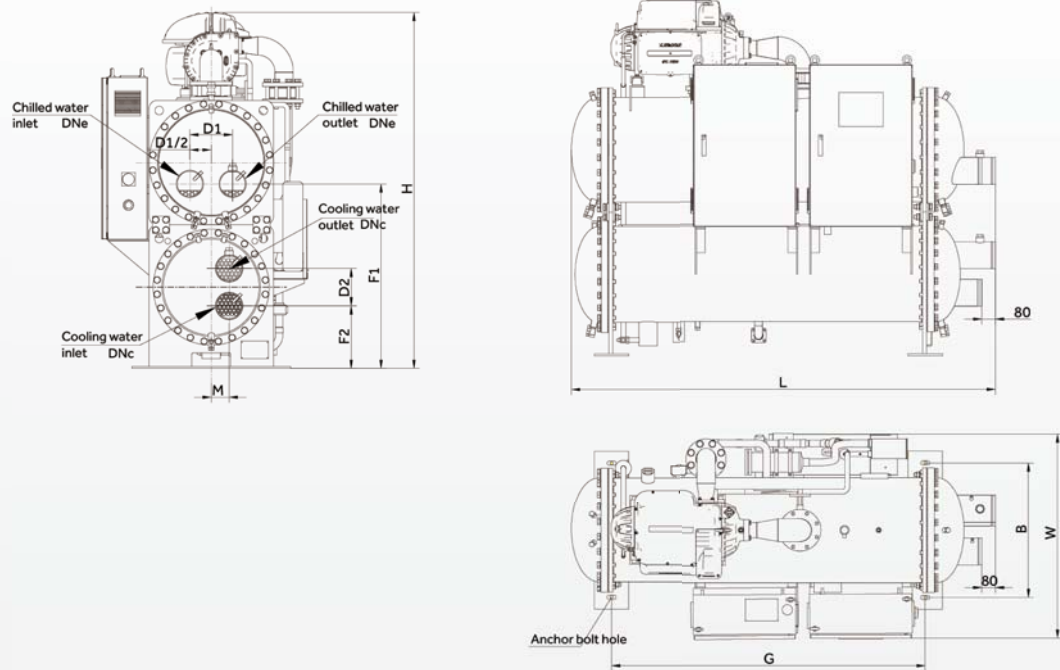




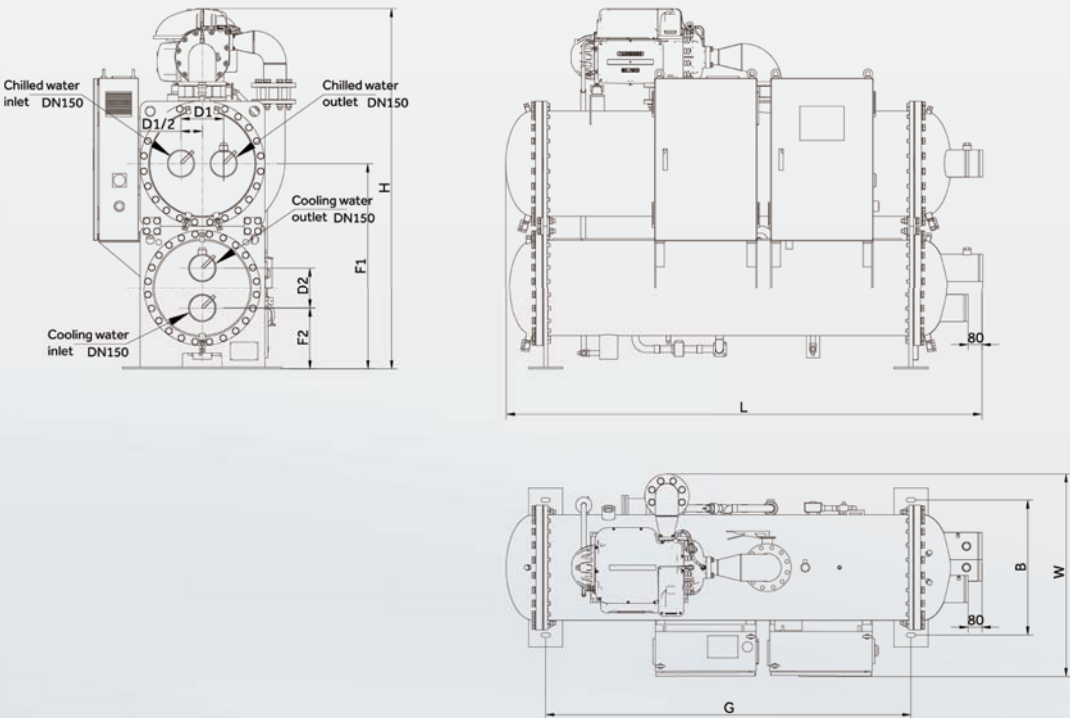


Unit Dimension Diagram

Single compressor unit dimension diagram



CODE MODEL	External dimensions mm			Installation dimensions mm		Nozzle dimensions mm						DNe	DNc
	L	W	H	B	G	D1	D2	F1	F2	M			
CC0440PWNI	2500	1200	2100	790	1846	250	220	1082	367	105		DN150	DN150
CC0530PWNI	2500	1200	2100	790	1846	250	220	1082	367	105		DN150	DN150

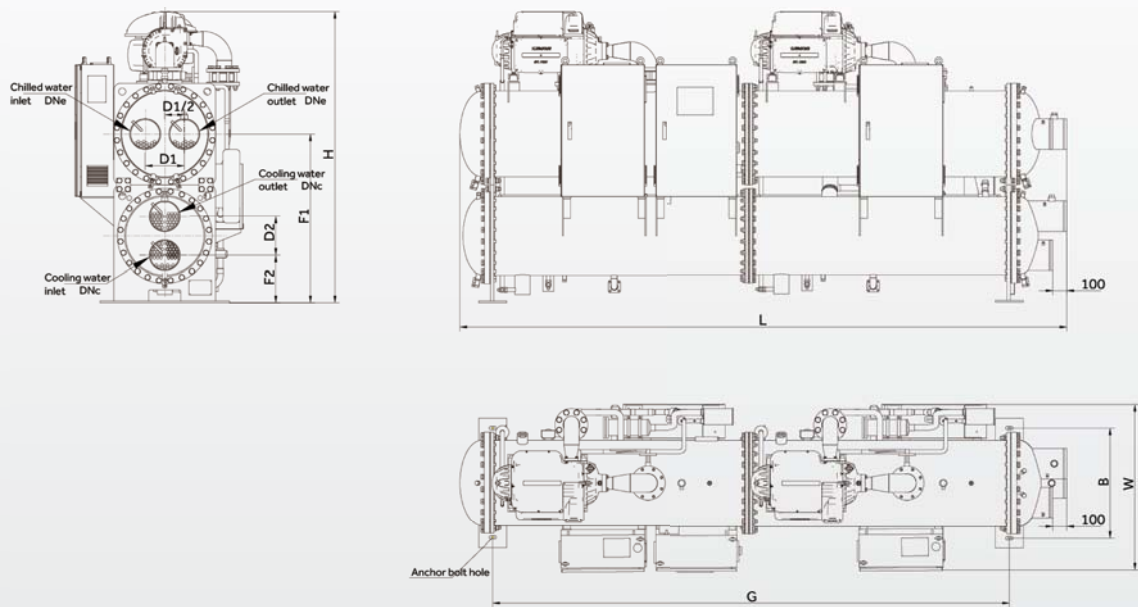


CODE MODEL	External dimensions mm			Installation dimensions mm		Nozzle dimensions mm						DNe	DNc
	L	W	H	B	G	D1	D2	F1	F2				
CC0740PWNI	2800	1200	2100	790	2146	250	240	1207	375			DN150	DN150

Unit Dimension Diagram

Twin-compressor series connection unit dimension diagram

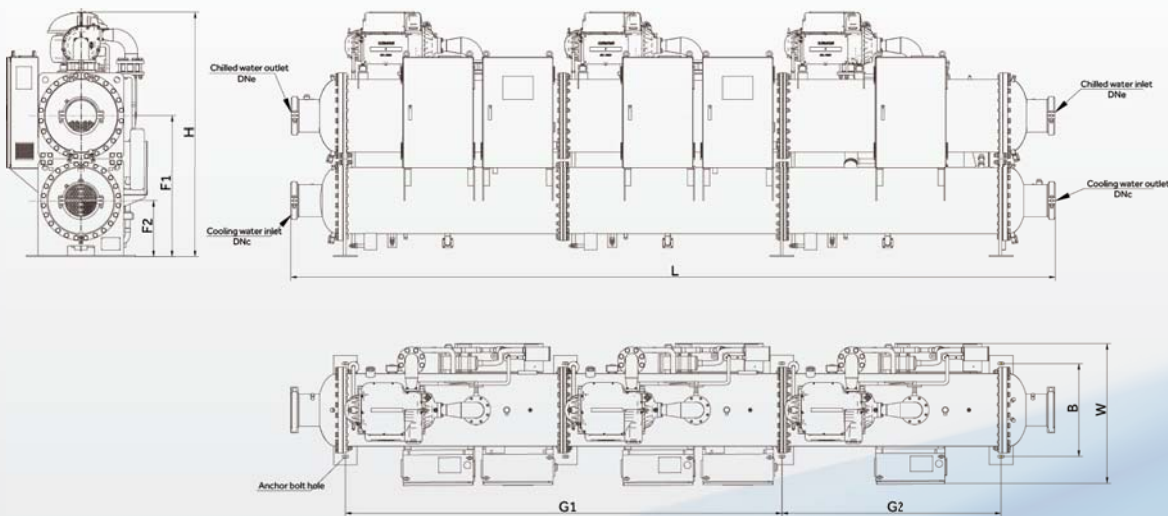
The double compressores chiller series connection standard, parallel connection is optional.



CODE MODEL	External dimensions mm			Installation dimensions mm		Nozzle dimensions mm						DNe	DNc
	L	W	H	B	G	D1	D2	F1	F2				
CC0880PWNI	4400	1200	2100	790	3719	280	280	1207	337			DN200	DN200
CC1100PWNI	4400	1200	2100	790	3719	280	280	1207	337			DN200	DN200

Three compressores series connection unit dimension diagram

The chiller with three compressor is parallel connection, and also can realize series connection for special requirements.



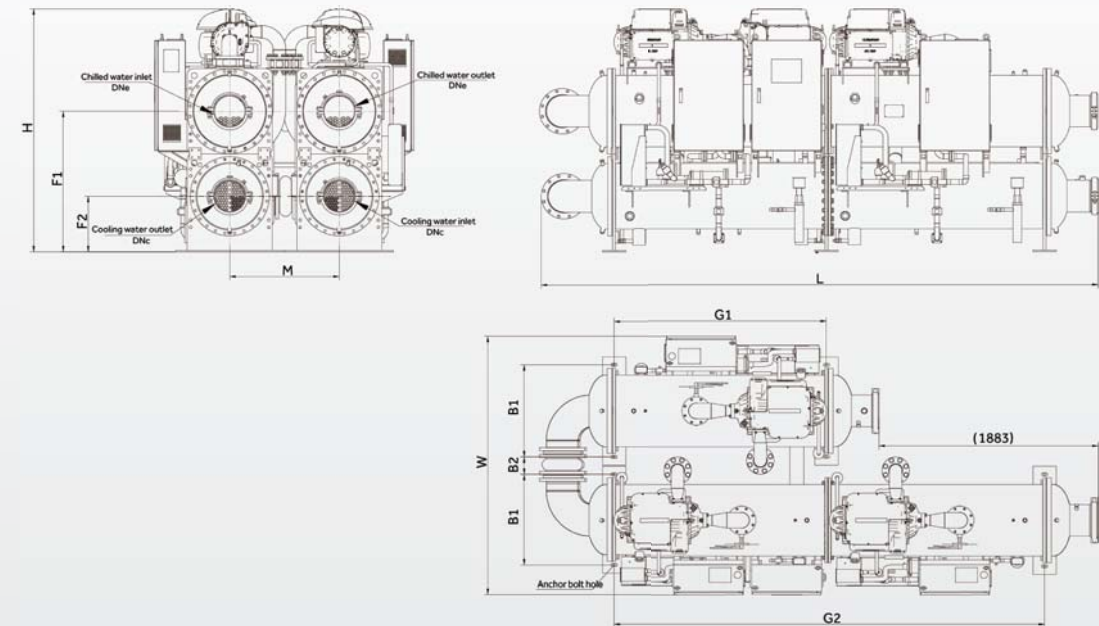
CODE MODEL	External dimensions mm			Installation dimensions mm		Nozzle dimensions mm						DNe	DNc
	L	W	H	B	G1	G2	F1	F2	M				
CC1330PWNI	6520	1200	2100	790	3719	1846	1207	477	940			DN250	DN250
CC1400PWNI	6520	1200	2100	790	3719	1846	1207	477	940			DN250	DN250
CC1580PWNI	6520	1200	2100	790	3719	1846	1207	477	940			DN250	DN250



Unit Dimension Diagram

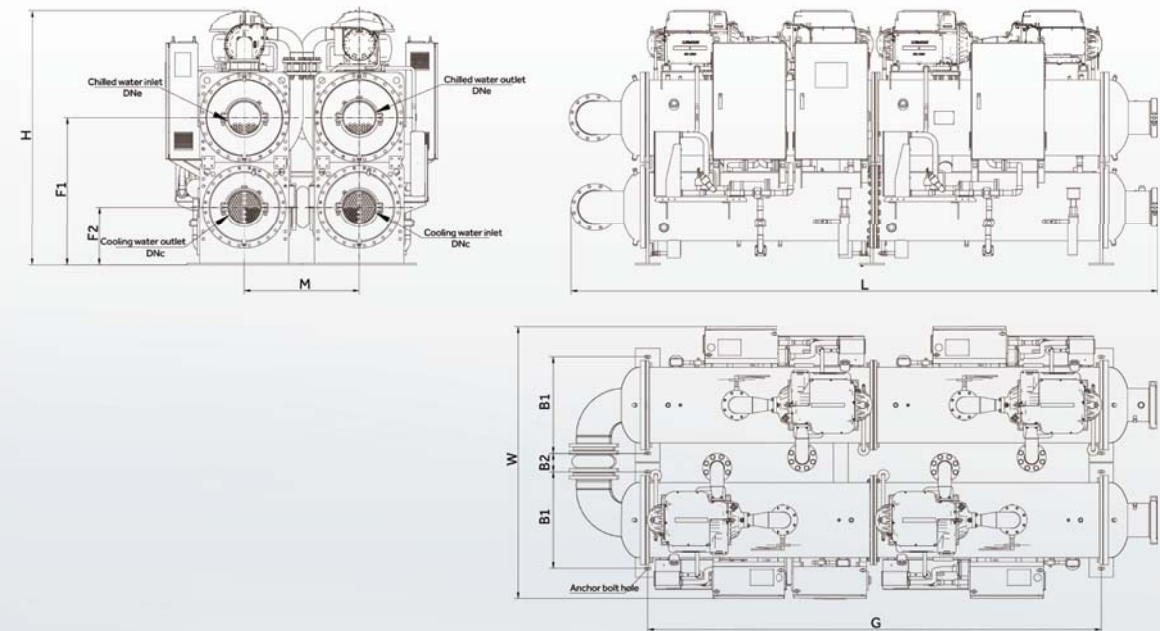
Three compressores series connection unit dimension diagram

The chiller with three compressor is parallel connection, and also can realize series connection for special requirements.



MODEL	CODE	External dimensions mm			Installation dimensions mm				Nozzle dimensions mm				
		L	W	H	B1	B2	G1	G2	F1	F2	M	DNe	DNc
CC1330PWNI		4800	2250	2250	790	150	1846	3719	1307	477	940	DN250	DN250
CC1400PWNI		4800	2250	2250	790	150	1846	3719	1307	477	940	DN250	DN250
CC1580PWNI		4800	2250	2250	790	150	1846	3719	1307	477	940	DN250	DN250

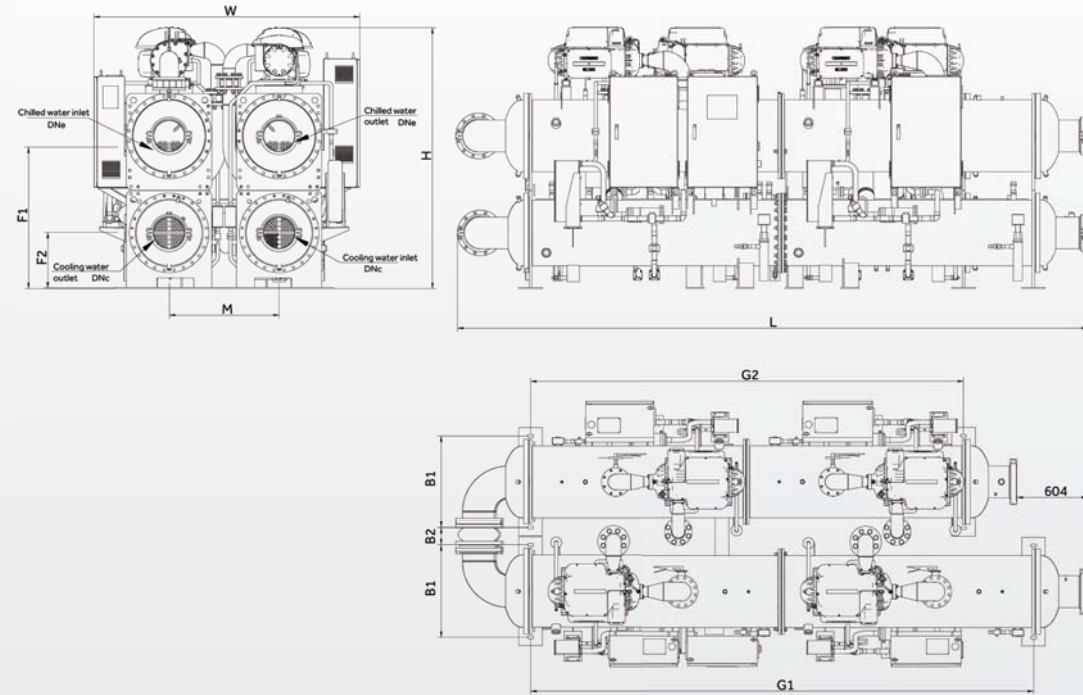
Four compressores parallel connection unit dimension diagram



MODEL	CODE	External dimensions mm			Installation dimensions mm				Nozzle dimensions mm			
		L	W	H	B1	B2	G	F1	F2	M	DNe	DNc
CC1760PWNI		4800	2250	2250	790	150	3719	1307	477	940	DN250	DN250
CC1930PWNI		4800	2250	2250	790	150	3719	1307	477	940	DN250	DN250
CC2110PWNI		4800	2250	2250	790	150	3719	1307	477	940	DN250	DN250

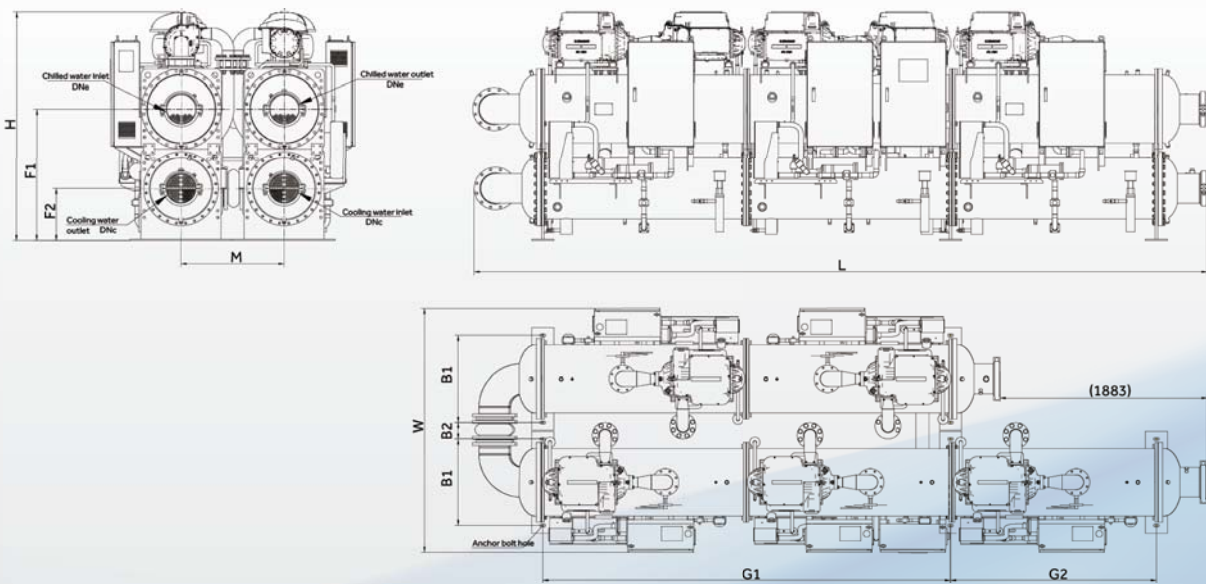
Unit Dimension Diagram

Four compressores parallel connection unit dimension diagram



MODEL	CODE	External dimensions mm			Installation dimensions mm				Nozzle dimensions mm				
		L	W	H	B1	B2	G1	G2	F1	F2	M	DNe	DNc
CC2460PWNI		5440	2280	2250	790	150	4319	3719	1307	477	940	DN250	DN250

Five compressores parallel connection unit dimension diagram

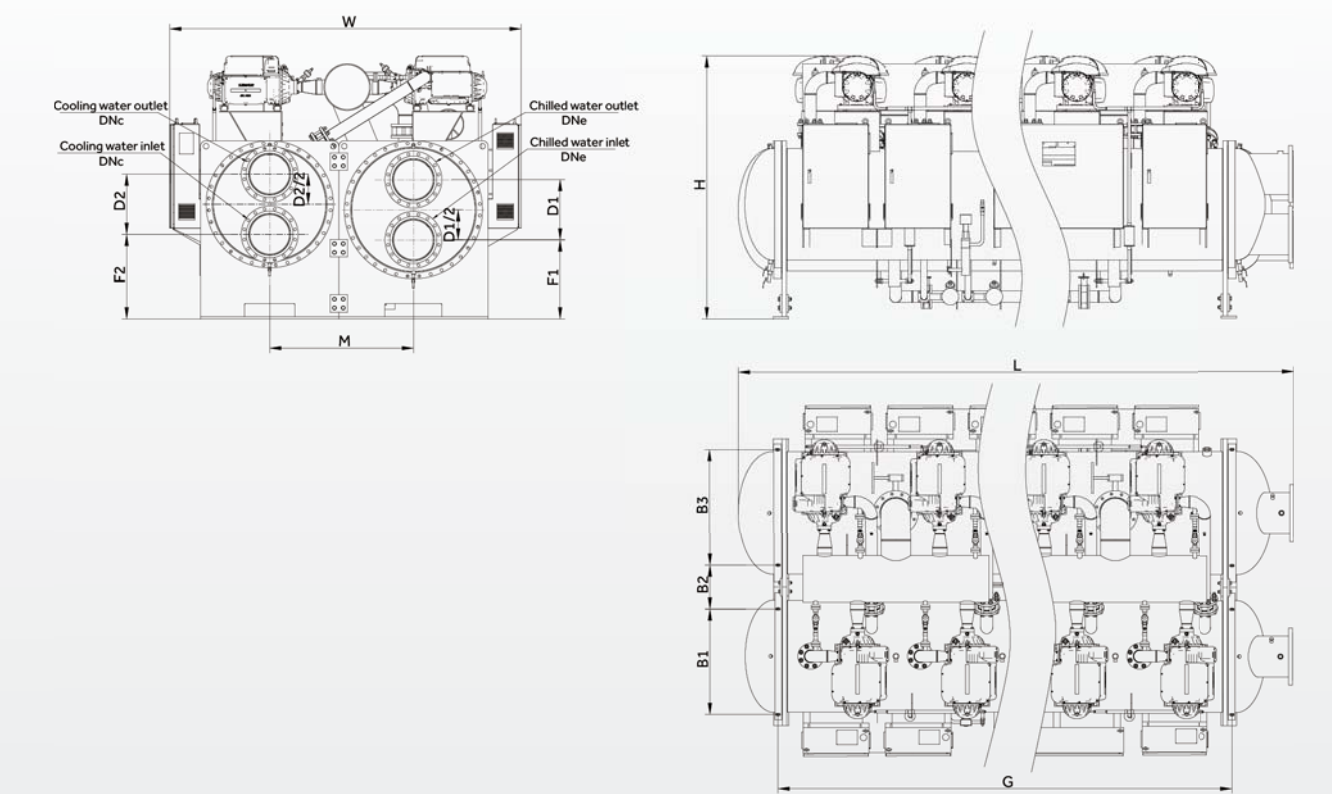


MODEL	CODE	External dimensions mm			Installation dimensions mm				Nozzle dimensions mm				
		L	W	H	B1	B2	G1	G2	F1	F2	M	DNe	DNc
CC2640PWNI		6750	2250	2250	790	150	3719	1846	1307	477	940	DN300	DN300
CC2810PWNI		6750	2250	2250	790	150	3719	1846	1307	477	940	DN300	DN300



Unit Dimension Diagram

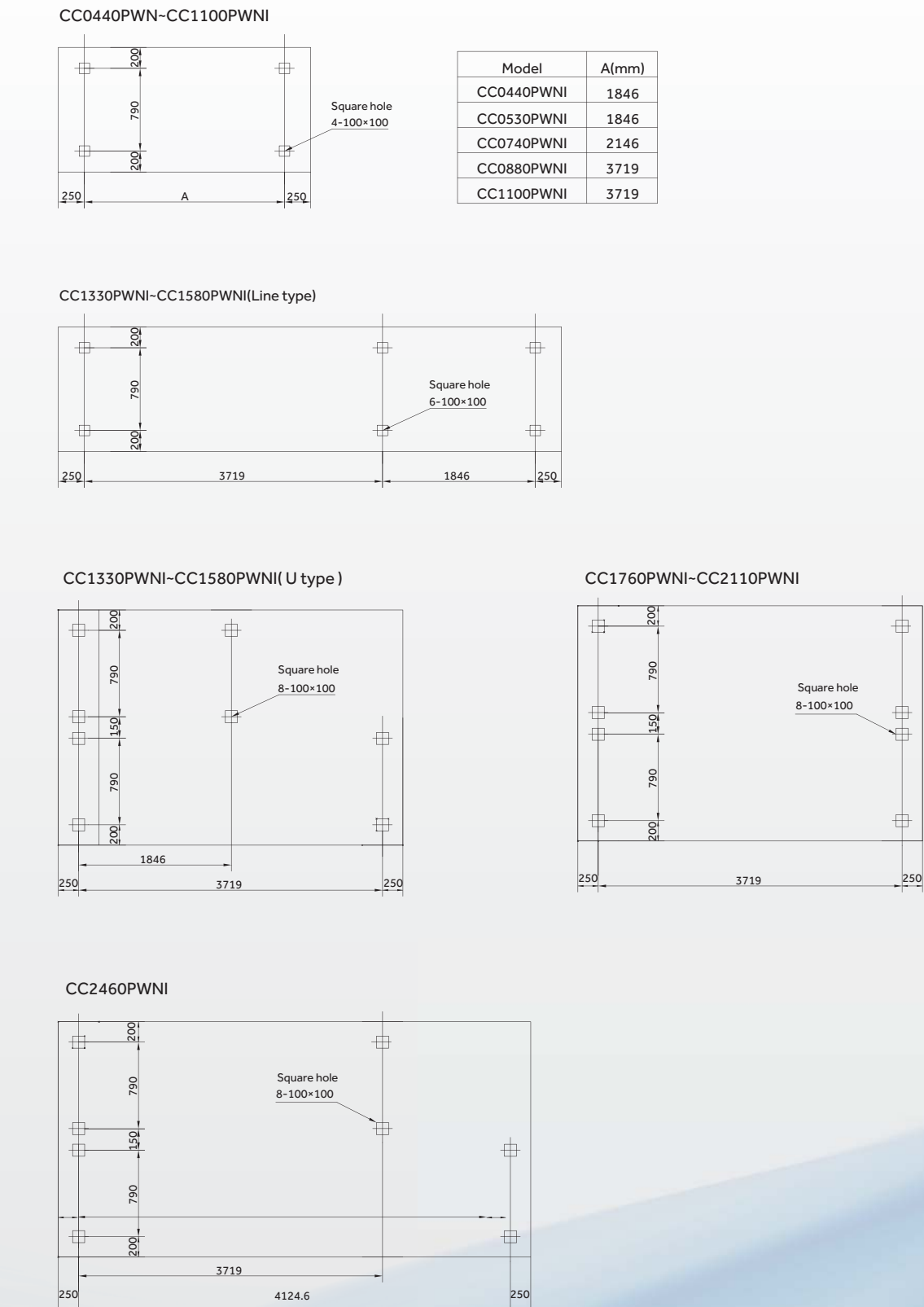
Big capacity oil free centrifugal chiller series (for example the model with six compressor)



CODE	External dimensions mm			Installation dimensions mm						Nozzle dimensions mm							
MODEL	L	W	H	B1	B2	B3	G1	G2	G3	D1	D2	F1	F2	M	DNe	DNc	
CC3170PWNI	4300	3200	2550	960	400	1060	3348			550	550	715	765	1310	DN350	DN350	
CC3520PWNI	4300	3200	2550	960	400	1060	3348			550	550	715	765	1310	DN350	DN350	
CC3870PWNI	5100	3200	2550	960	400	1060	4148			550	550	715	765	1310	DN350	DN350	
CC4220PWNI	5100	3200	2550	960	400	1060	4148			550	550	715	765	1310	DN350	DN350	
CC5280PWNI	5300	3800	2700	1160	400	1160	4148			550	550	715	765	1310	DN400	DN400	
CC6330PWNI	6600	3800	2700	1160	400	1160		3348	2170	620	620	730	730	1460	DN450	DN450	
CC7030PWNI	6600	3800	2700	1160	400	1160		3348	2170	620	620	730	730	1460	DN450	DN450	

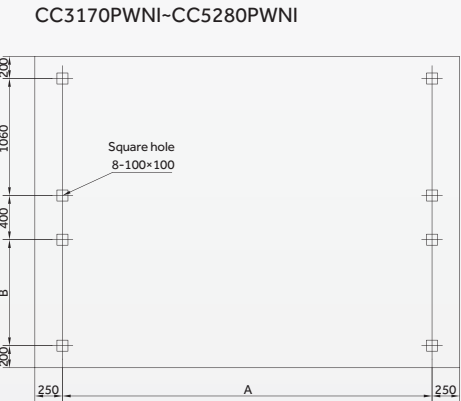
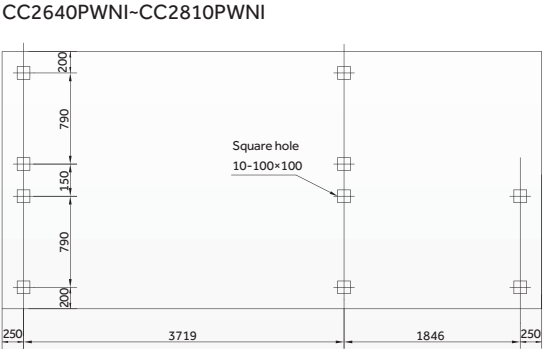
- Notes:
- Above products direction of the evaporator and condenser water inlet and water outlet can be adjusted according to user requirements
  - Product dimension also can be changed if user have special requirements

The Unit Installation Foundation Drawing

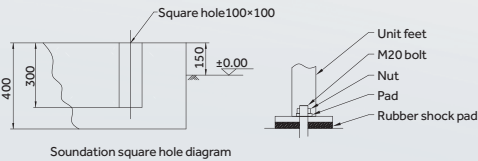
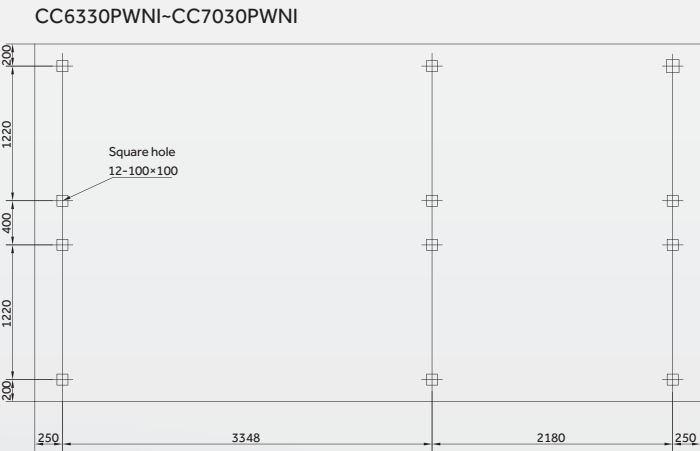




The Unit Installation Foundation Drawing



Model	A(mm)	B(mm)
CC3170PWNI	3348	960
CC3520PWNI	4148	960
CC3870PWNI	4148	960
CC4220PWNI	4148	960
CC5280PWNI	4148	1106



- NOTE:
1. As Haier chillers are virtually vibration free, vibration pad is not factory-furnished and could be chosen by users if needed.
  2. If the users need to build the foundation by themselves, they can refer to the above table to make installation.
  3. If the machine room is built on the floor slab, the building surface needs enough strength to withstand the weight of the chiller operation.
  4. When building the concrete foundation, a drainage ditch should be constructed around the foundation for water drainage; edges of the foundation should be smooth.
  5. The standard concrete contains 1:2:4 of cement, sand and pebble.
  6. After setting up the chiller, the levelness of unit length and width should be less than 1/4" (6.35mm).

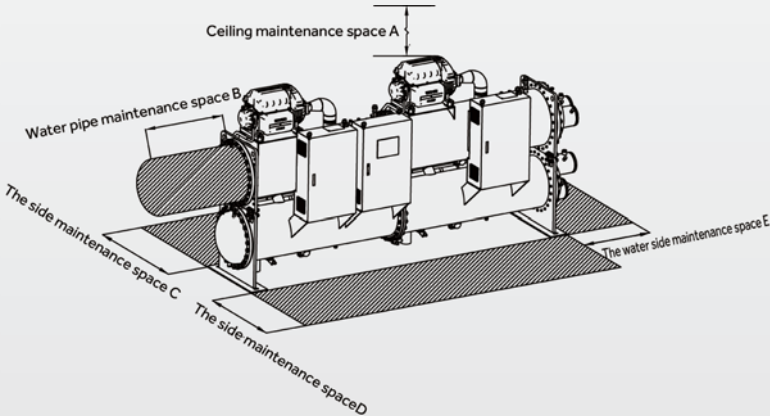
Installation Space Diagram

Water-cooled magnetic bearing centrifugal chiller installation space diagram

mm

Model	A	B	C	D	E
CC0440-CC0530PWNI	500	2000	1500	1500	1500
CC0740PWNI	500	2300	1500	1500	1500
CC0880-CC2110PWNI	500	2000	1500	1500	2000
CC2460PWNI	500	2300	1500	1500	2300
CC2640-CC2810PWNI	500	2000	1500	1500	2000
CC3170PWNI	1000	3500	1500	1500	2000
CC3520-CC5280PWNI	1000	4200	1500	1500	2000
CC6330-CC7030PWNI	1000	3500	1500	1500	2300

Note: Above data is minimum dimension



Performance Table

Cooling water inlet temperature(°C)																
Chilled water outlet temp.(°C)	20		22		24		26		28		30		32		34	
	Cooling capacity	Power input	Cooling capacity	Power input	Cooling capacity	Power input	Cooling capacity	Power input	Cooling capacity	Power input	Cooling capacity	Power input	Cooling capacity	Power input	Cooling capacity	Power input
5	0.96	0.72	0.97	0.79	0.97	0.85	0.97	0.92	0.96	0.96	0.93	0.96	0.89	0.96	0.86	0.97
6	0.97	0.71	0.99	0.78	1.00	0.85	1.00	0.92	0.99	0.97	0.97	0.99	0.93	0.99	0.89	1.00
7	1.00	0.70	1.01	0.77	1.02	0.84	1.03	0.91	1.03	0.98	1.00	1.00	0.96	1.00	0.93	1.01
8	1.01	0.68	1.03	0.76	1.05	0.83	1.05	0.90	1.05	0.97	1.03	1.00	0.99	1.00	0.96	1.02
9	1.03	0.66	1.05	0.74	1.07	0.82	1.08	0.89	1.08	0.96	1.06	1.00	1.02	1.00	0.98	1.02
10	1.04	0.64	1.07	0.73	1.09	0.81	1.11	0.89	1.11	0.96	1.09	1.00	1.05	1.00	1.01	1.02
12	1.05	0.60	1.09	0.69	1.12	0.77	1.15	0.86	1.16	0.94	1.11	1.00	1.12	1.01	1.07	1.03
15	1.03	0.47	1.11	0.60	1.17	0.71	1.20	0.81	1.22	0.90	1.24	0.98	1.22	1.01	1.17	1.04



COOLING TOWER SCHEDULE

UNIT NO.	CT-R-01 TO 2
Q'TY	2 (DUTY)
LOCATION	ROOF
TYPE	INDUCED DRAFT CROSS FLOW,VERTICAL DISCHARGE PREMIUM ENERGY SAVING TYPE
MINIMUM CHILLER CAPACITY (TONS)	250
WATER FLOW RATE (US.GPM)	750
MAXIMUM PRESSURE DROP (FT.WATER)	15
ENTERING WATER TEMPERATURE (°F)	100
LEAVING WATER TEMPERATURE (°F)	90
AMBIENT AIR TEMPERATURE (°FWB)	84
TEMPERATURE APPROCH (°F)	6
TEMPERATURE RANGE (°F)	10
FAN MOTOR POWER CONSUMPTION (KW)	1X5.5 WITH VSD CONTROL
ELECTRICAL SUPPLY (VOLT/PHASE/HERTZ)	380 / 3 / 50
SPRING VIBRATION ISOLATOR TYPE	SPRING
MINIMUM STATIC DEFLECTION (INCH)	3 INCH
OPERATING SOUND PRESSURE LEVEL MEASURED AT 1.5M AROUND COOLING TOWER	<65 dBA
REMARK	1)COMPLETE WITH UL ASHRAE STANDARD 84 & AHRI STANDARD 1060 2)STAINLESS STEEL RAILING AROUND COOLING TOWER 3)STAINLESS STEEL LADDER BOTH SIDE 4)FAN MOTOR SHALL BE PREMIUM EFFICIENCY , IE3

AIR TO AIR HEAT EXCHANGER SCHEDULE (INFORMATION)

UNIT NO.	AHE-R-01
Q'TY	1
LOCATION	ROOF FLOOR
TYPE	ROTARY, HEAT RECOVERY WHEEL
EFFECTIVENESS (%)	80
EXTERNAL STATIC PRESSURE (INCH WG.)	0.5
PRESSURE DROP OF PURGE UNIT (INCH WG.)	2.5
POWER CONSUMPTION ( HP )	5.5
POWER SUPPLY (VOLT/PHASE/HERTZ)	380/3/50
SUPPLY AIR FLOW (CFM)	21,760
EXHAUST AIR FLOW (CFM)	21,760
OUTDOOR AIR TEMPERATURE (°FDB / °FWB)	97/84
EXHUAST AIR TEMPERATURE (°FDB)	80
EXHUAST AIR RELATIVE HUMIDITY ( % RH )	60
REMARK	1) CONFORMED WITH UL ASHRAE STANDARD 84 & AHRI STANDARD 1060 2) MOLECULAR SIEVE OR SILICA GEL DESICCANT TYPE

AIR CLEANER UNIT

UNIT NO.	LOCATION SERVED	EQUIPMENT LOCATION	Q'TY	AIR FLOW RATE (CFM)	APPROX EXT.SP (IN.WG)	FAN MOTOR APPROX (WATT)	POWER SUPPLY (V/PH/HHZ)	AIR CLEANING PROCESS TYPE	PREMARK
	LEVEL 6		1						
ACU-6-01	KITCHEN	LEVEL 6	1	4,800	1.2	150	220/1/50	ELECTROSTATIC PRECIPITATION	
NOTE AIR CLENER UNIT COMPLETED WITH 1. AIR CLEANER UNITS SHELL CONFORM ASHRAE STANDARD 52.2 LASTEST EDITION.MINIMUM EFFICIENCY 95% 2.1 WASHABLE POLYESTER PRE-FILTER,PRESSURE DROP NOT MORE THAN 130PA. AIR VELOCITY NOT MORE THAN 500FFPM 2.2 ACTIVATED CARBON FILTER BANK, PRESSURE DROP NOT MORE THAN 130PA. AIR VELOCITY NOT MORE THAN 500FFPM 2.3 ACCESS DOOR INTERLOCK SAFETY SWITCH WHEN ACCESS DOOR IS OPENED 2.4 TOTALLY ENCLOSED POWER SUPPLY :SOLID-STATE WITH BUILT-IN SHORT PROTECTION.UL APPROVED 2.5 LED LIGHT INDICATED THE PERFORMANCE STATUS OF THE IONIZING/COLLECTING CELL									

WATER COOLED WATER CHILLER SCHEDULE

UNIT NO.	WCH-5-02 TO 02	
	AHRI CONDITION	EXACT OPERATION CONDITION
Q'TY	2 ( 2 DUTY )	2 ( 2 DUTY )
LOCATION	LEVEL 5	LEVEL 5
CAPACITY (TONS)	250	250
EVAPORATOR WATER FLOW RATE ( US.GPM ) WATER TEMPERATURE ENTERING (DEG.F) WATER TEMPERATURE LEAVING (DEG.F) MAX PRESSURE DROP (FT) WORKING PRESSURE (PSI) FOULING FACTOR ((DEG.F)*SQ.FT/BTUH) NUMBER OF EVAPORATOR PASSES	702.5	600
	55	55
	45	45
	20	15
	150	150
	0.0001	0.00010
	2 PASS	2 PASS
CONDENSER WATER FLOW RATE ( US.GPM ) WATER TEMPERATURE ENTERING (DEG.F) WATER TEMPERATURE LEAVING (DEG.F) MAX PRESSURE DROP (FT) WORKING PRESSURE (PSI) FOULING FACTOR ((DEG.F)*SQ.FT/BTUH) NUMBER OF CONDENSER PASSES	824.8	750
	90	90
	100	100
	19	15
	150	150
	0.003	0.00025
	2 PASS	2 PASS
COMPRESSOR TYPE ENERGY EFFICIENCY RATIO (kW/Ton) IPLV,IP (kW/Ton) MAXIMUM POWER CONSUMPTION (Kw) BEARING	MAGNETIC BEARING	SCREW OR SCROLL W/VSD
	CENTRIFUGAL	DUAL COMPRESSOR/CIRCUIT
	0.65	0.65
	≤ 0.3635	≤ 0.3635
	162.5	162.5
	OIL FREE	OIL FREE
REFRIGERANT	HFC-134A	HFC-134A
ELECTRIC SUPPLY (V/PH/Hz)	380-3-50	380-3-50
VIBRATION ISOLATOR	SPRING	SPRING
MINIMUM STATIC DEFLECTION ( INCH )	2	2
REMARK	1.C/W REFRIGERANT LEAK OR 02 SENSOR AND AUTOMATIC CONTROL PANEL 2.C/W UNIT MOUNTED STARTER 3.CHILLER MUST HANDLE WITH VARIABLE EVAPORATOR FLOW 4.MAXIMUM REFRIGERANT CHARGE 4.1 HCFC-123 1.97 LB/TR 4.2 HCC-134A 3.1 LB/TR 5.MINIMUM COP=6.3 6.MOTOR COMPRESSOR PREMIUM EFFICIENCY TYPE,IE3	1.C/W REFRIGERANT LEAK OR 02 SENSOR AND AUTOMATIC CONTROL PANEL 2.C/W UNIT MOUNTED STARTER 3.CHILLER MUST HANDLE WITH VARIABLE EVAPORATOR FLOW 4.MAXIMUM REFRIGERANT CHARGE 4.1 HCFC-123 1.97 LB/TR 4.2 HCC-134A 3.1 LB/TR 5.MINIMUM COP=5.41 6.MOTOR COMPRESSOR PREMIUM EFFICIENCY TYPE,IE3
NOTE BLOCK LOAD CALCULATION FOR CHILLER SELECTION BAASE ON THE FOLLOWS; 1. GLASS PERFORMANCE 1.1 VISION GLASS U=4.98W/SQ.M K , SC=0.42 1.2 VISION GLASS U=1.60W/SQ.M K , SC=0.35 2. OUTDOOR AIR RATE 130% OF ASHREA STANDARD 62.1 2010		

WATER PUMP SCHEDULE

UNIT NO.	CHWP-5-01 TO 03	CHWP-5-01 TO 03	PBP-R-01
Q'TY	3 ( 2 DUTY , 1 STAND BY )	3 ( 2 DUTY , 1 STAND BY )	1
LOCATION	LEVEL 5 ( CHILLER ROOM )	LEVEL 5 ( CHILLER ROOM )	ROOF
TYPE	END SUCTION SPLIT-COUPLING	END SUCTION SPLIT-COUPLING	END SUCTION MULTI-STAGE CENTRIFUGAL PUMP
WATER FLOW RATE (US.GPM)	600	600	25
TOTAL DYNAMIC HEAD (FT)	90	90	100
WORKING PRESSURE (PSI)	150	150	150
MAXIMUM SPEED MOTOR (RPM)	1450	1450	2,900
PUMP EFFICIENCY (%)	75	75	50
POWER CONSUMPTION (KW)	18.5	18.5	1.5
ELECTRIC SUPPLY (V/PH/Hz)	380 / 3 / 50	380 / 3 / 50	380 / 3 / 50
VIBRATION ISOLATOR	SPRING	SPRING	SPRING
MINIMUM STATIC DEFLECTION ( INCH )	2	2	1
REMARK			EQUIPED WITH 1. 2 SETS OF END SUCTION PUMP 2. PRESSURE TANK (REMOVABLE DIAPHARM TYPE)100 LITR (MIN.) 3. AUTOMATIC CONTROL PANEL
NOTE	1. TOTAL DINAMIC HEAD IS GUIDE FOR PUMP QUOTATION ONLY, EXACT TOTAL DINAMIC HEAD SHALL REVISE AS SITE INSTALLATION BY CONTRACTOR / PUMP SUPPLIER AND REQUEST FOR APPROVEL BEFORE ORDER AND INSTALLATION 2. PUMP SELECTION @ NON OVERLOAD IN ANY ASE 3. MOTOR SHALL BE PREMIUM EFFICIENCY TYPE, IE3.		

EQUIPMENT SCHEDULE FOR AIR CONDITIONING SYSTEM 1

SCALE

NTS.

KEY PLAN



OWNER



บริษัท เมืองไทย แคปปิตอล จำกัด (มหาชน)  
MUANGTHAI CAPITAL PUBLIC COMPANY LIMITED  
32/1 ถนนเจริญบุรีภิรมย์ แขวงบางกอก  
เขตบางพลัด กรุงเทพมหานคร 10700  
โทร : 02-880-1033 , แฟกซ์ : 02-880-1173

ARCHITECT & ENGINEERING



บริษัท ปาล์มเมอร์ แอนด์ เทอร์เนอร์ (ประเทศไทย) จำกัด  
PALMER & TURNER (THAILAND) LTD.  
231/9 BANGKOK CABLE BUILDING II, 3RD FL. SOI SARASIN,  
PATHUMVANI, BANGKOK 10330  
TEL. 651-9180, FAX. (662) 651-9170 E-mail: pttthai@t-group.net

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193/120-123, 29th floor Lake Rajada Office Complex,  
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T : (662) 264-0690 F:(662)26-0689 pia@pialnterior.com

LIGHTING DESIGNER :



84/13 6TH FLOOR FIFTY FIFTH TOWER ,SUKHUMVIT 55,  
KLONGTON-NUA,WATTANA,BANGKOK 10110,THAILAND  
T-66 2381 5530-31 F-662056 3764  
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Wholly owned by THE RED ANT PTE LTD

CONSULTANTS



ISO 9001 Certified  
Consulting, Engineer & Architects  
Project Planning Services Co.,Ltd.  
บริษัท โปรเจกต์แพลนนิ่ง เซอร์วิส จำกัด (มหาชน)

CONTRACTOR



McTric Company Limited  
121/105 Ratchadaphisek Rd.  
39 Fl., RS Tower, Dindaeng, Bangkok 10400, Thailand  
TEL. (+66) 0-26412100 FAX. (+66) 0-26412030  
http://www.mc tric.com

PROJECT

MUANGTHAI CAPITAL HEADQUARTER  
เมืองไทย แคปปิตอล สำนักงานใหญ่  
ถนนเจริญบุรีภิรมย์ เขตบางพลัด กทม.

AS-BUILT DRAWING

REV.No.	DESCRIPTION	DATE	APPROVED
-	-	-	-
MC	DRAFTS AIR CONDITION SYSTEM BY:	..... นาย อนุรักษ ด้วนาคี	
MC	CHECKED BY:	..... นาย ปริณญา ทองดี	
PPS	APPROVED BY:	..... นาย วิษณุพงศ์ วรรณกุล	

SCALE :
NTS.

DRAWING TITLE :	
EQUIPMENT SCHEDULE FOR AIR CONDITIONING SYSTEM 1	
DRAWING NUMBER:	TOTAL
AS-AC-1-07	08/67



# MUANGTHAI CAPITAL HEADQUARTER PROJECT

## Functional Test Procedure (FTP)

**Subject** : งานทดสอบเครื่องทำน้ำเย็น (Chiller)

**TCR No.:** AC-FTP-01/1

**ประเภทของงาน** : ระบบปรับอากาศและระบายอากาศ (MVAC)

**Ref. No.:** WCH-5-01

**Location** : CHILLER PLANT LEVEL 5

**Date** : 5-May-2020

		WCH-5-01			
		1. Data of Chiller			
Brand	: <b>HAIER</b>	Model	: <b>CC1100PWN1</b>	Serial No.	: AA8R06E1M0059K940001
Description		Design	Submission	Test Run	
1.1 Compressor Type		Magnetic Bearing Cen.Type	Magnetic Bearing Cen.Type		
1.2 Minimum Capacity/Cell : Tons		250	293.2	249.2	
				Set chiller Maximum run @ 85%	
1.3 Evaporater					
1.3.1 Evaporater water flow rate : US. GPM		600	702.5	600	
1.3.2 Water temp. Entering : ° F		55	55	55	
1.3.3 Water temp. Leaving : ° F		45	45	45.2	
1.3.4 Water Pressure Entering : Psig		N/A	N/A	142	
1.3.5 Water Pressure Leaving : Psig		N/A	N/A	134	
1.3.6 Maximum pressure Drop : FT		15	20	18.4 (8 Psi )	
1.4 Condensor		2 pass	2pass	2pass	
1.4.1 Condensor water flow rate : US. GPM		750	824.8	750	
1.4.2 Water temp. Entering : ° F		90	90	89	
1.4.3 Water temp. Leaving : ° F		100	100	95	
1.4.4 Water Pressure Entering : Psig		N/A	N/A	93	
1.4.5 Water Pressure Leaving : Psig		N/A	N/A	85	
1.4.6 Maximum pressure Drop : FT		15	19	18.4 (8 Psi )	
1.6 Energy Efficiency ratio : kW/Ton		0.65	0.613	0.6	
1.7 Maximum Power Consumption : kW		162.5	179.6	149.6	
		2. Control Panel Board			
2.1 Circuit Breaker Rating : Amp.				N/A	
2.2 Line Voltage : R/S/T				388	392    386
2.3 Running Current :RLA				320	
2.4 Max RLA : Amp.				356	
2.5 Starter Type				VSD	
		3. Accessories Setting			
Description		Fail		Pass	
3.1 Emergency Stop		<input type="checkbox"/>		<input checked="" type="checkbox"/>	
3.2 Motorized Pressure relife Valve		<input type="checkbox"/>		<input checked="" type="checkbox"/>	
		4. BMS Monitoring Status			
Description		Fail		Pass	
4.1 Chiller compressure status Status		<input type="checkbox"/>		<input checked="" type="checkbox"/>	
4.2 Chiller Auto Status		<input type="checkbox"/>		<input checked="" type="checkbox"/>	
4.3 Chiller Manual Status		<input type="checkbox"/>		<input checked="" type="checkbox"/>	
		Testing Instrument			
Type of Instrument		Model		Serial No.	
		Notes			
<b>Tested</b> Signed: ..... Name: ..... Date: .....		<b>Reviewed by PPS:</b> Signed: ..... Name: (.....) Date: .....		<b>Verified by I</b> Signed: ..... Name: ..... Date: .....	



# McTric Public Company Limited

## MVAC Inspection Sheet CHILLER INSPECTION



PROJECT NAME : MUANGTHAI CAPITAL HEADQUARTER

DATE : 5 May 2020

PROJECT NO :

BY :

Room No : Chiller plant room

Location : Level 5

Chiller No. **WCH-5-01**

1 Model Type / Manufacturer **HAIER**  
Capacity **293.2 Ton**

2 **Refrigerant Type** **HFC-134a**

3 Compressor  
3.1 Quantity **2 Sets**  
3.2 Compression Type **Magnetic Bearing, Centrifugal**  
3.3 Casing type  
3.4 Electrical Characteristic **380-3-50**  
3.5 Starter **VSD**

4 Temperature and Pressure Readings Type.

Conventional Gauge / Thermostat ☒ Digital ☐  
The following readings type.  
Cooler Water Temp. In ☒ **55.0 F**  
Cooler Water Temp. Out ☒ **45.2 F**  
Cooler Water Pressure In ☒ **142 Psig**  
Cooler Water Pressure Out ☒ **134 Psig**  
Condenser Water Temp. In ☒ **89 F**  
Condenser Water Temp. Out ☒ **95 F**  
Condenser Water Pressure In ☒ **93 Psig**  
Condenser Water Pressure Out ☒ **85 Psig**  
Evaporating Water Side Resistance ☒ **8 Psid**  
Suction Pressure ☒ **36.8/35.7 Psig**  
Condensing Water Side Resistance ☒ **8 Psid**  
Liquid Line Temp ☒ **116.5/115.7 Psig**

5 Flow switch  
Cooler Water ☒ Yes ☐ No  
Condenser Water ☒ Yes ☐ No

6 Motorized Valves  
Cooler Water ☒ Yes ☐ No  
Condenser Water ☒ Yes ☐ No

7 Vibration Isolator Type ☒ Spring ☐ Neoprene Rubber Pad ☐

8 Flexible Pipe ☒ Yes ☐ No

9 Condition of Chiller  
☐ Unsatisfactory ☐ Poor ☐ Satisfactory ☒ Good ☐ Very Good

10. Will require replacement in  
☐ Immediately ☐ Within 12 months ☐ 0-5 years ☒ 5-10 years ☐ 10+ years

11 General Comments **Set capacity of chiller run maximum @ 249.2 Tons ( 85 % of 293.2 Ton )**

		Reviewed by PPS.	Verified by PPS. if need
Signature		Signature	Signature
Name		Name	Name
Date		Date	Date



## WATER-COOLED CHILLER COMMISSIONING REPORT

Customer Name	Muangthai Capital	Commission Date	5 <sup>th</sup> May 2020
Job Site Name	Muangthai Capital	Address	Bangkok
Project Number	N/A	Unit Model	CC1100PWNI
Unit Serial Number	AA8R06E1M0059K940001	Unit Tag Number	NO#1
Installation Provider	McTric Co.,Ltd.	Start-Up Engineer	MANOCH P.

### DESIGN CONDITION

	KW	Flow rate GPM.	Temperature In F	Temperature Out F	Pressure Drop FT.	pass	Suction temp	Condenser temp
cooler		702.5	55	45	20	2	-	-
condenser		824.8	90	100	19	2	-	-

#### Compressor:

Volts: 380      RLA: 320      maxRLA: 356

Compressor Model TT400-E-1ST-F-0-CH      Compressor S/No. 191967020,19167030

PHASE VOLTAGE, L1 : 226      L2 : 228      L3 : 224

LINE VOLTAGE, L1 – L2 : 388      L1 – L3 : 392      L2 – L3 : 386

POWER SUPPLY FREQUENCY: 50      RATED MAIN CIRCUIT BREAKER: N/A

INSULATION, PHASE TO PHASE (MΩ) : T1 – T2 : OL      T2 – T3 : OL      T1 – T3 : OL

PHASE TO GROUND (MΩ) : T1 – T2 : OL      T2 – T3 : OL      T1 – T3 : OL

#### STARTER:

mfg: Haier      TYPE: VSD      S/N:

#### Refrigerant:

TYPE: R134a      charge: By Factory KG



# MUANGTHAI CAPITAL HEADQUARTER PROJECT

## Functional Test Procedure (FTP)

**Subject** : งานทดสอบเครื่องทำน้ำเย็น (Chiller)  
**ประเภทของงาน** : ระบบปรับอากาศและระบายอากาศ (MVAC)  
**Location** : CHILLER PLANT LEVEL 5

**TCR No.:** : AC-FTP-01/2

**Ref. No.** : WCH-5-02

**Date** : 5-May1-2020

		<b>WCH-5-02</b>			
		1. Data of Chiller			
Brand	: <b>HAIER</b>	Model	: <b>CC1100PWNI</b>	Serial No.	: AA8R06E1M0059K7H0001
Description		Design	Submission	Test Run	
1.1 Compressor Type		Magnetic Bearing Cen.Type	Magnetic Bearing Cen.Type		
1.2 Minimum Capacity/Cell : Tons		250	293.2	249.2	
				Set chiller Maximum run @ 85%	
1.3 Evaporater					
1.3.1 Evaporater water flow rate : US. GPM		600	702.5	600	
1.3.2 Water temp. Entering : ° F		55	55	54.0	
1.3.3 Water temp. Leaving : ° F		45	45	45.0	
1.3.4 Water Pressure Entering : Psig		N/A	N/A	142	
1.3.5 Water Pressure Leaving : Psig		N/A	N/A	134	
1.3.6 Maximum pressure Drop : FT		15	20	18.4 (8 Psi )	
1.4 Condensor		2 pass	2pass	2pass	
1.4.1 Condensor water flow rate : US. GPM		750	824.8	750	
1.4.2 Water temp. Entering : ° F		90	90	86.4	
1.4.3 Water temp. Leaving : ° F		100	100	92.4	
1.4.4 Water Pressure Entering : Psig		N/A	N/A	93	
1.4.5 Water Pressure Leaving : Psig		N/A	N/A	85	
1.4.6 Maximum pressure Drop : FT		15	19	18.4 (8 Psi )	
1.6 Energy Efficiency ratio : kW/Ton		0.65	0.613	0.6	
1.7 Maximum Power Consumption : kW		162.5	179.6	149.6	
		2. Control Panel Board			
2.1 Circuit Breaker Rating : Amp.				N/A	
2.2 Line Voltage : R/S/T				388	392   386
2.3 Running Current :RLA				320	
2.4 Max RLA : Amp.				356	
2.5 Starter Type				VSD	
		3. Accessories Setting			
Description		Fail		Pass	
3.1 Emergency Stop		<input type="checkbox"/>		<input checked="" type="checkbox"/>	
3.2 Motorized Pressure relife Valve		<input type="checkbox"/>		<input checked="" type="checkbox"/>	
		4. BMS Monitoring Status			
Description		Fail		Pass	
4.1 Chiller compressure status Status		<input type="checkbox"/>		<input checked="" type="checkbox"/>	
4.2 Chiller Auto Status		<input type="checkbox"/>		<input checked="" type="checkbox"/>	
4.3 Chiller Manual Status		<input type="checkbox"/>		<input checked="" type="checkbox"/>	
		Testing Instrument			
Type of Instrument		Model		Serial No.	
		Notes			
		Reviewed by PPS:		Verified by	
Tested		Signed: .....		Signed: .....	
Name: .....		Name: (.....)		Name: .....	
Date: .....		Date: .....		Date: .....	



# McTric Public Company Limited

## MVAC Inspection Sheet

### CHILLER INSPECTION



PROJECT NAME : MUANGTHAI CAPITAL HEADQUARTER

DATE : 5 May 2020

PROJECT NO :

BY :

Room No : Chiller plant room

Location : Level 5

Chiller No. **WCH-5-02**

1 Model Type / Manufacturer **HAIER**  
Capacity **293.2 Ton**

2 Refrigerant Type **HFC-134a**

3 Compressor  
3.1 Quantity **2 Sets**  
3.2 Compression Type **Magnetic Bearing, Centrifugal**  
3.3 Casing type  
3.4 Electrical Characteristic **380-3-50**  
3.5 Starter **VSD**

4 Temperature and Pressure Readings Type.

Conventional Gauge / Thermostat ☒ Digital ☐  
The following readings type.  
Cooler Water Temp. In ☒ **54.0 F**  
Cooler Water Temp. Out ☒ **45.0 F**  
Cooler Water Pressure In ☒ **142 Psig**  
Cooler Water Pressure Out ☒ **134 Psig**  
Condenser Water Temp. In ☒ **86.4 F**  
Condenser Water Temp. Out ☒ **92.4 F**  
Condenser Water Pressure In ☒ **93 Psig**  
Condenser Water Pressure Out ☒ **85 Psig**  
Evaporating Water Side Resistance ☒ **8 Psid**  
Suction Pressure ☒ **33.4/34.3 Psig**  
Condensing Water Side Resistance ☒ **8 Psid**  
Liquid Line Temp ☒ **113.5/112.8 Psig**

5 Flow switch  
Cooler Water ☒ Yes ☐ No  
Condenser Water ☒ Yes ☐ No

6 Motorized Valves  
Cooler Water ☒ Yes ☐ No  
Condenser Water ☒ Yes ☐ No

7 Vibration Isolator Type ☒ Spring ☐ Neoprene Rubber Pad ☐

8 Flexible Pipe ☒ Yes ☐ No

9 Condition of Chiller  
☐ Unsatisfactory ☐ Poor ☐ Satisfactory ☒ Good ☐ Very Good

10. Will require replacement in  
☐ Immediately ☐ Within 12 months ☐ 0-5 years ☒ 5-10 years ☐ 10+ years

11 General Comments **Set capacity of chiller run maximum @ 249.2 Tons ( 85 % of 293.2 Ton )**

	Reviewed by PPS,	Verified by PPS (if need)
Signature	Signature	Signature
Name	Name	Name
Date	Date	Date



# WATER-COOLED CHILLER COMMISSIONING REPORT

Customer Name	Muangthai Capital	Commission Date	5 <sup>th</sup> May 2020
Job Site Name	Muangthai Capital	Address	Bangkok
Project Number	N/A	Unit Model	CC1100PWNI
Unit Serial Number	AA8R06E1M0059K7H0001	Unit Tag Number	NO# 2
Installation Provider	McTric Co.,Ltd.	Start-Up Engineer	MANOCH P.

## DESIGN CONDITION

	KW	Flow rate GPM.	Temperature In F	Temperature Out F	Pressure Drop FT.	pass	Suction temp	Condenser temp
cooler		702.5	55	45	20	2	-	-
condenser		824.8	90	100	19	2	-	-

### Compressor:

Volts: 380      RLA: 320      maxRLA: 356

Compressor Model TT400-E-1ST-F-0-CH      Compressor S/No. 191967020,19167030

PHASE VOLTAGE, L1 : 224      L2 : 226      L3 : 223

LINE VOLTAGE, L1 – L2 : 389      L1 – L3 : 391      L2 – L3 : 387

POWER SUPPLY FREQUENCY: 50      RATED MAIN CIRCUIT BREAKER: N/A

INSULATION, PHASE TO PHASE (MΩ) : T1 – T2 : OL      T2 – T3 : OL      T1 – T3 : OL

PHASE TO GROUND (MΩ) : T1 – T2 : OL      T2 – T3 : OL      T1 – T3 : OL

### STARTER:

mfg: Haier      TYPE: VSD      S/N:

### Refrigerant:

TYPE: R134a      charge: By Factory KG