



# GST Chiller Proposal



2023

# Electric Chiller Application

## 1. Chiller Introduction

### 1-1. ELE. Chiller Application

### 1-2. REF. Chiller Application

### 1-3. HEX. Application

### 1-4. Installation Type

### 1-5. Chiller Certification

## 2. Road Map

### 2-1. Intro


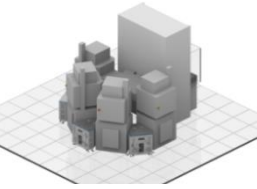



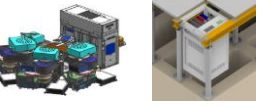




### 2-2. Cryogenic Chiller

### 2-2. Heat Exchanger

### 2-3. Electric Chiller

### 2-4. Energy Saving

### 2-5. Environment

Main Tool		Electric Chiller				
Maker	Model	Model	Type	POU Design	Dimension	Lay out
LAM	Kiyo Series(CX ,EX) Flex Series(DL,DS,Exelan) Metal Series(Metal-M,HP,45) Coronus (CoronusHP)	EES-08	<b>Single</b> ※ Bottom Chiller		600*520*420	
	Kiyo Series (EX,EXP,FX,GX) Flex Series (FX,GX,HX,HX+)	EHD-1008	<b>Dual</b> ※ Bottom Chiller		600*645*570	
	Flex Series (GS)	ED-1008	<b>Dual</b> ※ Bottom Chiller		680*800*570	
TEL	RLSA & VIGUS	EES-08	<b>Single</b> ※ Bottom Chiller		600*450*522	
AMAT	Mesa G5 Mesa SYM3				-	
SEMES	Michelan-O3				-	
MATTSON	Paradigm-E				460*460*750	


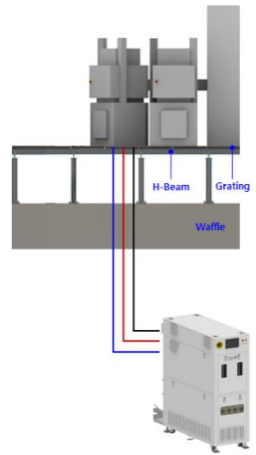






# Refrigerator chiller Application

## 1. Chiller Introduction

- 1-1. ELE. Chiller Application
- 1-2. REF. Chiller Application
- 1-3. HEX. Application
- 1-4. Installation Type
- 1-5. Chiller Certification

## 2. Road Map

- 2-1. Intro
- 2-2. Cryogenic Chiller
- 2-2. Heat Exchanger
- 2-3. Electric Chiller
- 2-4. Energy Saving
- 2-5. Environment

Main Tool		Refrigerator Chiller				
Maker	Model	Model	Type	Design	Dimension	Lay out
LAM	FlexHX+ Triton Flex HS VANTEX B, BX	RDHS-181512	<b>Triple</b> ※ Bottom+Top Chiller		600*1000*1900	CSF Installation 
	Kiyo-GXE AKARA	RSHS-1812	<b>Dual</b> ※ Bottom Chiller		450*1000*1800	
	Coronus_HP Metal-M-HP	RS-06	<b>Single</b> ※ Bottom Chiller		500*1100*1500	
	Flex-DL / DS Flex-FX/GX/HX Kiyo-EX-/FX	RSHS-0612	<b>Combi</b> ※ Bottom + Top Chiller		550*1100*1600	
TEL	RLSA	RS-06	<b>Single</b> ※ Bottom Chiller		500*1100*1500	
AMAT	SYM3, G5	RD-06	<b>Dual</b> ※ Bottom+Top Chiller		800*1400*1750	
Mattson	Paradigm_E	RS-06	<b>Single</b> ※ Bottom Chiller		500*1100*1500	

※ Display (FPD) : Supplied large numbers of Refrigerator


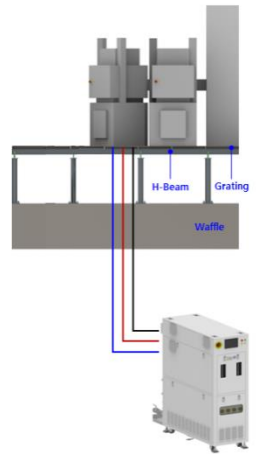





# Heat - Exchanger Application

## 1. Chiller Introduction

- 1-1. ELE. Chiller Application
- 1-2. REF. Chiller Application
- 1-3. HEX. Application
- 1-4. Installation Type
- 1-5. Chiller Certification

## 2. Road Map

- 2-1. Intro
- 2-2. Cryogenic Chiller
- 2-2. Heat Exchanger
- 2-3. Electric Chiller
- 2-4. Energy Saving
- 2-5. Environment

Main Tool		Heat Exchanger Chiller				
Maker	Model	Model	Type	Design	Dimension	Lay out
LAM	Speed	HD-06	Dual		550*850*1500	CSF Installation 
	IKANO	HS-04	Single		500*850*1000	
AMAT	Producer Prevision	HS-06	Single		500*850*1000	
	Ultima	HD-06	Dual		550*850*1500	
	Endura2	HS-06	Single		500*850*1000	
	MAHA_HP GEMINI	HS-06	Single		500*850*1000	

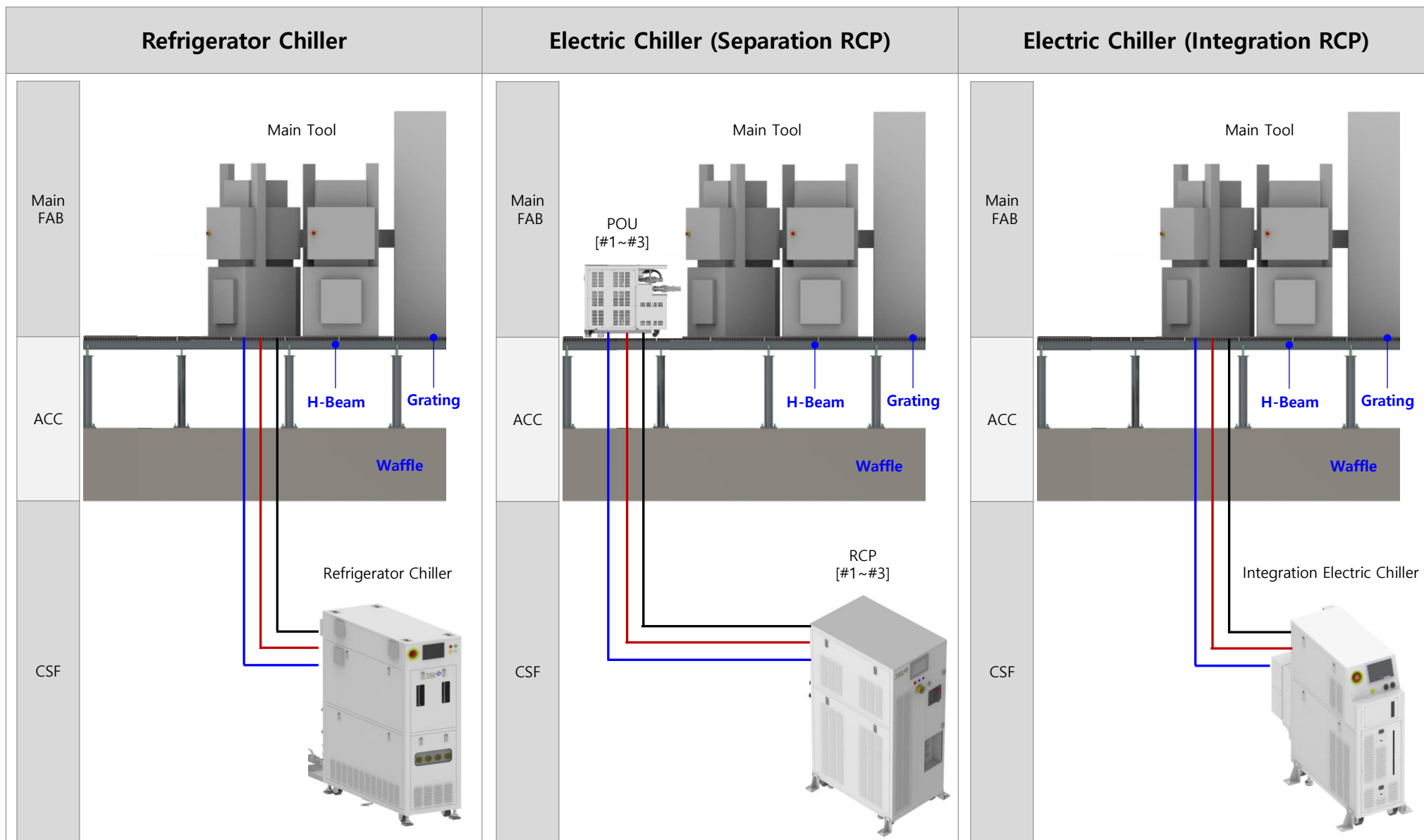
※ Display (FPD) : Supplied large number of Heat Exchanger

## 1. Chiller Introduction

- 1-1. ELE. Chiller Application
- 1-2. REF. Chiller Application
- 1-3. HEX. Application
- 1-4. Installation Type**
- 1-5. Chiller Certification

## 2. Road Map

- 2-1. Intro
- 2-2. Cryogenic Chiller
- 2-2. Heat Exchanger
- 2-3. Electric Chiller
- 2-4. Energy Saving
- 2-5. Environment





## All CE, SEMI S2, NRTL certification acquired for each Products & Customers

### 1. Chiller Introduction

- 1-1. ELE. Chiller Application
- 1-2. REF. Chiller Application
- 1-3. HEX. Application
- 1-4. Installation Type
- 1-5. Chiller Certification

### 2. Road Map

- 2-1. Intro
- 2-2. Cryogenic Chiller
- 2-2. Heat Exchanger
- 2-3. Electric Chiller
- 2-4. Energy Saving
- 2-5. Environment

**CE**

**CERTIFICATE OF COMPLIANCE**

Model No. : EES-04, 06, 08  
 Name of Product : Chiller\_E2  
 Applicant : Global Standard Technology Co., Ltd.  
 #1128, Sinwold-ri, Iweil-myeon, Jicheon-gun, Chungbuk, Korea  
 Order Number : G-44-2011-02439  
 Date of Issue : September 5, 2011  
 Issue Number : 1  
 Technical File Number : J11-CE-0075  
 Technical File holder : SGS United Kingdom Limited  
 E.U. : Unit 10, South Industrial Estate, Broomby, Durham, DH9 5AD.  
 Test Required : Conformity to Annex I, the Essential health and safety requirements of the Machinery Directive, section 1.

**Conclusion**  
 The apparatus meets the requirements of the directive and hence fulfills the requirements of:  
 The Machinery Directive 2006/42/EC.  
 The Low Voltage Directive 2006/95/EC.  
 The EMC Directive 2004/108/EC.

This certificate is only valid for the equipment and configuration described in cooperation with the test data detailed above. It does not permit the use of the SGS PRODUCT CERTIFICATION MARK.

The CE mark as shown below can be used, under the responsibility of the manufacturer, after completion of an EC Declaration of Conformity and compliance with all relevant CE Directives.

Worono Lee  
Manager

Eric Lee  
General Manager

Copyright of this certificate is owned by SGS Korea and may not be reproduced other than in full and with the prior approval of the General Manager of SGS Korea.

18-34, Barkan-ri, Gyeongsang-do, Korea 425-040  
 T+82 (0)11 428 9700 F+82 (0)11 427 2201 www.sgskorea.com

Member of SGS Group (Societe Generale de Surveillance)

SGSPAPER  
11566710

**SEMI**

Test Report No. K7447-S14 page 2 of 104  
 File No.: KP-14-219 10.01.2014

**TEST REPORT**  
 SEMI S2 -0712

**Environmental, Health, and Safety Guideline for Semiconductor Manufacturing Equipment**

Report No. : K7447-S14  
 Date of Issue : 10.01.2014

Testing Laboratory : TÜV NORD Korea Ltd.  
 Address : #1702 Korea Trade Tower,  
 159-1 Samseong-Dong, Gangnam-Gu, Seoul 135-726, Korea

Testing location : Jicheon Branch  
 #1128, Sinwold-ri, Iweil-myeon, Jicheon-gun, Chungbuk, Korea

Applicant : Global Standard Technology Co., Ltd  
 Address : #9-7B, Dongtan Industrial Complex, Song-ri, Dongtan-myeon,  
 Hwiseong-ri, Gyeonggi-do, Korea

Standard : SEMI S2-0712  
 Test Report Form No. : MACHINERY - SEMI (Rev. 0)  
 Test modified by : TÜV NORD Korea Ltd.

Type of test object : ELECTRIC CHILLER

Trademark : GST

Model/type reference : EES-08  
 Manufacturer : Global Standard Technology Co., Ltd

Number of pages (Report) : 104 Pages  
 Number of pages (Attachments) : -

Prepared by : Y. C. Kim / Test Engineer  
 Reviewed by : I. G. Kim / Project Engineer

**NRTL**

**CERTIFICATE**  
 No. UBU 17 02 88729 008

Holder of Certificate: Global Standard Technology Co., Ltd.  
 15-13, Dongsangdan-dong, Dongtan-myeon  
 Hwiseong-ri, Gyeonggi-do 18487  
 REPUBLIC OF KOREA

Certification Mark: TÜV SÜD US

Product: Industrial Chiller (E2-Chiller)

The product was voluntarily tested according to the relevant safety requirements noted above. It can be marked with the certification mark above. The mark must not be altered in any way. This product certification system operated by TÜV SÜD America Inc. most closely resembles system 3 as defined in ISO/IEC 17067. Certification is based on the TÜV SÜD "Testing and Certification Regulations". TÜV SÜD America Inc. is an OSHA recognized NRTL and a Standards Council of Canada accredited certification body.

Test report no.: MAEA7007717

Date: 2017-03-03  
 Page 1 of 2

TÜV SÜD AMERICA INC • 10 Centennial Drive • Peabody, MA 01960 USA • www.TUVamerica.com

**EMC**

**EMC TEST REPORT**

Report No. : F80501RF-IMS002841  
 Page : 1 of 28

SGS File No. : G-44-2011-00176  
 Applicant : Global Standard Technology Co., Ltd.  
 Equipment under Test (EUT):  
 Name : CHILLER-E2  
 Model No. : EES-06 (Alt. Model : EES-04, EES-08)  
 Serial No. : ET-00473  
 Standards : EN 55011:2007  
 EN 61000-6-2:2005  
 EN 61000-4-2:1995/A1:1998/A2:2001  
 EN 61000-4-3:2006  
 EN 61000-4-4:2004  
 EN 61000-4-5:2005  
 EN 61000-4-6:2007

Date of Test : August 11, 2011 to August 25 2011  
 Date of Issue : September 21, 2011

Test Result : PASS

In the configuration tested the EUT complied with the standards specified above.

Tested by : John Oh  
 Approved Signatory : Carl Lee

Remarks:  
 This report details the Result of the testing carried out on one sample. The Result contained in this test report do not relate to other samples of the same product. The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in this report.  
 This report may only be reproduced and distributed in full. If the product in this report is used in any configuration other than that detailed in the report, the manufacturer must ensure the new system complies with all relevant standards. Any mention of SGS International Electrical Approvals or testing sites by SGS International Electrical Approvals in connection with distribution or use of the product described in the report must be approved by SGS International Electrical Approvals in writing.

## GST Chiller Development Time Table

	2023	2024	2025	2026	2027	2028
<b>Cryogenic Chiller</b>	-50°C ~ -80°C 7.0kW@-60°C Size 1000(W)mm	-80°C ~ -90°C 7.0kW@-80°C Size 800(W)mm	-80°C ~ -100°C 7.0kW@-90°C Size 700(W)mm	-90°C ~ -100°C 8.0kW@-100°C	-100°C ~ -120°C 10.0kW@-110°C Size 10% ↓	-100°C ~ -120°C 10.0kW@-110°C Size 20% ↓
<b>Heat Exchanger</b>	250°C	300°C	350°C	380°C Size 10% ↓	400°C Size 20% ↓	400°C Size 30% ↓
<b>Electric Chiller</b>	SMPS, TEM, Pump Energy Efficiency 5% ↑	SMPS, TEM, Pump Energy Efficiency 20% ↑	SMPS, TEM, Pump Energy Efficiency 30% ↑	SMPS, TEM, Pump Energy Efficiency 35% ↑	SMPS, TEM, Pump Energy Efficiency 40% ↑	SMPS, TEM, Pump Energy Efficiency 45% ↑
<b>Refrigerant Chiller</b>	CO2 Refrigerator 2.5kW@-10°C EER 3	CO2 Refrigerator 5.0kW@-10°C EER 2.5	Natural & HFO 6.0kW@-40°C EER 2.0	Natural & HFO 8.0kW@-40°C EER 1.5	Natural & HFO 9.0kW@-40°C EER 1	Natural & HFO 10.0kW@-40°C EER 1
<b>GWP</b>	[GWP 3922] HFC 100%	[GWP 1397] HFC 90%, CO <sub>2</sub> 10%	[GWP 239] HFC 30%, HFO 60%, CO <sub>2</sub> 10%	[GWP 239 / GWP 1] HFC 10%, HFO 80%, CO <sub>2</sub> 15%, He 5%	[GWP 239 / GWP 1] HFC 5%, HFO 75%, CO <sub>2</sub> 15%, He 5%	[GWP 239 / GWP 1] HFC 0%, HFO 80%, CO <sub>2</sub> 15%, He 5%

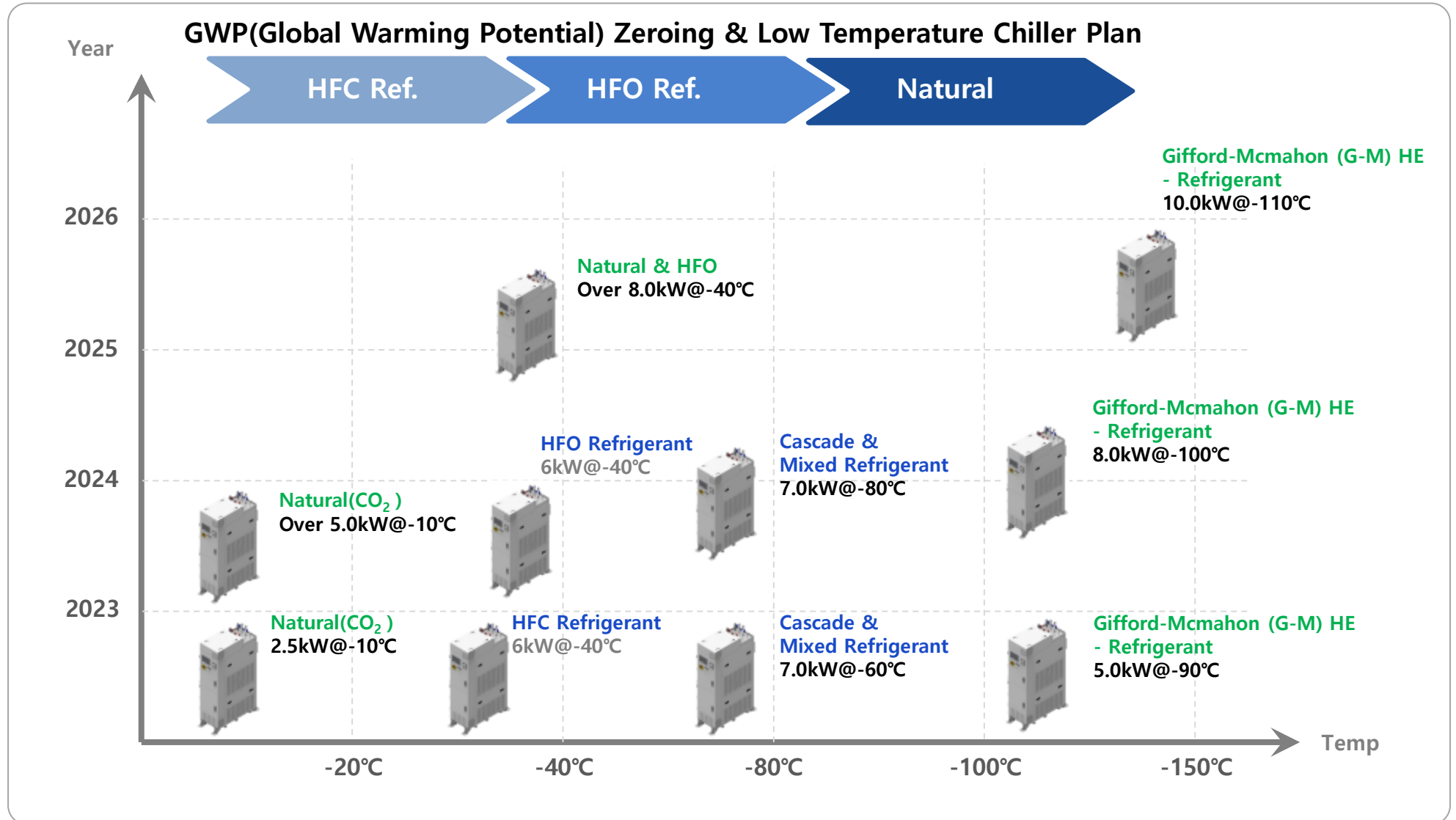
### 1. Chiller Introduction

- 1-1. ELE. Chiller Application
- 1-2. REF. Chiller Application
- 1-3. HEX. Application
- 1-4. Installation Type
- 1-5. Chiller Certification

### 2. Road Map

- 2-1. Intro
- 2-2. Cryogenic Chiller
- 2-2. Heat Exchanger
- 2-3. Electric Chiller
- 2-4. Energy Saving
- 2-5. Environment

## GST Refrigeration Plan : Convert to eco -friendly refrigerant



### 1. Chiller Introduction

- 1-1. ELE. Chiller Application
- 1-2. REF. Chiller Application
- 1-3. HEX. Application
- 1-4. Installation Type
- 1-5. Chiller Certification

### 2. Road Map

- 2-1. Intro
- 2-2. Cryogenic Chiller**
- 2-2. Heat Exchanger
- 2-3. Electric Chiller
- 2-4. Energy Saving
- 2-5. Environment



## G-M (Gifford-McMahon) Refrigerator

- Development review : Cryogenic Chiller development through G-M application 『Target performance : 12,000W at -100℃』
- Using He as refrigerant to make less than -229℃(44K) temperature feasible system
- G-M Refrigerator Advantage
  - Eco-friendly [ Without HFC, Use He ]
  - Compact [ Simple structure of Refrigeration part, Compression part ]
  - Temperature scalability [ Cryogenic temperature feasible system ]

Step	Analysis	Development	Improve
Main task	<ul style="list-style-type: none"> <li>▪ G-M cycle cooling CAPA. Check</li> <li>▪ Decide Wet heat exchange method</li> <li>▪ Decide possible chiller integration method</li> </ul>	<ul style="list-style-type: none"> <li>▪ Development chiller Spec confirmation</li> <li>▪ Development chiller design &amp; production</li> <li>▪ Development chiller evaluation &amp; debugging</li> </ul>	<ul style="list-style-type: none"> <li>▪ Check possibility of additional improvement reflection</li> </ul>
Schedule	<ul style="list-style-type: none"> <li>▪ ~ 23/6</li> </ul>	<ul style="list-style-type: none"> <li>▪ 23/7 ~ 23/12</li> </ul>	<ul style="list-style-type: none"> <li>▪ 24/01 ~</li> </ul>

■ Lab evaluation progress completion : HFE-7200 -131.65℃ measurement completion

Before Operation  
: T1 268.3K (-4.85℃)  
: T2 280.4K (7.25℃)

After Operation  
: T1 144.3K (-128.85℃)  
: T2 271.7K (-1.45℃)

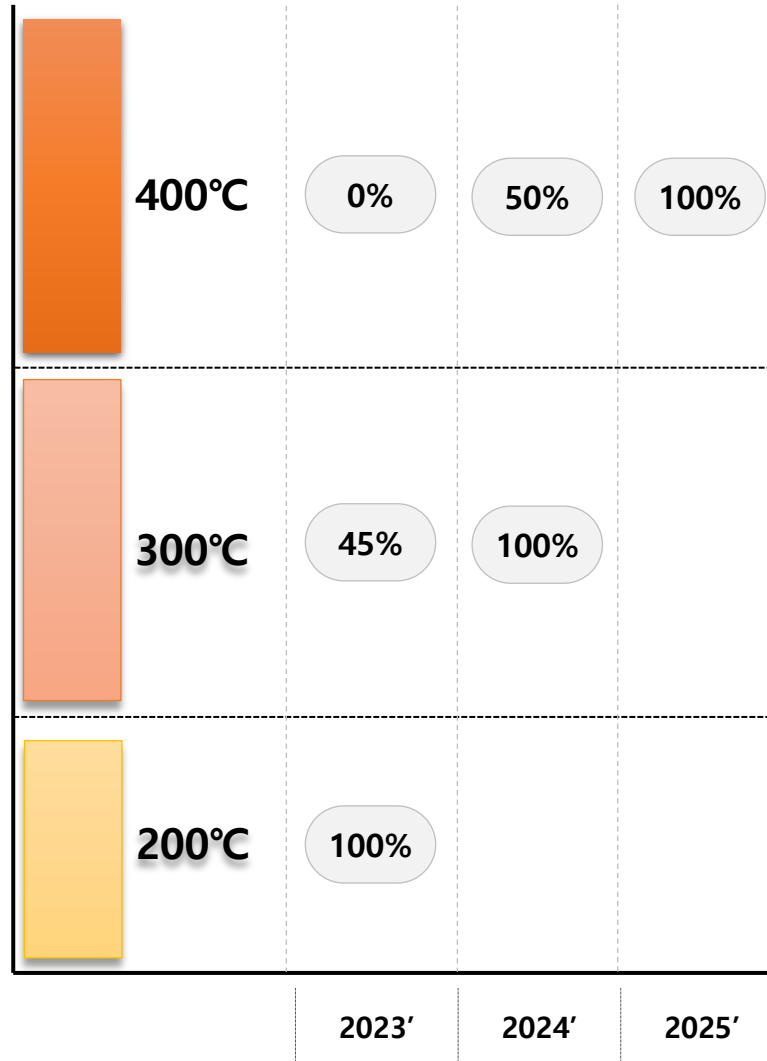
After about 40 mins. HFE 7200 reach 141.5K(-131.65℃)

Check low temp. contact part crystalline state

## High temperature Heat Exchanger



Design Concept



### Research & Development

- Fluid : Property analysis, [Securing safety \(Human body/ Environment\)](#)
- Parts : [Securing durability](#)
- Assembly : [Leak, Insulation review](#)
- System : [Mix, Fume Recycle, Reservoir structure review](#)
  - Development completed and mass production in progress

- 1. Chiller Introduction
  - 1-1. ELE. Chiller Application
  - 1-2. REF. Chiller Application
  - 1-3. HEX. Application
  - 1-4. Installation Type
  - 1-5. Chiller Certification
- 2. Road Map
  - 2-1. Intro
  - 2-2. Cryogenic Chiller
  - 2-2. Heat Exchanger**
  - 2-3. Electric Chiller
  - 2-4. Energy Saving
  - 2-5. Environment

## E Chiller High performance Product Development

### 1. Chiller Introduction

- 1-1. ELE. Chiller Application
- 1-2. REF. Chiller Application
- 1-3. HEX. Application
- 1-4. Installation Type
- 1-5. Chiller Certification

### 2. Road Map

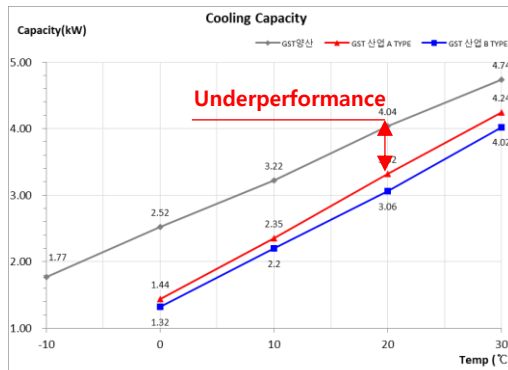
- 2-1. Intro
- 2-2. Cryogenic Chiller
- 2-2. Heat Exchanger
- 2-3. Electric Chiller
- 2-4. Energy Saving
- 2-5. Environment

■ Target - Capacity : -20@3.0kW → -25@4.5kW

Completion — In Progress — Expectation —

Details	y2021						y2022						y2023						y2024																
	M7	M8	M9	M10	M11	M12	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	M1	M2	M3	M4	M5
TE Module Capacity calculation	[1st]												2nd																						
TE Module development 1st/ 2nd							[1st]						2nd																						
Al Fin design & development 1st/ 2nd	[1st]												2nd																						
AL Block design / production 1st/ 2nd							1st						2nd																						
SMPS development 1st/ 2nd	[1st]						Verification/Reliability evaluation /Certification						2nd																						
Purchase request & production							1st						2nd																						
Performance Evaluation							1st						2nd																						

- High performance SMPS develop complete & reliability evaluation in progress [Size 35% Down]
- Dropped due to 1st evaluation underperformance



- Key Device 2nd development TFT configuration
- Low temp. process Risk review needed

DC Power Supply

Electric Current Voltage UP ↑ & 1:1

TE Module

Qh-ΔT UP ↑

AL Cold Plate

K = Coefficient Of Heat Transfer  
A = Area  
ΔT= Out Temp – In Temp

Q = K·A·ΔT UP ↑

- Power consumption, Utility usage increase
- Breaker capacity increase
- Size increase
- Necessary Capacity check needed [ -25 @ 4.5kW ]

## Energy Saving

- 1. Chiller Introduction
  - 1-1. ELE. Chiller Application
  - 1-2. REF. Chiller Application
  - 1-3. HEX. Application
  - 1-4. Installation Type
  - 1-5. Chiller Certification
- 2. Road Map
  - 2-1. Intro
  - 2-2. Cryogenic Chiller
  - 2-2. Heat Exchanger
  - 2-3. Electric Chiller
  - 2-4. Energy Saving
  - 2-5. Environment

Contents	Category	Contents	Current State
Refrigerant Compression Type	Electric Power	<p>Variable Frequency</p> <ul style="list-style-type: none"> <li>▪ Refrigerant Compressor rotation speed(RPM) variation according to load qty (Heat-Load) of process</li> </ul> <p>Minimize unnecessary energy consumption and maximize efficiency</p>	<ul style="list-style-type: none"> <li>• Some product application complete</li> <li>• Application expansion</li> </ul>
TE-Module Type	Electric Power	<p>DC Power</p> <ul style="list-style-type: none"> <li>▪ Control Voltage(V)/Current(A) in proportion to load qty(Heat-Load) of process</li> </ul> <p>Cool / Heat change possible according to current flow direction</p>	<ul style="list-style-type: none"> <li>• Development complete</li> <li>• New product application complete</li> </ul>
	Process Cooling Water	<p>Control Signal</p> <p>PCW</p> <p>Proportional Control Vale(PCW)</p> <ul style="list-style-type: none"> <li>▪ Calculate load qty(Heat-Load) of process from controller and calculate necessary Heat dissipation amount</li> </ul> <p>Proportion control valve PCW flow rate control according to Heat dissipation amount (endothermic amount+used power)</p>	<ul style="list-style-type: none"> <li>• Development complete</li> <li>• New product application expected</li> </ul>

## Low GWP Refrigerant Application Plan

### ■ GST Alternative Refrigerant usage current state and plan

	2023'	2024'	2025'	2026'	2027'	
<b>R-404A</b> GWP 3922	90%	45%	25%	5%	0%	Non-Flammable Currently 90% are applied and in use <a href="#">Percentage of usage to Zero until 2027</a>
<b>R-448A</b> GWP 1387	5%	25%	30%	35%	5%	Non-Flammable Will replace 404A and expected to be used until 2027 <a href="#">Evaluation completed and application in progress to some models</a>
<b>R-449A</b> GWP 1397	5%	25%	30%	35%	5%	Non-Flammable Will replace 404A and expected to be used until 2027 <a href="#">Evaluation completed and application in progress to some models</a>
<b>R-454A</b> GWP 239	0%	0%	10%	20%	80%	Lower-Flammable Under reviewing as Convincing next generation refrigerant, Identified as reviewing government level deregulation due to some flammability
<b>CO2</b> GWP 1	0%	5%	5%	5%	10%	Non-Flammable Natural refrigerant with GWP1 level "Development in progress" Commercialization needed with all refrigerant related parts

### 1. Chiller Introduction

- 1-1. ELE. Chiller Application
- 1-2. REF. Chiller Application
- 1-3. HEX. Application
- 1-4. Installation Type
- 1-5. Chiller Certification

### 2. Road Map

- 2-1. Intro
- 2-2. Cryogenic Chiller
- 2-2. Heat Exchanger
- 2-3. Electric Chiller
- 2-4. Energy Saving
- 2-5. Environment



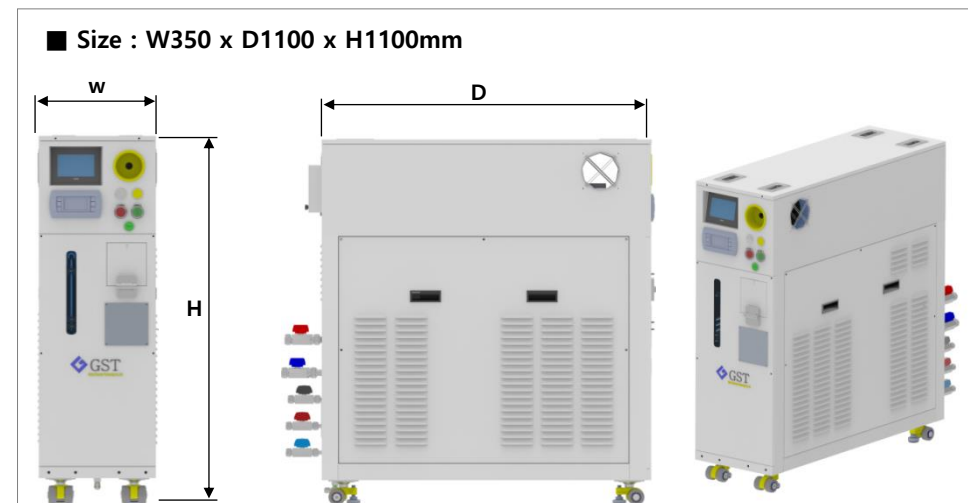
## CO2 Chiller

- Eco-friendly Chiller development using CO2 refrigerant
- Responding to need of realization of world wide carbon neutralization with GWP"1" refrigerant
- Refrigerant comparison

Refrigerant category	Name	Examples	GWP range	Ready to use	Natural
Alternatives to HFCs with low GWP	HFC A1	R-407/F, R-134a	From 1 400 to 2 500	currently	
	Mixtures of HFO A1	R-449A, R-450A	From 400 to 1 500	currently	
Intermediate refrigerants	Mixtures of HFO A2L, R-32	R-447A, R-454B y R-32	150....700	> 2016	
	HFO	R-123yf, R-1234ze	4....6	> 2016	
Future-ready refrigerants for the future	A3	R-290 (propane)	3	currently	✓
	A1	R-744 (CO <sub>2</sub> )	1	currently	✓

R-449A mainly used in current Europe market.  
R-744 refrigerant is the Natural Top.1 in existence

- GST prototype lay-out ( target cooling CAPA. : 2,500W at -10°C )



- Development plan( Prototype production completion 22/10)

Step	Analysis	Development	Improve
Main task	<ul style="list-style-type: none"> <li>▪ CO2 refrigerant characteristic &amp; System analysis (Done)</li> <li>▪ Spec confirmed and parts order(Done)</li> <li>▪ P&amp;ID and Design, Production completion (In progress)</li> </ul>	<ul style="list-style-type: none"> <li>▪ Evaluation of CO2 refrigerator basic performance</li> <li>▪ Evaluation result analysis</li> </ul>	<ul style="list-style-type: none"> <li>▪ Reliability evaluation</li> <li>▪ Built various Line-Up and transit to mass production system</li> </ul>
Development Schedule	<ul style="list-style-type: none"> <li>▪ 22/6 ~ 22/12</li> </ul>	<ul style="list-style-type: none"> <li>▪ 22/12 ~ 23/06</li> </ul>	<ul style="list-style-type: none"> <li>▪ 23/07 ~</li> </ul>

- 1. Chiller Introduction
- 1-1. ELE. Chiller Application
- 1-2. REF. Chiller Application
- 1-3. HEX. Application
- 1-4. Installation Type
- 1-5. Chiller Certification

## 2. Road Map

- 2-1. Intro
- 2-2. Cryogenic Chiller
- 2-2. Heat Exchanger
- 2-3. Electric Chiller
- 2-4. Energy Saving
- 2-5. Environment



# Thank you !

Sales & Service

America (Austin) +1.512.289.6246

China (Xian) +86.029.8882.3030

China (Wuxi) +86.510.8520.8557

Korea (Hwaseong) +82.31.371.2230

Taiwan (Hsinchu) +886.922.924.500

[sales@gst-international.com](mailto:sales@gst-international.com)