2019 模擬測驗( )

TEST PROJECT – REFRIGERATION AND AIR CONDITIONING

測試計畫-冷凍空調

WSC 2019

TEST PROJECT MODULES

WSC2017_TP38_pre_EN

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測試計畫模組

There are Three (3) Modules to complete in the 20 hour competition.

此部分有三個模組，需在 19 小時內完成

A) Component Fabrication 組件加工	Marks Time Allowed 3.0 Hrs 佔 分，計時 3.0 小時
B)Refrigeration System Installation and Commissioning 冷凍系統安裝和試車	Marks Time Allowed 13.0 Hrs 佔 分，計時 13.0 小時
C)Air Conditioning System Fault Find, Repair and Commissioning 冷凍系統故障排除、維修和試車	Marks Time Allowed 3.0 Hrs 佔 分，計時 3.0 小時

TEST PROJECT DOCUMENTATION

測試項目文件說明

Section 1: Competitor Instructions – Competition Details

This contains all of the competition details, except for the specific information on the refrigeration and air conditioning systems to be used in the competition. This will be provided to all participating countries approximately six (6) months prior to the competition to enable it to be translated into the Competitor's language and passed onto the Competitor. This document will be superseded by Section 4 prior to the competition.

章節 1:選手指導說明書-競賽細節

此份文件內涵所有競賽細節(除了在競賽中所使用的冷凍空調系統的特定資訊)。本資料將在競賽前 6 個月提供給各參賽國家，以便各國翻譯成該國語言供選手閱讀。本文件的章節 4 將會在賽前有所更動。

Section 2: Competitor Instructions – Manufacturers, Equipment and Materials Manuals

This contains the full operating manuals, wiring diagrams and specifications of the major equipment to be used in the competition. This will be provided to all participating countries approximately three (3) months prior to the prior to the competition to enable it to be translated into the Competitor's language and passed onto Competitors, all information will be available online via the WorldSkills Infrastructure List for competition

章節 2：選手說明書—製造商，設備和材料說明書

這章節包含完整的操作手冊，在比賽中使用主要設備的配線圖及規格表。本資料將在競賽前 3 個月提供給各參賽國家，以便各國翻譯成該國語言供選手閱讀。所有的資訊會公布在 WorldSkills 線上網站的 競賽材料設備清單。

Section 3: Test Project Drawings

The drawings will be distributed with Section 1. The drawings may be altered as part of the 30% change to the project which will take place at the competition. The drawings are issued as a guide only and are finalized at the competition.

章節 3:測試計畫圖示

此圖示將與章節 1 一起發布。所有圖示在競賽中可能會有 30%的變動性。此圖示現階段之發布僅供參考，最終圖示在競賽時才能確定。

Section 4: Competition Instructions

This document supersedes Section 1 and will be provided to all Competitors at the Information Session prior to start of the competition and will include a 30% change to the test project described in Section 1, it will include or provide reference to:

- The Competitor's competition timetable
- Health, safety and environment requirements
- Category competition rules and procedures
- Refrigeration Competition Standards
- Additional information

章節 4:競賽說明

此文件對章節 1 所進行的更動以及其中提及在測試項目上 30%的更動，會在競賽前的資訊會議提供給選手。並會附上下列參考資料:

- 選手競賽時程表
- 健康、安全和環境規定
- 職類競賽規則和程序
- 冷凍競賽標準
- 其他資訊

Section 5: Marking Scale

The marking summary will be distributed with Section 2 approximately three months prior to the competition. The marking scale detail will be finalized by the Experts prior to the competition dependent on the availability of materials and equipment supplied by the host nation and the 30% change to the Test Project.

章節 5:評分表

評分總表會在競賽前三個天與章節 2 一同公布。評分表細項將視主辦國提供之現有設備、材料以及測試計畫書讓裁判於賽前定案。

TIME ALLOWED FOR EACH MODULE

To enable all Competitors complete the Modules they will carry out the work at the same time. The

Competition Time Table in the Competitors Instructions Section 4 must be followed. Where system pipe work is installed, the Competitor is free to work autonomously in a safe manner with all relevant assessment being completed outside of competition time, pressure transducers may be used to ensure minimum pressure test and evacuation requirements are met by the Competitors. Competitors MUST perform all electrical testing in the presence of an Expert prior to energizing the installation.

每個模組的容許時間

為讓所有選手能夠完成模組，他們將在同一時間內進行工作。所有選手必須遵守選手說明書第四部分的競賽時程表。當管線系統裝設完成，在安全規定下，選手可自行進行工作，壓力感測器可以用於確保最小壓力測試，選手可完成抽真空；在競賽時間外，完成所有的評分。在裁判指導下，選手必須在送電前，進行所有電路測試。

CHECK POINTS 查核點

An important part of this competition are the procedures used to carry out various tasks. Therefore, at various points in this competition you must ask an Expert to observe and check your work. Once checked the Expert must place their initial in a progress box as per the **example below**.

由於各個工作單元之測試步驟為競賽過程中很重要的一部份，因此競賽過程中之各個查核點均需請裁判進行查核動作，一旦查核完，請裁判依下列格式簽名並註記國別:

Electrical Installation Testing 電氣安裝測試	Expert 1 Initials and Country CM AUS Expert 2 Initials and Country MF UK Expert 3 Initials and Country DO IE

INFORMATION CONCERNING SAFETY REQUIREMENTS

安全要求相關資訊

During the competition, all Competitors MUST follow the safety rules listed below along with the local Health, Safety and Environment requirements of the host country.

在競賽進行期間，所有選手務必遵守主辦國當地之相關健康與安全規定。

SHOES 工作鞋

- Fully enclosed work shoes or boots must be worn at all times.
- 競賽期間全程穿著全包覆式安全工作鞋或工作靴。

CLOTHING 衣著

- Legs must be covered at all times, by either long work trousers or overalls.
- 腿部不得外露，應著長工作褲或連身長褲。
- Upper body must be covered at all times.
- 任何時候上半身都要被包覆著。
- Arms must be covered with long sleeves, when brazing and using refrigerant.
- 在銲接或處理冷媒系統時，需穿著長袖上衣確保手臂不外露。

CLEAR SAFETY GLASSES 透明護目鏡

- Must be worn when necessary to protect your eyes.
- 必要時務必配戴護目鏡
- Must be worn when brazing, soldering, filing, reaming, hack-sawing, drilling, grinding and using refrigerant, dry nitrogen and compressed air.
- 進行硬銲、軟銲、銼、鉸、鋼鋸、鑽、研磨等加工，以及使用冷媒、乾燥氮氣、壓縮空氣時、務必配戴護目鏡。

GLOVES 工作手套

- Must be worn when brazing and using refrigerants
- 在銲接或處理冷媒系統時，務必戴上工作手套
- All Electrical work involving live testing will require wearing of approved gloves
- 在進行和動態測試有關之電氣工作時，務必戴上經核可之工作手套

ELECTRICAL 電氣部分

- Competitors must NOT switch on (apply power) to any electrical equipment until they receive permission from an Expert, except for hand power tools.
- 非經裁判允許，選手不得送電或啟動任何電氣設備之開關(電力手工具除外)。

Any Competitor that is identified as not wearing the correct safety attire or is engaging in any unsafe practice will be stopped and advised on the correct safety practice by an Expert. If the unsafe working practice is repeated the Expert may STOP the Competitor and report the issue to the chief or Deputy Chief Expert. The Competitor may not be allowed to continue until the safety issue is resolved. The Competitor will lose associated safety marks.

選手若經認定未依規定著裝或未依規定進行安全操作，將被停止進行該單元工作，並由裁判給予安全操作建議。此外，若再次出現危險操作，裁判可停止選手工作，並通報裁判長或副裁判長。至安全問題解決前，選手可能無法繼續競賽。選手在安全相關項目將會被扣分。

If the Competitor continues to ignore the safe working practice they may be removed from the competition area for a safety briefing for ten minute by the host country health, safety and environment representative, the time taken to complete the safety briefing will be considered to be a part of the Competitor's competition time.

如果選手繼續忽略安全操作，他們可能要暫離競賽區，聽取主辦國衛生與安全代表的 10 分鐘安全簡報。這段簡報時間將視為競賽時間。

COMPETITION DETAILS - MODULE A (TASK 1)
競賽細節-模組 A(任務 1)

COMPONENT FABRICATION AND BRAZING

組件加工和銲接

MAXIMUM TIME ALLOWED - 3 HOURS **MARKS**

最長容許工時-3 小時 **配分: 分**

SCOPE 範圍

The Competitors are required to fabricate a copper tubing part of the refrigerant circuit that will form the hot gas side heat exchanger, this coil will be incorporated into the design of the system at a later stage. The coil is constructed according the drawing R.001 and R.002. This entire will be mounted on the working cradle (R.003) and sit also in the bottom of a tank to heat up the water with the potential of the hot gas temperature being installed in Module B.

選手必須對熱氣側的熱交換器冷媒盤管進行銅管加工。之後將會把這個盤管組裝到設計的系統中。這個盤管根據圖 R.001 及 R.002 進行加工，整組盤管將會被安裝到工作架(R.003)中的槽底座，並以安裝在模組 B 中的熱氣溫度潛熱加熱水

TIMING 時間

Competitors are to all complete the copper tubing construction at the same time in the morning of C1, this will allow for marking to take place in the afternoon, any Competitors that do not finish Module A in the allocated time will be required to submit the unfinished project for assessment. Competitors will receive additional points for completing this module in less than the allocated time (as defined in the marking summary) providing that the fabricated component does not leak when pressure tested.

選手必須在 C1 上午規定的相同時間內完成銅管線路的組裝，下午將會進行評分。選手若未能在模組 A 規定的時間內完成，仍必須將未完成的作品呈交進行評分。根據評分標準守則，選手若在時間內提前完成模組且經過加壓測試未產生洩漏，會額外加分。

ASSESSMENT 評分

Competitors will be assessed as per technical description, the marking scale will reflect dimensions and tolerances for assessment in addition to the quality of brazed joints. Fabricated component will be tested for leaks by pressure testing with dry nitrogen to ensure no leaks are present. Any Competitor who does not complete Module A in the required time (3 hours) will be allowed to complete it after it is assessed and handed back to them during Module B – no additional time will be allowed for either Module A or Module B for those who do not complete the fabrication in the allotted time.

選手的評分將依照技術規則，除了考量焊接點的品質外，評分機制會考量成品的尺寸與公差。已加工的零件會灌入乾燥氮氣，做壓力測試，確保當時無漏。選手未在指定時間(3 小時)內完成模組 A，經允許後可以在評分後繼續完成，評分作品會於模組 B 還給選手，然而在模組 A 或模組 B 的比賽時間不會因此延長。

DRAWINGS 圖示

R.1 Construction part for hot gas side heat exchanger	R.1 熱氣側熱交換器組裝部分
R.2 Hot gas heat exchanger	R.2 熱氣熱交換器
R.3 Working cradle	R.3 工作架

COMPONENTS 組件

Components to be installed are shown in drawing R.001

圖 R.001 為需進行安裝的組件

To be filled in by COMPETITORS under supervision by an Expert
此表須在裁判的監督下由選手填寫

PRESSURE TEST ATTEMPT #1
第一次壓力測試

Starting test pressure: _____ ☐ kPa ☐ psi
起始測試壓力

Starting Time: _____
起始時間

Test pressure after standing time: _____ ☐ kPa ☐ psi
站壓後測試壓力

Finishing Time: _____
完成時間

PRESSURE TEST ATTEMPT #2
第二次壓力測試

Starting test pressure: _____ ☐ kPa ☐ psi
起始測試壓力

Starting Time: _____
起始時間

Test pressure after standing time: _____ ☐ kPa ☐ psi
站壓後測試壓力

Finishing Time: _____
完成時間

	裁判(1,2,3)簽名並註記國家
heat recovery coil Pressure Test 熱回收盤管壓力測試	Expert 1 Initials & Country: Expert 2 Initials & Country: Expert 3 Initials & Country:

COMPETITION DETAILS - MODULE B (TASK 2)
競賽細節-模組 B(任務 2)

REFRIGERATION SYSTEM INSTALLATION AND COMMISSIONING

冷凍系統安裝和試車

MAXIMUM TIME ALLOWED - 13 HOURS **MARKS**

最長容許工時–13 小時 配分： 分

SCOPE 範圍

Competitors are to install a refrigeration system to refrigerate a small scale ice rink and use the hot gas side to heat up water for heat pump application. This system shows the potential of a refrigerant circuit to cool down water on one hand and heat up water for using it for hand washing for example.

The Competitors are required to use the supplied components along with the coil fabricated in Module A to form a refrigeration system for cooling down water to form ice and heat up water with the hot gas side. If the hot water reaches a fixed temperature the system has to switch with the solenoid valves direct to the condenser. A capacity control valve is used to ensure suction pressure does not drop below design. Refrigerant is R134a.

Competitors are required to connect all components to a prewired electrical panel

選手需要安裝一個冷凍系統來製冷一個小型的儲冰槽，並使用熱氣側來加熱水，形成熱泵應用。此系統一方面呈現了冷媒管路冷卻水的能力和加熱水來使用，例如用來洗手。

在模組 A，選手需要利用供應的組件沿著盤管進行加工，來組成一個冷卻水以製冰和在熱氣側加熱水的冷凍系統。若熱水達到一固定溫度，系統必須以電磁閥直接轉換入冷凝器。容量控制閥用來確保吸入壓力不低於預設值。使用冷媒是 R134a。

選手必須將所有的組件連接到一個預先裝好的配電板。

TIMING 時間

Competitors are to all complete the installation over C1, C2 and C3. The completed project with ice rink frozen may be left running and displayed on C4.

選手須在 C1, C2 和 C3 內完成所有的安裝。完成的儲冰槽冷凍成品須在 C4 時運作和展示。

ASSESSMENT 評分

Competitors will be assessed as per technical description with particular weighting on the commissioning and operation of the project.

選手將會依照技術規則中成品的試車和運作特殊權重規則接受評分。

DRAWINGS 圖示

R.1	Construction part for hot gas side heat exchanger	R.1 熱氣側熱交換器的組裝
R.2	Hot gas heat exchanger	R.2 熱氣熱交換器
R.3	Working cradle	R.3 工作架
R.4	Refrigerant flow diagram	R.4 冷媒流程圖
R.5	Electrical switch box	R.5 電氣開關箱
R.6	Electrical diagram	R.6 電路圖
R.7	Ice rink coil	R.7 儲冰槽盤管
R.8	List of mechanical and electrical components	R.8 機械和電子組件清單

COMPONENTS 組件

Components to be installed will include the following;

需安裝的組件包含如下:

- Compressor (Copeland RRT10K1E-PFZ959)r
- Condensor Coil assembly (Copeland 566-1167-01)
- Liquid Receiver (Copeland 577-0315-05)
- Filter Drier (Emerson Climate EK-0525))
- Sight Glass (Emerson Climate HMI-1TT2)
- Thermostatic Expansion Valve (Sporlan)
- Hot gas regulator (Danfoss KVC 12)
- Suction Accumulator (Alltemp)
- Solenoid Valves (Sporlan)
- Check Valve (Danfoss)
- Service Valves (NDL)
- Pressure Relief Valves (Superior)
- High and Low Pressure Control (Ranco)
- Electrical switchboard
- Electronic Temperature Controls (Johnson Controls (A421ABC-02C) for cold water and hot water

壓縮機(Copeland RRT10K1E-PFZ959)r

裝配冷凝盤管(Copeland 566-1167-01)

儲液器(Copeland 577-0315-05)

乾燥過濾器(Emerson Climate EK-0525))

冷媒觀測窗(Emerson Climate HMI-1TT2)

感溫室膨脹閥(Sporlan)

熱氣調節器(Danfoss KVC 12)

液氣分離器(Alltemp)

電磁閥(Sporlan)

單向止逆閥(Danfoss)

手動球閥(NDL)

洩壓閥(Superior)

高低壓控制(Ranco)

電氣開關板

冷熱水電子溫度控制器(Johnson Controls(A421ABC-02C)

SYSTEM DESIGN SPECIFICATIONS

系統設計規格

The following system design specifications for the installation should be used for commissioning and control setting and are as follows:

下列安裝系統設計規格應用於試車和控制設定，如下所示：

SYSTEM SPECIFICATIONS 系統規格

- Rrefrigerant = R134a
- Maximum ambient temperature = 35°C Db, 28°C Wb
- Design saturated suction temperature = -15°C
- Suction line pressure drop = 1 K

冷媒= R134a

最高環境溫度= 35°C Db, 28°C Wb

預設飽和吸入溫度=-15°C

吸入線壓降= 1 K

CONTROL AND SAFETY SETTING 控制與安全設定

- Low Pressure Controller cut off K lower than design saturated suction temperature (SST).
- 低於設計的飽和低壓溫度 K，低壓開關切出。
- Low Pressure Controller cut in at -10 °C saturated suction temperature
- 低壓開關切入設定在-10 °C 飽和吸入溫度。
- Capacity control valve to maintain -15 °C saturated suction temperature
- 容量控制閥保持在-15 °C 飽和低壓吸入溫度。
- High Pressure cut out the system when the Condensing temperature reaches 55 °C
- 高壓開關切出設定在冷凝溫度達 55°C。
- Temperature controller cut out at -15 °C
- 溫度開關切出設定在-15 °C
- Temperature controller cut in at -10 °C
- 溫度開關切入設定在-10 °C
- Temperature controller cut in at 46 °C to switch the solenoid valves & cut out at 35 °C to start heating water again
- 溫度控制器在 46°C 切入轉換電磁閥，在 35°C 切出再次開始加熱水

SYSTEM OPERATION 系統運轉

- Capacity control valve set to maintain -15 °C saturated suction temperature and limit temperature cycling to safety only (unit should run continually and not cycle on and off)
- 容量控制閥設定好維持-15 °C 飽和吸入溫度和限制溫度循環在安全值中(機組應持續運轉且不時開時關)

INSTALL AND COMMISSION REFRIGERATION SYSTEM
安裝和試車冷凍系統

All Competitors will be required to perform the following tasks to complete this module, task 6 has an Expert sign off sheet which needs to be filled in and signed prior to moving ahead on this task

所有的選手將須進行下列任務來完成這個模組。任務六須由裁判簽名表格，經過裁判填寫和簽名後才能進行下一項目。

1. INSTALL REFRIGERATION SYSTEM 冷凍系統安裝

All Competitors will supplied with all necessary equipment and materials to complete the installation of the refrigeration system in accordance with test project drawings and WorldSkills International Standard for Refrigeration and Air Conditioning.

大會將依照冷凍空調測試計畫圖示和國際技能大賽標準提供所有選手必備的設備及材料來完成冷凍系統安裝。

Refer to the following project drawings to assist to complete this task

請參照下列計畫圖示完成此任務

R.1	Construction part for hot gas side heat exchanger	R1. 熱氣側熱交換器組裝部分
R.2	Hot gas heat exchanger	R.2 熱氣熱交換器
R.3	Working cradle	R.3 工作架
R.4	Refrigerant flow diagram	R.4 冷媒流程圖
R.5	Electrical switch box	R.5 電氣開關箱
R.6	Electrical diagram	R.6 電路圖
R.7	Ice rink coil	R.7 儲冰槽盤管
R.8	List of mechanical and electrical components	R.8 機械和電子組件清單

2. INSTALL ELECTRICAL SYSTEM 電氣系統安裝

All Competitors will supplied with all necessary equipment and materials to complete the installation of the refrigeration system in accordance with test project drawings and WorldSkills International Standard for Refrigeration and Air Conditioning.

大會將依照冷凍空調測試計畫圖示和國際技能大賽標準提供所有選手必備的設備及材料來完成冷凍系統安裝。

Refer to the following project drawings to assist to complete this task

請參照下列圖示完成此任務

R.5	Electrical switch box	R.5 電氣開關箱
R.6	Electrical diagram	R.6 電路圖
R.008	List of mechanical and electrical components	R.008 (R8?) 機械和電子組件清單

3. PRESSURE TEST SYSTEM 壓力測試系統

Carry out a staged pressure test of the primary refrigeration system (R134a) in accordance with manufacturer's equipment instructions and WorldSkills standards. The pressure test point should not drop from the starting point in the fifteen (15) minutes after the pressure test is isolated from the Nitrogen cylinder. If the pressure test has not been achieved, the Competitor can continue to fix the leak and achieve the pressure test, however the full mark for Pressure Test will be lost. The pressure test will be monitored remotely via a data logging process to ensure all Competitors achieve the required pressure and standing time.

請依照製造廠商設備說明書及世界技能競賽技術標準進行主要冷凍系統(R134a)的階段壓力測試。當氮氣瓶被斷開時,壓力測試開始起 15 分鐘內不能降低。如果壓力測試未達要求，選手可以繼續探漏、除漏和補漏，並繼續完成壓力測試，但壓力測試分數將會全部扣除。壓力測試將有遠端監控和資料輸入流程，以確保所有選手在規定的壓力測試時間內完成。

To be filled in by COMPETITORS under supervision by an Expert

此表須在裁判的監督下由選手填寫

PRESSURE TEST ATTEMPT #1

第一次壓力測試

Starting test pressure: _____ ☐ kPa ☐ psi
起始測試壓力

Starting Time: _____
起始時間

Test pressure after standing time: _____ ☐ kPa ☐ psi
站壓後測試壓力

Finishing Time: _____
完成時間

PRESSURE TEST ATTEMPT #2

第二次壓力測試

Starting test pressure: _____ ☐ kPa ☐ psi
起始測試壓力

Starting Time: _____
起始時間

Test pressure after standing time: _____ ☐ kPa ☐ psi
站壓後測試壓力

Finishing Time: _____
完成時間

	裁判(1,2,3)簽名並註記國家
Refrigeration Pressure Test 冷凍壓力測試	Expert 1 Initials & Country: Expert 2 Initials & Country: Expert 3 Initials & Country:

4. EVACUATION 抽真空

Evacuate the primary refrigeration system (R134a) in accordance with manufacturer's instructions and WorldSkills standards using the **Deep Vacuum Method** to hold a vacuum of at least 1000 microns (130Pa absolute) of mercury. The evacuation point should not rise to a value greater than 1000 microns in the Ten (10) minutes after the vacuum pump is isolated from the system under test.

依照製造廠商設備說明書及技術標準以深度抽真空法進行主要冷凍系統(R134a)的抽真空作業。真空度至少須達 1000 微米(130pa 絕對壓力)Hg 汞柱高。測試時，真空幫浦與系統隔離(移除?)後，真空度在十分鐘內不得回升到高於 1000 微米。

To be filled in by EXPERTS ONLY

此表僅由裁判填寫

EVACUATION TEST ATTEMPT #1

第一次抽真空測試

Starting evacuation level:
初始真空度 _____ ☐ microns

Starting Time:
開始時間 _____

Evacuation level after standing time:
站空後的真空度 _____ ☐ microns

Finishing Time:
完成時間 _____

EVACUATION TEST ATTEMPT #2

第二次抽真空測試

Starting evacuation level:
初始真空度 _____ ☐ microns

Starting Time:
開始時間 _____

Evacuation level after standing time:
站空後的真空度 _____ ☐ microns

Finishing Time:
完成時間 _____

Comments:
備註

裁判(1,2,3)簽名並註記國家

Refrigeration Evacuation Test 冷凍系統抽真空測試	Expert 1 Initials & Country: Expert 2 Initials & Country: Expert 3 Initials & Country:

5. CHARGING WITH REFRIGERANT 冷媒填充

Charge the refrigeration system (R134a) with the required weight of refrigerant to ensure operation according to specification above, and in accordance with acceptable trade and environmental practices.

請依相關商用規定及環境規範進行符合冷凍系統規定重量冷媒之充填主要冷凍系統(R134a)以確保其正常運轉。

To be filled in by EXPERTS ONLY

此表僅由裁判填寫

Bottle weight prior to charging: _____ ☐ kg(公斤) ☐ lb(磅)
填充前瓶重

Bottle weight at completion of charging: _____ ☐ kg(公斤) ☐ lb(磅)
填充後瓶重

Comments:
備註

6. 水槽充填

Charge the primary refrigeration system (R134a) with the required weight of refrigerant to ensure operation according to specification above, and in accordance with acceptable trade & environmental practices.
請依相關商用規定及環境規範進行符合冷凍系統規定重量冷媒之充填主要冷凍系統(R134a)以確保其正常運轉。

To be filled in by EXPERTS ONLY
此表僅由裁判填寫

Bottle volume prior to charging: _____ ☐ L(公升) ☐ fl oz(盎司)
充填前容器體積(熱水槽)

Bottle volume at completion of charging: _____ ☐ L(公升) ☐ fl oz(盎司)
充填後容器體積(熱水槽)

Comments:
備註

To be filled in by EXPERTS ONLY
此表僅由裁判填寫

Bottle volume prior to charging: _____ ☐ L(公升) ☐ fl oz(盎司)
充填前容器體積(冰水槽)

Bottle volume at completion of charging: _____ ☐ L(公升) ☐ fl oz(盎司)
充填後容器體積(冰水槽)

Comments:
備註

7. ELECTRICAL TESTING 電氣測試

Under the supervision of an Expert, perform all necessary safety checks to ensure the Test Project is safe to energize.

在裁判監督下，進行所有安全檢查確保測試計畫安全後才能送電。

PLEASE FILL IN THE EXPERT CHECK POINT SHEET BELOW BEFORE PROCEEDING ANY FURTHER

在進行下一步之前，請填寫在下列文件的裁判檢核評分表格。

To be filled in by EXPERTS ONLY

此表僅由裁判填寫

Competitor Name:
選手姓名:

Competitor Country:
選手國家:

All wiring inspected by Expert prior to energizing:
送電前裁判已檢查所有的線路: ☐ Yes

Electrical safety checks performed prior to energizing:
送電前已確認電氣安全檢查 ☐ Yes

Comments:
備註:

	裁判(1, 2, 3) 簽名並註記國家
Refrigeration System Electrical Test 冷凍系統電氣測試	Expert 1 Initials & Country: Expert 2 Initials & Country: Expert 3 Initials & Country:

8. COMMISSION THE SYSTEM 系統試車

Competitors are to commission the system for operation in accordance with the design specifications supplied. Please fill out the following commissioning document with the system fully operational and as close to operating temperatures as possible. Please indicate units by checking appropriate boxes.

選手依設計規格進行系統運轉試車，請照下列系統滿載運轉模式以及盡可能接近運轉溫度來填妥試車文件，並依照正確的單位勾選方框。

Ambient Temperature: 環境溫度	_____	□Celsius □Fahrenheit
Refrigerant Type: 冷媒種類	_____	
Mass of Refrigerant Charge: 冷媒填充質量	_____	□grams □pounds
Suction Pressure: 吸入壓力	_____	□kPa □psi
Discharge Pressure: 吐出壓力	_____	□kPa □psi
Condenser Subcooling: 冷凝器過冷度	_____	□Kelvin □Fahrenheit Degrees
Total System Superheat: 總系統過熱度	_____	□Kelvin □Fahrenheit Degrees
LP Control Cut In: 低壓開關切入	_____	□kPa □psi
LP Control Cut Out: 低壓開關切出	_____	□kPa □psi
HP Control Cut Out: 高壓開關切出	_____	□kPa □psi
HP Control Cut In: 高壓開關切入	_____	□kPa □psi
Capacity regulator setting: 容量調節閥設定值	_____	□Celsius □Fahrenheit
Compressor Operating Current: 壓縮機運轉電流	_____	□Amps
Condenser fan Current: 冷凝器風扇電流	_____	□Amps

Hot Recovery Temperature: _____ □Celsius □Fahrenheit
熱回收桶溫度

Ice tank Temperature: _____ □Celsius □Fahrenheit
冰水槽溫度

COMPETITION DETAILS - MODULE C (TASK 3)
競賽細節-模組 C (任務 3)

AIR CONDITIONING SYSTEM FAULT FIND, REPAIR & COMMISSIONING

空調系統故障判斷、修復、性能測試

MAXIMUM TIME ALLOWED - 3 HOURS **MARKS**

最長容許工時– 3 小時 **配分: 分**

SCOPE 範圍

Competitors will be provided with an air conditioning system that has been leak tested and verified to have no leaks, pressure testing of the system is not required at any point in time. Competitors will be required to identify a electrical fault and a refrigeration system fault on the supplied air conditioning systems, once faults have been identified the Competitors will be required to repair the faults including full refrigerant recovery and recharging of refrigerant charge to manufacturer's specifications. Competitors will then be required to commission the system and plot operating conditions on a psychometric chart.

提供選手已通過漏氣測試且排除漏氣的空調系統，此階段不需做壓力測試，選手必須找出一處電氣故障以及一處空調系統中冷凍系統故障。一旦選手找到這些故障，他們必須檢修故障，包括全部冷媒回收以及按照廠商規格重新填充冷媒。隨後，選手必須進行系統試車以及在空氣線圖上指出運轉情況。

TIMING 時間

Competitors are all to complete this module on C4 at the same time

選手在 C4 同時間內完成此項模組。

ASSESSMENT 評分

Competitors will be assessed as per technical description with particular weighting on the fault finding and commissioning of the project.

將依照技術說明中，測試項目的故障排除以及試車標準的評分權重，來進行選手評分。

DRAWINGS 圖示

R.009 ???

R.10 Psychometric chart (SI units) 空氣線圖(國際標準)

R.11 Psychometric chart (IP units) 空氣線圖(英制)

1. RECLAIM SYSTEM 回收系統

All Competitors are required to repair the fault they have identified on the unit, the refrigerant will need to be removed from the system to complete the repair then the system pressure tested, evacuated and recharged with refrigerant. All necessary materials will be provided to repair the equipment and return it to an operating state.

All repairs MUST be done with all relevant safety rules adhered to.

所有的選手必須辨識機組中的故障並且進行檢修。為了完成檢修，須先從系統中移除冷媒，其後進行系統壓力檢測、抽真空和冷媒再填充。進行檢修時所需的材料皆會提供，並且使機組回復到運轉模式。

所有檢修**務必**遵照相關安全規則進行。

To be filled in by EXPERTS ONLY

此表僅由裁判填寫

Reclaim System 回收系統

Reclaim bottle weight prior to reclaim: _____ ☐ kg(公斤) ☐ lb(磅)

回收前回收瓶重量

Reclaim bottle weight at completion of reclaim: _____ ☐ kg(公斤) ☐ lb(磅)

完成回收後，回收瓶重量

Comments:

備註

2. EVACUATION 抽真空

Evacuate the refrigeration system in accordance with manufacturer's instructions and WorldSkills standards using the **Deep Vacuum Method** to hold a vacuum of at least 1000 microns (130Pa absolute) of mercury. The evacuation point should not rise to a value greater than 1000 microns in the Ten (10) minutes after the vacuum pump is isolated from the system under test.

以深度抽真空法進行冷凍系統的抽真空作業時，請依製造廠商設備說明書及技術標準進行。真空度至少須達到 1000 微米(130Pa 絕對壓力)Hg 汞柱高。測試時，真空幫浦與系統隔離(移除?)後，真空度在十分鐘內不得回升到高於 1000 微米。

To be filled in by EXPERTS ONLY

此表僅由裁判填寫

Evacuation Test
抽真空測試

Starting evacuation level: _____ ☐ microns（微米）
起始真空度

Starting Time: _____
起始時間

Evacuation level after standing time: _____ ☐ microns（微米）
站空後真空度

Finishing Time: _____
完成時間

Comments:
備註

	裁判(1, 2, 3) 簽名並註記國家
Air Conditioning System Evacuation 空調系統抽真空	Expert 1 Initials & Country: Expert 2 Initials & Country: Expert 3 Initials & Country:

3. CHARGING WITH REFRIGERANT 冷媒填充

Charge the refrigeration system with the required weight of refrigerant to ensure operation according to specification above, and in accordance with acceptable trade and environmental practices.

以規定的冷媒重量來充填冷凍系統，以確保運轉時能符合上述規格與相關商用規定及環境規範。

To be filled in by EXPERTS ONLY

此表僅由裁判填寫

Refrigerant Charging
冷媒填充

Bottle weight prior to charging: _____ ☐ kg(公斤) ☐ lb(磅)
填充前的瓶重

Bottle weight at completion of charging: _____ ☐ kg(公斤) ☐ lb(磅)
完成填充後的瓶重

Comments:
備註

4. FAULT FINDING 故障排除

All Competitors are required to identify an electrical fault and a refrigeration system fault with the operation of the unit, the root cause must be found and repaired. Once the fault is identified Competitors are to fill in this sheet of paper identifying what they believe to be the fault with the equipment. An Expert then needs to sign this sheet of paper.

所有選手必須找出一處電氣故障與一處運轉機組中冷凍系統故障，且必須找到故障根源並檢修。一旦選手找到故障，請將他們認為設備中的故障寫在答案紙上，隨後裁判得在答案紙上簽名核可。

All fault finding MUST be done with all relevant safety rules adhered to. 所有的故障排除必須遵守相關的安全規章。

Once faults are found and recorded the Competitor is free to continue by running the unit and progressing to the next stage of the Module.

一旦選手找到錯誤並且完整記錄在答案紙上，選手可自行繼續進行機組運作並進行下一階段的工作。

ELECTRICAL SYSTEM FAULT 電氣系統故障

Please write down what the fault with the equipment is and any supporting information that indicates what the fault was.請寫下設備故障點並提供相關資訊說明該故障

_____

_____

_____

Please indicate what repairs need to be done to the system to return it to normal operation

請說明系統須進行何種檢修並使其回復到正常運轉狀態。

_____

_____

_____

REFRIGERATION SYSTEM FAULT 冷凍系統故障

Please write down what the fault with the equipment is and any supporting information that indicates what the fault was.請寫下設備出現何種故障並提供相關資訊說明該故障

_____

_____

_____

Please indicate what repairs need to be done to the system to return it to normal operation

請說明系統須如何進行檢修並使其回復到正常運轉狀態

_____

_____

_____

5. REPAIR SYSTEM 檢修系統

All Competitors are required to repair the faults they have identified on the unit, refrigerant must be removed from the system to repair the refrigeration fault. All necessary materials will be provided to repair the equipment and return it to an operating state

所有選手必須檢修機組中所找到的故障，檢修故障時，冷媒必須從系統中移除。會提供所有必備的材料，來檢修設備並且使其回復到運轉狀態。

All repairs MUST be done with all relevant safety rules adhered to.

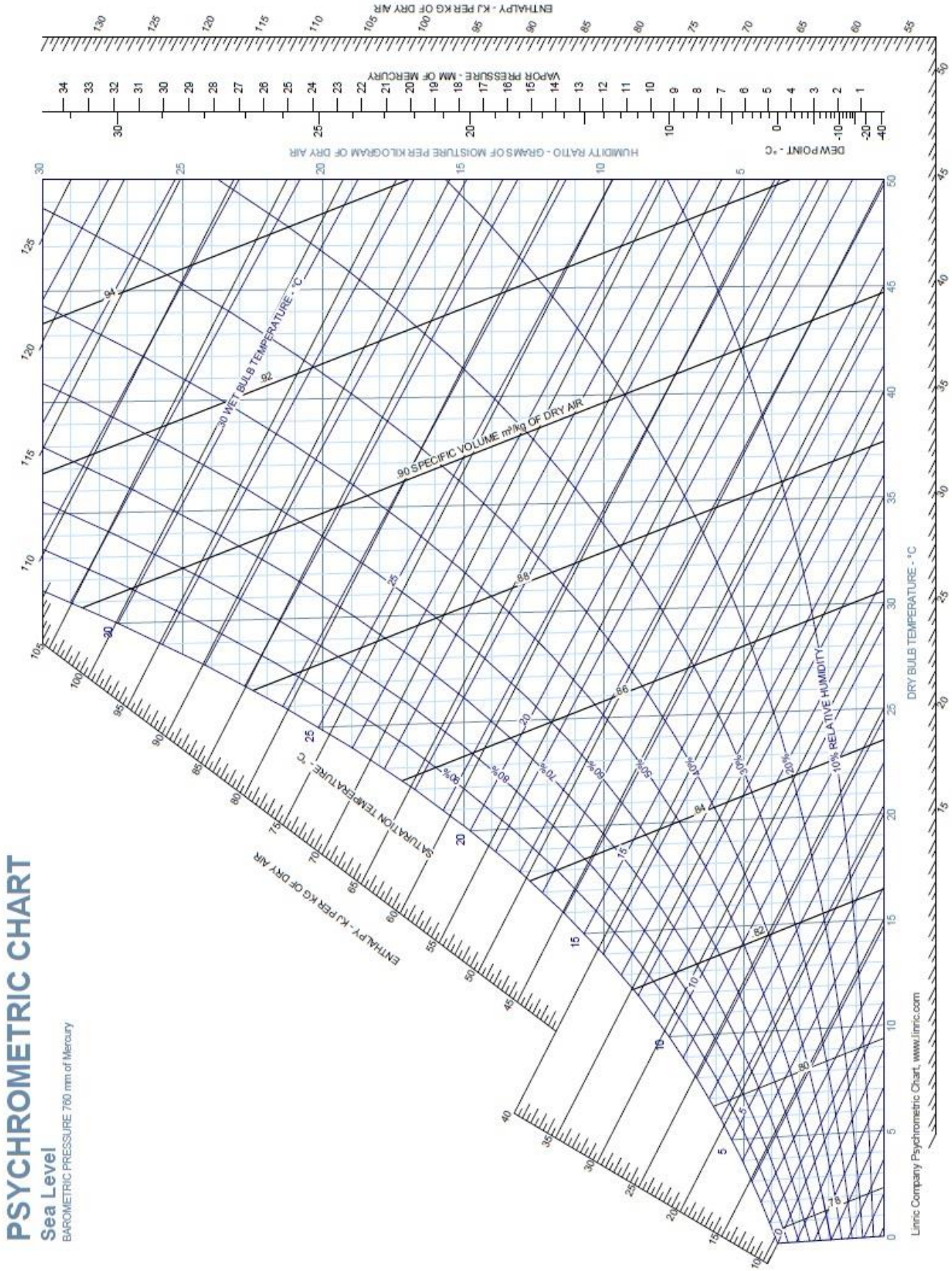
所有的檢修必須遵照相關安全規章進行。

6. COMMISSION THE SYSTEM 系統試車

Competitors are to commission the system for operation in accordance with the manufacturers specifications supplied. Please fill out the following commissioning document with the system fully operational, on "Cooling" mode, indoor fan on highest speed and as close to operating temperatures as possible. Please indicate units by checking appropriate boxes.

選手按照廠商提供的規格表進行系統試車運轉。請針對下列冷卻模式、高速運轉下的內風扇、以及盡可能接近運轉的溫度等項目，填妥系統完全運轉的試車文件，並依照正確的單位勾選方框。

Ambient Temperature: 環境溫度	_____	□Celsius □Fahrenheit
Return Air Dry Bulb Temperature: 回風乾球溫度	_____	□Celsius □Fahrenheit
Return Air Wet Bulb Temperature: 回風濕球溫度	_____	□Celsius □Fahrenheit
Supply Air Dry Bulb Temperature: 出風乾球溫度	_____	□Celsius □Fahrenheit
Supply Air Wet Bulb Temperature: 出風濕球溫度	_____	□Celsius □Fahrenheit
Air Velocity of indoor unit: 室內機風速	_____	□m/sec □ft/sec
Air Volume of indoor unit: 室內機風量	_____	□m3/sec □cfm
Indoor Fan Speed: 室內機風扇速率	□High 高速	□Medium 中速 □Low 低速
Mode of Operation: 運轉模式		□Cooling 冷氣 □Heating 暖氣
Refrigerant Type: 冷媒種類	_____	
Mass of Refrigerant Charge: 冷媒填充質量	_____	□grams □pounds
Suction Pressure: 吸氣壓力/低壓	_____	□kPa □psi
Discharge Pressure: 高壓	_____	□kPa □psi
Condenser Subcooling: 冷凝器過冷度	_____	□Kelvin □Fahrenheit Degrees
Total System Superheat: 總系統過熱度	_____	□Kelvin □Fahrenheit Degrees
Compressor Operating Current: 壓縮機運轉電流	_____	□Amps
Indoor Fan Operating Current: 室內機風扇運轉電流	_____	□Amps


PSYCHROMETRIC CHART
Sea Level
BAROMETRIC PRESSURE 760 mm of Mercury
ENTHALPY - kJ PER KG OF DRY AIR
SATURATION TEMPERATURE - °C
WET BULB TEMPERATURE - °C
SPECIFIC VOLUME m³/kg OF DRY AIR
RELATIVE HUMIDITY
DRY BULB TEMPERATURE - °C
HUMIDITY RATIO - GRAMS OF MOISTURE PER KILOGRAM OF DRY AIR
VAPOR PRESSURE - MM OF MERCURY
DEW POINT - °C
Limric Company Psychrometric Chart, www.limric.com