

Test Project

Refrigeration and Air Conditioning

Part A – Description of the Modules and Competitor
Instructions

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Introduction

This Test Project was developed by Independent Test Project Designers.

Part A Description of the Modules and Competitor Instructions will be released by WorldSkills International to the Experts, Interpreters, and Competitors prior to their arrival at the competition to enable it to be translated into the Competitors preferred language.

Part B Specifications and Drawings will be released by the Skill Competition Manager to the:

- Experts at the Competition (C-3)
- Competitors at the Competition (C-2)

This Test Project reflects international best practice as described by the Technical Description and the WorldSkills Occupational Standards. The Test Project's Marking Scheme will only assess and allocate marks to those skills that are set out in the Standards Specification.

Description of project and tasks

The Test Project is a series of standalone modules.

There are four (4) modules to complete in the 18-hour competition.

A) Component Fabrication	13 Marks Time Allowed 2 Hrs
B) Refrigeration System Installation and Commissioning	62 Marks Time Allowed 14 Hrs
C) Refrigeration System Electrical Fault Finding	14 Marks Time Allowed 1 Hr
D) Refrigeration System Refrigeration Fault Finding	11 Marks Time Allowed 1 Hr

Test Project Documentation

The Test Project is a series of standalone modules and consists of the following two (2) parts:

Part A - Description of the modules and competitor's instructions

This contains all of the competition details for each module, including the task description, time limits and instructions to Competitor.

Part B – Test Project, specifications drawings, and information

This contains the Test Project drawings, information, and specifications including the following:

1. WSC2022SE_TP38_BB_A4_01_EN.pdf - Refrigeration system piping diagram
2. WSC2022SE_TP38_BB_A4_02_EN.pdf - Electrical circuit diagram
3. WSC2022SE_TP38_BB_A4_05_EN.pdf - Refrigeration system components layout
4. WSC2022SE_TP38_BB_A4_06_EN.pdf - Ice rink coil drawing
5. WSC2022SE_TP38_BB_A4_07_EN.pdf - Refrigerated sign drawing
6. WSC2022SE_TP38_BB_A4_08_EN.pdf - Refrigeration system installation specifications
7. WSC2022SE_TP38_BB_A4_09_EN.pdf - Fault finding system's specification and drawings

This will be provided to all participating Experts at the Competition C-3 to enable it to be translated into the Competitor's language and presented to the Competitor at C-2.

Equipment manufacturers' drawings and instructions

The details of the most equipment was released online by WorldSkills to the participating countries February 2022 in preparation for WS2022 Shanghai to enable relevant manufacturers' instructions to be sourced by the Experts and translated into the Competitor's language if needed and provided to Competitors prior to the competition.

Additional Information

Any additional information will be provided to all Competitors at Familiarization prior to start of the competition, including the Competitor's competition timetable.

Time allowed for each module

To enable all Competitors to complete the modules they must carry them out in the times allocated in the Competition timetable.

Check points

While system pipe work and electrical wiring is being installed, the Competitor is free to work autonomously in a safe manner with most relevant assessments being completed outside of competition time.

However, Competitors **MUST** perform some tasks in the presence of the Experts as specified in the Test Project. Therefore, at various points in this competition you must ask the Experts to observe and check your work. Once checked the Experts must place their initial in a progress box as per the example below.

EXPERTS SIGN OFF	
Install Refrigeration Major Components	Expert 1 Initials and Country: Expert 2 Initials and Country: Expert 3 Initials and Country:

Information concerning safety requirements

During the competition, all Competitors **MUST** follow the safety rules listed in the Technical Description which are summarized, below along with the local Health, Safety, and Environment requirements of the Host Country.

Shoes

- Fully enclosed safety shoes or boots with protective toe caps must be worn at all times.

Clothing

- Legs must be covered at all times, by either long work trousers or overalls.
- Upper body must be covered at all times.
- Arms must be covered with long sleeves within the workstation.

Safety Glasses

- Must be worn when necessary to protect your eyes.
- Must be worn when brazing, soldering, filing, reaming, cutting, drilling, grinding, and using refrigerant, dry nitrogen, and compressed air and testing for voltage and current.

Gloves

- Must be worn when brazing, using refrigerants, cutting, filing or drilling or pressure testing
- Electrical protection gloves must be worn when testing a live circuit

Electrical

- Competitors must NOT switch on (apply power) to any electrical equipment until they receive permission from an Expert, except for hand power tools.

Any Competitor that is identified by two Experts as not wearing the correct safety attire or is engaging in any unsafe practice will be stopped and advised on the correct safety practice. The Experts will record this on the Competitor's Health, Safety, and Environment report and will result in a loss of marks.

If the unsafe working practice is repeated, the Experts 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.

If the Competitor continues to ignore the safe working practice, they may be removed from the competition area for a safety briefing for ten minutes 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.

Instructions to the Competitor

Module A – Componente fabrication and brazing

Maximum time allowed – 2 hours

13 marks

Start Time:	Expert:	Competitor:
Finish Time:	Expert:	Competitor:
Time Taken:		

The Competitor and expert will record the START and FINISH TIMES above for this module.

Scope

The Competitors are required to fabricate copper tubing as part of the refrigerant circuit to form the:

- Evaporator coil, to be installed during module B into the Ice Tank
- Refrigerated sign, be installed during Module B onto the inlet of the Evaporator coil.

The coils are to be constructed according the drawings listed below.

Timing

All Competitors are to complete the copper tubing fabrication at the same time in the morning of Day 1, and will marked later that day. Any Competitors that do not finish Module A in the allocated time (2 hours) will be required to submit the unfinished project for assessment. They will be allowed to complete it after it is assessed 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.

Assessment

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.

Competitors will receive additional points for completing this module in less than the allocated time, as defined in the marking scheme.

Drawings

- WSC2022-SE_TP38_BB_A4_06_EN.pdf - Ice rink coil drawing
- WSC2022-SE_TP38_BB_A4_07_EN.pdf – Refrigerated sign drawing

Components

Components to be installed are shown in the drawings.

Experts Comments:

Fabrication	Expert 1 Initials and Country: Expert 2 Initials and Country: Expert 3 Initials and Country:
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Module B – Refrigeration system installation and commissioning

Maximum time allowed - 14 hours

63 marks

Scope

Competitors are to install a refrigeration system to refrigerate a small ice tank. The Competitors are required to use the supplied components along with the coils fabricated in Module A to form a refrigeration system for cooling down water to form ice.

Timing

Competitors are to all complete the installation over 3 days of the competition as listed below.

Day 1

- The Fabrication module A must be handed to the Expert for marking after the allocated two hours
- The following major components must be mounted per the diagram:

- WSC2022-SE_TP38_BB_05_A4_EN.pdf - Refrigeration system components layout diagram:
- Condensing unit
- Suction accumulator
- Electrical control box
- Dual Pressure Control
- Low Pressure and High-Pressure gauges
- Condenser fan controller

- The Dual Pressure Control must be adjusted to the required settings.

Items a), b), and c) will be marked by the Experts at the end of Day 1 whether they are completed or not.

Day 2

a) All refrigerant pipework and components must be installed per the refrigeration system drawing:

- WSC20122-SE_TP38_BB_A4_01_EN.pdf - Refrigeration system piping diagram

Do NOT install insulation on the pipework or components until after they have been marked.

b) The flares for the inlet and outlet of the Thermostatic Expansion Valve MUST be assessed by the Experts before they are connected.

c) The refrigeration system must be pressure tested to the required pressure and any leaks rectified.

Items a), b) and c) will be marked by the Experts at the end of Day 2 whether they are completed or not.

Day 3

a) The refrigeration system must be evacuated to the required vacuum.

Note: The system MUST be successfully pressure tested to requirements before it can be evacuated.

b) All electrical cables and wiring must be installed per the electrical drawings:

- WSC2022-SE_TP38_BB_A4_02_EN.pdf – Electrical circuit diagram

c) The refrigeration system must be commissioned to the design specifications with the ice tank frozen and left running and displayed.

Note: The system MUST be successfully evacuated to requirements and fully insulated on all necessary pipework before it can be charged with refrigerant

What ever you have completed of Items a), b) and c) at the end of Day 3 will be marked by the Experts at the end of that day.

Assessment

Competitors will be assessed as per Technical Description and the WorldSkills Occupational Standards with particular weighting on the commissioning and operation of the project.

Each task will be assessed by the Experts at the end of the allocated day even if the Competitor has not completed it.

Drawings and Specifications

WSC2022SE_TP38_BB_A4_01_EN.pdf - Refrigeration system piping diagram

WSC2022SE_TP38_BB_A4_02_EN.pdf – Electrical circuit diagram

WSC2022SE_TP38_BB_A4_05_EN.pdf - Refrigeration system components layout

WSC2022SE_TP38_BB_A4_06_EN.pdf - Ice rink coil drawing

WSC2022SE_TP38_BB_A4_07_EN.pdf – Refrigerated sign drawing

WSC2022SE_TP38_BB_A4_08_EN.pdf - Refrigeration System Installation Specifications

Components

Components to be installed are specified in the Infrastructure List.

Tasks

All Competitors will be required to perform the following tasks to complete this module.

A number of Tasks MUST be either observed and/or signed off by Experts.

Task 6 has an Expert sign off sheet which needs to be filled in and signed prior to moving ahead on this task

TASK 1. INSTALL REFRIGERATION MAJOR COMPONENTS

All Competitors will be supplied with all necessary equipment and materials to complete the installation of the refrigeration system in accordance with Test Project drawings and WorldSkills International Refrigeration and Air Conditioning Occupational Standards. Refer to the relevant project drawings to complete this task.

The following major components must be mounted by the end of Day 1 when they will be marked whether completed or not.

- Condensing unit
- Suction accumulator
- Electrical control box
- Dual Pressure Control
- Low Pressure and High-Pressure gauges
- Condenser fan controller

EXPERTS SIGN OFF	
Install Refrigeration Major Components	Expert 1 Initials and Country: Expert 2 Initials and Country: Expert 3 Initials and Country:

TASK 2. SET DUAL PRESSURE CONTROL

This must be completed by the end of Day 1 when they will be marked whether completed or not.

Competitors are to bench set the Dual Pressure Control in accordance with the design specifications supplied and complete the following reports. Please indicate measurement units by ticking (✓) the appropriate boxes.

This Task is to be carried out and the report filled in by COMPETITORS.

These settings will be assessed and signed off by the Experts at the end of Day 1.

Dual Pressure Control

Pressure unit

- | | | | | | |
|----------------------------------|-------|------------------------------|------------------------------|------------------------------|---------------------------------|
| • Low Pressure Control Cut In: | _____ | <input type="checkbox"/> kPa | <input type="checkbox"/> psi | <input type="checkbox"/> bar | <input type="checkbox"/> kg/cm2 |
| • Low Pressure Control Cut Out: | _____ | <input type="checkbox"/> kPa | <input type="checkbox"/> psi | <input type="checkbox"/> bar | <input type="checkbox"/> kg/cm2 |
| • High Pressure Control Cut Out: | _____ | <input type="checkbox"/> kPa | <input type="checkbox"/> psi | <input type="checkbox"/> bar | <input type="checkbox"/> kg/cm2 |
| • High Pressure Control Cut In: | _____ | <input type="checkbox"/> kPa | <input type="checkbox"/> psi | <input type="checkbox"/> bar | <input type="checkbox"/> kg/cm2 |

Experts Comments:

EXPERTS SIGN OFF	Expert 1 Initials and country:
	Expert 2 Initials and Country:
	Expert 3 Initials and Country:

TASK 3 INSTALL REFRIGERANT PIPEWORK AND COMPONENTS

a) Install all refrigerant pipework and components per the refrigeration system drawing:

- WSC20122-SE_TP38_BB_A4_01_EN.pdf - Refrigeration system piping diagram

Do NOT install insulation on the pipework or components until after they have been marked and pressure tested.

b) The flares for the inlet and outlet of the Thermostatic Expansion Valve MUST be assessed by the Experts before they are connected.

Items a and b) will be marked by the Experts at the end of Day 2 whether they are completed or not.

EXPERTS SIGN OFF	
Thermostatic Expansion Valve Flares assessed	Expert 1 Initials and Country: Expert 2 Initials and Country: Expert 3 Initials and Country

TASK 4. PRESSURE TEST SYSTEM

All refrigerant pipework and components should be installed and pressure tested by the end of Day 2.

Do NOT install insulation on the pipework or components until after they have been marked and passed the Pressure Test.

Carry out a staged pressure test of the refrigeration system in accordance with manufacturer's equipment instructions, WorldSkills Occupational Standards and the WSC2022-SE_TP38_BB_A4_08_EN.pdf - Refrigeration System Installation Specifications.

The pressure test point should not drop more than the equivalent of 1°C 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 successfully, the Competitor can continue by finding and fixing the leak/s and achieve the pressure test; however, the full marks for Pressure Test will be lost.

This Task **MUST** be carried out and the report filled in by COMPETITORS under the supervision of the Expert/s

PRESSURE TEST ATTEMPT 1

- | | | Pressure unit |
|-----------------------------------|-------------|--------------------------|
| • Starting test pressure: | _____ □ kPa | □ psi □ bar □ kg/ |
| • Starting Time: | _____ | |
| • Test pressure after 15 minutes: | _____ □ kPa | □ psi □ bar □ kg/cm2 |
| • Finishing Time: | _____ | |

PRESSURE TEST ATTEMPT 2

- | | | Pressure unit |
|-----------------------------------|-------------|--------------------------|
| • Starting test pressure: | _____ □ kPa | □ psi □ bar □ kg/cm2 |
| • Starting Time: | _____ | |
| • Test pressure after 15 minutes: | _____ □ kPa | □ psi □ bar □ kg/cm2 |
| • Finishing Time: | _____ | |

NOTE: Task 5 Evacuation can not be commenced until after the system has been successfully pressure tested.

Experts Comments:

EXPERTS SIGN OFF	
Refrigeration System Pressure Test	Expert 1 Initials and Country: Expert 2 Initials and Country: Expert 3 Initials and Country:

TASK 5. INSTALL ELECTRICAL SYSTEM

This MUST be carried out by the end of Day 3.

All Competitors will be supplied with all necessary equipment and materials to complete the installation of the electrical system in accordance with Test Project drawings and World Skills International Refrigeration and Air Conditioning Standard Specification.

Refer to the relevant project drawings to complete this task.

The main cable duct MUST be installed on the back (rear) of the vertical panel.

Experts Comments:

EXPERTS SIGN OFF	
Electrical Installation Completed, but not Tested	Expert 1 Initials and Country: Expert 2 Initials and Country: Expert 3 Initials and Country:

TASK 6. EVACUATE SYSTEM

This should be carried out by the end of Day 3.

The Task must NOT be commenced until the Experts have Signed Off Task 4 Pressure Test.

Evacuate the system in accordance with manufacturer's instructions, WorldSkills Occupational Standards and the WSC2022-SE_TP38_BB_A4_08_EN.pdf - Refrigeration System Installation Specifications using the Deep Vacuum Method.

This Task is to be carried out and the report filled in by COMPETITORS under the supervision of the Expert/s

EVACUATION TEST ATTEMPT #1

Starting evacuation level: _____ □ microns

Starting Time: _____

Evacuation level after 10 minutes: _____ □ microns

Finishing Time: _____

EVACUATION TEST ATTEMPT #2

Starting evacuation level: _____ □ microns

Starting Time: _____

Evacuation level after 10 minutes: _____ □ microns

Finishing Time: _____

NOTE: Task 6 Break the Vacuum can not be commenced until after the system has been successfully evacuated and all necessary pipework has been insulated.

Experts Comments:

EXPERTS SIGN OFF	
Refrigeration Evacuation Test	Expert 1 Initials and Country: Expert 2 Initials and Country: Expert 3 Initials and Country:

TASK 7. BREAK THE VACUUM

The Task must NOT be commenced until the Experts have Signed Off Task 6 Evacuation and the Electrical Installation work is completed to ensure the sustainable use of refrigerant and all pipe work has been insulated.

Evacuation test completed ☐ Yes

Pipework insulation fitted ☐ Yes

Electrical installation completed ☐ Yes

Break the vacuum by charging the refrigeration system with 1.5 kg (3.3 lb) of liquid refrigerant as the initial charge in accordance with acceptable trade and environmental practices.

This Task is to be carried out and the report filled in by COMPETITORS under supervision by Expert/s

Cylinder weight prior to charging: _____ ☐ kg ☐ lb

Cylinder weight at completion of charging: _____ ☐ kg ☐ lb

Weight of the refrigerant added: _____ ☐ kg ☐ lb

Experts Comments:

EXPERTS SIGN OFF	
Break the Vacuum	Expert 1 Initials and Country: Expert 2 Initials and Country: Expert 3 Initials and Country:

TASK 8. ELECTRICAL TESTING

Perform all necessary safety checks to ensure the installed refrigeration system's is safe to energize and record the results below: This will be carried out in Day 3 and MUST be completed successfully before commencing Task 9 Finalizing the Refrigerant Charge.

- a) Electrical Supply Voltage
 - (i) Active to Earth _____ volts
 - (ii) Neutral to Earth _____ volts
 - (iii) Active to Neutral _____ volts
- b) Earth continuity from supply lead to:
 - (i) Control panel _____ Ω
 - (ii) Compressor _____ Ω
 - (iii) Fan motor _____ Ω
- c) Continuity from supply lead to:
 - (i) Control panel's Active _____ Ω
 - (ii) Control panel's Neutral _____ Ω
- d) Using an Ohm-meter measure the refrigeration system's resistance between:
 - (i) Active and Neutral _____ Ω
 - (ii) Active and Earth _____ Ω
 - (iii) Neutral and Earth _____ Ω
- e) Based on your tests, is the unit safe to connect to the electrical supply?

☐ Yes or ☐ No, because:

 - (i) It is Electrically Safe ☐ Yes or ☐ No
 - (ii) The earth is not connected ☐ Yes or ☐ No
 - (iii) The polarity is not correct ☐ Yes or ☐ No
 - (iv) There is a short between Active and Earth ☐ Yes or ☐ No
 - (v) There is a short between Neutral and Earth ☐ Yes or ☐ No
- f) Carryout any repairs necessary to make the unit safe to connect to the electrical supply under the supervision of the Experts

These results will be assessed and signed off by the Experts.

All wiring inspected by Expert prior to energizing: ☐ Yes ☐ No

Electrical safety checks performed prior to energizing: ☐ Yes ☐ No

NOTE: The system can not be connected to the power supply until after these electrical tests have been successfully completed.

Experts Comments:

EXPERTS SIGN OFF	
Refrigeration System Electrical Test	Expert 1 Initials and Country: Expert 2 Initials and Country: Expert 3 Initials and Country:

TASK 9. FINALIZE THE REFRIGERANT CHARGE

The Task must NOT be commenced until the Experts have Signed Off Task 8 Electrical Testing.

1. Operate the refrigeration system, check its operating conditions and add additional refrigerant vapour as required until the system's optimum charge is achieved.
2. Record the final details of the refrigerant charge below.

Cylinder weight prior to charging: _____ □ kg □ lb

Cylinder weight at completion of charging: _____ □ kg □ lb

Weight of the refrigerant added: _____ □ kg □ lb

Experts Comments:

EXPERTS SIGN OFF	
Charging Refrigerant	Expert 1 Initials and Country: Expert 2 Initials and Country: Expert 3 Initials and Country:

TASK 10. COMMISSION THE SYSTEM

The Task must NOT be commenced until the Experts have Signed Off Task 9 Finalize the Refrigerant Charge

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

This Task is to be carried out and the report filled in by COMPETITORS

- Ambient Temperature: _____ ☐ Celsius ☐ Fahrenheit
- Ice Tank Ice/Water Temperature _____ ☐ Celsius ☐ Fahrenheit
- Refrigerant Type: _____ ☐
- Mass of Refrigerant Charge: _____ ☐ grams ☐ pounds
- Suction Pressure (Gauge): _____ ☐ kPa ☐ psi ☐ bar ☐ kg/cm²
- Evaporation Temperature _____ ☐ Celsius ☐ Fahrenheit
- Discharge Pressure: (Gauge): _____ ☐ kPa ☐ psi ☐ bar ☐ kg/cm²
- Condensing Temperature _____ ☐ Celsius ☐ Fahrenheit
- Liquid Line Subcooling: _____ ☐ Kelvin ☐ Fahrenheit Degrees
- Thermostatic Expansion Valve _____ ☐ Kelvin ☐ Fahrenheit Degrees

Superheat:

- Total Suction Superheat: _____ ☐ Kelvin ☐ Fahrenheit Degrees
- Hot Gas Bypass Valve setting: _____ ☐ kPa ☐ psi ☐ bar ☐ kg/cm²
- Compressor Operating Current: _____ ☐ Amps

These results will be assessed and signed off by the Experts at the end of Day 3.

Experts Comments:

EXPERTS SIGN OFF	
Refrigeration System Commissioning	Expert 1 Initials and Country: Expert 2 Initials and Country: Expert 3 Initials and Country:

Module C – Refrigeration System Electrical Fault Finding

Maximum time is 1.0 hour

14 marks

Start Time:	Expert:	Competitor:
Finish Time:	Expert:	Competitor:
Time Taken:		

The Competitor and Expert will record the START and FINISH TIMES above for this module.

This Task is to be carried out and the report filled in by COMPETITORS under supervision by Expert/s

There are ____ number of electrical fault/s on the refrigeration system.

Competitors will receive additional points for completing this module in less than the allocated time, as defined in the marking scheme.

1. Electrical Safety Tests

Carry out the following electrical tests to ensure it is safe to connect to the electrical supply and record the results below:

(a) Electrical Supply Voltage at the power outlet.

- (i) Active to Earth _____ volts
- (ii) Neutral to Earth _____ volts
- (iii) Active to Neutral _____ volts

(b) The refrigeration unit's earth continuity.

- (i) Earth pin on the supply cable to unit frame _____ Ω
- (ii) Earth pin on the supply cable to the compressor _____ Ω

(c) c.The refrigeration unit's supply continuity

- (i) Active pin on the supply cable to the unit's terminal _____ Ω
- (ii) Neutral pin on the supply cable to the unit's terminal _____ Ω

(d) Using an Ohm-meter measure the resistance on the refrigeration unit's supply cable between Earth and:

- (i) Active _____ Ω
- (ii) Neutral _____ Ω

(e) Based on your tests, is the unit safe to connect to the electrical supply?

☐ Yes or ☐ No, because:

- | | |
|--|---|
| (i) It is Electrically Safe | <input type="checkbox"/> Yes or <input type="checkbox"/> No |
| (ii) The earth is not connected | <input type="checkbox"/> Yes or <input type="checkbox"/> No |
| (iii) The polarity is not correct | <input type="checkbox"/> Yes or <input type="checkbox"/> No |
| (iv) There is a short between Active and Earth | <input type="checkbox"/> Yes or <input type="checkbox"/> No |
| (v) There is a short between Neutral and Earth | <input type="checkbox"/> Yes or <input type="checkbox"/> No |
| (vi) The Active is not connected | <input type="checkbox"/> Yes or <input type="checkbox"/> No |
| (vii) The Neutral is not connected | <input type="checkbox"/> Yes or <input type="checkbox"/> No |

(f) Reconnect any wiring you removed and ensure the unit is safe to connect to the electrical supply under the supervision of the Experts

EXPERTS SIGN OFF	
Electrical Safety Tests	Expert 1 Initials and Country: Expert 2 Initials and Country: Expert 3 Initials and Country:

Electrical Compressor Tests

- (a) Each Competitor is to disconnect the cable connections to the compressor and take resistance readings from it and record their values below.

Compressor Wiring Resistance readings

- (i) A and B _____ Ω
(ii) B and C _____ Ω
(iii) C and A _____ Ω

- (b) Insulation Resistance readings using an Insulation Resistance Tester (IR) set on 500 volts

- (i) A to E _____ $M\Omega$
(ii) B to E _____ $M\Omega$
(iii) R to E _____ $M\Omega$

- (c) c. Based on your reading above, do the compressor motor windings have a:

- (i) Short Circuit ☐ Yes ☐ No
(ii) Open Circuit ☐ Yes ☐ No
(iii) Earth Leakage ☐ Yes ☐ No
(iv) Is the compressor electrically safe to connect to operate? ☐ Yes ☐ No

- (d) Reconnect the electrical connections to the refrigeration unit's compressor as they were originally connected:

- (i) Completed correctly ☐ Yes ☐ No

- (e) Reconnect all wiring you removed and ensure the unit is safe to connect to the electrical supply under the supervision of the Experts

- (i) Completed correctly ☐ Yes ☐ No

EXPERTS SIGN OFF	
Electrical Compressor Tests	Expert 1 Initials and Country: Expert 2 Initials and Country: Expert 3 Initials and Country:

Electrical Fault Finding

Each Competitor will:

1. Connect the refrigeration unit to the supply and turn it on.
2. Observe its operation and record below if the following components are operating after 5 minutes:
 - Evaporator fan ☐ Yes ☐ No
 - Condenser fan ☐ Yes ☐ No
 - Compressor ☐ Yes ☐ No
3. Determine the fault and identify it on the list below with a tick ✓:

Note: The unit's electronic controller is not faulty.

- ☐ No active supply to condensing unit
- ☐ No neutral supply to condensing unit
- ☐ Compressor open circuit
- ☐ High pressure control open circuit
- ☐ Hot water temperature sensor open circuit
- ☐ Electronic Expansion Valve coil incorrect Polarity
- ☐ Compressor overload (Klixon) open circuit
- ☐ No active supply to evaporator fan
- ☐ No neutral supply to evaporator fan
- ☐ Low pressure control open circuit
- ☐ Solenoid coil open circuit
- ☐ Evaporator fan motor open circuit
- ☐ Condenser fan motor open circuit

Once the fault is identified, the Experts will sign off this Task below.

Re-assemble Units

Re-connect any wiring and refit covers to return the units back to the condition they were in before you commenced this module.

Experts Comments:

EXPERTS SIGN OFF	
Refrigeration System Electrical Fault Finding	Expert 1 Initials and Country: Expert 2 Initials and Country: Expert 3 Initials and Country:

Module D – Refrigeration System Refrigeration fault finding

Maximum time is 1.0 hour

11 marks

Start Time:	Expert:	Competitor:
Finish Time:	Expert:	Competitor:
Time Taken:		

1. The Competitor and expert will record the **START and FINISH TIMES above**.

Competitors will receive additional points for completing this module in less than the allocated time, as defined in the Marking Scheme.

2. Operate the refrigeration unit and record its operating conditions below:

- Ambient Temperature: _____ ☐ Celsius ☐ Fahrenheit
- Air on Evaporator Dry Bulb Temperature: _____ ☐ Celsius ☐ Fahrenheit
- Air off Evaporator Dry Bulb Temperature: _____ ☐ Celsius ☐ Fahrenheit
- Refrigerant Type: _____
- Suction Gauge Pressure: _____ ☐ kPa ☐ psi ☐ bar ☐ kg/cm²
- Saturated Suction Temperature _____ ☐ Celsius ☐ Fahrenheit
- Total Suction Superheat: _____ ☐ Kelvin ☐ Fahrenheit
- Unit's Operating Current: _____ ☐ Amps

3. Determine the two refrigeration fault and identify it on the list below by a tick ✓:

- ☐ Under charge of refrigerant
- ☐ Over charge of refrigerant
- ☐ Non-condensable mixed with refrigerant
- ☐ Blockage in liquid line before dryer
- ☐ Blockage in liquid line after dryer
- ☐ Blockage in suction line at the compressor
- ☐ Blockage in suction line at the evaporator
- ☐ Low pressure control cut-out set too high
- ☐ High pressure switch set wrong
- ☐ Fan pressure control set wrong
- ☐ Compressor inefficient (not pumping)
- ☐ Blocked refrigerant metering device
- ☐ Restricted refrigerant metering device
- ☐ Incorrect heat recovery water tank level
- ☐ Superheat control setting above 10K
- ☐ Other fault

Once the fault or faults have been identified and repaired, the Competitor is to demonstrate the operation after the repair of the faults.

Experts will sign off your results below.

Experts Comments:

EXPERTS SIGN OFF	
Refrigeration System Refrigeration Fault Finding	Expert 1 Initials and Country: Expert 2 Initials and Country: Expert 3 Initials and Country:

Equipment, machinery, installations, and materials required

All required equipment and materials for the Test Project are specified in the Infrastructure List.

Therefore, no additional equipment, machinery, installations, or materials are listed below.

Marking Scheme

This Test Project has as a marking scheme matching the assessment criteria as given in the Technical Description (Marking Summary). For each of these criteria a detailed list of aspects to be assessed have been defined and will be used by the Experts to assess the competitor's skills and the completed Test Project.

The Marking Scheme Summary is provided for your information.