Skills Compétences Canada

Project - Part A

Refrigeration and Air Conditioning

POST-SECONDARY

1 Introduction

This Test Project was developed by Independent Designers.

Part A Description of the Modules and Competitor Instructions will be released by Skills Competences Canada

Part B Specifications and Drawings will be released by Skills Competences Canada

- Competitors at the Competition

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

2 Description of project and tasks

The Test Project is a series of standalone modules.

There are two (2) Modules to complete in the 13-hour competition.

A) Component Fabrication 20 Marks Time Allowed 3 Hrs

B) Evaporator Fabrication, Refrigeration System Installation and Commissioning & Safety 80 Marks Time Allowed 9 Hrs

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 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:

This will be provided to all participating Competitors at the Competition Day 1.

Equipment manufacturers' drawings and instructions
The details of the equipment will be provided at the event.

Additional Information
Any additional information will be provided to all Competitors at the Familiarisation Session 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 is 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 Judges as specified in the Test Project. Therefore, at various points in this competition you must ask the Judges to observe and check your work. Once checked the Judge's must place their initial in a progress box as per the example below.

JUDGE'S SIGN OFF	
Install Refrigeration Major Components	Judge 1 Initials and Province: Judge 2 Initials and Province:

Information concerning safety requirements
During the competition, all Competitors **MUST** follow the safety rules listed in the Contest Description which are summarized, below.

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 testing for voltage and current.

GLOVES

- Must be worn when brazing, using refrigerants, cutting, filing or drilling or pressure testing
- Electrical protection gloves do not need to be worn when testing a live circuit

ELECTRICAL

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

Any Competitor that is identified by 2 Judges 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 Judges will record this on the competitor's Health and Safety report and will result in a loss of marks.

If the unsafe working practice is repeated, the Judges may STOP the Competitor and report the issue to the NTC Chair. 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 safety representative, the time taken to complete the safety briefing will be considered to be a part of the Competitor's competition time.

3 Instructions to the Competitor

MODULE A - COMPONENT FABRICATION AND BRAZING

MAXIMUM TIME ALLOWED – 3 HOURS **20 MARKS**

Start Time:	**Judge:**	**Competitor:**
Finish Time:	**Judge:**	**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:

- Dual temperature Kit, to be installed during module B on the sideboard according to diagram.

The dual temperature piping assembly is to be constructed according to 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 be marked and returned by 1pm that day. Any Competitors that do not finish Module A in the allocated time (3 hours) will be allowed to complete it 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
SCNC2026_TP38_BB_A4_01_EN.pdf - DUAL TEMPERATURE PIPING DRAWING

COMPONENTS
Components to be installed are shown in the drawings.

EXPERTS SIGN	
Fabrication	Judge 1 Initials: Judge 2 Initials:

Module B - Refrigeration System Installation and Commissioning

MAXIMUM TIME ALLOWED - 10 HOURS **80 MARKS**

SCOPE
All Competitors are to complete the copper tubing fabrication of the water-cooled heat exchanger. Install a refrigeration system to refrigerate a small medium temperature chill room enclosure and to chill a water filled tank. The Competitors are required to use the supplied components along with the dual temperature kit fabricated in Module A and the heat exchanger fabricated in Module B to form a dual temperature refrigeration system to chill the water in the tank. The Competitor will also use the supplied air cooled evaporator for cooling down the enclosure

DRAWINGS

SCNC2026_TP38_BB_A4_02_EN.pdf - REFRIGERATION COIL DRAWING

TIMING
Competitors are to all complete the installation over 2 days of the competition as listed below.

- The Fabrication from module A must be handed to the Judge to measure the specific dimensions on completion of the dual temperature piping assembly.

- The following major components must be mounted per the diagram:

  SCNC2026_TP38_BB_A4_04_EN.pdf - REFRIGERATION SYSTEM

  COMPONENTS LAYOUT

- COMPONENTS LAYOUT

  - Condensing unit
  - Electrical control box
  - Dual Pressure Control
  - Low Pressure and High-Pressure gauges
  - Two expansion valves
  - Evaporator pressure regulator
  - EEV Controller
  - Evaporator

Module A and all dimensions on the drawing will be marked by the Judges at the lunch break of Day 1 whether they are completed or not.

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

- SCNC2026_TP38_BB_A4_03_EN.pdf - REFRIGERATION SYSTEM PIPING DIAGRAM

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

b) All flares must be assessed by the Judges before they are connected.

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

d) The Dual Pressure Control must be adjusted to the required settings during the pressure test.

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

- **The system MUST be successfully pressure tested to requirements before it can be evacuated.**

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

- SCNC2026_TP38_BB_A4_05_EN.pdf - ELECTRICAL CIRCUIT DIAGRAM

g) The refrigeration system must be commissioned to the design specifications and left operational.

- The system MUST be successfully evacuated to requirements and fully insulated on all necessary pipework and electrical completed before it can be charged with refrigerant.

  Whatever you have completed will be marked by the Judges at the end of that day.

ASSESSMENT

Competitors will be assessed as per Contest Description and the WorldSkills Standard Specification with particular weighting on the commissioning and operation of the project.

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

DRAWINGS AND SPECIFICATIONS

SCNC2026_TP38_BB_A4_01_EN.pdf - DUAL TEMPERATURE PIPING DRAWING

SCNC2026_TP38_BB_A4_02_EN.pdf - REFRIGERATION COIL DRAWING

SCNC2026_TP38_BB_A4_03_EN.pdf - REFRIGERATION SYSTEM PIPING DIAGRAM

SCNC2026_TP38_BB_A4_04_EN.pdf - REFRIGERATION SYSTEM COMPONENTS LAYOUT

SCNC2026_TP38_BB_A4_05_EN.pdf - ELECTRICAL CIRCUIT DIAGRAM

SCNC202_TP38_BB_A4_06_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 Judges.

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

4 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 World Skills International Refrigeration and Air Conditioning Standard Specification.

Refer to the relevant project drawings to complete this task.

The following major components will be marked on day 1 whether completed or not.

- Dual Temperature Piping Assembly
- Refrigeration coil

EXPERTS SIGN OFF	
Install Refrigeration Major Components	Judge 1 Initials: Judge 2 Initials:

5 Task 2. Set Dual pressure control

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 Judges during pressure testing.

Dual Pressure Control Pressure unit

- Low Pressure Control Cut In: _____ □ psi
- Low Pressure Control Cut Out: _____ □ psi
- High Pressure Control Cut Out: _____ □ psi
- High Pressure Control Cut In: _____ □ psi

Judges' Comments:

JUDGES SIGN OFF	
Pressure Control Setting	Judge 1 Initials: Judge 2 Initials:

6 Task 3 Install refrigerant pipework and components

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

- SCNC2025_TP38_BB_A4_03_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 Pressure Gauges MUST be assessed by the Judges before they are connected.

JUDGES SIGN OFF	
Pressure Gauge Flares assessed	Judge 1 Initials: Judge 2 Initials:

7 Task 4. Pressure Test System

All refrigerant pipework and components should be installed and pressure tested.

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 standards and the 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 Judge/s

PRESSURE TEST ATTEMPT 1

- Starting test pressure: _____ □ psi
- Starting Time: _____
- Test pressure after 15 minutes: _____ □ psi
- Finishing Time: _____

PRESSURE TEST ATTEMPT 2

- Starting test pressure: _____ □ psi
- Starting Time: _____
- Test pressure after 15 minutes: _____□ psi
- Finishing Time: _____

NOTE: Task 6 Evacuation cannot be commenced until after the system has been successfully pressure tested.

Judges' Comments:

JUDGES SIGN OFF	
Refrigeration System Pressure Test	Judge 1 Initials: Judge 2 Initials:

8 Task 5. Install Electrical System

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.

JUDGES SIGN OFF	
Electrical Installation Completed, but not Tested	Judge 1 Initials: Judge 2 Initials:

Task 6. Evacuate system

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

Evacuate the system in accordance with manufacturer's instructions, WorldSkills Standards and the 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 Judge/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: _____

9 Task 7. Electrical testing

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

a) Electrical Supply Voltage
   i. Live to Earth _____ volts
   ii. Neutral to Earth _____ volts
   iii. Live 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 Live_____Ω
   ii. Control panel's Neutral_____Ω

d) Using an Ohm-meter measure the refrigeration system's resistance between:
   i. L1 and L2_____Ω
   ii. L1 and Earth_____Ω
   iii. L2 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 Live 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 Judges

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

All wiring inspected by Judge prior to energizing: □ Yes □ No

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

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

JUDGES SIGN OFF	
Refrigeration System Electrical Test	Judge 1 Initials: Judge 2 Initials:

11 Task 8. Break the Vacuum

Cannot be commenced until after the system has been successfully evacuated and all necessary pipework has been insulated.

JUDGES SIGN OFF	
Refrigeration Evacuation Test	Judge 1 Initials: Judge 2 Initials:

The Task must NOT be commenced until the Judges have Signed Off Task 6 Evacuation and Task 7 Electrical Testing 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 Judge/s

Cylinder weight prior to charging: _____□ kg _____□ lb

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

Weight of the refrigerant added: _____□ kg _____□ lb

JUDGES SIGN OFF	
Break the Vacuum	Judge 1 Initials: Judge 2 Initials:

10 Task 9. Finalize the refrigerant charge

1. Operate the refrigeration system, check its operating conditions and add additional refrigerant LIQUID 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

JUDGES SIGN OFF	
Charging Refrigerant	Judge 1 Initials: Judge 2 Initials:

11 Task 10. Commission the System

The Task must NOT be commenced until the Judges 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 and witnessed and signed off by judges

12 Commissioning Report

- Ambient Temperature: _____ □ Celsius □ Fahrenheit
- Cabinet chill Room Temperature: _____ □ Celsius □ Fahrenheit
- Refrigerant Type: _____
- Mass of Refrigerant Charge: _____ □ pounds
- Suction Pressure (Gauge): _____ □ psi
- Evaporation Temperature_____ □ Celsius □ Fahrenheit
- Discharge Pressure: (Gauge): _____ □ psi
- Condensing Temperature: _____ □ Celsius □ Fahrenheit
- Liquid Line Subcooling: _____ □ Celsius □ Fahrenheit
- Thermostatic Expansion Valve (chill room) _____ □ Celsius □ Fahrenheit
- Superheat: _____ □ Celsius □ Fahrenheit
- Thermostatic Expansion Valve (ICE coil) _____ □ Celsius □ Fahrenheit
- Superheat: _____ □ Celsius □ Fahrenheit
- Total Suction Superheat: _____ □ Celsius □ Fahrenheit
- Evaporator Pressure regulator Valve setting: _____□ psi
- Compressor Operating Current: _____ □ Amps

These results will be assessed and signed off by the Judges at the end of Day 2 (demonstration).

Judges' Comments:

JUDGES SIGN OFF	
Refrigeration System Commissioning	Judge 1 Initials: Judge 2 Initials: