



2024 Nova Scotia Skills Competition
Official Competition Name: **HVAC/R (Refrigeration)**
Competition Level: **Post Secondary**
Competition Location: **NSCC Ivany Campus**
Competition Date: **April 5, 2024**

Competitor Name: _____

TASK 1- ELECTRICAL DIAGRAM Time 30 Minutes

Draw a schematic wiring diagram for a low temperature, refrigeration system utilizing an 8045-00 timer for control of the defrost cycle. The thermostat will be an A-421 type to allow for pump-down on the off cycle in addition to the defrost cycle. The temperature control and timer will require a (120V) continuous power supply in addition to the power supply for switching circuits. **ADDITIONAL COMPONENTS MAY BE ADDED TO THE PUMPDOWN and DEFROST CIRCUITS ON THE DAY OF COMPETITION**

The Condensing unit provided will be a 120 Volt Copeland Water-cooled system with a CSIR compressor motor. The compressor starting components will consist of a potential relay, capacitor and overload. The motor should be wired as per the factory nameplate based on the "less control" option. Power to the condensing unit will be controlled by a compressor relay/contacter (CC) in the upper left hand control box. The coil of the (CC) will be 120 volts and will be part of the compressor protection circuit which will include all compressor safety controls. This compressor protection circuit will include a combination HP/LP control at a minimum. **ADDITIONAL SAFETY CONTROLS OR COMPONENTS MAY BE ADDED TO THE COMPRESSOR PROTECTION CIRCUIT ON THE DAY OF COMPETITION.**

The Evaporator will be a 208/240V Ref Plus coil with Electric Heat. The Evaporator will include a Defrost Termination/Fan (DDT) delay control and a High Limit Control (HL). Due to the sequence of the defrost controls and the wiring panel configuration the DTT and HL controls should be applied to the neutrals of their respective circuits.

To allow the (120V) timer to safely control the high voltage (240V) evaporator fan motor and defrost heaters, two additional 2-pole relays will be added to the timer panel so that all lines of power are isolated when the fan or heater are de-energized. The 120 Volt Evaporator Fan Relay (FR) will control the 240 Volt Evaporator Fan. The 120 Volt

Defrost Heater Relay (DR) will control the 240 Volt Defrost Heaters. The defrost controls and timer circuits must be applied to the coils of these additional relays.

This application will require a modification of the factory wiring and a reassignment of terminals which will be provided once the wiring component starts. DO NOT REFERENCE THE EVAPORATOR FACTORY WIRING DIAGRAM FOR TERMINAL DESIGNATIONS.

APPROPRIATELY LABEL COMPONENTS AND TERMINALS IN THE COMPLETED DIAGRAM.

Submit ladder diagram to judge to be reviewed for operation & forwarded to PTC.

TASK 2- ELECTRICAL CONTROL WIRING & COMMISSIONING - Time – 4.0 Hours

All connections must be made at the designated terminal strips, relays, and components using proper wiring techniques for wire type and terminal type. Stranded and solid wire will be utilized. Various shielding materials will be utilized. Proper terminals must be used unless otherwise specified.

Using the wiring diagram provided by the judge, select materials as required and wire project according to provided approved wiring diagram, approved panel layout diagrams and updated terminal designation information.

Line voltage panel wiring to be completed using #14 stranded wire and solderless terminals. (Check color codes provided)

Wiring from the defrost control panel to the evaporator terminal strip is provided by 2 pre-run conduits. The left-hand conduit contains 5 wires and is intended for the 240-volt loads. The right-hand conduit has 6 wires and is intended for the 120-volt control wiring associated with the defrost and refrigeration circuits and their associated control. **Colour codes apply to all wires in both conduits.**

Power supply from disconnect to control panel will be completed using 14/3 BX cable. Use approved installation and connection methods for solid wire.

Terminate the power supply on the bottom three terminals of the left-hand control box as per diagram.

Connecting wire from solenoid to Control panel to be completed using 14/3 Cabtire.

Connecting wire from pressure control to Control panel to be completed using 14/3 Cabtire.

Connecting wire from compressor to control panel to be completed using 14/3 Cabtire

Provide and terminate grounds for all components and boxes. **Exclusions must be approved by judge.**

All wiring to be neat, straight, square and secured together using wire ties. Wiring should not cross in front of controls that require access for service and troubleshooting.

There is to be no external connections outside thermostat, timer, control box, conduit, or system components. **Circuits to be independently wired and to have one wire only under each screw.**

Maretttes are permitted; however, they should be minimized. Deductions will be given for excessive wire use, excessive wire waste and unnecessary connections or junctions.

Main power wiring at the disconnect is to be completed by the competitor. L1, L2, N, and Ground should all be terminated according to the diagram provided on the disconnect box cover. Competitors are responsible to verify the correct wiring of the provided male plug. **Verify proper wiring of power supply with Judge.**

Proper colour codes must be followed:

All Grounds : Green

All Neutrals: White (Exceptions in DTT and Limit Circuits with switched neutrals)

Power Supply: Red, Black or Blue are acceptable

240V Line voltage Conduit (Left) from Control Box to Coil

- Heater Circuit: L1(Red), L2(Red)
- Evaporator Fan Circuit: L1(Blue), L2(Blue)
- Ground: Green

120V Control voltage Conduit (Right) from Control Box to Coil

- Refrigeration Fan Circuit: Blue
- Defrost Termination Circuit: Red
- Defrost Limit Circuit: Black
- Common Neutral: White
- Ground: Green

Additional Wires can be added if required.

Unused wires can be removed if deemed unnecessary.

Fan terminal designations will be provided

- H1
- H2
- H3
- 4
- M
- X
- N

Wiring coloring codes within the two control panel boxes can be selected by the competitor but must be consistent with Line, neutral and ground accepted colour code practices listed above. Individual circuits should be consistent in colour from the line

leaving the terminal strip through to the load. Circuits should be easily distinguishable by colour from other circuits.

Electrical Connections:

Should have no exposed copper when viewed at 90 degrees.

Should be properly secured and tightened.

All connections are at component terminals or terminal screws of terminal blocks.

Final Inspection (No Power):

Set Pressure Control and Timer Prior to Energizing Circuits

Pressure control Setting

- 134a System
- LP cut out for pump-down/pump-out: 2-5 psig
- LP differential: 10 psig
- LPC cut in: _____
- HPC cut out: Determined based on a temperature 60°F above a Maximum Ambient of 70°F
- HPC cut out: _____

Timer Setting:

- 4 defrost periods per day
- Initiation of defrost: 6am, 6pm, noon and midnight
- Duration of defrost: 60 minutes
- Set current time of day to competition end time of 3PM

Once the checkboxes and blanks above are complete verify and explain all settings with a Judge and confirm settings are recorded.

Final Inspection (No Power):

Inspect Power Supply

The following power supply safety checks must be performed and witnessed by a judge prior to applying power.

1. Test that there is no fault between live and neutral
2. Test that there is no fault between live and ground
3. Test that there is ground continuity between cord cap and all line voltage metal boxes

Final Inspection (Power applied): judge must be present

Have your wiring checked by a judge prior to energizing the completed circuits.

Install all required safety covers before applying power.

Power must be applied to input Thermostat settings:

Thermostat Settings

- Cool Thermostat (N/O close on rise of temperature)
- Cut in: 70°F
- Differential 2
- Offset 1
- Time delay 1
- TEMPERATURE SCALE *F
- KEYPAD LOCK – OFF

Once the checkboxes and blanks above are complete verify and explain all settings with a Judge and confirm settings are recorded.

Final Testing Sequence:

With power applied confirm the proper operation of the following components by cycling the appropriate controls:

Cycle the thermostat to control the liquid line solenoid valve (Use setpoint)

Cycle the Low-Pressure Control to cycle the compressor contactor (Jumper Required)

Cycle the Timer to initiate Defrost (Manual Adjustment)

Energize the TRS to terminate defrost (Jumper required)

Energize the Fan Relay to cycle the Evaporator Fan (Jumper Required)

End of Task



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TASK 3 – FLARING, BRAZING & BENDING- Time 60 Minutes

- CUT (3) SECTIONS OF 1/4" OD COPPER TUBING ACCORDING TO PROVIDED PLAN AND SHOW TO JUDGE
- PREPARE TUBING AS NECESSARY ACCORDING PROVIDED LAYOUT FOR A LIQUID LINE ASSEMBLY
- PROJECT CONSISTS OF 4 BENDS AND UP TO 8 CONNECTIONS
- FLARES MUST BE COMPLETED TO THE STANDARD BELOW FOR THE FILTER DRIER/SIGHTGLASS ASSEMBLY.
- HAVE FLARES INSPECTED BY JUDGE. INITIAL _____
- BRAZE CONNECTIONS MUST BE COMPLETED TO THE PROVIDED STANDARD FOR THE SOLENOID VALVE AND OTHER SYSTEM CONNECTIONS. (REQUIRES JUDGE SUPERVISION)
- HAVE BRAZE INSPECTED BY JUDGE. INITIAL _____
- SECURE PIPING WITH CUSHION CLAMPS AND CENTER COMPONENTS ACCORDING TO PLAN
- HAVE LAYOUT MEASUREMENTS INSPECTED BY JUDGE. INITIAL _____
- PRESSURIZE WITH NITROGEN TO 150PSIG
- HAVE PRESSURE TEST VERIFIED BY JUDGE. INITIAL _____
- SECTION COMPLETE

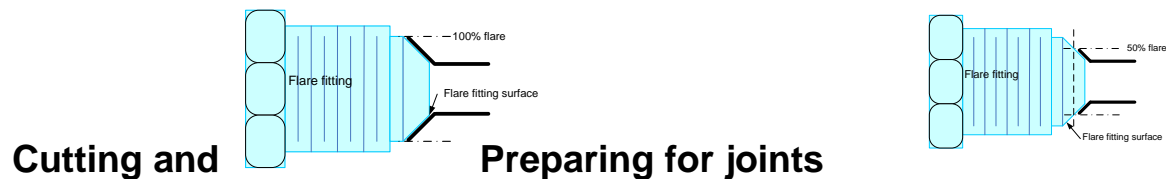
Time allotted- 30 Minutes

This is a timed event. You must remain for the 30 minutes. You cannot return to the main project until the MINIMUM 30 MINUTES time has lapsed

Pipe work connections

Flare surface to be smooth with no burrs, cracks, or indentations

Flared copper must be no more than 100% and no less than 50% of the flare fitting surface.



All piping/tubing must be cut square with an approved tool and must be reamed.

Brazing

Brazing must be completed in the presence of a judge

The judge will provide a brief safety overview prior to torch use.

Competitors must select an appropriate filler metal based on the provided layout plan.

Competitors must purge while brazing using a gauge manifold

All components must be brazed in place on the commercial trainer

Pressure Testing

All components must be tested to 150psig using a gauge manifold

