

SkillsUSA

2015 Contest Projects

Heating, Ventilation Air Conditioning and Refrigeration

Click the “Print this Section” button above to automatically print the specifications for this contest. Make sure your printer is turned on before pressing the button.

2015 SkillsUSA Championships HVACR Contest

June 25, 2015 Louisville, Kentucky



Contestant Procedure Sheet

Event #1: Brazing

**Sponsor: Harris Products
Group**

Time Allowed: 60 minutes

This exercise involves your ability to accomplish the following in the allotted time period:

1. Read and follow a piping diagram
2. Select, measure, cut, and assemble material
3. Use tools and torch
4. Join piping with silver braze alloy and phosphorus-copper-silver braze alloy into a leak-tight assembly
5. During brazing the part must be held in the vise in the position indicated on the drawing

Notes:

1. Use all tools necessary
2. Follow drawing accurately
3. Work safely
4. Clean up work area when finished

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Judging Criteria

Event #1 – Brazing

Sponsor: Harris Products Group

A. Wear safety glasses - 5 points maximum

5 points if glasses continually worn.

0 points if glasses not worn.

B. Layout tube cuts - 5 points maximum

5 points if contestant makes 7 cuts or less.

0 points if contestant makes more than 7 cuts.

C. Clean prior to brazing - 8 points maximum

8 points if contestant cleans all parts by:

a.) using tube brush, sand cloth, (or abrasive pad), to clean fitting I.D. and tube O.D.

b.) using deburring tool on tube ends.

4 points if contestant cleans fitting I.D. and tube O.D. but *does not deburr*.

0 points if there is no part cleaning, (even if they deburr).

D. Flux required connections - 8 points maximum

8 points if contestant fluxes *only* connections where Safety Silv 45 is called out, (reference alloy B call out on drawing).

4 points if contestant fluxes any connections where Dynaflow is called out, (reference alloy A callout on drawing).

0 points if no flux is used on any connections where Safety Silv 45 is called out.

E. Correct braze alloy selection - 8 points maximum

8 points if contestant uses correct alloys as shown on drawing.

4 points if contestant uses Safety Silv 45 where Dynaflow is called out on the drawing.

0 points if contestant uses Dynaflow on any steel to copper connection, (where Safety Silv 45 is called out).

F. Braze equipment use; startup - 8 points maximum

Opening tank valves

4 points if contestant stands to side of regulators when opening cylinder valves.

0 points if contestant stands in front of regulators when opening cylinder valves.

Adjusting delivery pressure and lighting torches

4 points if contestant uses proper delivery pressure settings as listed on the tip chart at the braze station. (Air/acetylene 13 - 15 PSI and oxy-acetylene 2-4 PSI for #2 tip, 3 -5 PSI for #3 tip).

0 points if contestant sets acetylene delivery pressure other than above.

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G. Assembly position in the vise - 5 points maximum

5 points if contestant positions part correctly in vise during brazing.

0 points if judge must remind contestant to braze part in the vise.

H. Filter drier installation and protection - 8 points maximum

4 points if contestant correctly positions drier in line with refrigerant flow direction.

4 points if contestant wraps filter drier with wet rag prior to brazing.

0 points if contestant positions drier incorrectly and doesn't wrap with a wet rag.

I. Brazing technique and joint appearance - 8 points maximum

4 points if contestant removes Schrader valve pin.

4 points if overall braze appearance is acceptable; (unacceptable items would include run down, balls, lumps, charred flux residue).

0 points if contestant makes any brazes not specified on drawing; (an example would be butt brazing two tubes together).

J. Assembly layout/size - 14 point maximum

14 points if finished assembly fits within template tolerances.

0 points if assembly is outside size limits.

K. Leak test - 18 point maximum

18 points if assembly is leak free.

5 points if contestant repairs leak and it passes second test.

0 points if it leaks after repair, (or if no repair is attempted).

L. Braze equipment use; shut down - 10 points maximum

Closing valves and bleeding lines.

10 points if contestant: (1) closes cylinder valve(s), (2) opens torch valves, (one at a time), to bleed pressure from line(s), (3) "backs off" (closes by turning counter-clockwise) regulator(s) adjustment screw.

5 points if contestant only closes cylinder valve(s), and, (or), only closes torch adjustment valves, but leaves pressure in the system, (evidenced by gauge pressure reading).

3 points if contestant only closes torch adjustment valves.

M. Clean up braze area - 5 points maximum

5 points if contestant straightens up braze table, (things to look for include putting lid on flux jar, not leaving drawing or instructions on table, not leaving unused rod, cleaning pad, torches, strewn about table).

0 points if no effort made to clean up after brazing.

Notes:

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EMERSON
Climate Technologies

Contestant Score Sheet

Event #2: Troubleshooting Procedure

Sponsor: Emerson Climate Technologies

Start Time _____

Contestant # _____

Stop Time _____

Total _____

Judge's Initial's _____

Safety

- A. Wear safety glasses

Score

Points

(0 to 10)

Performance

- A. Select proper tools and use correctly
B. Check ambient temperature
C. Verify system charge via manifold gauge static pressure
D. Turn on system switch
E. Check low side pressure
F. Check high side pressure
G. Use wiring diagram
H. Check voltage at compressor
I. Check thermostat setting/operation
J. Check L.P. control setting/operation
K. Check solenoid coil operation
L. Check solenoid coil voltage or amperage
M. Correctly identify fault

(0 to 10)

(0 to 5)

(0 to 5)

(0 to 5)

(0 to 5)

(0 to 5)

(0 to 5)

(0 to 5)

(0 to 5)

(0 to 5)

(0 to 5)

(0 to 5)

(0 to 35)

Total

Max 110

Maximum score is 110. No fractional points to be given.

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Contestant Procedure Sheet

Event #2: Troubleshooting Procedure

**Sponsor: Emerson Climate
Technologies**

Time Allowed: 30 Minutes

Description of Job:

Perform or follow proper system troubleshooting procedures to identify cause of no cooling.

Problem Statement:

The complaint is no cooling. System short cycles.

Notes:

1. Follow all normal safety procedures.
2. Use proper tools and/or instruments.
3. Return tools and instruments to proper place when finished.
4. Normal conditions: 115 psig HP, 21 psig LP, 12.1 amps, 10°F SH, 10°F SC.

Judges Notes:

1. Have student read Problem Statement prior to starting.
2. Clarify any questions or concerns.
3. Problem Statement must not leave judging area.

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Judges Instruction Sheet

Event #2: Troubleshooting Procedure

**Sponsor: Emerson Climate
Technologies**

DO NOT CHAT WITH CONTESTANTS OR TALK TO ANY SPECTATOR (could be instructor or parent). Call for Technical Committee Member to answer spectator questions.

Total Your Own Score Sheet Print your name on Score Sheet

Grading Instructions:

1. Safety:

- a. Contestants must wear safety glasses. If not, DEDUCT 10 POINTS, then remind contestant.

2. Performance:

- a. When contestant has proper size wrench available but uses adjustable wrenches, **DEDUCT POINTS.**
- b. Low side gauge to suction service valve. Leave attached.
- c. High side gauge to receiver service valve. Leave attached.
- d. Did contestant verify system sequence of operation using wiring diagram?
- e. Contestant does not necessarily have to troubleshoot in the same sequence as the score sheet.
- f. Did contestant verify operation of thermostat, L.P., and solenoid coil per contestant score sheet?
- g. If contestant identifies the faulty wiring to solenoid coil problem correctly, without completing ALL of the performance functions listed, (A through M on the score sheet), ask him/her if there are any other system checks they would want to do to verify the problem and ask them to explain how they came to their conclusion.
- h. When contestant indicates He/She is finished, Escort them back to the waiting area.
- i. Deduct points for any performance checks that were not done by the contestant or correctly explained per item G above.
- j. Normal conditions: 115 psig HP, 21 psig LP, 12.1 amps, 10°F SH, 10°F SC.

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Turn to the Experts

Problem Statement

Event #3: Airflow, Superheat and Subcooling Measurements

Sponsor: Carrier Corporation

Time Allowed: 25 Minutes

This exercise involves measuring the airflow of a typical indoor fan section of a residential type air – conditioning system and then measuring the “suction gas superheat” and “liquid subcooling” of the same air conditioning system. Choosing from the instruments provided, you are to measure the total airflow of the air conditioning system, the suction gas superheat as well as the liquid Subcooling, and then answer the related questions on the attached procedure sheet.

Procedure: See next page.

- Notes:
1. Follow all normal safety procedures.
 2. Use tools and/or instruments properly.
 3. Perform tasks in proper sequence.
 4. Explain your procedure and findings to your judge.
 5. Return tools, instruments, etc. to their proper place when finished.

Judges Notes:

1. Have contestant read this “Problem Statement” and procedure sheet prior to starting. These sheets are not to leave the contest area.
2. The “Procedure Sheet” is for the contestant to use as a worksheet. Place contestant number in upper right and affix behind judges completed score sheet.
3. Clarify any questions after contestant reads instructions and before the judge starts the timing for the event.

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Turn to the Experts

Contestant Score Sheet

Event #3: Airflow using Velocity Pressure, and measure Superheat and Subcooling

Sponsor: Carrier Corporation

25 minute max

Stop Time _____

Contestant # _____

Start Time _____

Total _____

Judge's Initial's _____

Safety

Score

Points

- A. Wear safety glasses

_____ (0 to 4)

Procedure for Measuring Airflow

- | | | |
|---|-------|-----------|
| A. Divided duct for traverse reading | _____ | (0 to 9) |
| B. Hooked up tubes to meter correctly | _____ | (0 to 9) |
| C. Properly positioned Pitot tube and read | _____ | (0 to 9) |
| D. Converted pressures to FPM and averaged properly | _____ | (0 to 13) |
| E. Calculated square footage area of duct properly | _____ | (0 to 9) |
| F. Calculated CFM correctly (_____) | _____ | (0 to 9) |
| G. What should airflow be? $\pm 10\%$
Is this airflow acceptable for a 2-ton system? | _____ | (0 to 13) |
| H. Explained consequences of too much / too little airflow | _____ | (0 to 13) |

Procedure for Measuring Suction Superheat

- | | | |
|--|-------|------------|
| A. Uses and reads gauge manifold correctly? | _____ | (0 to 9) |
| B. Uses and reads electronic thermometer correctly? | _____ | (0 to 4) |
| C. Calculates the superheat and subcooling properly and correctly? | _____ | (0 to 9) |
| (Safety Deduction) * | _____ | (0 to -10) |
| Total | _____ | (110 max) |

NOTES:

- Maximum score is 110. No fractional points are to be given.
- Judge should volunteer to hold Pitot tube for contestant, BUT contestant MUST instruct judge about where to hold and how to position Pitot tube for each reading.

***Caution: Judges should watch contestants carefully; be prepared to intervene if safety is not being observed! (0 to 10 point deduction)**

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Turn to the Experts

Contestant Score Sheet

Event #3: Airflow using Temperature Rise,
and measure Superheat and Subcooling.

Sponsor: Carrier Corporation

25 minute max

Stop Time _____

Contestant # _____

Start Time _____

Total _____

Judge's Initials _____

Safety

- A. Wear safety glasses _____
- B. Worked safely while taking electrical readings _____

Score Points

(0 to 4)

(0 to 4)

Procedure for Measuring Airflow

- A. Turned on electric heat and allowed time to warm up _____
- B. Chose proper probes for temperature difference and read TD correctly (____ degrees TD) _____
- C. Measured volts and amps correctly * (____ Volts _____ Amps) _____
- D. Chose proper formula to calculate CFM _____
- E. Calculated CFM correctly (____) _____
- F. Explained consequences of too much / too little airflow _____
- G. What should airflow be? (____) _____
- Is this airflow acceptable for a 2-ton system? _____

(0 to 13)

(0 to 9)

(0 to 9)

(0 to 13)

(0 to 13)

(0 to 14)

(0 to 9)

Procedure for Measuring Suction Superheat and Subcooling

- A. Uses and reads gauge manifold correctly? _____
- B. Uses and reads electronic thermometer correctly? _____
- C. Calculates the subcooling and superheat properly and correctly? _____

(0 to 9)

(0 to 4)

(0 to 9)

(Safety Deduction) * _____ (0 to -10)

Total _____ (110 max)

NOTES:

- Maximum score is 110. No fractional points are to be given.
- Inform contestants that voltage and amperage are to be taken from the disconnect box. If they ask for the motor amperage you may tell them it is _____ amps.

* Judges may assist with setting the thermostat at the contestant's request- watch contestants closely when they are measuring voltage and amperage. Be prepared to intervene quickly if they appear to be unsafe. (0 to 10 point deduction)

Velocity Pressures

Velocity Pressure (in. wg.)	Velocity (Ft/Min)	Velocity Pressure (in. wg.)	Velocity (Ft/Min)	Velocity Pressure (in. wg.)	Velocity (Ft/Min)	Velocity Pressure (in. wg.)	Velocity (Ft/Min)
0.01	400	0.29	2150	0.59	3050	1.28	4560
0.02	565	0.30	2190	0.60	3100	1.32	4600
0.03	695	0.31	2230	0.62	3150	1.36	4670
0.04	800	0.32	2260	0.64	3200	1.4	4730
0.05	895	0.33	2300	0.66	3250	1.44	4800
0.06	980	0.34	2330	0.68	3300	1.48	4870
0.07	1060	0.35	2370	0.70	3350	1.52	4930
0.08	1130	0.36	2400	0.72	3390	1.56	5000
0.09	1200	0.37	2440	0.74	3440	1.6	5060
0.10	1270	0.38	2470	0.76	3490	1.64	5120
0.11	1330	0.39	2500	0.78	3530	1.68	5190
0.12	1390	0.40	2530	0.80	3580	1.72	5250
0.13	1440	0.41	2560	0.82	3620	1.76	5310
0.14	1500	0.42	2590	0.84	3670	1.8	5370
0.15	1550	0.43	2620	0.86	3710	1.84	5430
0.16	1600	0.44	2650	0.88	3750	1.88	5490
0.17	1650	0.45	2680	0.90	3790	1.92	5550
0.18	1700	0.46	2710	0.92	3840	1.96	5600
0.19	1740	0.47	2740	0.94	3880	2	5660
0.20	1790	0.48	2770	0.96	3920	2.04	5710
0.21	1830	0.49	2800	0.98	3960	2.08	5770
0.22	1880	0.50	2830	1.00	4000	2.12	5830
0.23	1920	0.51	2860	1.04	4080	2.16	5880
0.24	1960	0.52	2880	1.08	4160	2.2	5940
0.25	2000	0.53	2910	1.12	4230	2.24	5990
0.26	2040	0.54	2940	1.16	4310	2.28	6040
0.27	2080	0.55	2970	1.20	4380		
0.28	2120	0.56	2990	1.24	4460		

Notes: 1. Data for standard air (29.92 in. Hg and 70F)
2. Data derived from the following equation: $V = 4005\sqrt{V_p}$

$$H_s = 1.1 \times \text{CFM} \times \Delta T$$

$$\text{Area (Rectangle)} = \frac{L \times W}{144}$$

$$H_t = 4.5 \times \text{CFM} \times \Delta h$$

$$\text{CFM} = \text{Area (sq.ft.)} \times \text{Velocity (ft/min)}$$

$$H_s = \text{volts} \times \text{Amps} \times 3.414 \text{ btu/watt}$$

$$\text{CFM} = \frac{\text{Volts} \times \text{Amps} \times 3.414 \text{ btu/watt}}{1.1 \times \Delta T}$$

$$V_{\text{fpm}} = 4005 \sqrt{V_p}$$

H_s = Sensible Heat H_t = Total Heat V_p = Velocity Pressure Δh = Total Heat Difference

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Contestant Score Sheet

Event #4: Electrical Troubleshooting, A/C

Sponsor: Lennox Industries

Troubleshooting

15 minute max

Wiring
Diagram

5 minute max

Stop Time _____

Contestant # _____

Start Time _____

Sub-Total _____

Judge's Initial's _____

Total _____ Troubleshooting +
Wiring Diagram

Safety

A. Wear safety glasses

Score _____

Points

(0 or 10)

B. Safe work practices

a. Used tools safely

(0 or 5)

b. Practiced safe work procedures

(0 or 5)

Performance

A. Used tools and instruments properly?

a. Used screw/nut drivers, pliers, etc, properly

(0 to 4)

b. Set meter correctly for ohms & volts

(0 to 8)

B. Troubleshooting

a. Followed proper troubleshooting procedures

(Read problem statement, set to "cooling"

Observe component operation)

(0 to 10)

Use required testing equipment in logical pattern

(0 to 15)

b. Correctly identified fault

i. Quotes "Unit miss-wired"

= 15 points

ii. Quotes "Y1&Y2 wires swapped"

= 25 points

(0,15,25)

c. Explained findings to judge properly

i. "Need to swap Y1 & Y2 wires at

~~Subbase~~ ~~furnace~~ terminal strip"

= 10 points

(0 or 10)

C. Answered wiring diagram questions correctly?

Q1. Required power source for L34 coil?

A, B, C

(0 or 9)

Q2. Controls used in Low Ambient Kit?

A, B, C

(0 or 9)

Judge's Copy



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Judging Guidelines

Event #4 – Electrical Troubleshooting - Wiring

Sponsor: Lennox Industries

Time Allowed: 5 minutes

This exercise involves the ability to read a wiring diagram found on a Residential Air Conditioner.

There are 2 questions in this exercise. Determine your answers using the wiring diagram provided. Indicate to the Judge the answer you have chosen for each question by pointing to the corresponding letter A, B, or C. Because of the close proximity of the other contestants, please do not say your answer out loud. Please indicate to the judge when you are ready to begin.

PROBLEM:

What is the voltage requirement of the 2nd stage solenoid coil installed inside the compressor labeled "L34"?

Q1

A	24 VAC	0 points
B	208-230/60/1	0 points
C	24 VDC	9 points

Q2

What controls make up the optional Low Ambient Control kit?

A	S49, RT14	0 points
B	S11, K159	9 points
C	S40, HR1	0 points

Judge's Copy

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Judge's Guidelines

The problem consists of a new Air Conditioning system installed a month ago and the home will not cool properly. The office advised the homeowner to turn the thermostat system switch to 'off' and the fan switch to 'auto'. The problem is Y1 and Y2 wires from the thermostat are reversed on the furnace terminal strip.

Before contestant arrival:

- 1) Set thermostat in mode OFF position, with fan set to AUTO position
- 2) Furnace and condensing unit access doors are removed
- 3) Furnace safety switch is in closed position
- 4) Manifold gauge set is attached

Safety

Score

Points

(0 to 20)

A. Wear safety glasses

(0 or 10)

B. a) Used tools safely

(0 or 5)

b) Practiced safe work procedures

(0 or 5)

Performance

A. Used tools and instruments properly

(0 to 12)

b) Used screw/nut drivers, pliers, etc., properly?

(0 to 4)

a) Set meter correctly when measuring volts or ohms?

(0 to 8)

B. Troubleshooting

Followed proper troubleshooting procedures?

(0 to 60)

Contestants are expected to:

1) Read the Problem Statement

2) Turn the thermostat to "call" for cooling

3) Observe System Components Operation

(0 to 10)

Judge's Copy

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4) Utilize required testing equipment in logical pattern

i) Check for cooling call from thermostat.

(1) Measurement from Y1 and Y2 to C at furnace and outdoor unit?

ii) Check for line voltage at contactor?

iii) Check for 24v at contactor coil?

iv) Look at attached pressure manifold set?

v) Trace fault to Y1 & Y2 wires switched at furnace terminal strip?

_____ (0 to 15)

Correctly identified fault?

vi) "Unit miss-wired" - Award 15 points

vii) "Y1 & Y2 wires swapped at furnace terminal strip" - Award 25 points

_____ (0, 15, 25)

5) Properly explained findings to judge?

i) "Need to swap Y1 to Y2 thermostat wires at furnace terminal strip" - Award 10 points

_____ (0 to 10)

C. Solved wiring diagram circuit correctly?

_____ (0 to 18)

Q1. What is the voltage requirement of the 2nd stage solenoid coil installed inside the compressor labeled "L34"?

A B C

_____ (0 or 9)

Q2. What controls make up the optional Low Ambient Control kit?

A B C

_____ (0 or 9)

Note: Maximum score is 110. No fractional points to be given.

Total

_____ (110 max)

Judge's Copy

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Contestant Procedure Sheet

Event #4 – Electrical Troubleshooting, A/C

Sponsor: Lennox Industries

Time Allowed: 15 minutes

This exercise involves the diagnosis of a typical problem found on a residential heating and air conditioning system.

Read the “customer complaint” below. Using tools and/or instruments provided, you are to determine the cause of the system problem. **(Please do not actually repair the unit.)** After you finish your assignment, explain to the judge what the problem is, your method of troubleshooting and what the corrective action would be.

CUSTOMER COMPLAINT OR PROBLEM

The problem consists of a home not cooling properly. The new system was installed a month ago.

The dispatcher for your heating and cooling company instructed the customer to turn the thermostat mode to ~~Heat~~ and the blower switch to ‘auto’ until you could arrive to troubleshoot. **Cool**

Notes:

1. You will be working with “**Live**” equipment voltages. The furnace 120 volt door interlock switch has been bypassed! **Use Caution!**
2. Follow all normal safety procedures
3. Use proper tools and/or instruments
4. Perform tasks in proper sequence
5. Explain your diagnosis to the judge
6. Return all tools, instruments, etc. to proper place when finished

Judge's Notes

1. Have contestant read CUSTOMER COMPLAINT OR PROBLEM statement
2. Clarify questions before beginning
3. CUSTOMER COMPLAINT OR PROBLEM statement must not leave immediate contest area

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Contestant Score Sheet

Event #4: Electrical Troubleshooting, A/C

Sponsor: Lennox Industries

	Troubleshooting 15 minute max	Wiring Diagram 5 minute max
Stop Time	_____	_____
Start Time	_____	_____
Sub-Total	_____	_____
Total	_____	Troubleshooting + Wiring Diagram

Contestant # _____

Judge's Initial's _____

Safety

A. Wear safety glasses

B. Safe work practices

a. Used tools safely

b. Practiced safe work procedures

Score

Points

(0 or 10)

(0 or 5)

(0 or 5)

Performance

A. Used tools and instruments properly?

a. Used screw/nut drivers, pliers, etc, properly

b. Set meter correctly for ohms & volts

B. Troubleshooting

a. Followed proper troubleshooting procedures

(Read problem statement, set to "cooling"

Observe component operation)

Use required testing equipment in logical pattern

b. Correctly identified fault

i. Quotes "Unit miss-wired"

= 15 points

ii. Quotes "Y1&Y2 wires swapped"

= 25 points

c. Explained findings to judge properly

i. "Need to swap Y1 & Y2 wires at

Subbase ~~furnace~~ terminal strip"

= 10 points

C. Answered wiring diagram questions correctly?

Q1. Required power source for L34 coil?

A, B, C

Q2. Controls used in Low Ambient Kit?

A, B, C

(0 or 9)

(0 or 9)

Judge's Copy

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Judge's Guidelines

The problem consists of a new Air Conditioning system installed a month ago and the home will not cool properly. The office advised the homeowner to turn the thermostat system switch to 'off' and the fan switch to 'auto'. The problem is Y1 and Y2 wires from the thermostat are reversed on the furnace terminal strip.

Before contestant arrival:

- 1) Set thermostat in mode OFF position, with fan set to AUTO position
- 2) Furnace and condensing unit access doors are removed
- 3) Furnace safety switch is in closed position
- 4) Manifold gauge set is attached

Safety

Score

Points

(0 to 20)

A. Wear safety glasses

(0 or 10)

B. a) Used tools safely

(0 or 5)

b) Practiced safe work procedures

(0 or 5)

Performance

A. Used tools and instruments properly

(0 to 12)

b) Used screw/nut drivers, pliers, etc., properly?

(0 to 4)

a) Set meter correctly when measuring volts or ohms?

(0 to 8)

B. Troubleshooting

Followed proper troubleshooting procedures?

Contestants are expected to:

(0 to 60)

1) Read the Problem Statement

2) Turn the thermostat to "call" for cooling

3) Observe System Components Operation

(0 to 10)

Judge's Copy

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4) Utilize required testing equipment in logical pattern

i) Check for cooling call from thermostat.

(1) Measurement from Y1 and Y2 to C at furnace and outdoor unit?

ii) Check for line voltage at contactor?

iii) Check for 24v at contactor coil?

iv) Look at attached pressure manifold set?

v) Trace fault to Y1 & Y2 wires switched at furnace terminal strip? _____

(0 to 15)

Correctly identified fault?

vi) "Unit miss-wired" - Award 15 points

vii) "Y1 & Y2 wires swapped at furnace terminal strip" - Award 25 points _____

(0, 15, 25)

5) Properly explained findings to judge?

i) "Need to swap Y1 to Y2 thermostat wires at furnace terminal strip" - Award 10 points _____

(0 to 10)

C. Solved wiring diagram circuit correctly?

(0 to 18)

Q1. What is the voltage requirement of the 2nd stage solenoid coil installed inside the compressor labeled "L34"?

A B C

(0 or 9)

Q2. What controls make up the optional Low Ambient Control kit?

A B C

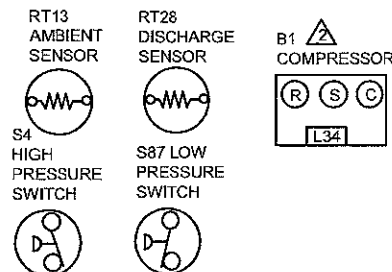
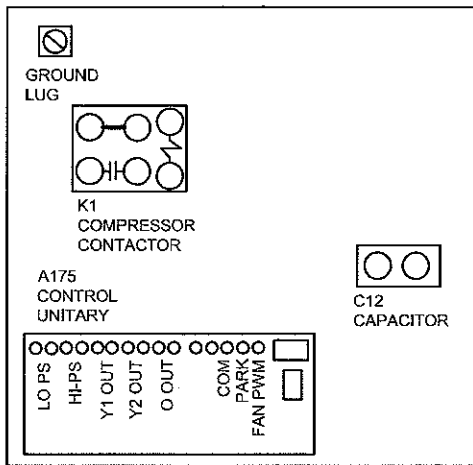
(0 or 9)

Note: Maximum score is 110. No fractional points to be given.

Total

_____ (110 max)

Judge's Copy



CFM PROFILE SELECTION				
MODEL	FAN RPM	STAGE 1 RPM	STAGE 2 RPM	EDA STAGE RPM
024	11	475	550	200
036	12	525	600	225
048	14	600	675	225
060	14	600	675	225

L34 SOLENOID IS LOCATED IN COMPRESSOR. COIL IS 24VDC. DO NOT CONNECT 24VAC TO COIL TERMINALS

FOR HUMIDITROL OPERATION (EDA), CONNECT FIELD PROVIDED WIRE FROM DS ON A92 TO DS ON A175. CUT JUMPER FROM DS TO R ON A175.

RESISTOR KIT (47W97) IS REQUIRED WHEN USING COMFORTSENSE 7000 (Y0349) WITH A175 OUTDOOR CONTROL. RESISTOR KIT NOT REQUIRED WHEN USING COMFORTSENSE 7000 (Y2081)

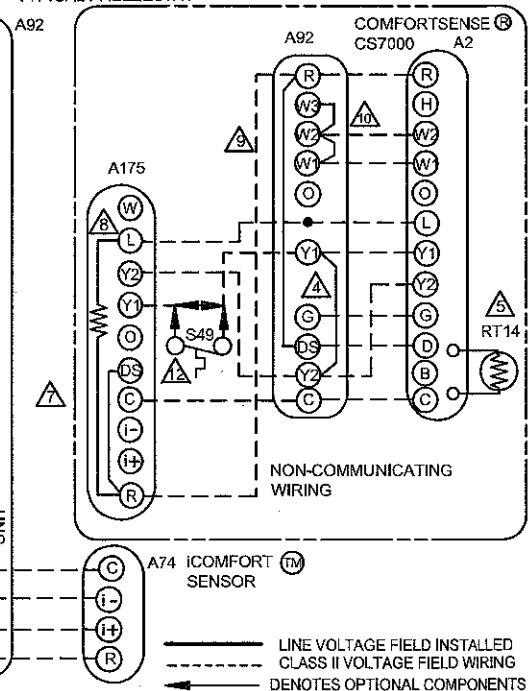
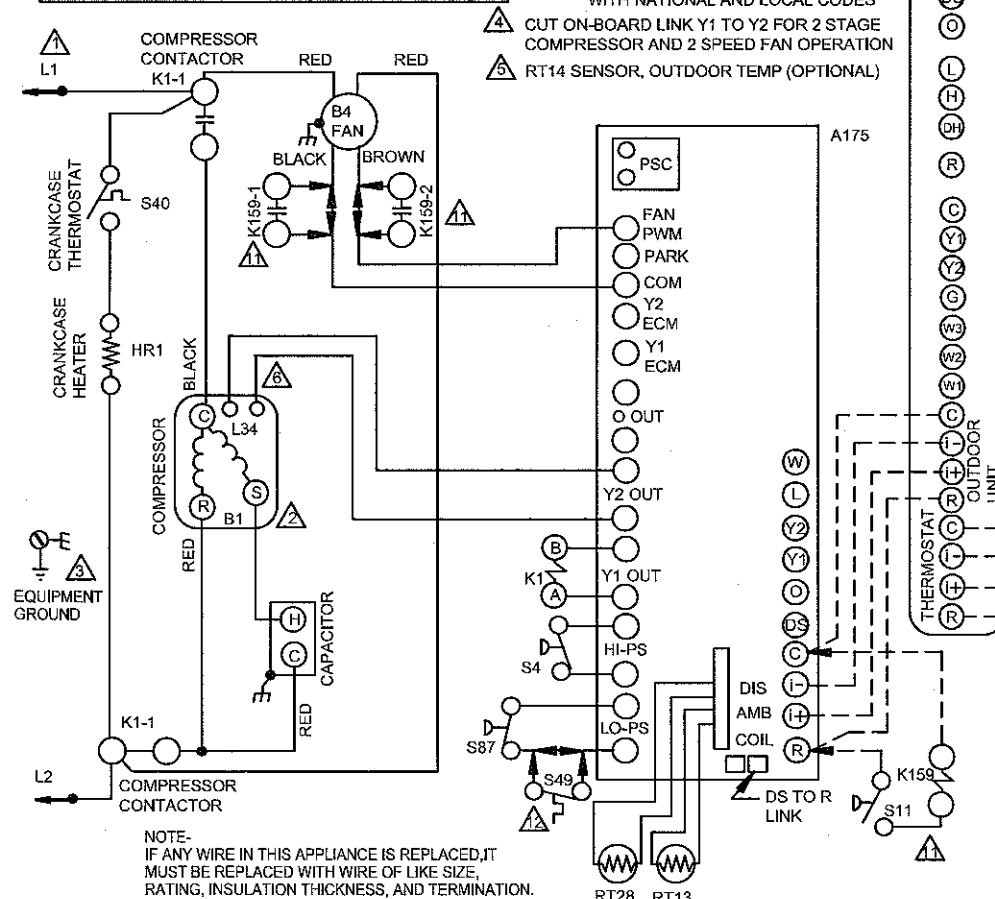
CUT ON-BOARD LINK FROM DS TO R FOR DEHUMIDIFICATION ON A9

METAL JUMPERS ACROSS W1, W2, AND W3 COME FROM FACTORY. REMOVE JUMPER FROM W1 TO W2 FOR TWO STAGE ELECTRIC HEAT, AIR HANDLERS ONLY

OPTIONAL LOW AMBIENT CONTROLS

TYPICAL FREEZE/STAT

- NOTE- FOR USE WITH COPPER CONDUCTORS ONLY. REFER TO UNIT RATING PLATE FOR MINIMUM CIRCUIT AMPACITY AND MAXIMUM OVERCURRENT PROTECTION SIZE
- REFER TO COMPRESSOR IN UNIT FOR ACTUAL TERMINAL ARRANGEMENT
- WARNING-ELECTRIC SHOCK HAZARD CAN CAUSE INJURY OR DEATH. UNIT MUST BE GROUNDED IN ACCORDANCE WITH NATIONAL AND LOCAL CODES
- CUT ON-BOARD LINK Y1 TO Y2 FOR 2 STAGE COMPRESSOR AND 2 SPEED FAN OPERATION
- RT14 SENSOR, OUTDOOR TEMP (OPTIONAL)



LENNOX	
COOLING CONDENSING	
XC21	
0412	Supersedes
0412	Form No. 537509-01

HUSSMANN**Contestant Procedure Sheet****Event: #5 – Refrigeration System Troubleshooting
(Electrical)****Sponsor: Hussmann****Time Allowed: 15 Minutes****DESCRIPTION OF THIS JOB**

This exercise involves diagnosis of a problem in a self-contained refrigeration display case commonly found in supermarkets and convenience stores.

The following tools and equipment are provided:

- • Screwdrivers
- • Needle-nosed pliers
- • Digital volt-ohmmeter (VOM)
- • Electrical diagram

JOB DESCRIPTION:

Locate an electrical fault in a commercial refrigeration unit.

PROBLEM STATEMENT:

You're about to deliver this new unit to your customer. A quick check reveals that the compressor does not operate.

Use the digital volt-ohm meter (VOM) and the electrical diagram to trace the voltage path.

Be able to:

1. *Use the schematic diagram to trace circuits on the equipment.*
 2. *Point out the fault on the cooler.*
 3. *Point out the fault on the electrical diagram and explain why it would cause the symptom.*
 4. *Explain the thought-process that led you to the fault.*
 5. *Explain how to remove the "bug" that's been placed in this unit.*
- Follow all normal safety procedures.
 - Treat the judge like a customer: explain the problem thoroughly and clearly.
 - When finished, return the unit to the condition it was in when you began.

Notes to Judge:

1. Have contestant read the "Problem Statement" shown above.
2. Ask the contestant to respond to all of the five (5) items listed above.
3. This document and the electrical diagram must not leave the contest area.

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Judges Scoring Instructions Confidential

Event #7: Refrigerant Procedures

Sponsor: RSES

- A Wear safety Glasses** (0 – 2)
- a) If contestant has and wears safety glasses, award (2) points.
 - b) If the contestant must be told to put on safety glasses, award (1) point.
 - c) If the contestant does not have safety glasses award (0) points.
- B Identify what type of Refrigerant is in this system** (0 – 3)
(Look at the name plate)
- C Connect gauges set properly to system** (0 – 7)
- a) Identify the high and low access fittings on the unit = 4 points
 - b) Connect high and low side hoses to the appropriate fittings = 2 points
 - c) Purge air from hoses = 1 point
- D Check system for refrigerant leak** (0 – 9)
- a) Contestant should check if system has some charge = 2 points
 - b) What would be done if no charge? = 2 points
 - c) Contestant should be familiar with the basic operation of an electronic leak detector = 1 point
 - d) Contestant should know and demonstrate the process for finding the leak with leak detector = 4 points

Note –Contestant does not need to find the exact leak to get all points!

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E Connect recovery unit to system and tank (0 – 7)

a) Contestant to explain the 3 methods of recovering refrigerant

1) Vapor = 1 point

2) Liquid = 1 point

3) Push-pull = 1 point

b) Contestant to connect recovery machine to system and tank = 6 points

c) Filter must be used = 1 point

d) Place tank on scale. Recovery should be stopped at what weight? = 2 points

1) 80 % of tanks maximum capacity

F Proper use of pressure vessel (0 – 2)

Contestant safely releases pressure from hoses and insures the valve are closed before doing so = 2 point

G Determine Pressure Rating on tank (0 – 2)

Each contestant must determine the pressure rating on the tank by looking at the DOT – 4BA rating = 2 points

H Check the Certification Date (0 – 2)

Each contestant must determine the retest date of the cylinder by finding it on the safety collar of the tank = 2 points

I Check refrigerant in tank to prevent cross contamination (0 – 5)

Contestant must determine the type of refrigerant in the tank by explaining the use of P/T verification = 6 points total

a) Checking the Temperature (2) points

b) Checking the Pressure (2) points

c) Using a P/T Chart (2) points

1

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J Perform recovery through a complete pull down (0 – 4)

(Judge is to discharge a small amount of refrigerant into hoses by opening and closing C&D valves)

- a) Contestant to run a recovery on the system; they must pull the system down to below 4 inches of vacuum = 3 points
- b) If they do not open valve on tank or manifold = 0 points

K EPA required recovery pull down level for this system (0 – 4)

This system contains 52 oz of refrigerant (less than 5 pounds); therefore a recovery to 4 ~~hgs~~ is required = 5 points

L Correctly connect vacuum pump and vacuum gauge (0 – 4)

- a) Contestant is to connect vacuum pump and vacuum gauges to system as agreed to in judges meeting and pull a vacuum = 3 points
- b) Manifold should be reading 0 PSI or below prior to connecting to vacuum pump = 2 points

M The purpose of pulling a vacuum on the system? (0 – 4)

A vacuum is pulled to remove air and moisture from the system piping and components.

- c) If contestant states only air or moisture, award 2 points
- d) If contestant states both air and moisture, award 3 points

N The purpose of the electronic vacuum gauge? What is the term of measurement they report? (0 – 5)

An electronic vacuum gauge allows technicians to:

- a) Accurately measure a deep vacuum = 2 points
- b) Ensure is tight and dry = 2 points
- c) Term of measurement used in a vacuum gauge is a micron
1 = 0 points

O Check vacuum pump for performance (0 – 3)

Use a vacuum micron gauge directly on the vacuum pump. A good pump should be able to pull below 100 microns = 3 points

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P Complete evacuation of the system (0 – 9)

Pull vacuum to approx. 1000 – 500 microns = 9 points

- 1) If contestant shuts machine off above 29 inches of vacuum – award zero (0) points
- 2) If contestant reads only the manifold to determine vacuum state (but must be below 29 inches of vacuum) – award six (6) points
- 3) If contestant stops evacuation before reaching 1000 microns – award six (6)

Q Check system for vacuum leaks (0 – 4)

(Have contestants explain what they are doing)

- a) Perform "standing vacuum check". Vacuum must hold for at reasonable amount of time and within reasonable amount of rise in microns to be acceptable for a dry, non-leaking system = 4 points

R Use the charging device, set up to properly recharge (0 – 8)

- a) Connect yellow hose of manifold to refrigerant tank and place tank on charging scale = 3 points
- b) "Zero" the scale or write down cylinder weight = 3 points
- c) Charging should be vapor unless contestant asks for "liquid charging restrictor" = 2 points

S What is the proper refrigerant charge for this unit (0 – 3)

Refrigerant Charge – award three (3) points

T Procedure for checking quality of refrigerant / oil in a system (0 – 4)

- a) Acid test can be run on the system oil = 2 points
- b) Moisture sight glass can be used for moisture = 2 points

U How can refrigerant be cleaned in a working system (0 – 4)

A filter dryer can be used to remove contaminants and dry the refrigerant)

- a) Filter only = 2 points
- b) Dryer only = 2 points

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- V **If Nameplate information is not available**, how is the proper charge determined? (0 – 5)

(Based on the type of metering device, either fixed orifice or expansion valve, charge using either superheat or Subcooling)

- a) Fixed restriction: SuperHeat = 2 points 2
- b) TXV: SubCool = 3 points

- W Replace all tools and Caps to their original locations (0 – 3)

(Contestant must put back all tools and caps)

If completed;

- a) Tools – award 2 points
- b) Caps – award 1 point

At this point the judge should subtotal the score for a maximum of 110 points and pass the scoring sheet to the refrigerant identification judge.

- X Identify the type of refrigerant in tanks (0 – 7)

(Contestant will take a pressure temperature reading on three tanks of refrigerant and determine the type of refrigerant in the tank)

- a) If contestant knows how to determine refrigerant by pressure temp method, -- award 4 points
- b) If contestant knows process but does not get readings correct. (At least 2 of the three refrigerants must be correctly identified to get all points for this section.)-- award 3 points 3

TOTAL SCORE (110 max)

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Problem Statement

Event #7: Refrigerant Procedures

Sponsor: RSES

Time allowed: 45 minutes

Read this entire "Problem Statement" page and clarify any questions you have with your judge before starting this event.

Notes:

1. Follow all normal safety procedures.
2. Use proper tools and/or instruments
3. Perform tasks in proper sequence.
4. Explain your process to the judge as you proceed.
5. Return tools and instruments to proper place when finished.

This exercise involves using the following tools and equipment:

- Package air conditioning unit
- Recovery unit and cylinder
- Vacuum pump
- Manifold set
- Electronic vacuum gauge
- Electronic scale
- Electronic leak detector

Contestant is to:

1. Check system for refrigerant leaks using electronic leak detector.
2. Properly hook-up the Recovery Unit and Cylinder to the Package AC system and recover some refrigerant.
3. Properly hook-up Vacuum Pump & Vacuum Gauge evacuate the system to industry standard also check for vacuum leaks.
4. Properly hook-up refrigerant cylinder and recharge the system.
5. Identify 3 types of unknown refrigerant.
6. Answer some questions the judge has for you regarding the processes you have just completed.

Return this sheet to Judge when you finish this event!

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Problem Statement

Event #7: Refrigerant Procedures

Sponsor: RSES

Time allowed: 45 minutes

While waiting for Event #7, contestants should carefully read this "Problem Statement" and organize their thoughts as to what actions they will be asked to perform. When called into this event, contestants will be given another copy of this sheet for reference during the contest. Contestants should clarify any questions with the event judge before starting this event.

Scenario: The service manager has informed you that this system has a leak. You'll need to find the leak; recover the remaining refrigerant; evacuate, recharge the system and ready the system for normal operation.

Notes:

1. Follow all normal safety procedures.
2. Use proper tools and/or instruments.
3. Perform tasks in proper sequence.
4. Explain your process to the judge as you proceed.
5. Return tools and instruments to proper place when finished.

This exercise involves using the following tools and equipment:

- Package air conditioning unit
- Recovery unit and cylinder
- Vacuum pump
- Manifold set
- Electronic vacuum gauge
- Electronic scale
- Electronic leak detector

Contestant is to:

1. Check system for refrigerant leaks using electronic leak detector.
2. Properly hook-up the Recovery Unit and Cylinder to the Package AC system and recover some refrigerant.
3. Properly hook-up Vacuum Pump & Vacuum Gauge, evacuate the system to industry standard, and check for vacuum leaks.
4. Properly hook-up refrigerant cylinder and recharge the system.
5. Identify 3 types of unknown refrigerant.
6. Answer some questions the judge has for you regarding the processes you have just completed.

DO NOT REMOVE THIS SHEET FROM THIS CHAIR!!!



Turn to the Experts

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Contestant Procedure Sheet

Event #8 Electrical Troubleshooting, Gas Heating

Sponsor: Carrier Corp.

Contestant: Read this entire "Procedure Sheet" page and clarify any questions you have with your judge before starting this event.

Time Allowed: 15 Minutes

DESCRIPTION OF THIS JOB

- This exercise involves diagnosing a non-working gas furnace.

SITUATION:

- It is 4:30pm on Monday afternoon in January. Your company has just installed a gas furnace for Mrs. Homeowner. The installers could not get the furnace to operate and have left the jobsite. Your employer has dispatched you with instruction to "get the furnace running before you go home tonight".

TASK:

- Determine why the heat is not operating.
- **Before** taking corrective actions check with judge.
- Explain your diagnostic process and conclusions to the judge.

JUDGE'S NOTES:

- Have Contestant read "Contestant Procedure Sheet" prior to starting.
- Clarify questions before beginning.
- "Contestant Procedure Sheet" must not leave immediate contest area.



Turn to the Experts

Judging Guidelines/Procedures

**Event #8: Electrical Troubleshooting,
Heating**

Sponsor: Carrier Corporation

Overview

Problem

The problem consists of a 90% AFUE condensing gas furnace that has a pressure switch tube disconnected. Also, the low voltage fuse in its control circuit is open.

Before contestant arrives at the station, the judge will verify a blown low voltage fuse is in the control board, the tube to the pressure switch is disconnected at the pressure switch tube connector, the thermostat is set to "off", and the furnace doors are resting against the unit. Provide black electrical tape for the contestants use on the blower door safety switch.

Expected Contestant Diagnostic Logic

Contestants are expected to:

A. Read the Problem Statement.

B. Notice the thermostat display is blank as a result of the blown fuse.

- Find the blown low voltage fuse using the furnace's wiring diagram with a VOM meter;

or

- Find the blown low voltage fuse using the furnace's control board LED and service code chart. LED code 24 secondary voltage fuse is open.

- Once the contestant finds the bad fuse the Judge will provide the contestant with a good new fuse.

C. Turn the thermostat to "call" heat

- Find the tube to the pressure switch tube is disconnected resulting in open pressure switch circuit code using the furnace's control board LED and service code chart. I.e. LED code 32 Pressure switch did not close on call for heat or re-open after call for heat is satisfied.

Or

- Find the tube to the pressure switch is disconnected by inspecting the furnace controls.
- Repair the disconnected tube by reattaching it to the pressure switch tube connector port.

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D. Observe Unit Operation

- Unit will attempt the ignition sequence
- Without gas the burner will not fire and control board LED will display code 34 signifying Ignition Proving Fault
- The Judge will explain to the contestant this is a test unit and the gas supply is not attached to the unit.

E. Contestant explains findings to judge and how the problem should be corrected

F. Judge dismisses contestant (replacing the fuse with a bad one, disconnected the pressure switch tube and remove the black electrical tape from the blower door safety switch)

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Judging

Upon Contestant Arrival Judge:

- Records Contestant Number.
- Allows contestant ample time to review Problem Statement.
- Answers questions contestant may have unless answer will provide contestant unfair advantage.
- Once contestant is ready the judge will record start time.
- After the contestant offers final explanation judge will record stop time.

Safety

A. Wear safety glasses – (0 or 4) points.

- Safety glasses must be in place before starting contest. Contestant is permitted to have glasses removed while reading Problem Statement.
- Points are awarded in an “all or nothing” basis.

B. Use tools and work safely – (0, 4, 9, or 14) points.

- Tools and test instruments must be used in accordance to their intended purpose. Any other use is not permitted (i.e. using a screwdriver for prying).
- Point guideline
 - Points are awarded for observing all safety procedures.
 - Ten points are deducted for connecting wiring or otherwise working on electrical (unless making voltage check) with unit powered.
 - Five points are deducted for using tools and instruments for purposes other than intended (ie using a screwdriver for prying).

Performance

A. Use tools properly? – (0 or 4) points

- The only hand tools necessary for this station is a nut driver to open the control box area.
 - Points awarded on an “all or nothing” basis

B. Use instruments properly? – (0 or 4) points

- Use of VOM to measure high voltage and or control low voltage of unit. Points awarded on an “all or nothing” basis

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C. Did contestant:

- Check low voltage for power? – (0 or 9) points
 - o Points awarded on an all or nothing basis
- Use the troubleshooting chart and/or wiring diagram? (0, 5, 10 or 13) points
- Correctly diagnose the "blown" fuse? (0, 5, 10 or 13) points
- Correctly diagnose the loose pressure switch tube and open limit switch? (0, 5, 10 or 13) points

D. Did contestant follow proper logical procedure? – (0, 5, 10, 15 or 18) points

- This section is subjective, however the following are guidelines the judge should use:
 - o Did contestant use a systematic approach in searching for the problem? – (0 or 5) points
 - o Did contestant replace the open fuse and attempt to fire the unit before making diagnosis? – (0 or 5) points
 - o Did contestant's actions appear to be consistent with expected diagnostic procedures? – (0 to 8) points

E. Explain findings to judge properly? – (0, 5, 10, 15 or 18) points

- At the conclusion of the station the judge will ask the contestant, "How did you come to your conclusions?" and "Tell me about your diagnostic approach."
- This section is subjective, however the following are guidelines the judge should use:
 - o Did contestant explain diagnostics in a manner consistent with the problems?
 - General comments about blank thermostat display and correcting bad fuse issues – (0 to 9) Nine points max
 - How determination was made with regard to the open pressure switch as a result of the loose tube – (0 to 9) Nine points max
 - Note: at least 50% point loss if contestant indicates that a problem exists in addition to the "blown" fuse, (i.e. failed control PCB) or appears to be guessing

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Turn to the Experts

Contestant Score Sheet

**Event #8: Electrical Troubleshooting,
Heating**

Sponsor: Carrier Corporation

Troubleshooting

15 minute max

Stop Time _____

Start Time _____

Total _____

Contestant # _____

Judge's Initial's _____

	Score	Points
1. Safety		
A. Wear safety glasses	_____	(0 or 4)
B. Used tools safely and worked safely	_____	(0 or 14)
2. Performance		
A. Use tools properly?	_____	(0 or 4)
B. Use instruments properly?	_____	(0 or 4)
C. Did contestant:		
1. Check low voltage wiring for power?	_____	(0 or 9)
2. Use troubleshooting charts or wiring diagram?	_____	(0 to 13)
3. Correctly diagnose the blown fuse?	_____	(0 to 13)
4. Diagnose loose tube & open pressure switch?	_____	(0 to 13)
D. Use a logical diagnostic procedure?	_____	(0 to 18)
E. Explain findings to judge properly?	_____	(0 to 18)
Total	_____	(110 max)

1. Safety

- | | | |
|--|-------|-----------|
| A. Wear safety glasses | _____ | (0 or 4) |
| B. Used tools safely and worked safely | _____ | (0 or 14) |

2. Performance

- | | | |
|--|-------|-----------|
| A. Use tools properly? | _____ | (0 or 4) |
| B. Use instruments properly? | _____ | (0 or 4) |
| C. Did contestant: | | |
| 1. Check low voltage wiring for power? | _____ | (0 or 9) |
| 2. Use troubleshooting charts or wiring diagram? | _____ | (0 to 13) |
| 3. Correctly diagnose the blown fuse? | _____ | (0 to 13) |
| 4. Diagnose loose tube & open pressure switch? | _____ | (0 to 13) |
| D. Use a logical diagnostic procedure? | _____ | (0 to 18) |
| E. Explain findings to judge properly? | _____ | (0 to 18) |

Total _____ (110 max)

Note: Points to be given in increments of 5.