

SkillsUSA

2011 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.

Heating, Ventilation, Air Conditioning & Refrigeration (HVACR)

There will be a Special Brazing Seminar Wednesday from 3 p.m. - 5 p.m. in the Contest Area for HVACR. Attendance is mandatory for contestants. However, the seminar is open to instructors and advisors as well.

2011 SkillsUSA Championships HVACR Contest

June 23, 2011 Kansas City, Missouri



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 phos-copper braze alloy into a leak-tight assembly

Notes:

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

2011 SkillsUSA Championships HVACR Contest

June 23, 2011 Kansas City, Missouri



Judging Criteria

Event #1 – Brazing

Sponsor: Harris Products Group

A. Wear safety glasses - 10 points maximum

10 points if glasses continually worn.
5 points if contestant needs to be reminded
0 points if glasses not worn

B. Layout tube cuts - 10 points maximum

10 points if contestant makes 7 to 9 cuts.
5 points if contestant makes 10 to 11 cuts.
0 points if contestant makes more than 11 cuts.

C. Clean prior to brazing - 15 points maximum

15 points if contestant uses tube brush or sand cloth to clean fitting I.D. and tube O.D., and uses deburring tool on tube ends.
10 points if contestant cleans fitting I.D. and tube O.D. (no-deburring).
0 points if there is no part cleaning or cleans only one part, or only deburrs.

D. Flux required connections - 10 points maximum

10 points if contestant fluxes *only* connections where Safety Silv 45 is called out, (reference alloy B call out on drawing).
5 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 - 10 points maximum

10 points if contestant uses correct alloys as shown on drawing.
5 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; start up - 10 points maximum

Opening tank valves

5 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

5 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.

2011 SkillsUSA Championships

HVACR Contest

June 23, 2011 Kansas City, Missouri

- G. Brazing technique and joint appearance - 10 points maximum
- 5 points if contestant removes Schrader valve pin.

5 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; (example would be butt brazing two tubes).
- H. Assembly Layout/Size - 15 point maximum
- 15 points if finished assembly fits within template tolerances.

0 points if assembly is outside size limits.
- I. Leak Test - 20 point maximum
- 20 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).
- J. 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 closes torch adjustment valves, but leaves pressure in the system, (evidenced by gauge pressure reading).

3 points if contestant only closes torch adjustment valves.
- K. 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:

2011 SkillsUSA Championships HVACR Contest

June 23, 2011 Kansas City, Missouri



THE HARRIS PRODUCTS GROUP

Contestant Score Sheet

Event #1 - Brazing

Sponsor: Harris Products Group

Stop Time _____

Contestant # _____

Start Time _____

Total _____

Judge's Initial's _____

	Score	Points
A. Wear safety glasses	_____	(0 to10)
B. Layout & tube cuts	_____	(0 to 10)
C. Pre-braze cleaning	_____	(0 to 15)
D. Flux required connections	_____	(0 to 10)
E. Braze alloy selection	_____	(0 to 10)
F. Braze equipment use - start	_____	(0 to 10)
G. Braze technique and joint appearance	_____	(0 to 10)
H. Assembly layout & size	_____	(0 to 15)
I. Leak test	_____	(0 to 20)
J. Braze equipment use – shut down	_____	(0 to 10)
K. Clean braze area	_____	(0 to 5)

Total _____ (125 max)

Note: Maximum Score is 125. No fractional points to be given.

*** If contestant performs an unsafe practice, STOP the action and correct the contestant. Deduct up to 5 points depending upon the severity of the issue.**



2011 SkillsUSA Championships HVACR Contest

June 23, 2011 Kansas City, Missouri



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. The 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.

2011 SkillsUSA Championships HVACR Contest

June 23, 2011 Kansas City, Missouri



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.



2011 SkillsUSA Championships HVACR Contest

June 23, 2011 Kansas City, Missouri



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 50)

Total

Max 125

Maximum score is 125. No fractional points to be given.

2011 SkillsUSA Championships HVACR Contest

June 23, 2011 Kansas City, Missouri



Turn to the Experts™

Contestant Procedure Sheet (use this sheet as your worksheet)

Event #3: Airflow and Superheat Measurements

Sponsor: Carrier Corporation

Time Allowed: 25 Minutes

There are **two** problems to solve in this event.

1. The first is to measure the **Airflow** in the system and determine if it is **adequate** for this particular system.
2. The second problem is to measure the **Suction Gas Superheat and Subcooling** in the system and determine if it is correct or not.

To determine the airflow, you may choose either method listed below. The Judge will decide which system you will be assigned to, and provide you with the appropriate instruments to make your determinations.

- A. **Velocity Pressure Method** using a Pitot Tube, Magnehelic® Gauge, and a tape measure.
- B. **Temperature Rise Method** using the system's resistance heaters along with a Voltmeter, Clamp-on Ammeter, and an Electronic Thermometer.

After measuring the actual airflow, determine if you believe it is correct or not for this system. Next, measure the Suction Gas Superheat in the same operating system and determine if you believe it is correct or not. Once again the judge will provide the necessary instruments for you to make your determination.

If you wish, you may use the data sheet provided for various formulae and equations which may be helpful in performing your calculations. There are also calculators for your use if you need one.

1. **Explain your procedures and answers to the judge.**
2. **Explain what complaint a customer might have if the airflow was too high or too low.**
3. **What should the airflow, superheat and subcooling be on this particular system?**

2011 SkillsUSA Championships HVACR Contest

June 23, 2011 Kansas City, Missouri



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.

2011 SkillsUSA Championships HVACR Contest

June 23, 2011 Kansas City, Missouri



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 Initial's _____

Safety

Score

Points

- | | | |
|---|-------|----------|
| A. Wear safety glasses | _____ | (0 to 5) |
| B. Worked safely while taking electrical readings | _____ | (0 to 5) |

Procedure for Measuring Airflow

- | | | |
|--|-------|-----------|
| A. Turned on electric heat and allowed time to warm up | _____ | (0 to 15) |
| B. Chose proper probes for temperature difference and read TD correctly (_____ degrees TD) | _____ | (0 to 10) |
| C. Measured volts and amps correctly * (_____ Volts, _____ Amps) | _____ | (0 to 10) |
| D. Chose proper formula to calculate CFM | _____ | (0 to 15) |
| E. Calculated CFM correctly (_____) | _____ | (0 to 15) |
| F. Explained consequences of too much / too little airflow | _____ | (0 to 15) |
| G. What should airflow be? (_____) | _____ | (0 to 10) |
| Is this airflow acceptable for a 2-ton system? | _____ | (0 to 10) |

Procedure for Measuring Suction Superheat and Subcooling

- | | | |
|--|-------|------------|
| A. Uses and reads gauge manifold correctly? | _____ | (0 to 10) |
| B. Uses and reads electronic thermometer correctly? | _____ | (0 to 5) |
| C. Calculates the subcooling and superheat properly and correctly? | _____ | (0 to 10) |
| (Safety Deduction) * | _____ | (0 to -10) |
| Total | _____ | (125 max) |

NOTES:

- Maximum score is 125. 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)**

2011 SkillsUSA Championships HVACR Contest

June 23, 2011 Kansas City, Missouri



Turn to the Experts™

Contestant Score Sheet

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

25 minute max

Sponsor: Carrier Corporation

Stop Time _____

Contestant # _____

Start Time _____

Total _____

Judge's Initial's _____

Safety

Score

Points

A. Wear safety glasses

_____ (0 to 5)

Procedure for Measuring Airflow

- | | | |
|--|-------|-----------|
| A. Divided duct for traverse reading | _____ | (0 to 10) |
| B. Hooked up tubes to meter correctly | _____ | (0 to 10) |
| C. Properly positioned Pitot tube and read | _____ | (0 to 10) |
| D. Converted pressures to FPM and averaged properly | _____ | (0 to 15) |
| E. Calculated square footage area of duct properly | _____ | (0 to 10) |
| F. Calculated CFM correctly (_____) | _____ | (0 to 10) |
| G. What should airflow be? $\pm 10\%$ | | |
| Is this airflow acceptable for a 2-ton system? | _____ | (0 to 15) |
| H. Explained consequences of too much / too little airflow | _____ | (0 to 15) |

Procedure for Measuring Suction Superheat

- | | | |
|--|-------|------------|
| A. Uses and reads gauge manifold correctly? | _____ | (0 to 10) |
| B. Uses and reads electronic thermometer correctly? | _____ | (0 to 5) |
| C. Calculates the superheat and subcooling properly and correctly? | _____ | (0 to 10)) |
| (Safety Deduction) * | _____ | (0 to -10) |
| Total | _____ | (125 max) |

NOTES:

- Maximum score is 125. 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)**

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: $V = 4005\sqrt{V_p}$

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

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

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

$$\text{CFM} = \frac{\text{Area (sq.ft.)} \times \text{Velocity (ft/min)}}{60}$$

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

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

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

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

2011 SkillsUSA Championships HVACR Contest

June 23, 2011 Kansas City, Missouri



Contestant Procedure Sheet

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.

Read the two-part question. Using the wiring diagram provided, you are to determine the correct answers to the question below. Tell the Judge the letter for the correct line style for Question 1 and the letter of the correct components for Question 2.

PROBLEM:

What do the heavy solid lines signify?

Q1

A Factory Installed Field Wiring High Voltage Connections

B Field Installed Factory Wiring Low Voltage Connections.

C Field Installed High Voltage Connections

Q2

What are components B1 B4 & K1?

A Compressor, Contactor & Outdoor Fan

B Low Pressure Switch, High Pressure Switch & Dual Run Capacitor

C Start Capacitor, Low Pressure Switch, High Pressure Switch

2011 SkillsUSA Championships HVACR Contest

June 23, 2011 Kansas City, Missouri



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. 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 down. The new system was installed yesterday.

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

Notes:

1. Follow all normal safety procedures
2. Use proper tools and/or instruments
3. Perform task in proper sequence
4. Explain your diagnosis to the judge
5. 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

2011 SkillsUSA Championships HVACR Contest

June 23, 2011 Kansas City, Missouri



Judges Guidelines

The problem consists of a new Air Conditioning system installed yesterday and the home will not cool off. The office advised the homeowner to turn the thermostat system switch to 'off' and the fan switch to 'auto'. The problem is an open contactor coil in the outdoor unit.

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.

	Score	Points
Safety		
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 20)
b) Used screw/nut drivers, pliers, etc, properly?	_____	(0 to 5)
a) Set meter correctly when measuring volts or ohms?	_____	(0 to 15)
B. Troubleshooting		
Followed proper troubleshooting procedures?		(0 to 65)
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)

2011 SkillsUSA Championships HVACR Contest

June 23, 2011 Kansas City, Missouri

4) Utilize required testing equipment in logical pattern

i) Check for cooling call from thermostat.

(1) Measurement from Y 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 open contactor coil in outdoor unit?

_____ (0 to 15)

Correctly identified fault?

vi) "Bad Contactor" - Award 15 points

(0, 15 or 25)

vii) "Open Contactor Coil" - Award 25 points

5) Explained findings to judge properly?

i) "Contactor in outdoor unit must be replaced."
- Award 10 points

_____ (0 to 10)

C. Solved wiring diagram circuit correctly?

(0 to 20)

Q1. What do the heavy solid lines mean?

A B C

(0 or 10)

Q2. What are components B1 B4 & K1?

A B C

(0 or 10)

Note: Maximum score is 125. No fractional points to be given.

Total

_____ (125 max)

2011 SkillsUSA Championships HVACR Contest

June 23, 2011 Kansas City, Missouri



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.

Read the two-part question. Using the wiring diagram provided, you are to determine the correct answers to the question below. Tell the Judge the letter for the correct line style for Question 1 and the letter of the correct components for Question 2.

PROBLEM:

What do the heavy solid lines mean?

Q1

- | | | |
|---|---|-----------|
| A | Factory Installed Field Wiring High Voltage Connections | 0 points |
| B | Field Installed Factory Wiring Low Voltage Connections. | 0 points |
| C | Field Installed High Voltage Connections | 10 points |

Q2

What components are B1 B4 & K1?

- | | | |
|---|--|-----------|
| A | Compressor, Contactor & Outdoor Fan | 10 points |
| B | Low Pressure Switch, High Pressure Switch & Dual Run Capacitor | 0 points |
| C | Start Capacitor, Low Pressure Switch, High Pressure Switch | 0 points |

JUDGES COPY

2011 SkillsUSA Championships HVACR Contest

June 23, 2011 Kansas City, Missouri



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 _____

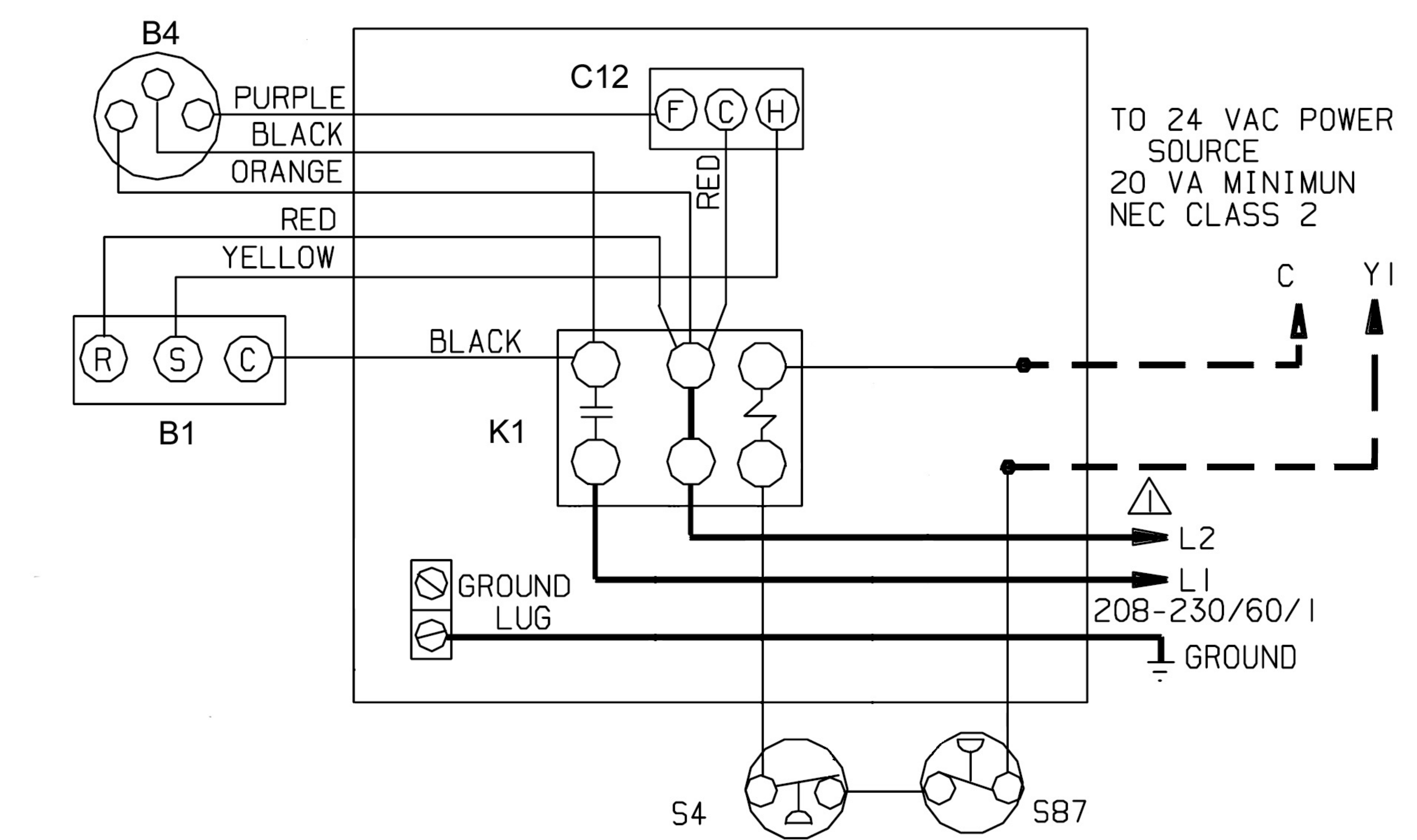
Safety

- | | Score | Points |
|-----------------------------------|--------------|---------------|
| A. Wear safety glasses | _____ | (0 or 10) |
| B. a) Used tools safely | _____ | (0 or 5) |
| b) Practiced safe work procedures | _____ | (0 or 5) |

Performance

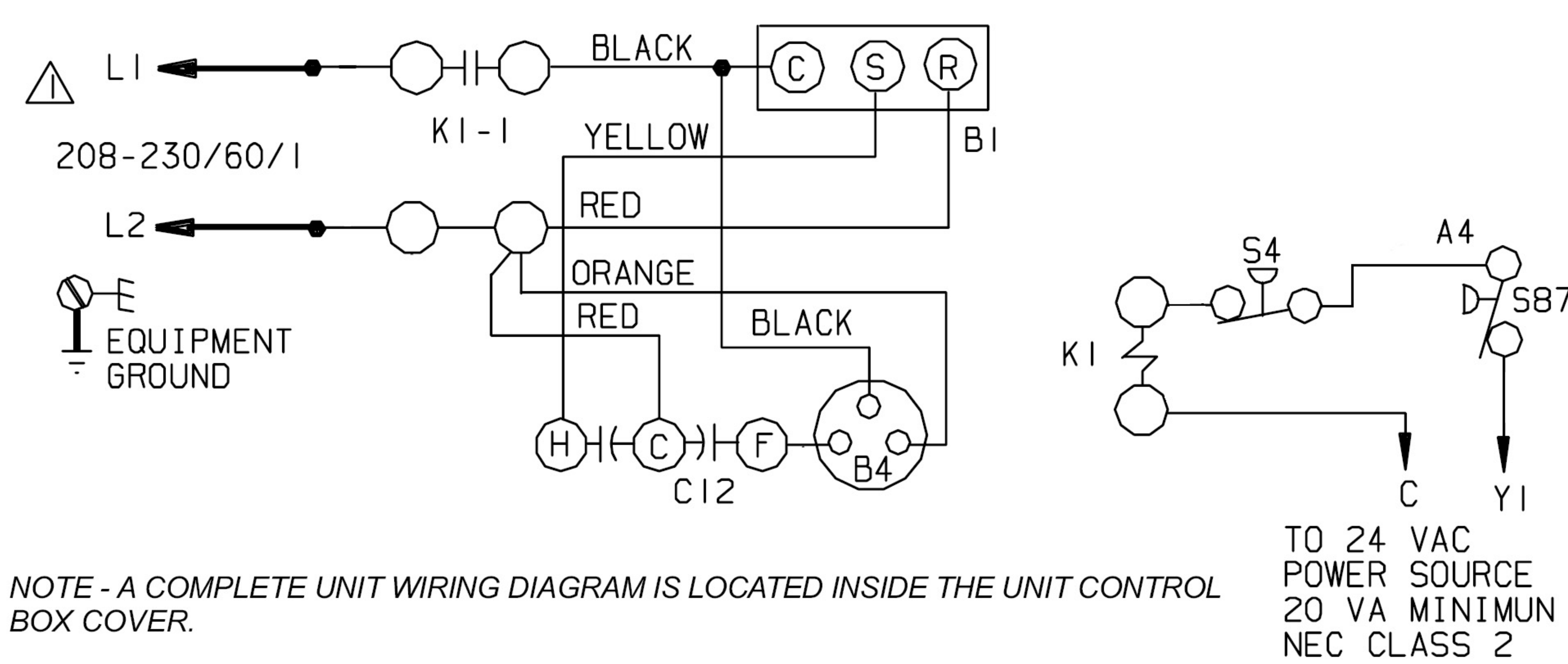
- | | | |
|--|--------------------|-----------|
| A. Used tools and instruments properly | _____ | (0 to 20) |
| B. Troubleshooting | | |
| a) Followed proper troubleshooting procedures? | _____ | (0 to 25) |
| b) Correctly identified fault? | _____ | (0 to 25) |
| c) Explained findings to judge properly? | _____ | (0 to 15) |
| C. Solved wiring diagram circuit correctly? | | |
| Q1. What do the heavy solid lines mean? | A B C _____ | (0 or 10) |
| Q2. What are components B1 B4 & K1? | A B C _____ | (0 or 10) |
| | Total _____ | (125 max) |

Note: Maximum score is 125. No fractional points to be given.



DESCRIPTION	
KEY	COMPONENT
B1	COMPRESSOR
B4	MOTOR-OUTDOOR FAN
C12	CAPACITOR-DUAL
K1, -1	CONTACTOR-COMPRESSOR
S4	SWITCH-HIGH PRESSURE
S87	SWITCH-LOW PRESS, COMP 1

⚠ FOR USE WITH COPPER CONDUCTORS ONLY. REFER TO UNIT RATING PLATE FOR MINIMUM CIRCUIT AMPACITY AND MAXIMUM OVERCURRENT PROTECTION SIZE.



WARNING-
ELECTRIC SHOCK HAZARD, CAN CAUSE INJURY OR DEATH. UNIT MUST BE GROUNDED IN ACCORDANCE WITH NATIONAL AND LOCAL CODES.

———— LINE VOLTAGE FIELD INSTALLED
- - - - CLASS 11 VOLTAGE FIELD INSTALLED

2011 SkillsUSA Championships HVACR Contest

June 23, 2011 Kansas City, Missouri



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 this fault could occur in the field.*
 - 6. 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.

Note 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.

2011 SkillsUSA Championships HVACR Contest

June 23, 2011 Kansas City, Missouri



HUSSMANN

Contestant Score Sheet

**Event: #5 – Refrigeration System Troubleshooting
(Electrical)**

Sponsor: Hussmann

Troubleshooting

15 minute max

Stop Time _____

Contestant # _____

Start Time _____

Total _____

Judge's Initial's _____

1. Safety

Score Points

- | | | | |
|-------------------------|------------------|-------|-----------|
| A. Wears safety glasses | (0 to 10 points) | _____ | (0 to 10) |
| B. Uses tools safely | (0 to 10 points) | _____ | (0 to 10) |

2. Performance

- | | | |
|---|------------------|-----------|
| A. Combines the use of voltmeter and electrical diagram to trace the path. | | (0 to 20) |
| Traces current path on diagram. | (0 to 10 points) | _____ |
| Relates current path on diagram to the equipment. | (0 to 10 points) | _____ |
| B. Points out the fault on the cooler. | | (0 to 20) |
| Points to fault on the cooler. | (0 to 20 points) | _____ |
| C. Points out the fault on the electrical diagram. | | (0 to 20) |
| | (0 to 20 points) | _____ |
| D. Provides an accurate and reasonable "diagnostic thought process". | | (0 to 20) |
| Checked for voltage at compressor. | (10 points) | _____ |
| Looked at wiring diagram to identify wires and terminals involved. | (10 points) | _____ |
| E. Demonstrates a thorough understanding of the unit fault. | | (0 to 25) |
| Explains how to remove the fault from this unit. | (15 points) | _____ |
| Explains how this fault could occur in the field. | (10 points) | _____ |

Note: Maximum score = 125. No fractional points given.

TOTAL _____ (125 max)

This "bug" addresses the skills shown below.

HVAC 7.0 — Diagnose and repair common problems in refrigeration systems according to applicable requirements identified by the Refrigeration Service Engineers Society

- 7.1 Diagnose electrical problems in self-contained refrigerated merchandisers
 - 7.1.1 Use a schematic diagram to trace circuits in equipment

2011 SkillsUSA Championships HVACR Contest

June 23, 2011 Kansas City, Missouri



Contestant Score Sheet

Event #6 – ICE Written Test

Sponsor: American Heating Air
Conditioning Institute (AHRI)

Contestant	Score
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Contestant	Score
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2011 SkillsUSA Championships HVACR Contest

June 23, 2011 Kansas City, Missouri

Problem Statement

Event #7: Refrigerant Procedures

Sponsor: JKL Technical Sales

Time allowed: 45 minutes

While waiting for Event #8, 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!!!

2011 SkillsUSA Championships HVACR Contest

June 23, 2011 Kansas City, Missouri

Problem Statement

Event #7: Refrigerant Procedures

Sponsor: JKL Technical Sales

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!

2011 SkillsUSA Championships HVACR Contest

June 23, 2011 Kansas City, Missouri



Judges Scoring Instructions Confidential

Event #7: Refrigerant Procedures

Sponsor: JKL Technical Sales

- 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 – 8)
-
- 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 = 2 points*
- D Check system for refrigerant leak (0 – 10)
-
- 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 = 2 points*
- 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!

2011 SkillsUSA Championships HVACR Contest

June 23, 2011 Kansas City, Missouri

- E Connect recovery unit to system and tank (0 – 8)
-
- 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 = 2 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 – 6)
-
- 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*

2011 SkillsUSA Championships HVACR Contest

June 23, 2011 Kansas City, Missouri

J Perform recovery through a complete pull down (0 – 5)

(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 = 2 points*

K EPA required recovery pull down level for this system (0 – 5)

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

L Correctly connect vacuum pump and vacuum gauge (0 – 5)

- 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 – 5)

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 5 points*

N The purpose of the electronic vacuum gauge? What is the term of measurement they report? (0 – 6)

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 = 2 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

2011 SkillsUSA Championships HVACR Contest

June 23, 2011 Kansas City, Missouri

P Complete evacuation of the system (0 – 10)

Pull vacuum to approx. 1000 – 500 microns = 10 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 – 5)

(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 = 5 points*

R Use the charging device, set up to properly recharge (0 – 9)

- 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” = 3 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*

2011 SkillsUSA Championships HVACR Contest

June 23, 2011 Kansas City, Missouri

- V If Nameplate information is not available, how is the proper charge determined? (0 – 6)
-

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

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

- W Replace all tools and Caps to their original locations (0 – 4)
-

(Contestant must put back all tools and caps)

If completed;

- a) *Tools – award 2 points*
- b) *Caps – award 2 points*

At this point the judge should subtotal the score for a maximum of 117 points and pass the scoring sheet to the refrigerant identification judge.

- X Identify the type of refrigerant in tanks (0 – 8)
-

(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 4 points*

TOTAL SCORE (125 max)

2011 SkillsUSA Championships HVACR Contest



June 23, 2011 Kansas City, Missouri

Contestant Score Sheet

Event #7: Refrigerant Procedures

Sponsor: JKL Technical Sales

45 minute max

Stop Time	
Start Time	
Total	

Contestant #

Judge's Initial's

	Score	Points
A. Safety Glasses		(0 – 2)
B. Identify correct refrigerant type for this system?		(0 – 3)
C. Connect gauges properly to system		(0 – 8)
D. Check system for refrigerant leak		(0 - 10)
E. Connect recovery unit to system and tank		(0 – 8)
F. Proper Use of Pressure Vessel		(0 – 2)
G. Tank Pressure Rating?		(0 – 2)
H. Tank Certification Date?		(0 – 2)
I. Type of Refrigerant in Tank?		(0 – 6)
J. Perform recovery through a complete pull down		(0 – 5)
K. EPA required level unit must be pulled down to?		(0 – 5)
L. Correctly connect vacuum pump and vacuum gauge		(0 – 5)
M. Purpose of pulling a vacuum on the system?		(0 – 5)
N. Purpose of an electronic vacuum gauge?		(0 – 6)
O. Check vacuum pump for performance		(0 – 3)
P. Complete evacuation of the system		(0 – 10)
Q. Check system for vacuum leaks		(0 – 5)
R. Use the charging device, set up to properly recharge		(0 – 9)
S. Proper refrigerant & charge for this unit?		(0 – 3)
T. Procedure for checking refrigerant/oil in a system?		(0 – 4)
U. Procedure for cleaned refrigerant in a working system?		(0 – 4)
V. Nameplate is not available, how is charge determined?		(0 – 6)
W. Replace all tools to their original locations		(0 – 4)

	Subtotal	(117 max)
X. Identify the type of refrigerant in tanks		(0 – 8)
	Total	(125 max)

NOTE: Maximum score – **125 Points**

2011 SkillsUSA Championships HVACR Contest

June 23, 2011 Kansas City, Missouri



Turn to the Experts.

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.

2011 SkillsUSA Championships**HVACR Contest**

June 23, 2011 Kansas City, Missouri

Turn to the Experts[®]**Judging Guidelines/Procedures****Event #8: Electrical Troubleshooting,
Heating****Sponsor: Carrier Corporation****Overview****Problem**

The problem consists of an 80% AFUE gas furnace that has a blown low voltage fuse in its control circuit. Also, the inducer pressure switch tube is disconnected at the inducer housing tube connector.

Before contestant arrives at the station, the judge will verify a blown low voltage fuse is in the control board, the inducer pressure switch tube is disconnected from the inducer housing tube connector, the thermostat is set to "off", and the furnace doors are resting against the unit.

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 disconnected inducer tube using the furnace's control board LED and service code chart. LED code 31 Pressure switch did not close. Or
 - Find the open pressure switch using the furnace's wiring diagram with a VOM meter.
 - Find and repair the disconnected pressure switch tube.

Continued next page

2011 SkillsUSA Championships**HVACR Contest**

June 23, 2011 Kansas City, Missouri

-
- D. Observe Unit Operation
 - Unit will attempt the ignition sequence.
 - Without gas the burner will not fire and control board LED will display 14.
 - 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 and disconnect the pressure switch tube at the inducer housing).

2011 SkillsUSA Championships**HVACR Contest**

June 23, 2011 Kansas City, Missouri

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** 5) Five 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 **to** 15) Fifteen 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** 5) Five 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** 5) Five points
- Use of VOM to measure high voltage and or control low voltage of unit.
 - Points awarded on an “all or nothing” basis

Continued next page

2011 SkillsUSA Championships**HVACR Contest**

June 23, 2011 Kansas City, Missouri

C. Did contestant:

- Check low voltage for power? – (0 **or** 10) Ten points
 - Points awarded on an “all or nothing” basis
- Use the troubleshooting chart and or wiring diagram? (0, 5, 10 **or** 15) points
- Correctly diagnose the “blown” fuse? (0, 5, 10 **or** 15) Fifteen points
- Correctly diagnose the loose inducer pressure switch tube? (0, 5, 10 **or** 15) Fifteen points

D. Did contestant follow proper/logical procedure? – (0, 5, 10 ,15 **or** 20) points

- This section is subjective; however the following are guidelines the judge should use.
 - Did contestant use a systematic approach in searching for the problem? – (0 **or** 5) points
 - Did contestant replace the open fuse and attempt to fire the unit before making diagnosis? – (0 **or** 5) points
 - Did contestant’s actions appear to be consistent with expected diagnostic procedures? – (0 **to** 10) points

E. Explain findings to judge properly? – (0, 5, 10 ,15 **or** 20) 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.
 - Did contestant explain diagnostics in a manner constant with the problems?
 - General comments about blank thermostat display and correcting bad fuse issues – (0 **to** 10) Ten points max
 - How determination was made with regard to the open inducer pressure switch as a result of the loose tube – (0 **to** 10) Ten 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.

2011 SkillsUSA Championships HVACR Contest

June 23, 2011 Kansas City, Missouri



Turn to the Experts™

Contestant Score Sheet

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

Sponsor: Carrier Corporation

Troubleshooting

15 minute max

Stop Time _____

Contestant # _____

Start Time _____

Total _____

Judge's Initial's _____

	Score	Points
--	-------	--------

1. Safety

- | | | |
|--|-------|----------------|
| A. Wear safety glasses | _____ | (0 or 5) |
| B. Used tools safely and worked safely | _____ | (0,5,10 or 15) |

2. Performance

- | | | |
|--|-------|-------------------|
| A. Use tools properly? | _____ | (0 or 5) |
| B. Use instruments properly? | _____ | (0 or 5) |
| C. Did contestant: | | |
| 1. Check low voltage wiring for power? | _____ | (0 or 10) |
| 2. Use troubleshooting charts or wiring diagram? | _____ | (0,5,10 or 15) |
| 3. Correctly diagnose the blown fuse? | _____ | (0,5,10 or 15) |
| 4. Diagnose loose tube & open pressure switch? | _____ | (0,5,10 or 15) |
| D. Use a logical diagnostic procedure? | _____ | (0,5,10,15 or 20) |
| E. Explain findings to judge properly? | _____ | (0,5,10,15 or 20) |

Total _____ (125 max)

Note: Points to be given in increments of 5.

2011 SkillsUSA Championships HVACR Contest

June 22, 2011 Kansas City, Missouri



THE HARRIS PRODUCTS GROUP

Contestant Score Sheet

Event #9 – Brazing Seminar

Sponsor: Harris Products Group

Contestant	Score
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Contestant	Score
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