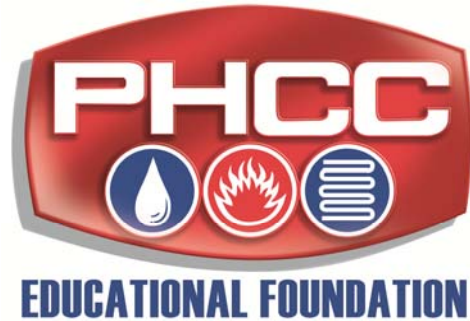


# **PHCC Educational Foundation**



## **Do-It-Yourself HVAC Apprentice Contest**

## Basic Guidelines for Planning an Apprentice Contest

1. Find volunteers! Members, teachers, technicians and inspectors all make good volunteers.
2. Designate a chairman or coordinator to run the contest. The role of chairman or coordinator can be done by anyone who is willing to volunteer and dedicate the time it takes to plan and administer the contest. He or she should have some HVAC background as well as the ability to answer technical questions about the contest.

The chairman/coordinator is responsible for delegating all necessary job tasks. His/her decisions are final.

Normally, the chairman/coordinator is the state or local apprenticeship committee chairman or an instructor at an apprentice school.

3. Set up a timeline or schedule of events.
4. Design the test and/or contest you will use. A sample contest has been provided at the end of this book.
5. Make a list of contest rules for the apprentices to follow. Provide this information with the registration form.
6. Make an agenda for the apprentices to follow. Include registration deadlines, time to arrive at the contest site and time of the awards presentation.
7. Find students to compete. Ideally, they should be PHCC apprentices and/or SkillsUSA students. You can have as few as three and as many as you feel you can handle.
8. Find a location for the contest. Some suggestions include outside under a tent, inside an exhibition hall, in a member's shop or at the apprentice school. If you use an exhibition hall, please note that you may have to obtain a permit from the local fire marshal. **If you can find an apprentice school or local community college that has package heat pumps or split system heat pumps that can be used for the contest, that is a good choice for a location. You will need this equipment for three sections of the contest.**
9. Build your modules or work stations if needed. The modules/work stations should be built to match the contest you use.
10. Talk with local suppliers and representatives about donating materials and prizes (tools, money, trophies, plaques, etc.) for your contest. Ask for everything from the materials take off list and seek sponsors to help fund the event.
11. Find at least three judges to help score the contest. Choose inspectors or industry experts who have no affiliation with the apprentices.

12. Make arrangements for apprentices to stay on site if they are coming from out of town.  
Make arrangements for volunteers who are not from your area.
13. Promote the contest! Have signs made recognizing your sponsors. Have people come to watch. Send out a press release announcing the contest ahead of time.
14. Arrange for a dumpster for trash once the contest is over.
15. Run the contest. This is the fun part!
16. Break down the contest once the apprentices are finished and judging is complete.  
Remove all materials, load the modules/work stations for storage, and clean the area.
17. Find a storage location for the modules/work stations so they can be reused in future years.
18. At the awards presentation, be sure to recognize all volunteers and sponsors. Recognize all of the contestants and then present the winners – 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> place.

## **Apprentice Contest FAQs**

**Q: How long does it take to plan a contest?**

A: Normally, it takes four to six months to plan a contest. However, it can be done in four weeks if you have dedicated help!

**Q: How much does it cost? How much should we budget to have a contest?**

A: The cost depends on the number of apprentices competing and the site you select for the contest. The two biggest expenses are the materials to build the modules/work stations and the space (tent or hall) you need for the contest.

**Q: Do the students have to pay to compete?**

A: That is up to you. If your budget needs help, you should charge to offset the cost. Generally, employers and contest sponsors cover most of the expense.

**Q: Where is the best place to hold the contest?**

A: It is a matter of preference. One option is to hold your contest in conjunction with your state convention. Another is to hold your contest in conjunction with the SkillsUSA state competition for your state. A good rule-of-thumb is to put the contest in a place where it is easily accessible for the largest audience possible.

**Q: Can anyone watch the apprentices compete?**

A: YES! Promote this as much as possible. Have friends, family, wives and other employees come to watch. This is a big event that can help your local apprentice program. It gives the apprentices an incentive to do quality work and to be competitive! See if you can get trade press or local press coverage.

## Recommended Contest Policies

**Purpose of the HVAC Apprentice Contest:** The purpose of the contest is to generate excitement about the HVAC trade and to provide outstanding students with an opportunity to demonstrate their skills before an international audience.

### Overview:

The HVAC Apprentice Contest offers HVAC apprentices a unique opportunity to demonstrate their knowledge and skills in a practical, hands-on event that is fun and exciting for everyone involved. The HVAC Apprentice Contest is held in conjunction with the {your event}.

Contestants have the opportunity to take in the full convention experience by attending the {state or local's} largest event of the year, complete with peer-to-peer networking and exposure to the latest technologies and products available to the industry.

{Your organization}, through the generous support of the industry's leading manufacturers and suppliers, provides the basic materials required for the contest. Contestants, typically with sponsorship support from their associations and/or employers, are responsible for travel and lodging expenses. Contestants are also required to provide their own basic hand tools. Convention registration is provided to contestants at no charge.

### Contest Scope:

Contestants demonstrate their ability to perform jobs or skills selected from the following list of competencies:

#### *Brazing*

- Read and interpret the refrigerant circuit drawing
- Follow all normal safety procedures
- Use proper brazing techniques to join tubing, fittings, and components
- Return all tools, instruments, etc. to their proper place when finished

The judge will be evaluating your work on the following criteria:

- Observance of safety procedures
- Laying out tube cuts
- Cleaning prior to brazing
- Fluxing required connections
- Correct brazing equipment use; start-up
- Filter-drier installation and protection
- Brazing technique and joint appearance
- Assembly layout/size
- Brazing equipment shut down
- Cleaning up brazing area

#### *Pressure Testing, Recovery & Recharging*

- Recover refrigerant from an air conditioning/heat pump split system

- Describe and connect refrigerant hoses for liquid recovery
- Describe and connect refrigerant hoses for vapor recovery
- Describe procedure for refrigerant recovery for system with a burn out or water in the system
- Explain method(s) of calculating the maximum capacity of the recovery cylinder
- Evacuate an air conditioning/heat pump split system
  - Describe the procedure
  - Demonstrate the procedure and evacuate the system
- Check an air conditioning/heat pump system for leaks
  - Explain leak checking during evacuation
  - Demonstrate leak checking of an evacuated system
  - Explain leak checking of a charged system
  - Demonstrate leak checking of a charged system
- Charge an air conditioning/heat pump system
  - Read and interpret the manufacturer's charging procedure
  - Explain procedure for checking the quality of refrigerant/oil in a system
  - Explain how refrigerant can be cleaned in a working system
  - Explain how to charge unit
  - Explain methods of determining the correct charge
- Identify refrigerant types using a pressure-temperature chart.
  - Use a pressure-temperature chart to identify refrigerant types
    - Cylinder 1 R = HCFC/HFC
    - Cylinder 2 R = HCFC/HFC
    - Cylinder 3 R = HCFC/HFC

#### *Taking Readings on a Working Package Unit*

- measure static pressure
- take temperature readings
- calculate air flow
- calculate heating and cooling actual operating performance (capacity)
- measure refrigerant pressures and calculate superheat and subcooling

#### *Electrical Diagnostics & Troubleshooting*

- Determine the cause of the system problem
- Explain to judge what the problem is, your method of troubleshooting, and the corrective action
- Follow all normal safety procedures
- Use proper tools and/or instruments
- Perform tasks in proper sequence
- Return all tools, instruments, etc. to their proper place when finished

#### *Basic Electrical Skills*

- Assemble components into a functional electrical circuit

**Eligibility – Who May Compete:**

1. Participants must be employed by an active PHCC member whose dues have been received at the {your state or local} office
2. All participants must be 3<sup>rd</sup> year apprentices or higher during 2014 and shall not have attained journeyman status. Exception: apprentices graduating in 2014 are eligible to compete. {You can tailor this to local needs.}
3. {Employers/schools} may enter multiple contestants, based on space availability.
4. Any exceptions to these eligibility requirements will be determined by the contest chairman.
5. Contestants are required to provide an interpreter if translation from English is necessary.

**Contestant Registration:**

Only properly registered participants may compete in the HVAC Apprentice Contest. Proper registration requires:

1. Submitting an official registration form with payment by the due date listed on the form.
2. Provisions may be made for alternates to be officially registered in the contest. The entry of individuals who are officially registered as alternates will be considered as a change in a contestant's registration, and such alternates may compete in the HVAC Apprentice Contest upon notification of the contest chairman at least 24 hours prior to the opening of the competition.

**Observer Policies:**

1. A roped or otherwise marked area will be designated for observers. No observers, including advisors, will enter the designated contest areas without approval from the contest chairman or his designee.
2. Observers are not permitted to talk with or gesture to contestants.
3. Judges and contest committee members have the authority to disqualify contestants who accept assistance from observers.
4. No observers will be permitted in the contest holding room or at the pre-contest orientation meeting unless specifically invited by the contest chairman or his designee.

**Judging Policies:**

1. Judges for the HVAC Apprentice Contest will be selected by the contest committee. Included on the judging panel will be industry experts, contractors and other qualified individuals who are able to objectively evaluate the contestants' work.
2. Judges shall not have any previous contact or relationship with any of the contestants participating in the HVAC Apprentice Contest. Any judge who has previous knowledge of a contestant will be excused from the contest.
3. All judges' decisions are final.

### **Contest Scoring:**

1. Scoring for the HVAC Apprentice Contest will be coordinated by the contest chairman.
2. A written tie-breaker test will be administered during the pre-contest orientation meeting. Scores from this test will only be used in the event of a tie for first, second or third place in the contest based on numerical score totals for the skills captions of the contest.
3. Speed in completing the project does not earn additional points toward the overall score. However, completion by the end of the contest time limit does have an effect on scoring.
4. Proper safety practices, including wearing of proper work attire and safety glasses, are required.
5. Numerical scoring and final contest ranking of contestants will not be released under any circumstances. The only ranking that will be released is the placement of the first, second and third place winners.
6. First, second and third place winners will be announced at {name the date, time and location}.

### **Tools Supplied by Each Contestant**

Each contestant is required to provide the following tools for his/her use in the HVAC Apprentice Contest. It is the responsibility of the contestant to coordinate the shipping and delivery of his tools to the contest site.

1. Clear safety glasses
2. Gloves
3. Refrigerant manifold gauge set
4. Digital thermometer\*
5. Digital hygrometer\*
6. Digital manometer\*
7. Clamp-on thermistor\*
8. Digital multimeter w/clamp-on ammeter and test leads\*
9. Refrigerant pressure-temperature chart (specify R-22 and/or R-401a)\*
10. Enthalpy chart\*
11. Handheld calculator\*
12. Thermistor vacuum gauge\*
13. Self-contained recovery machine\*
14. Adjustable wrench/pliers
15. Screwdriver/nut driver
16. Static pressure tips\*
17. Refrigerant recovery cylinder\*
18. Electronic leak detector\*
19. Valve core remover
20. Vacuum pump\*
21. Refrigeration service wrench

\* NOTE: Items marked with asterisk may be provided by the contest committee or facility where contest is being held.



**Interpretation of Contest Policies and Rules:**

Interpretations of the contest policies and rules, if necessary, will be made by the contest chairman. All decisions of the chairman are final.

**How to Register for the Contest**

Complete registration materials will be available on the {your association} web site {URL address} beginning on {date materials will be available}. Included in the registration materials will be the contest policies, a draft schedule of the contest and related events, and a contestant application form. Contestant application forms must be completed and submitted with payment to the address listed on the form by {your application deadline}.

Based on the eligibility requirements listed above, the contest chairman will determine whether a candidate is eligible to participate in the contest. Candidates will be notified of the status of their application by {date apprentices will receive confirmation of their participation}.

## Recommended Prize List

Following is a list of suggested prizes to seek for your contestants. Ideally, the same prize package should be offered for first, second and third place in the contest. Cash prizes should vary based on placement. It is not necessary to obtain all items on the list. A good prize package would include one power tool, a tool box and lots of small tools to go in the tool box, along with cash prizes.

- 3/8" heavy duty variable speed drill w/ case
- Specialty HVAC tool kits
- Digital manometer
- Digital thermal hygrometer
- Infrared thermometer
- Superheat/subcool calculator
- Digital thermometer
- Digital clamp-on ammeter
- Flaring tool
- Tubing cutter
- Tube deburrer
- Vise grip set
- Adjustable pliers
- Linesman pliers
- Wire-stripping pliers
- Utility knife
- Torpedo level
- Torch kit
- Drill bit kit
- Allen wrench set
- Tool box or tool bag
- Cash prizes

## Sample Contest Itinerary

### **{Night Before the Contest}**

6:00pm Contestant Orientation Meeting (Mandatory)  
{Location}

### **{Contest Day}**

6:45am Contestant Arrival at Contest Site  
{Location}

7:00am Approximate Contest Start Time

12:00 – 12:30pm Lunch Break

4:30pm Scheduled Contest End (subject to change by contest chairman)

5:30pm Judging Complete; Apprentices Return to Area for Contest Teardown

8:00pm {Event where awards are presented}  
(Awards will be presented to contest winners at this event)

**Important Note:** Contestants are required to participate in the contest teardown which occurs once the judges have completed their review. We need your help in cleaning up after the contest. This can be done in an hour or less with good participation. Also, participation by all contestants is required at the {awards event}, where the contest winners will be recognized.

Contestants who do not participate in the entire contest event – contestant orientation meeting, contest, teardown and {awards event} - will not finish among the top three and will be ineligible for the prize packages.

# Sample Registration Form

**HVAC Apprentice Contest**  
**Sponsored by {Your Organization}**  
**{Date and Time}**  
**{Location}**

## Contestant Application Form

**Instructions:** Please send the completed Contestant Application Form by {application deadline}, along with the \${amount} registration fee, to {Contest Name}, {Address}, {City, State, Zip} or fax to {fax number}.

Contestant Name: \_\_\_\_\_ Year of Apprenticeship: \_\_\_\_\_

Address: \_\_\_\_\_ Shirt/Jacket Size: \_\_\_\_\_

City/State/Zip: \_\_\_\_\_

Phone: \_\_\_\_\_ Fax: \_\_\_\_\_ E-mail: \_\_\_\_\_

Name of Apprenticeship Training Program: \_\_\_\_\_

Employer Company: \_\_\_\_\_

Address: \_\_\_\_\_

City/State/Zip: \_\_\_\_\_

Phone: \_\_\_\_\_ Fax: \_\_\_\_\_ E-mail: \_\_\_\_\_

Employer Contact Person: \_\_\_\_\_ Title: \_\_\_\_\_

PHCC Member Sponsor's Name: \_\_\_\_\_

Name and Phone Number of Local News Media: \_\_\_\_\_

**Questions?** Please contact {name and contact info}.

# Sample Confirmation Letter for Competing Apprentices

{Date}

{Contestant Name}

{Address}

{City, State, Zip}

Dear {Contestant Name}:

Please accept this letter as your confirmation for the HVAC Apprentice Contest sponsored by {your organization}. Also, please take a moment to review the Contest Itinerary (enclosed) to help plan your time at the event. We appreciate your participation and look forward to a great contest!

## **Contestant Orientation Meeting**

We have scheduled a mandatory meeting for all contestants on {date} in {exact location}. This meeting will start at {time}, offering contestants an opportunity to ask questions and make final preparations for the contest.

## **Contest Date/Time**

The contest will be held on {date} at {exact location}. You will receive instructions and a set of specifications when you arrive at the contest site.

Please bring your tools to the contest area by {time}. The contest will begin promptly at {time}. The contest will end at {time}; however, please note that the contest chairman may, at his sole discretion, allow additional time for the contest.

All contestants are required to report back to the contest area at the time designated by the contest chairman for teardown.

## **Awards**

Awards for the HVAC Apprentice Contest will be presented at {event} which starts on {date and time}. All contestants must attend this event!

## **Housing & Travel**

Sponsoring PHCC chapters and/or employers are responsible for making contestants' accommodations, so please be sure to verify your hotel reservation in advance. Please confirm with your sponsor to ensure that your room reservation has been made. {Tailor this to meet your local needs.}

Sincerely,

{Contest Chairman}

cc: {Apprentice's Employer/Sponsor}

## Sample Contest Rules

1. Contestants must report to the mandatory pre-contest orientation prior to the contest, as scheduled in the program, for instructions from the contest chairman.
2. Participants must meet clothing requirements for the contest.
  - A. The penalty for contestants who do not satisfy the dress requirements will be a maximum of 5 percent of the total possible contest points.
  - B. Contestants must wear leather work boots or safety shoes and work clothing or company uniform during the competition or be subject to a maximum penalty of 5 percent of total points. Hat or cap is optional.
  - C. No canvas, vinyl, plastic or leather athletic-type of shoes can be worn. Sandals or open-toed shoes are not permitted. Contestants may be disqualified where improper footwear constitutes a health and/or safety hazard.
  - D. Safety glasses are specified to be worn at all times during the contest. Glasses must have side shields or goggles must be worn. Prescription safety glasses must also have side shields or must be covered with goggles.
  - E. Contestants with long hair that poses a possible safety or sanitary hazard must wear hair containment devices or hairnets.
3. During the contest, participants must work independently without assistance from judges, teachers, fellow students, or observers. Contestants may be disqualified on the spot for receiving such assistance.
4. Participants who do not bring required tools, as specified in the contest regulations, will be assessed penalty points by the judges. The contest chairman may, at his discretion, furnish the required item(s) but must assess a 2-point penalty per item.
5. All guidelines in the contest booklet provided must be followed.

## Sample Observer Rules

To ensure a fair contest, the following rules regarding observer behavior will be in effect for the duration of the event. Failure to comply with these rules may result in the disqualification of the contestant.

1. A roped or otherwise marked area will be designated for observers.
2. No observers, including advisors/instructors, will enter the designated contest areas without the approval of the Contest Chairman.
3. No observers will talk or gesture to contestants.
4. Judges will disqualify contestants who accept assistance from observers.

**NOTE: It is highly recommended that you post the observer rules in prominent locations around the contest site perimeter.**

# Judging Criteria

## Brazing

1. **Wear safety glasses** – 10 points maximum
  - a. 10 points if glasses continually worn.
  - b. 5 points if contestant needs to be reminded.
  - c. 0 points if glasses not worn.
2. **Laying out tube cuts** – 5 points maximum
  - a. 5 points if contestant makes 13 cuts or less.
  - b. 0 points if contestant makes more than 15 cuts.
3. **Cleaning prior to brazing** – 10 points maximum
  - a. 10 points if contestant uses tube brush, sand cloth, or abrasive pad to clean fitting I.D. and tube O.D., and uses deburring tool on tube ends.
  - b. 5 points if contestant cleans fitting I.D. and tube O.D. (no deburring).
  - c. 0 points if there is no part cleaning or cleans only one part, or only deburrs.
4. **Fluxing required connections** – 10 points maximum
  - a. 10 points if contestant fluxes only connections with dissimilar metals.
  - b. 5 points if contestant fluxes any connections not requiring flux.
  - c. 0 points if no flux is used on any connections.

5. **Correct brazing equipment use; start-up** – 15 points maximum

### Opening tank valves

- a. 5 points if contestant stands to side of regulators when opening cylinder valves.
- b. 0 points if contestant stands in front of regulators when opening cylinder valves.

### Adjusting delivery pressure and lighting torches

- a. 5 points if contestant uses proper delivery pressure settings as listed on the tip chart at the brazing station.
- b. 0 points if contestant sets acetylene delivery pressure other than above.

### Nitrogen purge setup

- a. 5 points if contestant properly sets up the nitrogen purge.
- b. 0 points if contestant does not properly set up the nitrogen purge.

6. **Filter-drier installation and protection** – 10 points maximum
  - a. 5 points if contestant correctly positions drier in line with refrigerant flow direction.
  - b. 5 points if contestant wraps filter-drier with wet rag prior to brazing.
  - c. 0 points if contestant position drier incorrectly and doesn't wrap with a wet rag.



7. **Brazing technique and joint appearance** – 10 points maximum
  - a. 5 points if contestant removes Schrader valve pin.
  - b. 5 points if overall braze appearance is acceptable (unacceptable items would include run down, balls, lumps, charred flux residue).
  - c. 0 points if contestant makes any brazes not specified on drawing.
  
8. **Assembly layout/size** – 15 points maximum
  - a. 15 points if finished assembly fits within template tolerances.
  - b. 0 points if assembly is outside size limits.
  
9. **Brazing equipment shut down** – 10 points maximum
  - a. 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.
  - b. 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).
  - c. 3 points if contestant only closes torch adjustment valves.
  
10. **Cleaning up brazing area** – 5 points maximum
  - a. 5 points if contestant straightens up brazing table (puts lid on flux jar, puts away drawings and instructions, removes unused rod, cleaning pad, torches, other items).
  - b. 0 points if no effort made to clean up after brazing.

**MAXIMUM SCORE: 100 POINTS.**



## 2014 HVAC Apprentice Contest Contestant Score Sheet Event 1 – Brazing

Contestant # \_\_\_\_\_

Judge's Initials: \_\_\_\_\_

Criteria	Scoring Range	Points Awarded
Wear safety glasses	0 to 10	
Laying out tube cuts	0 to 5	
Cleaning prior to brazing	0 to 10	
Fluxing required connections	0 to 10	
Correct brazing equipment use; start-up	0 to 15	
Filter-drier installation and protection	0 to 10	
Brazing technique and joint appearance	0 to 10	
Assembly layout/size	0 to 15	
Brazing equipment shut down	0 to 10	
Cleaning up brazing area	0 to 5	
<b>TOTAL</b>	<b>0 to 100</b>	

NOTE: Maximum score is 100. No fractional points to be given.

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

## **Judging Criteria**

### **Recovery, Evacuation, Recharging & Identification of Refrigerants**

- 1. Wear safety glasses – 2 points maximum**
  - a. 2 points if glasses continually worn.
  - b. 1 point if contestant needs to be reminded.
  - c. 0 points if glasses not worn.
  
- 2. Connect gauges set properly to system – 8 points maximum**
  - a. 4 points if contestant correctly identifies the high and low access fittings on the unit.
  - b. 2 points if contestant connects high and low side hoses to the appropriate fittings.
  - c. 2 points if contestant purges air from hoses.
  
- 3. Check system for refrigerant leak – 10 points maximum**
  - a. 2 points if contestant checks whether system has some charge.
  - b. 2 points if contestant explains what would be done if no charge.
  - c. 2 points if contestant demonstrates proficiency with basic operation of leak detector.
  - d. 4 points if contestant correctly demonstrates the process for finding the leak with the leak detector.
  
- 4. Connect recovery unit to system and tank – 8 points maximum**
  - a. 3 points if contestant explains all 3 methods of recovering refrigerant (vapor = 1 point, liquid = 1 point, push pull = 1 point)
  - b. 2 points if contestant correctly connects recovery machine to system and tank.
  - c. 1 point if contestant uses filter.
  - d. 2 points if contestant stops recovery at correct weight (80% of tank's maximum capacity).
  
- 5. Proper use of pressure vessel – 2 points maximum**
  - a. 2 points if contestant safely releases pressure from hoses and insures the valves are closed before doing so.
  - b. 0 points if contestant does not insure the valves are closed before releasing pressure from hoses.
  
- 6. Determine pressure rating on tank – 2 points maximum**
  - a. 2 points if contestant correctly determines pressure rating on the tank by looking at the DOT-4BA rating.
  - b. 0 points if contestant incorrectly determines pressure rating on the tank.
  
- 7. Check the certification date – 2 points maximum**
  - a. 2 points if contestant determines the retest date of the cylinder by finding it on the safety collar of the tank.
  - b. 0 points if contestant does not correctly determine the retest date of the cylinder.

- 8. Check refrigerant in recovery tank to prevent cross contamination** – 6 points maximum
- 6 points if contestant correctly determines refrigerant in the tank by explaining the use of P/T verification (checking temperature = 2 points, checking pressure = 2 points, using P/T chart = 2 points).
- 9. Perform recovery through a complete pull down** – 5 points maximum  
(Judge discharges a small amount of refrigerant into hoses by opening and closing C&D valves.)
- 3 points if contestant pulls system down to below 4 inches of vacuum.
  - 2 points if contestant does not open valve on tank or manifold.
- 10. EPA required recovery pull down level for this system** – 5 points maximum
- 5 points if contestant completes recovery to 4 psig.
- 11. Correctly connect vacuum pump and vacuum gauge** – 5 points maximum
- 3 points if contestant correctly connects vacuum pump and vacuum gauges to system as agreed to in judges meeting and pulls a vacuum.
  - 2 points if manifold reading is 0 PSI or below prior to connecting vacuum pump.
- 12. Explain the purpose of pulling a vacuum on the system** – 5 points maximum
- 5 points if contestant states both air and moisture.
  - 2 points if contestant state only air or moisture.
- 13. Explain the purpose of the electronic vacuum gauge and its term of measurement** – 6 points maximum
- 2 points if contestant explains that the electronic vacuum gauge accurately measures a deep vacuum.
  - 2 points if contestant explains that the electronic vacuum gauge ensures it is tight and dry.
  - 2 points if contestant identifies the term of measurement as a micron.
- 14. Check vacuum pump for performance** – 3 points maximum
- 3 points if contestant uses micron gauge directly on the vacuum pump.
- 15. Complete evacuation of the system** – 10 points maximum
- 10 points if contestant pulls vacuum to approximately 1000-500 microns.
  - 6 points if contestant reads only the manifold to determine vacuum state (but must be below 29 inches of vacuum).
  - 6 points if contestant stops evacuation before reaching 1000 microns.
  - 0 points if contestant shuts off machine above 29 inches of vacuum.

**16. Check system for vacuum leaks** – 5 points maximum  
a. 5 points if vacuum holds for a reasonable amount of time and within reasonable amount of rise in microns to be acceptable for a dry, non-leaking system.

**17. Describe and demonstrate the procedure for evacuating a system** – 9 points maximum  
a. 3 points if contestant connects yellow hose of manifold to refrigerant tank and places tank on charging scale.  
b. 3 points if contestant zeroes the scale or writes down cylinder weight.  
c. 3 points if contestant uses vapor method unless contestant asks for “liquid charging restrictor”.

**NOTE TO JUDGES: Demonstration only. DO NOT RECHARGE the system – no refrigerant!**

**18. Explain the procedure for checking quality of refrigerant/oil in a system** – 4 points maximum  
a. 2 points if contestant identifies acid test to be run on system oil.  
b. 2 points if contestant identifies sight glass can be used for moisture.

**19. Explain how refrigerant can be cleaned in a working system** – 4 points maximum (A filter drier can be used to remove contaminants and dry the refrigerant.)  
a. 4 points if contestant identifies filter drier.  
b. 2 points if contestant identifies only filter.  
c. 2 points if contestant identifies only drier.

**20. Explain how proper charge is determined if nameplate information is not available** – 6 points maximum  
a. 3 points if contestant identifies fixed orifice uses superheat method.  
b. 3 points if contestant identifies TXV uses subcooling method.

**21. Replace all tools and caps to their original locations** – 4 points maximum  
a. 2 points if tools returned to original location.  
b. 2 points if caps returned to original location.

**22. Identify type of refrigerant in tanks** – 9 points maximum  
a. 9 points if contestant identifies all refrigerants correctly.  
b. 6 points if contestant identifies two of three correctly.  
c. 3 points if contestant identifies one of three correctly.  
d. 0 points if contestant incorrectly identifies all three refrigerants.

**MAXIMUM SCORE: 120 POINTS.**



## 2014 HVAC Apprentice Contest Contestant Score Sheet Pressure Testing, Recovery & Recharging

Contestant # \_\_\_\_\_

Judge's Initials: \_\_\_\_\_

Criteria	Scoring Range	Points Awarded
Wear safety glasses	0 to 2	
Connect gauges properly to system	0 to 8	
Check system for refrigerant leak	0 to 10	
Connect recovery unit to system and tank	0 to 8	
Proper use of pressure vessel	0 to 2	
Tank pressure rating	0 to 2	
Tank certification date	0 to 2	
Identify type of refrigerant in recovery tank	0 to 6	
Perform recovery through a complete pull down	0 to 5	
EPA required level unit must be pulled down to	0 to 5	
Correctly connect vacuum pump and vacuum gauge	0 to 5	
Explain purpose of pulling a vacuum on the system	0 to 5	
Explain purpose of an electronic vacuum gauge	0 to 6	
Check vacuum pump for performance	0 to 3	

Complete evacuation of the system	0 to 10	
Check system for vacuum leaks	0 to 5	
Describe and demonstrate the procedure for evacuating a system	0 to 9	
Explain procedure for checking refrigerant/oil in a system	0 to 4	
Explain procedure for cleaning refrigerant in a working system	0 to 4	
Explain how to determine charge if nameplate is not available	0 to 6	
Replace all tools to their original locations	0 to 4	
Identify type of refrigerant in tanks	0 to 9	
TOTAL	0 to 120	

NOTE: Maximum score is 120. No fractional points to be given.

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

## **Judging Criteria**

### **Taking Readings on a Working Package Unit**

- 1. Wear safety glasses – 5 points maximum**
  - a. 5 points if glasses continually worn.
  - b. 2 points if contestant needs to be reminded.
  - c. 0 points if glasses not worn.
  
- 2. Work safely while taking electrical readings – 5 points maximum**
  - a. 5 points if contestant follows proper safety protocol while taking electrical readings.
  - b. 0 points if contestant does not follow proper safety protocol.
  
- 3. Measure and Record Readings – 30 points maximum**
  - a. 2 points if contestant correctly measures and records suction pressure.
  - b. 2 points if contestant correctly measures and records high side pressure.
  - c. 2 points if contestant correctly measures and records return air (heat on).
  - d. 2 points if contestant correctly measures and records supply air (heat on).
  - e. 2 points if contestant correctly measures and records return air static pressure (cooling on).
  - f. 2 points if contestant correctly measures and records supply air static pressure (cooling on).
  - g. 2 points if contestant correctly measures and records electric heater actual operating amperage.
  - h. 2 points if contestant correctly measures and records electric heater actual operating voltage.
  - i. 2 points if contestant correctly measures and records outdoor (contest area) ambient air temperature.
  - j. 2 points if contestant correctly measures and records return air (cooling on).
  - k. 2 points if contestant correctly measures and records supply air (cooling on).
  - l. 2 points if contestant correctly measures and records supply air static pressure (heat on).
  - m. 2 points if contestant correctly measures and records return air static pressure (heat on).
  - n. 2 points if contestant correctly measures and records liquid line temperature.
  - o. 2 points if contestant correctly measures and records suction line temperature.
  
- 4. Calculate cooling airflow – 5 points maximum**
  - a. 5 points if contestant correctly calculates the cooling airflow.
  
- 5. Calculate liquid line subcooling – 5 points maximum**
  - a. 5 points if contestant correctly calculates the liquid line subcooling.
  
- 6. Calculate suction line superheat – 5 points maximum**
  - a. 5 points if contestant correctly calculates the suction line superheat.



- 7. Calculate heating airflow using two different methods – 10 points maximum**
  - a. 10 points if contestant correctly calculates heating airflow using two different methods.
  - b. 5 points if contestant correctly calculates heating airflow using only one method.
  - c. 0 points if contestant is unable to correctly calculate heating airflow.
  
- 8. Calculate actual total cooling capacity – 5 points maximum**
  - a. 5 points if contestant correctly calculates the actual total cooling capacity
  
- 9. Calculate actual sensible heating capacity – 5 points maximum**
  - a. 5 points if contestant correctly calculates actual sensible heating capacity.
  
- 10. Calculate total external static pressure – 5 points maximum**
  - a. 5 points if contestant correctly calculates total external static pressure.

**MAXIMUM SCORE: 80 POINTS.**



## 2014 HVAC Apprentice Contest Contestant Score Sheet Taking Readings on a Working Package Unit

Contestant # \_\_\_\_\_

Judge's Initials: \_\_\_\_\_

Criteria	Scoring Range	Points Awarded
Wear safety glasses	0 to 5	
Work safely while taking electrical readings	0 to 5	
Measure and record readings	0 to 30	
Calculate cooling airflow	0 to 5	
Calculate liquid line subcooling	0 to 5	
Calculate suction line superheat	0 to 5	
Calculate heating airflow using two different methods	0 to 10	
Calculate actual total cooling capacity	0 to 5	
Calculate actual sensible heating capacity	0 to 5	
Calculate total external static pressure	0 to 5	
<b>TOTAL</b>	<b>0 to 80</b>	

NOTE: Maximum score is 80. No fractional points to be given.

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

## **Judging Criteria**

### **Electrical Diagnostics & Troubleshooting**

- 1. Wear safety glasses – 5 points maximum**
  - a. 5 points if glasses continually worn.
  - b. 2 points if contestant needs to be reminded.
  - c. 0 points if glasses not worn.
  
- 2. Work safely while taking electrical readings – 5 points maximum**
  - a. 5 points if contestant follows proper safety protocol while taking electrical readings.
  - b. 0 points if contestant does not follow proper safety protocol.
  
- 3. Identify causes of system malfunction – 30 points maximum**
  - a. 15 points if contestant correctly identifies a faulty condenser fan motor capacitor.
  - b. 15 points if contestant correctly identifies a bad wire/faulty connection at the reversing valve.
  
- 4. Explain troubleshooting method – 10 points maximum**
  - a. 10 points if contestant correctly explains and uses proper troubleshooting method to identify the problems.
  
- 5. Repair faulty components – 10 points maximum**
  - a. 10 points if contestant correctly repairs faulty components.
  - b. 5 points if contestant correctly repairs only one faulty component.
  - c. 0 points if contestant fails to repair faulty components.

**MAXIMUM SCORE: 60 POINTS.**

**NOTE TO JUDGES: Following completion of scoring in first round, return the unit to its original faulted condition.**



## 2014 HVAC Apprentice Contest Contestant Score Sheet Electrical Diagnostics & Troubleshooting

Contestant # \_\_\_\_\_

Judge's Initials: \_\_\_\_\_

Criteria	Scoring Range	Points Awarded
Wear safety glasses	0 to 5	
Work safely while taking electrical readings	0 to 5	
Identify causes of system malfunction	0 to 30	
Explain troubleshooting method	0 to 10	
Repair faulty components	0 to 10	
<b>TOTAL</b>	<b>0 to 60</b>	

NOTE: Maximum score is 60. No fractional points to be given.

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

## **Judging Criteria Basic Electrical Skills**

- 1. Wear safety glasses – 5 points maximum**
  - a. 5 points if glasses continually worn.
  - b. 2 points if contestant needs to be reminded.
  - c. 0 points if glasses not worn.
  
- 2. Work safely while taking electrical readings – 5 points maximum**
  - a. 5 points if contestant follows proper safety protocol while taking electrical readings.
  - b. 0 points if contestant does not follow proper safety protocol.
  
- 3. Read and interpret wiring diagram – 10 points maximum**
  - a. 10 points if contestant correctly interprets wiring diagram by placing components in the correct location.
  
- 4. Assemble components into a functional electrical circuit – 50 points maximum**
  - a. 10 points if contestant correctly wires compressor according to wiring diagram.
  - b. 10 points if contestant correctly wires condensing fan according to wiring diagram.
  - c. 10 points if contestant correctly wires indoor fan according to wiring diagram.
  - d. 10 points if contestant correctly wires heat strip according to wiring diagram.
  - e. 10 points if contestant correctly wires limit switch according to wiring diagram.

**MAXIMUM SCORE: 70 POINTS.**

**NOTE TO JUDGES: Following completion of scoring in first round, return the unit to its original condition.**

**2014 HVAC Apprentice Contest**  
**Contestant Score Sheet**  
**Basic Electrical Skills**

Contestant # \_\_\_\_\_

Judge's Initials: \_\_\_\_\_

<b>Criteria</b>	<b>Scoring Range</b>	<b>Points Awarded</b>
Wear safety glasses	0 to 5	
Work safely while taking electrical readings	0 to 5	
Read and interpret wiring diagram	0 to 10	
Assemble components into a functional electrical circuit	0 to 50	
<b>TOTAL</b>	<b>0 to 70</b>	

NOTE: Maximum score is 70. No fractional points to be given.

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