



Skill India

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National
Skill Development
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Transforming the skill landscape



India **skills**

Test project: Refrigeration & Air Conditioning

Category: Construction and Building Technology

Skill Explained

The electronics industry is very diverse with multi specializations. Some Technicians / engineers will work across many fields of electronics, but increasing specialization and technical developments in Electronics means that specialist technician/engineers are widely required and employed. Refrigeration and Air Conditioning is an area with increasing opportunities. The key areas in this field are: Domestic Refrigerators, Cold Storages, Chillers, domestic air conditioners, HVAC etc. where Refrigeration and Air conditioner engineers can find a career either in Manufacturing, QC, After Sales Service or Maintenance.

The Air Conditioner Engineer works with various tools and instruments and has to always update himself on the latest technology, trends, refrigerants, gas charging methods, HSE techniques and must work with PPE and take care of HSE and use only recommended and approved solvents and chemicals.

Eligibility Criteria- Competitors born on or after 01 Jan 1997 are only eligible to attend the Competition

Duration of Test project: 16 hours

TEST PROJECT MODULES

There are three (3) Modules to complete in the 16-hour competition.

- Component Fabrication 13.5 Marks Time Allowed 2 Hrs
- Refrigeration System Installation and Commissioning 49 Marks Time Allowed 10Hrs
- Air Conditioning System Fault Find, Repair and Commissioning 37.5 Marks Time Allowed 4 Hrs

TEST PROJECT DOCUMENTATION

Section 1: Competitor Instructions – Competition Details

This contains all of the competition details, except for the specific information on the refrigeration and air conditioning systems to be used in the competition.

Section 2: Competitor Instructions – Manufacturers, Equipment and Materials Manuals

This contains the full operating manuals, wiring diagrams and specifications of the major equipment to be used in the competition.

Section 3: Test Project Drawings

The drawings will be distributed with Section 1. The drawings may be altered as part of the 30% change to the project which will take place at the competition. The drawings are issued as a guide only and are finalized at the competition.

Section 4: Competition Instructions

This document supersedes Section 1 and will be provided to all Competitors at the Information Session prior to start of the competition and will include a 30% change to the test project described in Section 1, it will include or provide reference to:

- The Competitor's competition timetable
- Health, safety and environment requirements
- Category competition rules and procedures
- Refrigeration Competition Standards
- Additional information

Section 5: Marking Scale.

Module A: 13.5 Marks on Day 1 for 2 Hours

Module B: 49 Marks on Day1 and 2 for 10 Hours

Module C: 37.5 Marks on Day 3 for 4 Hours

The marking scale detail will be finalized by the Experts prior to the competition dependent on the availability of materials and equipment supplied and the 30% change to the Test Project.

TIME ALLOWED FOR EACH MODULE

All Competitors will carry out the work at the same time. The Competition Time Table in the Competitors Instructions must be followed. Where system pipe work is installed, the Competitor is free to work autonomously in a safe manner with all relevant assessment being completed outside of competition time, pressure transducers may be used to ensure minimum pressure test and evacuation requirements are met by the Competitors. Competitors **MUST** perform all electrical testing in the presence of an Expert prior to energizing the installation.

CHECK POINTS

An important part of this competition are the procedures used to carry out various tasks. Therefore, at various points in this competition 1 or 2 Experts will observe and check your work. Once checked the Expert must place will sign in a sheet as given below.

Electrical Installation	Expert 1 Initials
Testing	Expert 2 Initials
	Expert 3 initials

INFORMATION CONCERNING SAFETY REQUIREMENTS

During the competition, all Competitors **MUST** follow the safety rules listed below along with the Indian Health, Safety and Environment requirements.

SHOES

- Fully enclosed work shoes or boots must be worn at all times.

CLOTHING

- Legs must be covered at all times, by either long work trousers or overalls.
- Upper body must be covered at all times.
- Arms must be covered with long sleeves, when brazing and using refrigerant.

CLEAR SAFETY GLASSES

- Must be worn when necessary to protect your eyes.
- Must be worn when brazing, soldering, filing, reaming, hack-sawing, drilling, grinding and using refrigerant, dry nitrogen and compressed air.

GLOVES

- Must be worn when brazing and using refrigerants
- All Electrical work involving live testing will require wearing of approved gloves

ELECTRICAL

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

Any Competitor that is identified as not wearing the correct safety attire or is engaging in any unsafe practice will be stopped and advised on the correct safety practice by an Expert. If the unsafe working practice is repeated the Expert may **STOP** the Competitor and report the issue to the chief or Deputy Chief Expert. The Competitor may not be allowed to continue until the safety issue is resolved. The Competitor will lose associated safety marks.

If the Competitor continues to ignore the safe working practice they may be removed from the competition area for a safety briefing for ten minutes by the host country health, safety and environment representative, the time taken to complete the safety briefing will be considered to be a part of the Competitor's competition time.

COMPETITION DETAILS - MODULE A (TASK 1) Day 1

COMPONENT FABRICATION, BRAZING AND ICE MAKING AND HOT WATER

MAXIMUM TIME ALLOWED – 2 HOURS

13.5 MARKS

SCOPE

The Competitors will each be given a 1'x1'x1.5' Plastic box . They are required to drill 2 holes, each of about 3/8" for copper tubing on a side wall. The evaporator copper tube will be placed vertically as per drawing in this box. Copper tube going into one hole will be connected to shut off valve 1 as per diagram 1. Water will be placed in this box and copper tube will be dipped in water. The box should also have a top as per diagram 2.

They also have to prepare Evaporator and Condenser Coils from Copper tubes which will also be given..

They have to connect all these as per diagram..

They are also required to make 8 holes each of 1 mm diameter in back and another hole of 4" diameter in front. The back hole will be inlet for hot ambient air and front hole will be outlet for cold air through a fan. The fan is of of 4" diameter and will have to be fixed in the front hole for thrusting cold air out. Electrical connection of fan will have to be made.

TIMING

Competitors have to complete the Plastic box and the complete project at the same time in the morning of day 1 so that marking can be done later. If any Competitor is not able to finish work in the allocated time, he will be required to submit the unfinished project for assessment.

Competitors will receive additional points for completing this module in less than the allocated time (as defined in the marking summary) providing that the fabricated box is as per drawing and specifications. Water should not leak from the box and holes should be done properly so that the incoming and outgoing ends of evaporator do not touch.

ASSESSMENT

Competitors will be assessed as per technical description, the marking scale will reflect dimensions and tolerances for assessment in addition to the quality of fabrication of the box. Any Competitor who does not complete Day 1 project in the required time (6 hours) will be allowed to complete it after it is assessed and handed back to him during next Module – no additional time will be allowed for either Module or Module for those who do not complete the fabrication in the allotted time.

DRAWINGS / Diagrams

Diagram 1: Construction part .

Diagram 2: Connection of Valves

Diagram 3: Lay out of competition area

Diagram 4: Refrigeration Cycle.

COMPONENTS and Tools

Components to be installed are given in the Components and Tools list.

COMPETITION DETAILS - MODULE B (TASK 2) Day 1 and 2

REFRIGERATION SYSTEM INSTALLATION AND COMMISSIONING

MAXIMUM TIME ALLOWED – 10 HOURS

49 MARKS

SCOPE

Competitors are to install a refrigeration system to refrigerate water contained in a Plastic box so that it is frozen twice.

In next step, the water is to be heated so that it becomes warm and its temperature goes upto 30-35 Degrees C.

Refrigerant is R134a.

Competitors are required to connect system to a pre wired electrical switch.

TIMING

Competitors have to complete the installation. The completed project with warm water may be left running and displayed.

ASSESSMENT

Competitors will be assessed as per technical description with particular weighting on the commissioning and operation of the project.

DRAWINGS

Diagram 1: Construction part for Refrigeration system.

Diagram 2: Connection of Valves.

Diagram 3: Lay out of Competition area

Diagram 4: Refrigeration Cycle

List of mechanical and electrical components

as per the below list:

COMPONENTS / Tools for one participant

Components to be installed will include the following;

- Reciprocating Compressor 1/4H.P.
- Capillary size 0.036'' length 11'
- Filter Drier 01 each
- Hand Shut off valve- 04
- R134a Refrigerant- 150gm
- Flare Nut ¼ -08
- Copper Tube ¼ -Roll of 50'
- Copper T-04 of ¼
- Brazing Torch, can
- Brazing Rod
- Recovery Unit
- Vacuum Pump 1.5CFM
- Electronic Leak Detector
- Flux
- Pipe Bender
- Spring Bender
- Tube Cutter
- Flare Tool
- Swaging Tool
- Electric wires
- Electrical Socket, Plug Top
- Fevicol
- Screws, nails different sizes
- Screw Driver Set
- Socket Wrench Set
- Crimping Plier
- Combination Plier
- Crow Plier
- Vice Grip Plier
- Pinch Off Plier
- Pipe Wrench
- Ratchet Wrench
- Files- Flat, round
- Hammer
- Extension cord 15Amp
- Plastic Box of 12''*12''*18''
- Tape electrical and Aluminium
- Pressure meters
- Digital Temperature Meter
- Digital Anemometer
- Digital Weight balance
- Nitrogen Cylinder with Regulator
- Extension Cord
- Measuring tape and scale
- Knife
- Hack Saw
- Soap solution for manual checking of leak
- Drill Machine and Bits
- Allen Key Set
- Line Tester
- Clamp Meter
- Digital Multi Meter

- Continuity Tester
- PPE-Gloves, Apron, Goggles, Shoes
- Spirit Leveller
- Capillary Tube Gauze
- Capillary Tube Cutter
- Hygrometer
- Lighter
- D.C Refrigerator 01
- Window AC 01
- Split AC 01
- Mounting system for Split AC 01
- MCB 6,20, 30Amp
- Over load relay
- Cable Tie
- Pressure Transducer
- Wire Stripper

SYSTEM DESIGN SPECIFICATIONS

The following system design specifications for the installation should be used for commissioning and control setting and are as follows:

SYSTEM SPECIFICATIONS

- Refrigerant = R134a

SYSTEM OPERATION

- First freeze water in Plastic box to ice by closing shut off valves 3 and 4 and opening 1 and 2.
- In next step, start the fan so that cold air comes out and system also works as an air cooler.
- In next step, close shut off valves 1 and 2 and open 3 and 4. Now, the condenser will work as evaporator and evaporator will work as condenser. Now, you can heat water to 35-40degrees C.
- Check the temperature of water and note down the readings.
- Again we can use fan to throw hot air out.

INSTALL AND COMMISSION REFRIGERATION SYSTEM

All Competitors will be required to perform the following tasks to complete this module, task 6 has an Expert sign off sheet which needs to be filled in and signed prior to moving ahead on this task

1. INSTALL REFRIGERATION SYSTEM

All Competitors will be supplied with all necessary equipment and materials to complete the installation of the refrigeration system in accordance with test project drawings and WorldSkills International Standard for Refrigeration and Air Conditioning.

Refer to the following project drawings / List to assist to complete this task

Diagram 1: Construction part for Refrigeration

Diagram 2: Construction of Holes in Plastic box

Refrigerant flow diagram

Electrical switch box

List of mechanical and electrical components, Tools

2. INSTALL ELECTRICAL SYSTEM

All Competitors will be supplied with all necessary equipment and materials to complete the installation of the refrigeration system in accordance with test project drawings and World Skills International Standard for Refrigeration and Air Conditioning.

Refer to the following project drawings to assist to complete this task

Diagram: Electrical switch box

Test for ice formation and water heating	Expert 1 Initials Expert 2 Initials Expert 3 Initials
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4. EVACUATION

Evacuate the primary refrigeration system (R134a) in accordance with manufacturer's instructions and World Skills standards using the **Deep Vacuum Method** to hold a vacuum of at least 1000 microns (130Pa absolute) of mercury. The evacuation point should not rise to a value greater than 1000 microns in the Ten (10) minutes after the vacuum pump is isolated from the system under test.

To be filled in by EXPERTS ONLY

EVACUATION TEST ATTEMPT #1

Starting evacuation level: _____ microns

Starting Time: _____

Evacuation level after standing time:

Finishing Time: _____ microns

EVACUATION TEST ATTEMPT #2

Starting evacuation level: _____ microns

Starting Time: _____

Evacuation level after standing time:

Finishing Time: _____ microns
Comments: _____

Refrigeration Evacuation Test	
	Expert 1 Initials
	Expert 2 Initials
	Expert 3 Initials

T5. CHARGING WITH REFRIGERANT

Charge the refrigeration system (R134a) with the required weight of refrigerant to ensure operation according to specification above, and in accordance with acceptable trade and environmental practices.

To be filled in by EXPERTS ONLY

Bottle weight prior to charging: _____ kg lb

Bottle weight at completion of charging: _____ kg lb

Comments:

6. ELECTRICAL TESTING

Under the supervision of an Expert, perform all necessary safety checks to ensure the Test Project is safe to energize.

PLEASE FILL IN THE EXPERT CHECK POINT SHEET BELOW BEFORE PROCEEDING ANY FURTHER

To be filled in by EXPERTS ONLY

Competitor Name:

Competitor Country:

All wiring inspected by Expert prior to energizing: Yes

Electrical safety checks performed prior to energizing: Yes

Comments:

Refrigeration System

Expert 1 Initials Expert 2

Electrical Test

Initials :

7. COMMISSION THE SYSTEM

Competitors are required to commission the system for operation in accordance with the design specifications supplied. Please fill out the following commissioning document with the system fully operational and as close to operating temperatures as possible. Please indicate units by checking appropriate boxes.

Ambient Temperature: _____ Celsius Fahrenheit

Refrigerant Type: _____
Mass of Refrigerant Charge: _____ grams pounds

Suction Pressure: _____ kPa psi

Discharge Pressure: _____ kPa psi

COMPETITION DETAILS - MODULE C (TASK 3) Day 3

AIR CONDITIONING SYSTEM FAULT FIND, REPAIR & COMMISSIONING

MAXIMUM TIME ALLOWED – 4 HOURS

37.5 MARKS SCOPE:

Competitors will be provided with an air conditioning system that has been leak tested and verified to have no leaks, pressure testing of the system is not required at any point in time. Competitors will be required to identify an electrical fault and a refrigeration system fault on the supplied air conditioning systems. Once faults have been identified the Competitors will be required to repair the faults including full refrigerant recovery and recharging of refrigerant charge to manufacturer's specifications. Competitors will then be required to commission the system and plot operating conditions on a psychometric chart.

TIMING

Competitors are required to complete this module at the same time as per time limit given.

ASSESSMENT

Competitors will be assessed as per technical description with particular weighting on the fault finding and commissioning of the project.

1. RECLAIM SYSTEM

All Competitors are required to repair the fault they have identified on the unit, the refrigerant will need to be removed from the system to complete the repair then the system pressure tested, evacuated and recharged with refrigerant. All necessary materials will be provided to repair the equipment and return it to an operating state.

All repairs MUST be done with all relevant safety rules adhered to.

To be filled in by EXPERTS ONLY

Reclaim System

Reclaim bottle weight prior to reclaim:

_____ kg lb

Reclaim bottle weight at completion of reclaim: _____ kg lb

Comments:

2. EVACUATION

Evacuate the refrigeration system in accordance with manufacturer's instructions and World Skills standards using the **Deep Vacuum Method** to hold a vacuum of at least 1000 microns (130Pa absolute) of mercury. The evacuation point should not rise to a value greater than 1000 microns in the Ten (10) minutes after the vacuum pump is isolated from the system under test.

To be filled in by EXPERTS ONLY

Evacuation Test

Starting evacuation level: _____ microns

Starting Time:

Evacuation level after standing time: _____ microns

Finishing Time:

Comments:

Air Conditioning System	
Evacuation	Expert 1 Initials
	Expert 2 Initials
	Expert 3 initials

3. CHARGING WITH REFRIGERANT

Charge the refrigeration system with the required weight of refrigerant to ensure operation according to specification above, and in accordance with acceptable trade and environmental practices.

To be filled in by EXPERTS ONLY
Refrigerant Charging

Bottle weight prior to charging:

_____ kg lb

Bottle weight at completion of charging:

_____ kg lb

Comments:

4. FAULT FINDING

All Competitors are required to identify an electrical fault and a refrigeration system fault with the operation of the unit, the root cause must be found and repaired. Once the fault is identified Competitors are to fill in this sheet of paper identifying what they believe to be the fault with the equipment. An Expert then needs to sign this sheet of paper.

All fault finding MUST be done with all relevant safety rules adhered to.

Once faults are found and recorded the Competitor is free to continue by running the unit and progressing to the next stage of the Module.

ELECTRICAL SYSTEM FAULT

Please write down what the fault with the equipment is and any supporting information that indicates what the fault was.

Please indicate what repairs need to be done to the system to return it to normal operation

REFRIGERATION SYSTEM FAULT

Please write down what the fault with the equipment is and any supporting information that indicates what the fault was.

Please indicate what repairs need to be done to the system to return it to normal operation

All repairs MUST be done with all relevant safety rules adhered to.

6. COMMISSION THE SYSTEM

Competitors are to commission the system for operation in accordance with the manufacturers specifications supplied. Please fill out the following commissioning document with the system fully operational, on "Cooling" mode, indoor fan on highest speed and as close to operating temperatures as possible. Please indicate units by checking appropriate boxes.

5. REPAIR SYSTEM

All Competitors are required to repair the faults they have identified on the unit, refrigerant must be removed from the system to repair the refrigeration fault. All necessary materials will be provided to repair the equipment and return it to an operating state

Amps

DESCRIPTION OF PROJECT AND TASKS

Refrigeration Cycle Normal Mode

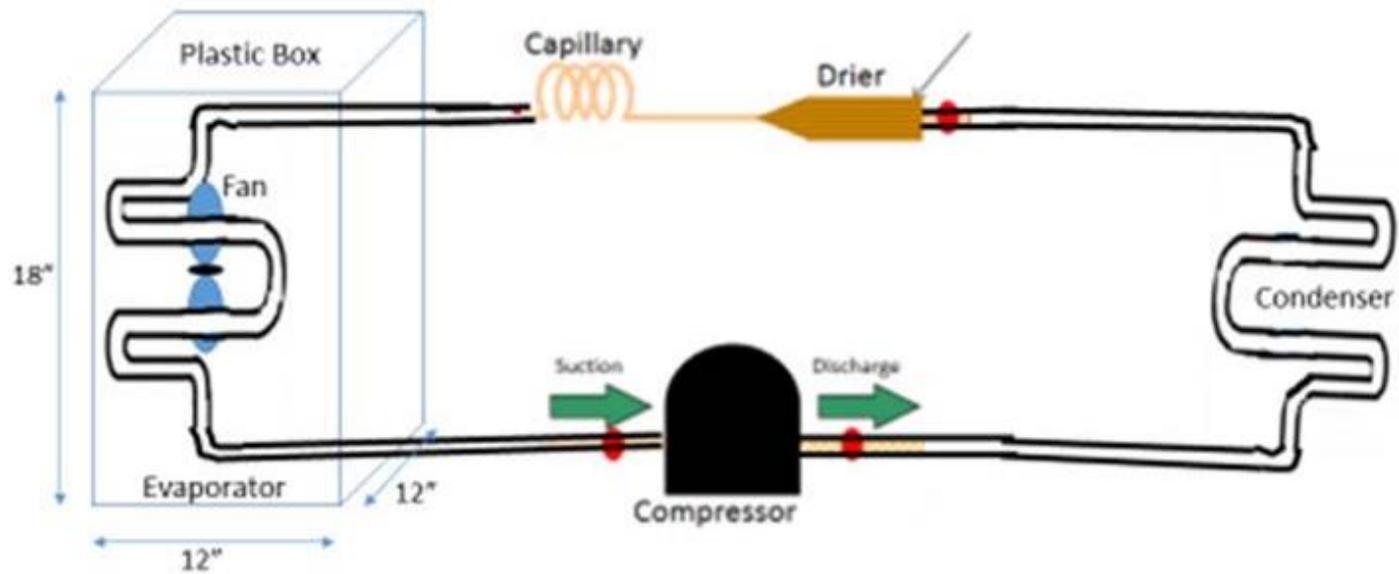
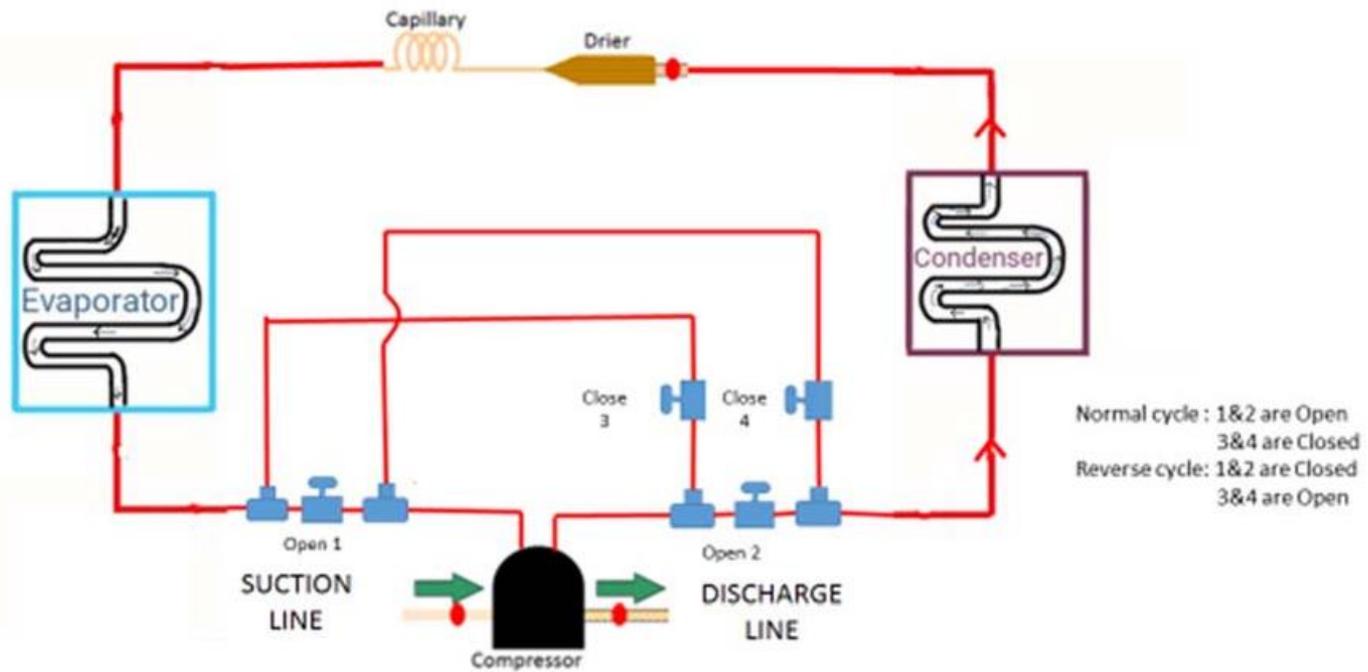
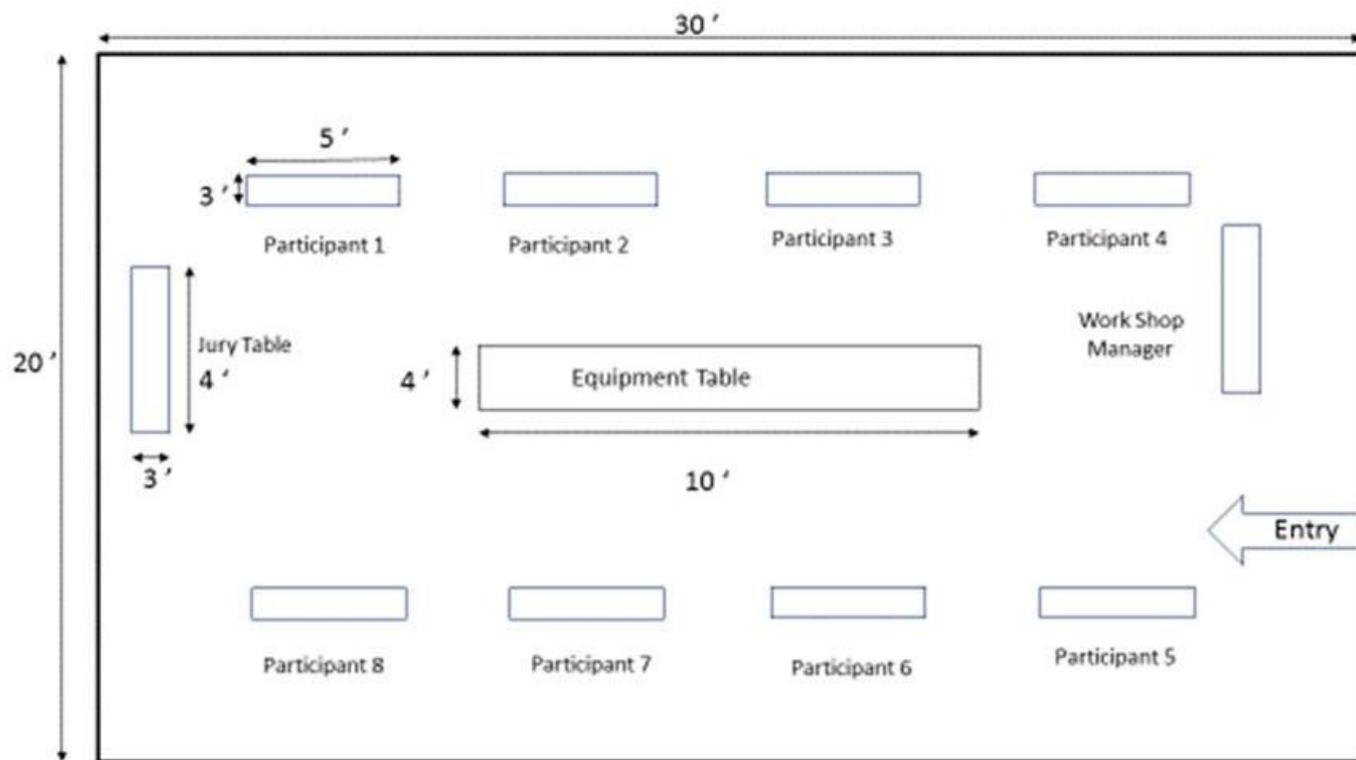


DIAGRAM - 1

DIAGRAM - 2





- The drawing is not as per scale
- All participants tables' are of size 5' X 3'

Drawing 3

Refrigeration Cycle

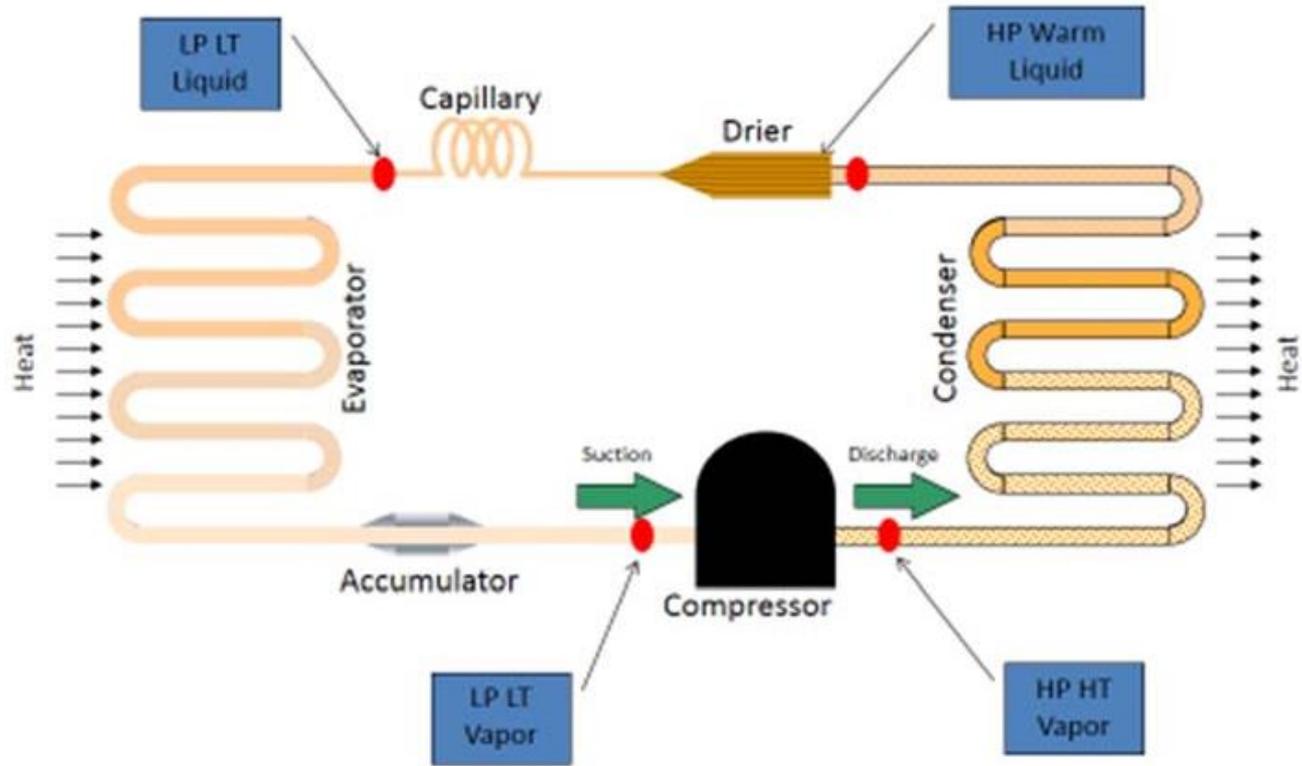


Diagram 4