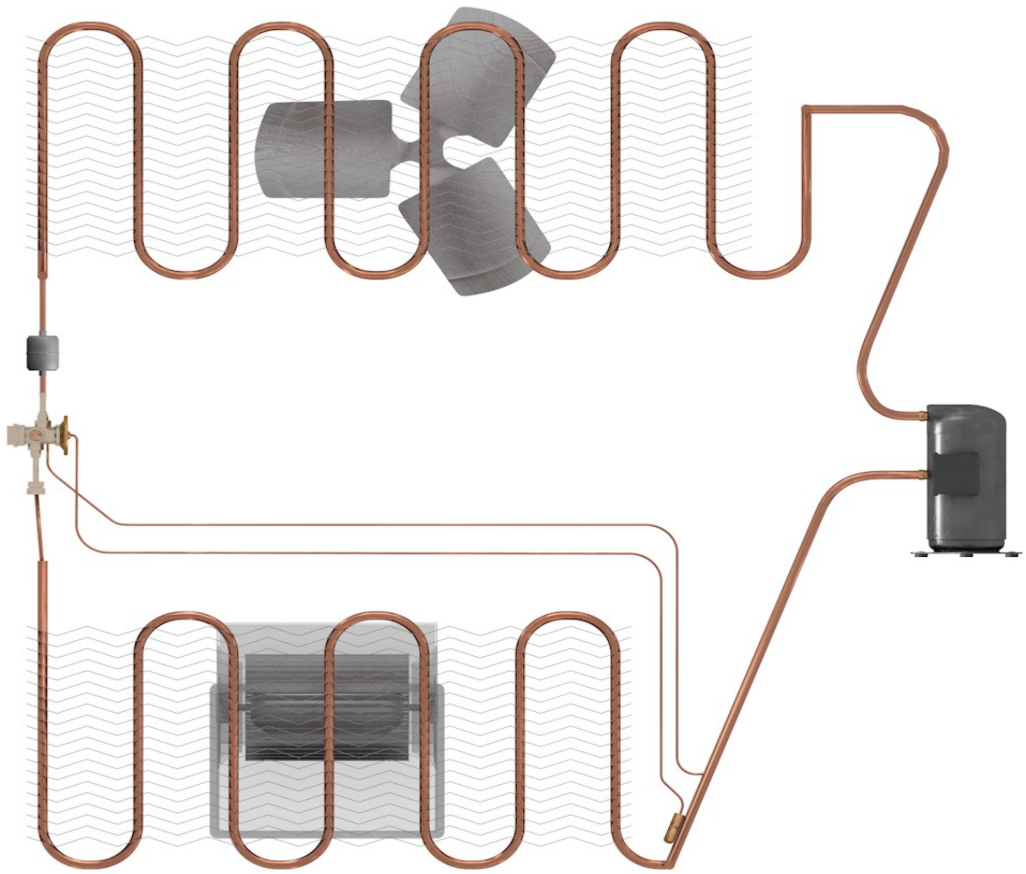
HVAC SIMULATOR

Nauman Innovation Group LLC



Comfort Cooling Curriculum
YouTube Videos
Technician Workbook

The content in this Curriculum is an excerpt from the ***Comfort Cooling Simulator*** full curriculum.

Visit us at www.HVACsimulator.com for more details.

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P.O. Box 521
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Phone: (800) 726-9696 **Fax:** (800) 546-3726
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Introduction

Comfort Cooling Curriculum

The ***Comfort Cooling Simulator,*** available for purchase, adopts the philosophy of evaluating the refrigeration theory through a “hands-off” approach, by using live data, in conjunction with real conditions that are seen by technicians in the field, in order to enhance their analysis and diagnosis competencies.

Introduction

Preface

Over the last ten years, the HVAC industry has made historic advancements in technology. Today, technicians' mechanical aptitude continues to be an essential component in the achievement of proficient skills. Although, HVAC technology has advanced, and the HVAC theory continues to grow at a rapid pace, the reality is that technicians' mechanical skills remain constant. In order for technicians to stay up to speed with the rapid technological advancements, it is necessary for technicians to engage in continuing HVAC education.

Nauman Innovation Group LLC believes in all forms of education, including, but not limited to, the use of simulators, virtual reality, YouTube videos, hands-on training, podcasts, and books. Our interactive process introduces the HVAC theory, by combining interactive simulators, with technician workbooks, which effectively facilitates learning.

We invite you to use this free technician's workbook, along with our YouTube videos, found on the ***HVAC Simulator*** YouTube channel, where you can expect to:

- Learn the Basic Refrigeration Cycle.
- Understand Pressure-Temperature relationship of refrigerants.
- Plot the refrigerant cycle on a Pressure Enthalpy Diagram.

"If you think training is expensive, try Ignorance."
- Peter Drucker

Introduction to the Workbook

Purpose

This ***Comfort Cooling Curriculum*** references a three-part Refrigeration Fundamentals video series, which assist technicians in learning the basic refrigeration fundamentals. Refrigeration knowledge is much more than simply using instruments to measure temperatures and pressures. This ***Technician Workbook*** helps technicians identify refrigeration components, analyze the refrigeration process, apply the Pressure Temperature Chart, and interact with the Pressure Enthalpy Diagram.

This curriculum is not a comprehensive refrigeration program, but instead, a means to test knowledge and confirm areas of improvement. Technicians are encouraged to reference the ***Comfort Cooling Simulator*** to apply these principles to diagnosing common conditions in the field.

Mission Statement

Our mission is to improve technical proficiency, one technician at a time.

How to Use this Curriculum

Use the workbook and watch the video simultaneously, or use each individually, and in whatever order you choose. There is no wrong way to use this curriculum.

Refrigeration diagnosis is the art of understanding the relationship between the refrigerant phase and how it responds to surrounding conditions.

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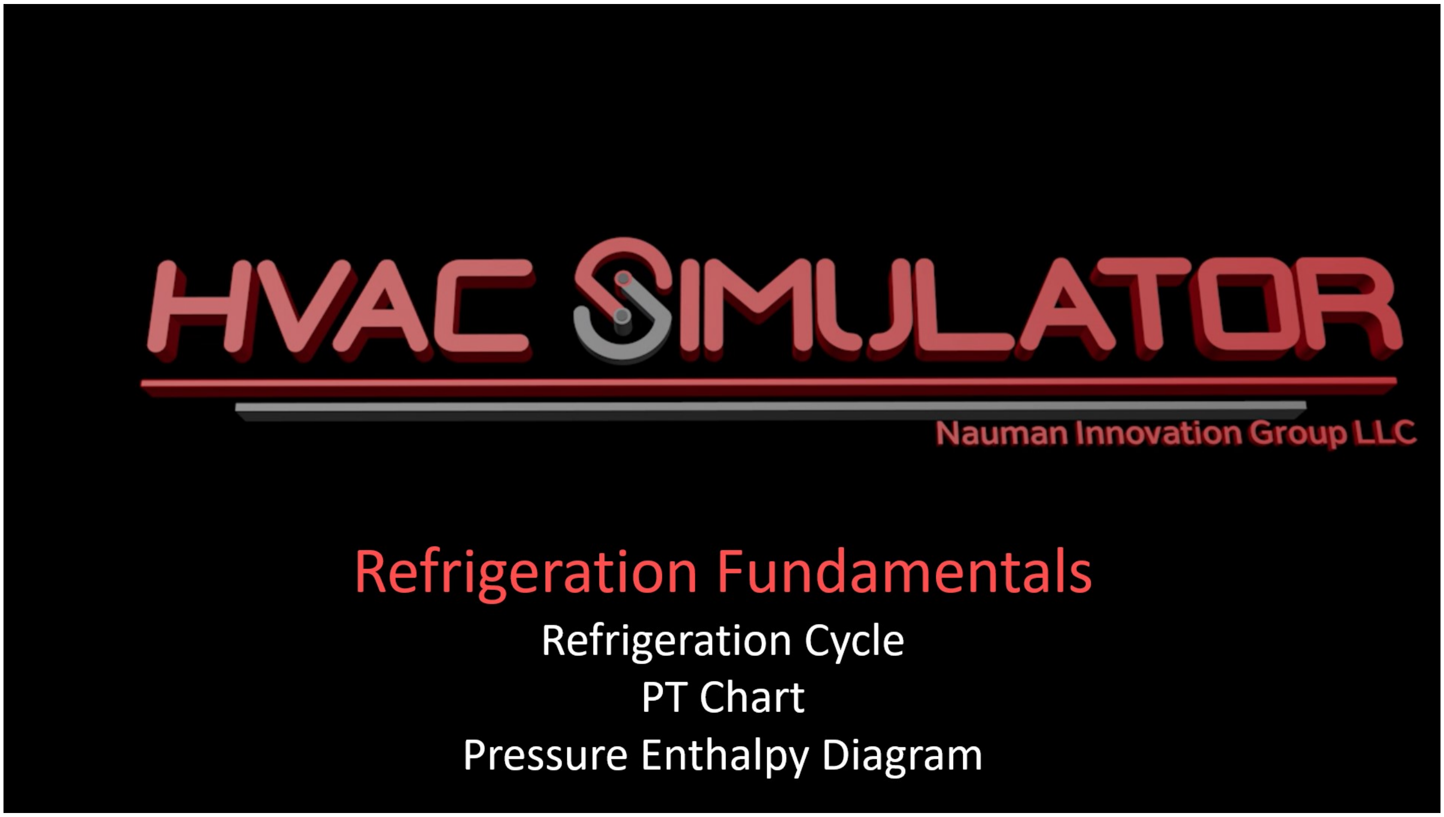
Videos



Videos are located on our webpage, our YouTube channel or on the HVACR Learning Network:

https://www.youtube.com/@hvacsimulator8345

https://www.HVACsimulator.com\training

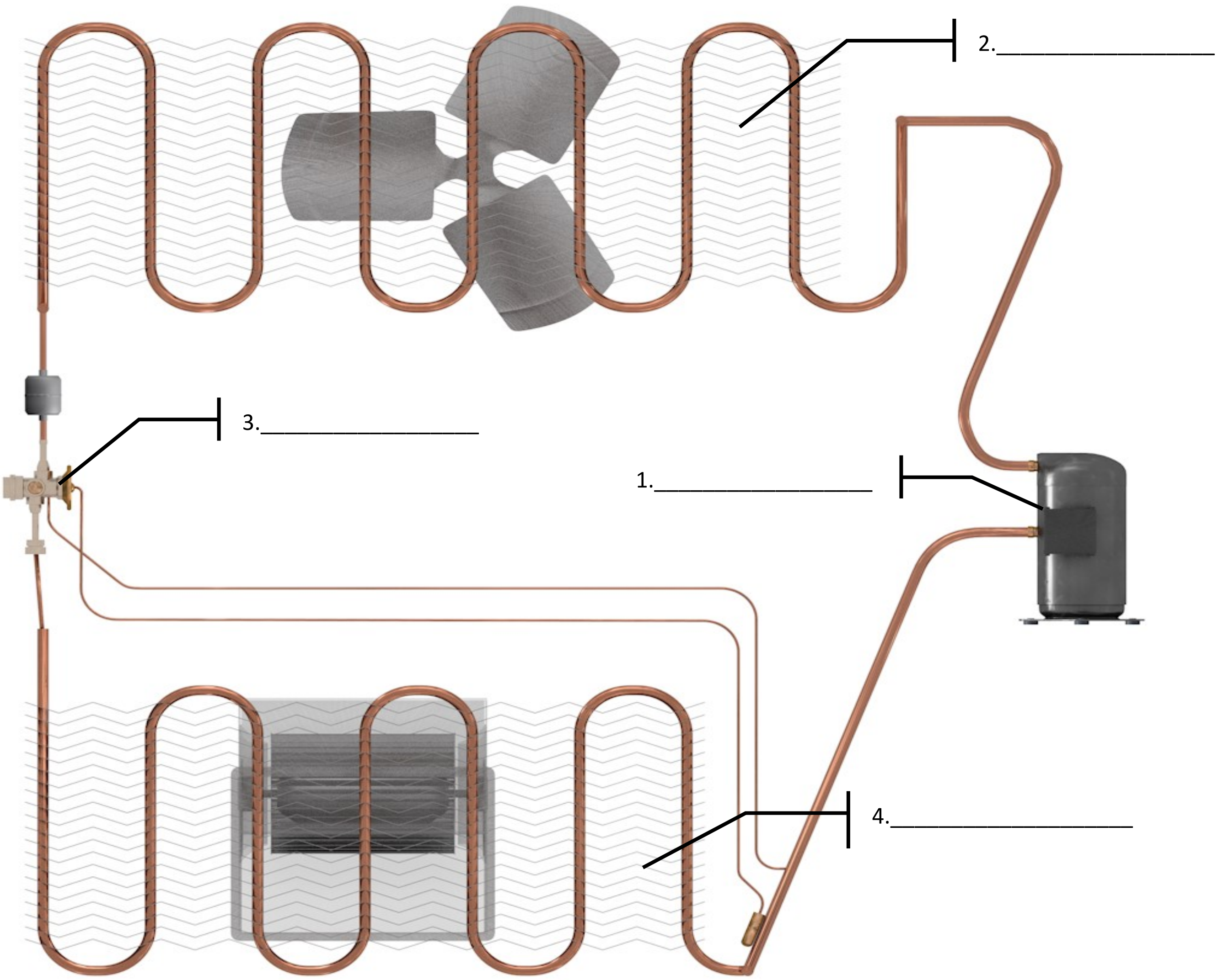
https://hvacr.elearn.network/pages/hvac-simulator-landing-page

Refrigeration Cycle

PT Chart

Pressure Enthalpy

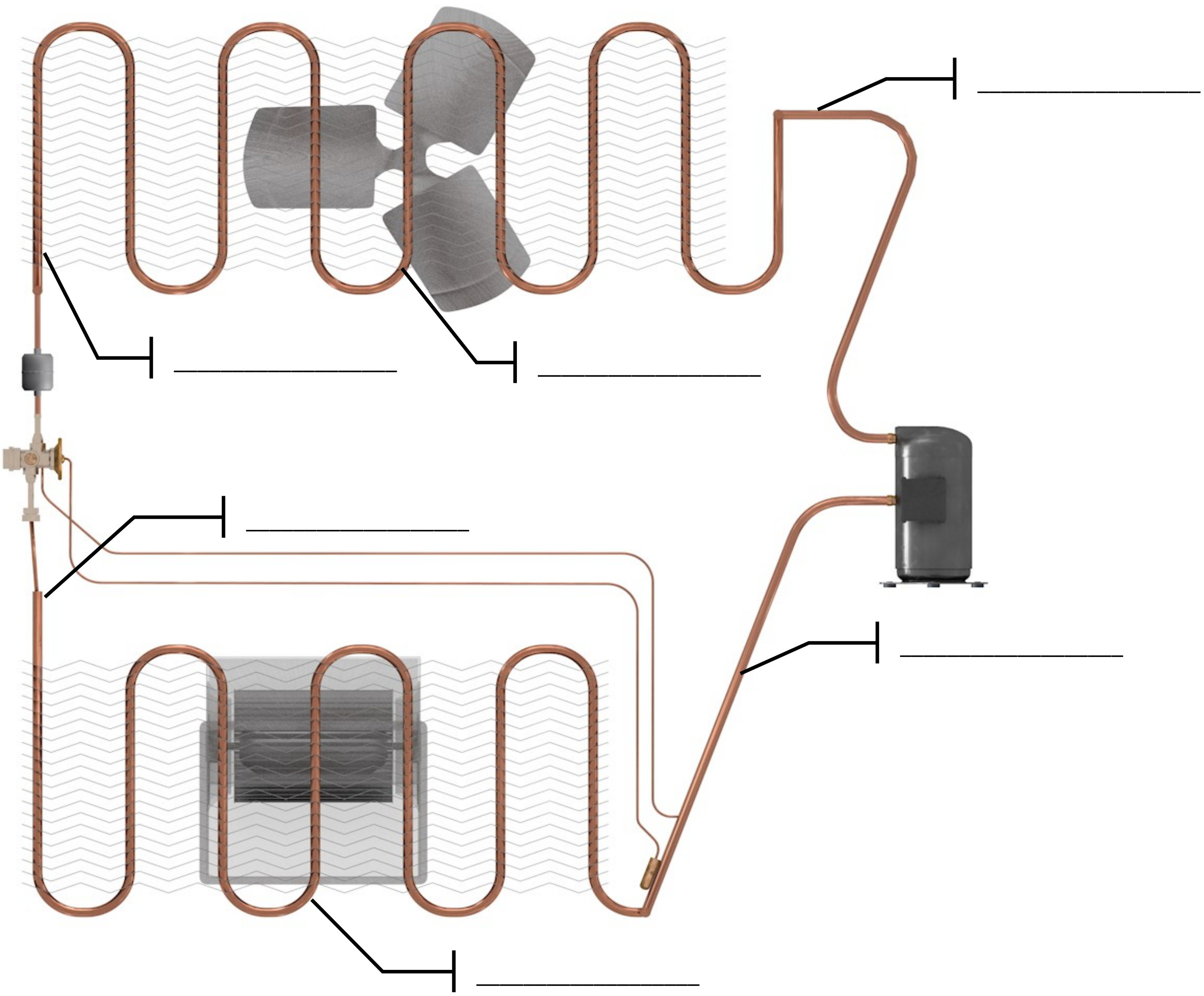
Refrigeration Cycle Video



Label the 4 components on in the Refrigeration Cycle diagram and write their function below.

1. ____
2. ____
3. ____
4. ____

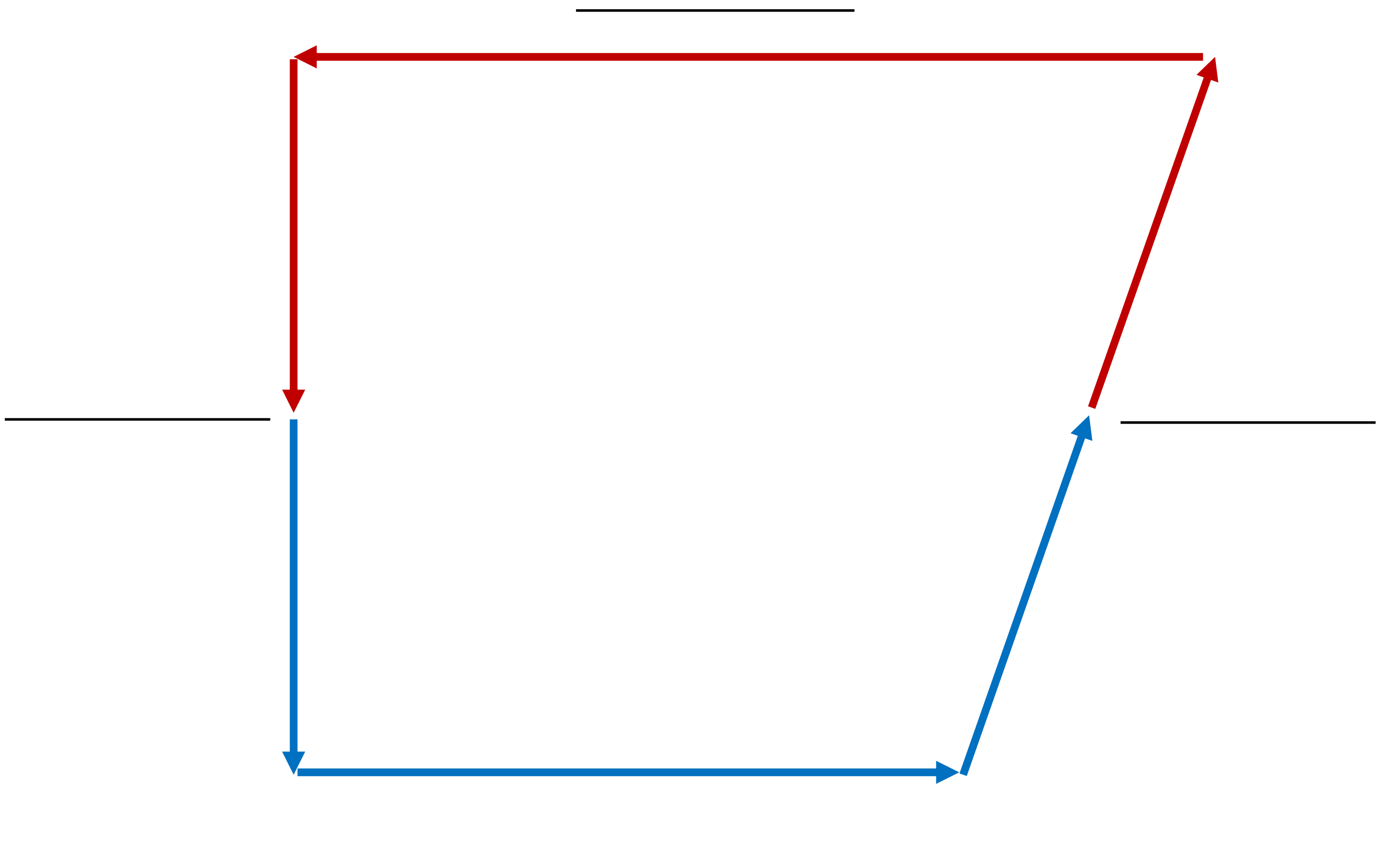
Refrigeration Cycle Video



Label the refrigerant phase on the Refrigeration Cycle diagram and write the definition of the phase below.

1. Saturated ____
2. Superheated Vapor____
3. Subcooled Liquid ____

Refrigeration Cycle Video



Label the 4 components on the polygon:

compressor, condenser coil, metering device, evaporator

Draw a line dividing the high pressure and low pressure side

Explain the equilibriums of the polygon.

PT Chart Video

What are the 3 states of matter:

1. ____

2. ____

3. ____

What are the 3 possible phases of refrigerant in a system:

1. ____

2. ____

3. ____

Define Superheated Vapor:

____

____

Define Subcooled liquid:

____

____

Define Saturated Refrigerant:

____

____

ASHRAE Class	A1	A1	A2L	A2L		ASHRAE Class
ODP	0.05	0	0	0		ODP
GWP	1810	2090	677	467		GWP
	HCFC R-22	HFC R-410A	HFC R-32	HFO R-454B		
°F				Bubble Liquid	Dew Vapor	°F
-40°	0.6	11	11	9.6	*8.5*	-40°
-35°	2.6	14	14.4	12.8	11.6	-35°
-30°	4.9	18	18.2	16.3	15	-30°
-25°	7.4	22	22.3	20.2	18.7	-25°
-20°	10.2	26	26.8	24.4	22.8	-20°
-15°	13.2	31	31.7	29	27.2	-15°
-10°	16.5	36	37.1	34.1	32	-10°
-5°	20.1	42	42.9	39.5	37.3	-5°
0°	24	48	49.3	45.4	43	0°
5°	28.3	55	56.1	51.8	49.2	5°
10°	32.8	62	63.5	58.7	55.8	10°
15°	37.8	70	71.4	66.2	63	15°
20°	43.1	78	80	74.2	70.7	20°
25°	48.8	87	89.2	82.8	79	25°
30°	55	97	99.1	92	87.9	30°
35°	61.5	107	109.7	101.8	97.4	35°
40°	68.6	118	121	112.3	107.6	40°
45°	76.1	130	133	123.5	118.5	45°
50°	84.1	143	145.8	135.5	130	50°
55°	92.6	156	159.5	148.2	142.4	55°
60°	102	170	174	161.7	155.4	60°
65°	111	185	189.5	176	169.4	65°
70°	121	201	205.8	191.1	184.1	70°
75°	132	218	223.2	207.2	199.7	75°
80°	144	238	241.5	224.1	216.3	80°
85°	156	255	260.9	242	233.8	85°
90°	168	275	281.3	260.9	252.2	90°
95°	182	296	302.9	280.8	271.7	95°
100°	196	318	325.7	301.8	292.3	100°
105°	211	341	**349.6**	323.8	314	105°
110°	226	365	374.9	347	336.8	110°
115°	243	391	401.4	371.4	360.9	115°
120°	260	418	429.3	397	386.2	120°
125°	278	447	458.7	423.9	412.8	125°
130°	297	477	489.5	452	440.8	130°
135°	317	508	521.8	481.6	470.2	135°
140°	337	541	555.8	512.5	501.1	140°
145°	359	576	591.4	544.9	533.7	145°
150°	382	613	628.8	578.9	567.9	150°

There is a direct pressure/temperature relationship to refrigerant. The PT Chart shows this relationship, but what phase does the refrigerant need to be for this to be true:

☐ Vapor ☐ Liquid ☐ Saturated

PT Chart Video

Label the refrigerants:

Single compound, Azeotropic, or Zeotropic

______________________ ______________________

______________________ ______________________

ASHRAE Class	A1	A1	A2L	A2L		ASHRAE Class
ODP	0.05	0	0	0		ODP
GWP	1810	2090	677	467		GWP
	HCFC R-22	HFC R-410A	HFC R-32	HFO R-454B		
°F				Bubble Liquid	Dew Vapor	°F
-40°	0.6	11	11	9.6	8.5	-40°
-35°	2.6	14	14.4	12.8	11.6	-35°
-30°	4.9	18	18.2	16.3	15	-30°
-25°	7.4	22	22.3	20.2	18.7	-25°
-20°	10.2	26	26.8	24.4	22.8	-20°
-15°	13.2	31	31.7	29	27.2	-15°
-10°	16.5	36	37.1	34.1	32	-10°
-5°	20.1	42	42.9	39.5	37.3	-5°
0°	24	48	49.3	45.4	43	0°
5°	28.3	55	56.1	51.8	49.2	5°
10°	32.8	62	63.5	58.7	55.8	10°
15°	37.8	70	71.4	66.2	63	15°
20°	43.1	78	80	74.2	70.7	20°
25°	48.8	87	89.2	82.8	79	25°
30°	55	97	99.1	92	87.9	30°
35°	61.5	107	109.7	101.8	97.4	35°
40°	68.6	118	121	112.3	107.6	40°
45°	76.1	130	133	123.5	118.5	45°
50°	84.1	143	145.8	135.5	130	50°
55°	92.6	156	159.5	148.2	142.4	55°
60°	102	170	174	161.7	155.4	60°
65°	111	185	189.5	176	169.4	65°
70°	121	201	205.8	191.1	184.1	70°
75°	132	218	223.2	207.2	199.7	75°
80°	144	238	241.5	224.1	216.3	80°
85°	156	255	260.9	242	233.8	85°
90°	168	275	281.3	260.9	252.2	90°
95°	182	296	302.9	280.8	271.7	95°
100°	196	318	325.7	301.8	292.3	100°
105°	211	341	**349.6**	323.8	314	105°
110°	226	365	374.9	347	336.8	110°
115°	243	391	401.4	371.4	360.9	115°
120°	260	418	429.3	397	386.2	120°
125°	278	447	458.7	423.9	412.8	125°
130°	297	477	489.5	452	440.8	130°
135°	317	508	521.8	481.6	470.2	135°
140°	337	541	555.8	512.5	501.1	140°
145°	359	576	591.4	544.9	533.7	145°
150°	382	613	628.8	578.9	567.9	150°

esco institute

What is unique about Azeotropic? ____

____

PT Chart Video

Calculate Superheat and Subcooling

R22

Low Pressure 69 psi / Line temperature 52^0 F

Superheat = ______________________________

R410A

High Pressure 325 psi / Line temperature 87^0 F

Subcool = ________________________________

R454B

Low Pressure 110 psi / Line temperature 52^0 F

Superheat = ______________________________

High Pressure 325 psi / Line temperature 87^0 F

Subcool = ________________________________

ASHRAE Class	A1	A1	A2L	A2L		ASHRAE Class
ODP	0.05	0	0	0		ODP
GWP	1810	2090	677	467		GWP
	HCFC **R-22**	HFC **R-410A**	HFC **R-32**	**HFO R-454B**		
°F				**Bubble** Liquid	**Dew** Vapor	°F
-40°	0.6	11	11	9.6	*8.5*	-40°
-35°	2.6	14	14.4	12.8	11.6	-35°
-30°	4.9	18	18.2	16.3	15	-30°
-25°	7.4	22	22.3	20.2	18.7	-25°
-20°	10.2	26	26.8	24.4	22.8	-20°
-15°	13.2	31	31.7	29	27.2	-15°
-10°	16.5	36	37.1	34.1	32	-10°
-5°	20.1	42	42.9	39.5	37.3	-5°
0°	24	48	49.3	45.4	43	0°
5°	28.3	55	56.1	51.8	49.2	5°
10°	32.8	62	63.5	58.7	55.8	10°
15°	37.8	70	71.4	66.2	63	15°
20°	43.1	78	80	74.2	70.7	20°
25°	48.8	87	89.2	82.8	79	25°
30°	55	97	99.1	92	87.9	30°
35°	61.5	107	109.7	101.8	97.4	35°
40°	68.6	118	121	112.3	107.6	40°
45°	76.1	130	133	123.5	118.5	45°
50°	84.1	143	145.8	135.5	130	50°
55°	92.6	156	159.5	148.2	142.4	55°
60°	102	170	174	161.7	155.4	60°
65°	111	185	189.5	176	169.4	65°
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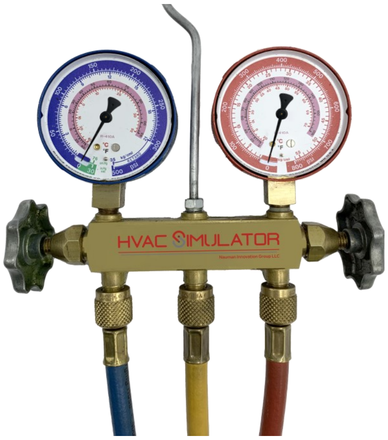
130°	297	477	489.5	452	440.8	130°
135°	317	508	521.8	481.6	470.2	135°
140°	337	541	555.8	512.5	501.1	140°
145°	359	576	591.4	544.9	533.7	145°
150°	382	613	628.8	578.9	567.9	150°

PT Chart Video

Label the type of gauge and list the pros and cons



Pros: ____

____

____

Conns: ____

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Pros: ____

____

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Conns: ____

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____

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Pros: ____

____

____

Conns: ____

____

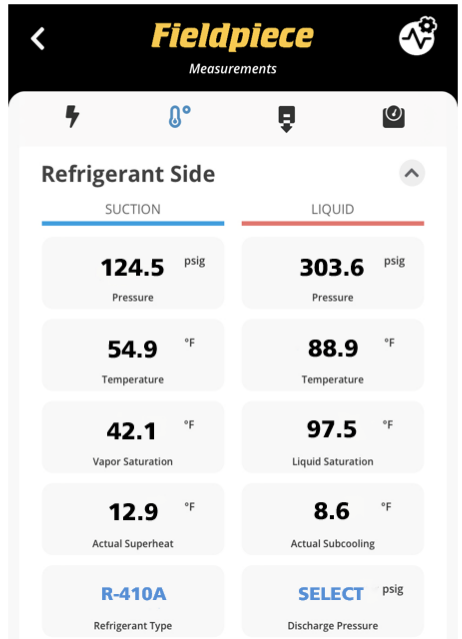
____

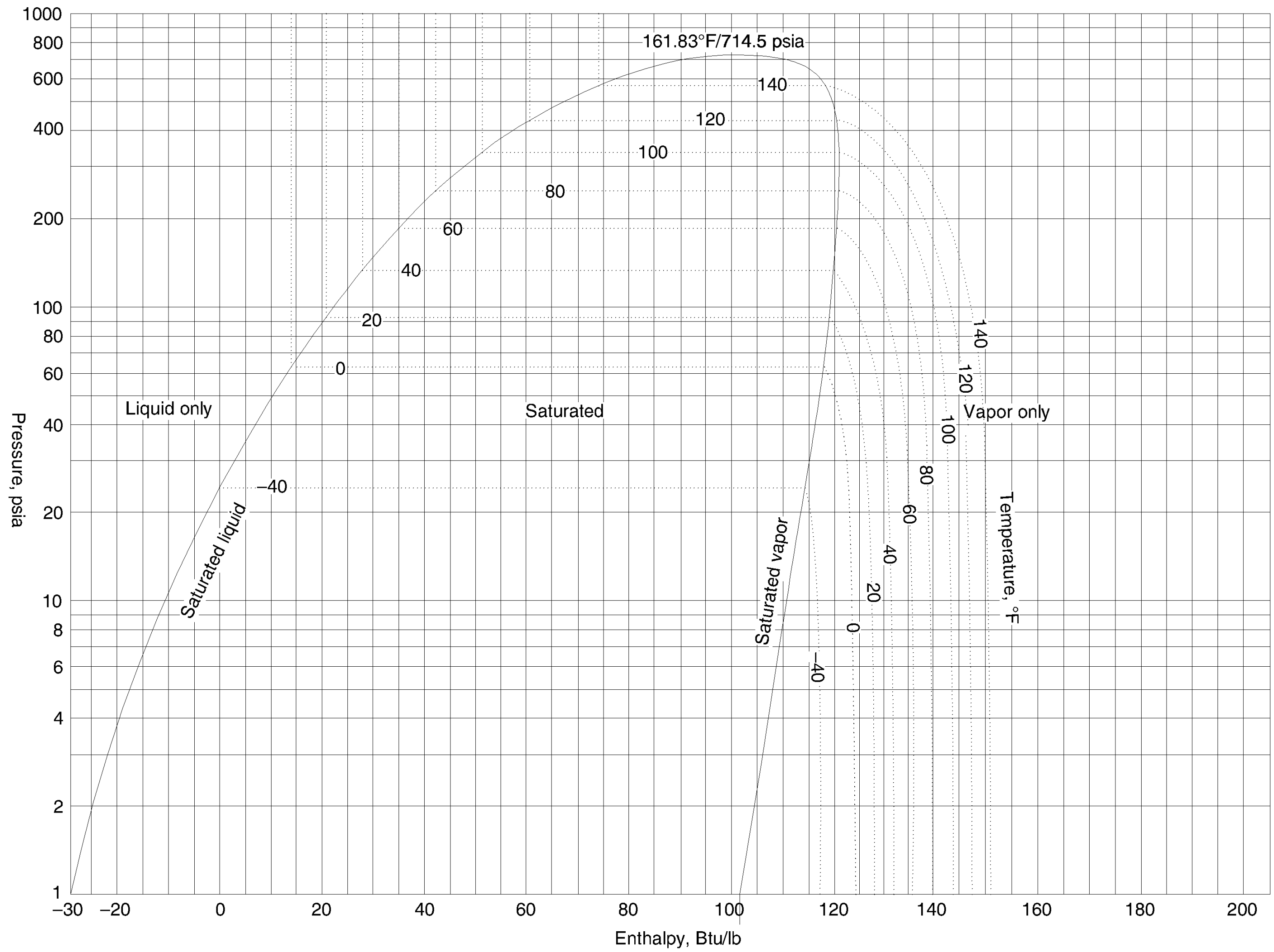
____

Pressure Enthalpy Diagram Video

Draw the following data onto the Pressure Enthalpy Curve with a 140⁰ discharge line temperature. The data represent a system operating at peak efficiency.

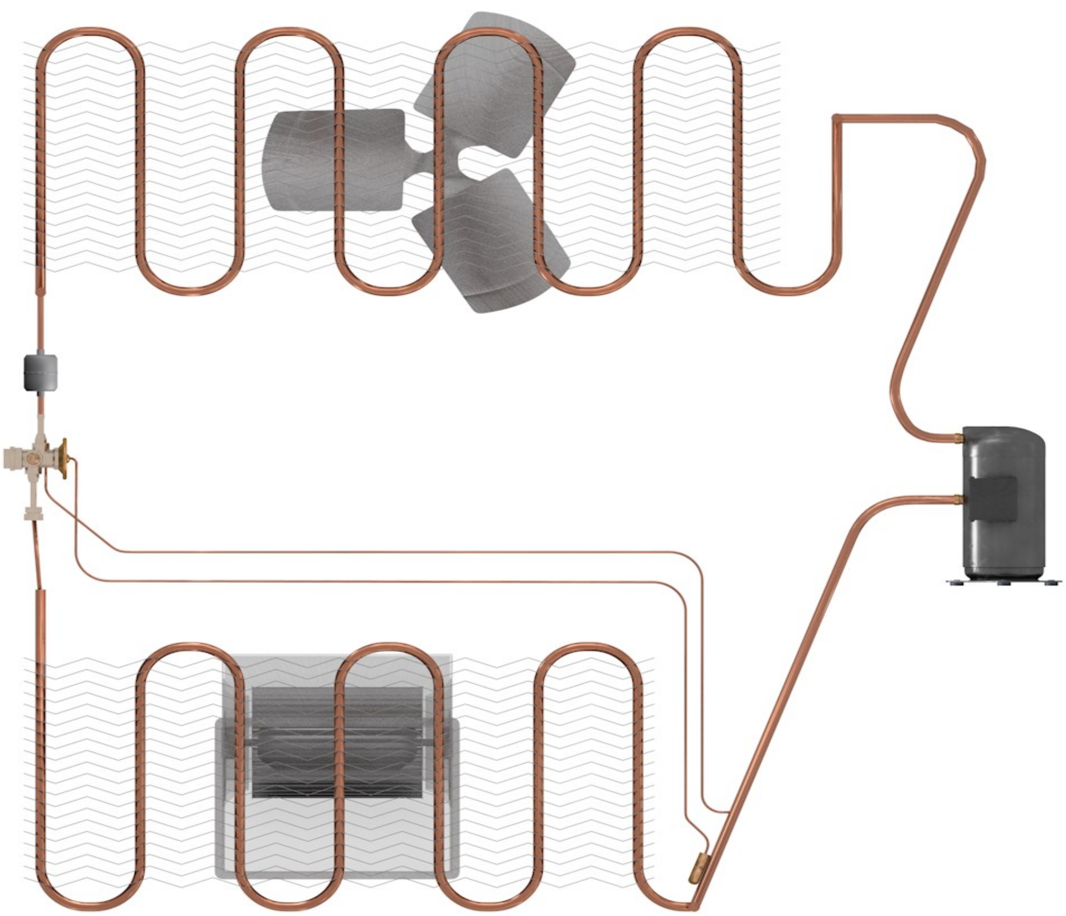
Note the units of measurements for pressure can either be psig or psia. At sea level the atmospheric pressure is 14.7 psi, so this needs to be added to the gauge pressure to calculate (psia) absolute pressure.





Pressure Enthalpy Diagram Video

Draw the saturation curve and label the three phases of refrigerant with respect to the curve.



Air Conditioning Analysis

The ***Comfort Cooling Simulator*** uses live data for technicians to analyze the refrigeration process with the following conditions. The technicians will evaluate the variables causing the conditions and complete the chart. Use this chart to test your students and technicians. The ***Comfort Cooling Simulator*** will make your team more proficient.

↑ Higher than normal ↓ Lower than normal

Condition	Discharge Pressure	Suction Pressure	Subcooling	Superheat	ΔT	Capacity
Restricticted/Low Airflow						
Excessive Airflow						
Undercharge						
Overcharge						
Liquid Line Restriction						
Low Ambient						
Dirty Condenser Coil						
Loose TXV						
Non-Condensibles						

Definitions

Azeotropic - blended refrigerants that have the same boiling point

Boiling point - the temperature at which the liquid refrigerant begins to boil or evaporate

Bubble point - the temperature of a zeotropic refrigerant at which it begins to vaporize

Dew point - the temperature of a zeotropic refrigerant at which it begins to condense

Fractionation - the composition of a zeotropic refrigerant as it changes phases

Glide - the temperature difference between blended refrigerants from the first molecule frigerant evaporates and last molecule of

Latent Heat - the heat required to change a liquid to a vapor or vapor to liquid without a change in temperature

Latent Heat of Evaporation - the heat required to change a liquid to vapor without a change in temperature

Latent Heat of Condensation - the heat required to change a vapor to liquid without a change in temperature

Saturated Condensing Temperature (SCT) - the temperature at which the refrigerant will change from vapor to liquid

Saturated Evaporating Temperature - the temperature at which the refrigerant will change from liquid to vapor

Saturated Suction Temperature (SST) - same as Saturated Evaporating Temperature

Saturation - mixture of liquid and vapor

Single Compound - refrigerant only has one molecule structure. The refrigerant will evaporate and condense at constant temperature with given pressure.

Subcool - the liquid that is lower than it's saturation temperature

Superheat - the vapor that is higher than it's saturation temperature

Zeotropic - blended refrigerants that have different boiling points. The PT-Chart will have bubble point and dew point and for saturation values.

HVAC SIMULATOR

Nauman Innovation Group LLC

OAT_________°F   Condenser Split ___________ °F   Speed Tap Color: _____

TESP ________ iwc

CFM ___________

_________ PSIG

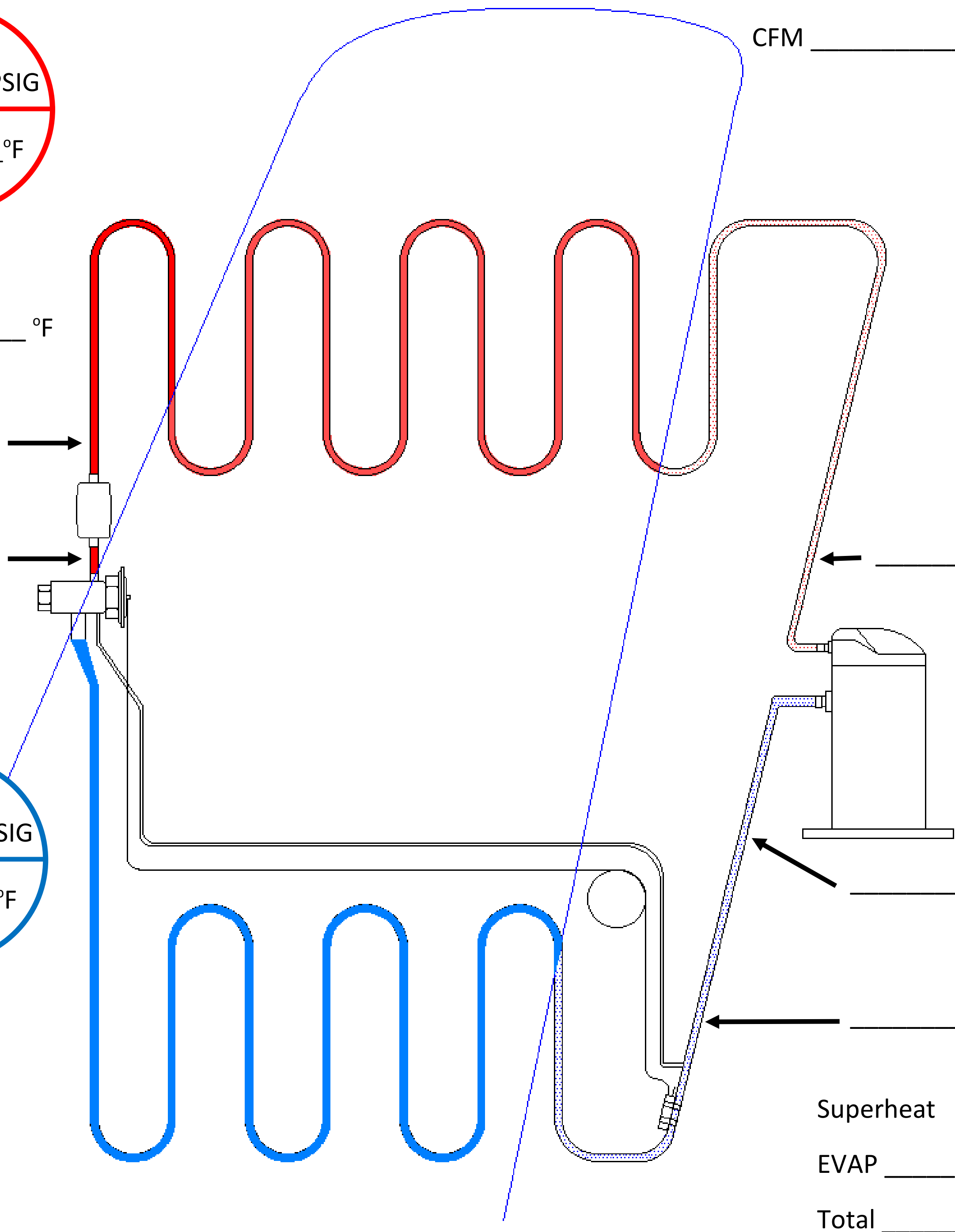
_________°F

SCT

Subcooling_______ °F

___________ °F

___________ °F



___________ °F

_________ PSIG

_________°F

SST

___________ °F

___________ °F

Superheat

EVAP ___________ °F

Total ___________ °F

Return Air

db ___________ °F

wb ___________ °F

ΔT ___________ °F

Supply Air

db ___________ °F

wb ___________ °F

HVAC Simulator was developed with the technician in mind. Training is essential to developing valuable skills and knowledge. Training is an effective way to understand theory in the ever advancing HVAC world.

Training helps students/technicians become more valuable employees, which can lead to promotions and better job opportunities, investing in yourself through training can be a great way to stay competitive and keep your career advancing.

Products offered:

- Heating Curriculum with desktop or digital simulator
- Comfort Cooling Curriculum with digital simulator

We offer many training tools and options. Check out our website for training videos, products and opportunities for growth individually, in a classroom, or as a company.

www.HVACsimulator.com

HVAC SIMULATOR

Nauman Innovation Group LLC

Nauman Innovation Group LLC
2601 West Lake Avenue
Suite A6 #147
Peoria, Illinois 61615
(309) 323-0013
office@hvacsimulator.com