



Index

Chapter 1 - Getting Started

- What is Garden City Ammonia Program?
- What is Refrigeration?
- Why Refrigeration?
- Why Take an Operator I Course?
- Is there a Career in the Industrial Refrigeration Field for Me?
- What are the Five Skill Areas that I Should Have?
- What is Certification?
- What are my Responsibilities Getting Started in this Field?
- What can I Expect on the First Week of My New Job as a Helper?
- What Type of Training Should I Expect?
- Are there Any Levels or Job Descriptions in this Field?
- Who is Covered Under the Process Safety Training Element?
- How Often Must This Training be Conducted?
- What Should this Training Accomplish?
- Are There Any National Standard for Operating Training?
- How much Must I Know about Process Safety Management to be an Operator?
- Are there Any Organizations that Can Help Me in my Career?

Chapter 2 - PSM Introduction

- What are My Responsibilities with the PSM Program?
- What if I am Facility Management?
- What if I am a Manager?
- What if I am an Operator?
- What if I am a Human Resources Manager?
- What is Process Safety Management?
- What is Hard Hat Safety?
- What is the History of Process Safety Management?
- What are Some of these Failures?
- What Regulations Came Out of these Failures?
- What is a Covered Process?
- Doesn't this seem Excessive for such a Commonly Used Chemical Such as Ammonia?



What is in the Employee Participation Element?
What is in the Process Safety Information Element?
What is a Process Hazard Analysis?
What is in the Mechanical Integrity Element?
What is in the Operating Procedures Element?
What is in the Employee Training Element?
What does "To the Extent they can affect the process" Mean?
How do I Properly Document this Training?
How do I Train the People Who are NOT Operating the Process?
How do I Train the People Who are Actually Operating the Process?
What is the Management of Change Element?
What is the Pre-Startup Safety Review Element?
What is the Incident Investigation Element?
What is the Contractors Element?
What is the Compliance Audit Element?
What is the Emergency Planning and Response Element?
What is the Hot Work Permit Element?
What is the Trade Secrets Element?
What is CFR 1910.119?

Chapter 3 – Ammonia

What is Anhydrous Ammonia?
Where is Ammonia?
What are some Chemical Characteristics of Ammonia?
What are some of the Benefits of Ammonia?
Why is Ammonia considered to be Environmentally Friendly Refrigerant?
Why is Ammonia's Pungent Odor Important for Safety?
How Dangerous is Ammonia to Living Things?
What is PEL for Ammonia?
What if my Company will not Provide me a Respirator?
What is IDLH for Ammonia?
What if we have a Release of 100 Pounds of Ammonia or Greater?
What Type of Injuries Can I Receive with Ammonia Exposure?
Do You Have Your Eyes Protected?
What Can be done If I am Exposed to Large Amounts of Ammonia?
Can I Wear Contact Lenses at Work?



Converting PPM to Percentage Concentrations?
Can Ammonia Burn?
What is the Fire Diamond for Ammonia?
DOT: Department of Transportation Symbols?
Are there Any Warning Labels or Signs that Let Us Know
That Ammonia Could
be Present in Areas?
Hydrostatic Expansion?
Should I Ever Apply Water to Liquid Ammonia?
Can I Apply Liquid Water to Ammonia Gas (Vapor)?
Where does Ammonia Go when it is Released?
Dilution Rate for Ammonia?
Why do We use Ammonia as a Refrigerant?
Are there any Common Questions or Misconceptions about Ammonia I should
Know?
What does ILAR Recommend you Have Access to for PPE?
Why is Oil Draining So Dangerous?
Toxicity / Flammability Classification?
Are there any Materials Ammonia should Avoid?
Contamination Inside the System?
What is Ammonia's Thermodynamic Properties?
Determining the Point of a Refrigerant Leak?
Different Types of Ammonia Sensors?
What are some other Regulations that one Might Become Familiar with when
Dealing with Ammonia?
What is RAGAGEP?
Can I Use Just any Hose to Transfer Ammonia?
How do I Read an MSDS?
What does Ammonia's Unique Saturation Chart Look Like?
Ammonia Home Work

Chapter 4 – Basic Electricity

- What is Electricity?
- How much Electrical Current can Hurt Me?
- What is Ark Flash?
- What does Electrical Calculations and Formulas do for Me?
- How much BTU's is in an Horsepower?
- Where can I Find the Information to do Calculations of Base Line Audits?
- How do I Calculate Kilowatts (kW)?
- What is Voltage?
- What is the Plants Power Factor?
- What is Amps?
- What is Full Load Amps? (FLA)
- What is Locked Rotor Amps? (LRA)
- How much Energy is a Horse Power? (HP)
- What is Break Horse Power? (BHP)
- What is the Percent Efficiency for an Electrical Motor?
- What is the Service Factor Rating on a Motor? (SF)
- What are some of the Horse Power Calculations?
- What is Ohm's Law?



Chapter 5 – Foundation

- What is a Rate?
- What is Tonnage?
- What is CFM?
- What is GPM?
- What is Mass Flow Rate?
- How do you find the Volume of a Round Cylinder?
- How do you find the Volume of a Room / Square / Rectangle?
- What is a Compression Ratio?
- What is Heat of Compression?
- What is a Closed Loop Refrigeration Cycle?
- What is an Opened Loop Refrigeration Cycle?
- What does an Enthalpy Diagram Look Like?
- What is the Definition of a Refrigerant?



What is the Definition of a Secondary Coolant?
Why is Pipe Labeling so Important?
Why do we Tag our Valves with Unique Identifiers?
Is there a Guideline for Colors of an Ammonia Pipe?
Does a New Operator Adjust Valves?
Why do we Do Walk-Throughs?
Why do we Take Readings or Rounds?
Do Systems Run Different from One Shift to Another?
What does "Air" Inside a Refrigeration System do?
Do all Refrigerants have the Same Operating Characteristics?
Where does Oil go in an Ammonia System?
Does Ice on Oil Pots Hurt Efficiency?
What is a King Valve?
What is a Queen Valve?
What is HPR?
What should I know about Charging a System?
Is Charging a New System or Component with Ammonia Different?
What is a Regulator?
What is a Solenoid?
What is a Check Valve?
What is an Isolation / Stop / Shut Off Valve?
What is a Float Valve?
What is a Level Probe / Controller?
What is a Relief Valve?
Where should Relief Valve Headers Discharge to?
Can you Turn on your Emergency Exhaust Fan Manually?
Does your Equipment Room have an Ammonia Alarm System?
What is the "Shut Down Button" on the Outside of My Engine Room?
What Information should be Found on your Main Engine Room Door?
What is a Block Flow Diagram?
What is a P&ID?
What is the Term Slug or Slugging?
What Causes a Fluid to have Movement?
What is Line Loss / Pressure Drop?
What is Liquid Viscosity?
What is a Pump Down?
What is a Pump Out?



What is a Line Opening Procedure / Permit?
What is Vibration Analysis?
What is Motor Alignment?
What is Oil Analysis?
What about Torqueing?
Can Water Condensation be a Problem in a Food Plant?
What are the Three Groups of Halocarbons?
What are Some Other Refrigerants?
What is a Zeoptrope or Azeotrope Refrigerant?
What are Organic / Inorganic Refrigerant Compounds?
Foundation Homework

Chapter 6 - Heat Transfer

What Are Some Key Numbers to Understand?
What is a BTU?
What is the First Law of Thermodynamics?
What is the Second Law of Thermodynamics?
What is Hot / Cold?
What is a Thermometer?
What is the Difference between Celsius and Fahrenheit?
How doe Heat Flow?
What are the Three Types of Heat Transfer?
What is Delta T (ΔT)?
What is Latent Heat?
What is Sensible Heat?
How Does Sensible / Latent Heat Affect Water?
What are some of the Basic Heat Transfer Equations?
What is Specific Heat?
What is Thermal Conductivity (k)?
What is R Value?
Why do we Insulate Portions of the Refrigeration System?
Non-Destructive Testing and Corrosion Under Insulation?
Heat Transfer Homework

Chapter 7 – Seeing Refrigeration From The Inside Out

What is Pressure?
How does Altitude Affect Atmospheric Pressure?
What is PSIA?
What is PSIG?
How do I Convert from PSIA to PSIG?
What is BARa?
What is a Vacuum?
Different Pressure Scales?
What is a Pressure Gauge?
What is Saturation?
What is Sub-Cooling?
What is Superheated?
What is a Vapor Pressure Curve?
What is more Important: Pressure or Temperature?
How do I Determine the Condition of the Refrigerant?
What is the Boiling Temperature of a Liquid?
What is the Condensing Temperature of a Gas?
What causes a Liquid to Boil?
What is Lifting of a Vessel?
What causes a Gas to Condense?
Densities of Gasses?
Densities of Liquids?
Volumes of Liquids?
Changing Space Changing State?
Seeing Refrigeration from the Inside Out Homework



Chapter 8 – Four Steps Of Refrigeration

How Important is the Four Steps of Refrigeration?
What is a Metering Valve / Expansion Valve?
What is Flash Gas / Tax Gas?
What is a Valve Bank / Valve Body?
What is an Evaporator?
What is a Compressor?
What is a Condenser?

What is the Refrigeration Cycle Summary?
GCAP's Airplane Wing?
Four Steps of Refrigeration Homework



Chapter 9 – Liquid Feeds

Liquid or Gas?
What are Some Evaporator Names?
What are the Three Feeds?
Why do we Use DX Systems?
How does the DX System Work?
DX Systems with an Accumulator?
75% SAT / 25% Superheated?
10° F Superheat on DX Systems?
Why Can't a Hand Expansion Valve Work on a DX System?
How does the TXV Valve Work?
Hunting and Surging?
What should I Know to Set Superheat?
Can't Control Superheat?
Internally / Externally Equalized TXV's?
Are Liquid Injection Cooling Systems Considered DX Systems?
DX Systems Review?
What are Flooded Systems?
What is a Surge Drum?
So how does the Flooded System Work?
Adjusting Flooded Systems?
Superheat in Flooded Systems?
Flash Gas in a Flooded System?
Disadvantages to a Flooded System?
Flooded / Baffled Shell and Tube?
Thermo-Syphon Systems?
Overfeed Systems?
How many Evaporators can be on this System?
Misconceptions of the Overfeed System?
Advantages of the Overfeed System?
How much Liquid is in an Overfeed Evaporator?
Superheat with the Overfeed System?

Flash Gas in the Overfeed System?
Metering Valve / Expansion Valve?
What should I do if I Lose Compressors on an Overfeed System?
Adjusting and Balancing Overfeed Systems?
Recording Metering Valve Positions?
Can Overfeeding an Overfeed Systems Drop Performance?
Positive Displacement Liquid Pumps?
Centrifugal Liquid Pumps?
Shaft Seal Liquid Pumps?
Semi-Hermetic Liquid Pumps?
How many Pumps can I Run?
Pump Pressure?
What is Cavitation?
Pump Slug?
What should be the Liquid Level in the Pump Package?
Defrosting Pumps?
What could a P&ID Look Like for a Pump Package?
Could we have More than One Pump Package?
High Level Floats Tripping?
Pumper Drum / Transfer Drum?
Double Pumper Drum?
Single Pumper Drum?
Can all Three Feeds be on the Same System?
Major Factor to Affect Heat Transfer in All Evaporators?
Forced Draft?
Induced Draft?
Parallel Flow?
Counter Flow?
Cross-Flow?
What are Reasons for Defrost?
Hot Gas Defrost?
Cool Gas Defrost?
Electric Defrost?
Water Defrost?
Continuous Glycol Defrost?
Air Defrost?
Liquid Feeds Homework

Chapter 10 - Compressor Applications

History of Compressors?
Positive Displacement Compressors?
What is the Definition of Equipment (Machinery) Room?
What are the Three Functions of a Compressor?
What is Heat of Compression?
Sizing of Compressors?
Sizing of Motors?
Limitation of Discharge Temperatures?
Compressor Safeties?
Single Stage Compression?
Two Stage Compression?
What are Open / Closed Compressors?
What are Compressors Driven By?
Can you Misalign a Direct Drive Motor?
Reciprocating Compressors?
Recip's Safety Springs?
Do Compressors Have Shaft Seals?
Recip's Volumetric Efficiency?
Recip's Cylinder Configuration?
Recip's RPM?
Recip's Compressor Capacity Control?
Recip's Oil Pressure?
Recip's Oil Flow?
Recip's Crankcase Oil Heater?
Why Does Oil Foam when you Start a Reciprocating Compressor?
Recip's Oil Separation?
Recip's Head Cooling?
Screw Compressors?
Screw Compressor Packages?
Single Screw Compressor?
Twin Screw Compressor?
Twin Screw Gear Ratios?
Direction of Rotation for Screw Compressors?
RPM of Screws?
Fixed Discharge Port of Screws?
Over / Under Compression of Screws?





Slide Valves for Screws?
Slide Stops for Screws?
Volumetric Efficiency of Screws?
Oil Flow of Screws?
Oil Separation in Screws?
Trouble Shooting the Oil Separator?
Cooling Screw Compressors?
Water / Glycol Oil Cooling?
Liquid Injection Oil Cooling?
Thermosyphon Oil Cooling?
Economizer / Side Port Screw Compressor?
Rotary Vane Compressor?
Oil Separation of Rotary Vanes?
Oil Cooling of Rotary Vanes?
Jacket Cooling of Rotary Vanes?
RPM of Vanes?
Capacity Control of Vanes?
Washboarding in Rotary Vanes?
Compressor Applications Homework

Chapter 11 - Condensers

History of Condensers?
Condensers Role in the Refrigeration Process?
Type of Condensers?
Air Cooled Condensers?
Water Cooled Condensers?
Evaporative Cooled Condensers?
Sizing Condensers?
Condenser Comparison?
Condenser Location?
Winter Operation?
Water Treatment?
Effects of Scale?
Water Distribution Nozzles?
Effects of Non-Condensable Gasses?
Checking for Non-Condensable Gasses?

Manual Purging?
Automatic Purging?
Condensate Drain Piping Considerations?
Condenser Homework



Chapter 12 - Different Systems

Class Room Handbook?
The Three Feeds?
Independent Thermosyphon?
Single Stage with Secondary Coolant Loop?
Single Stage Recirculating System with Thermosyphon Oil Cooling?
Single Stage Recirculating System with Liquid Injection Oil Cooling?
Single Stage Multiple Compressor Header?
Simple Two Stage Compression?
Two Stage Compression?
Complex Multi-Pressure Two Stage System?
GCAP's Airplane Wing?
CIRO Screens

Chapter 13 - Practice Exam

Chapter 14 - Acronyms and Definitions

Chapter 15 - Handouts