Refrigerating Engineers & Technicians Association

CIRO STUDY GUIDE

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Introduction to the CIRO Study Guide

This CIRO Study Guide is designed to help you prepare to demonstrate what you know and can do in this RETA certification test. You will be tested on concepts addressed in IR-1, IR-2, IR-4, BE-1 and BE-2.

You will improve your chances of earning your CIRO credential by treating this CIRO Study Guide as you would the technical manuals in a refrigeration facility where you work. Your chances of earning the CIRO credential improve if you are familiar with the details in the CIRO Study Guide. Just as your job requires that you know what is in operating manuals and when to refer to them to understand or resolve a problem, the CIRO test requires that you know what is in the References document and when to use it. ***You will not be told when to use the references for this test.***

Calculators

All calculations for the CIRO examination can be completed with a simple calculator. Candidates should bring a simple, non-printing calculator. Test centers are not required to provide a calculator to candidates during this test.

CIRO Content Outline

Content Areas	Number of Questions
1. Safety Standards and Practices	20
2. Electricity	15
3. Heat Flow	15
4. Monitoring System Performance	20
5. Valves, Controls and DX Systems	20
6. Liquid Overfeed and Flooded Systems	20
7. Two-Stage and Secondary Coolant Systems	15
8. Evaporator Defrost	10
Total Questions	135

The test includes 10 questions that are distributed across all content areas that are not included in candidate scores. Test results are based on 125 scored questions. The 10 pilot questions are being tested for use in future CIRO examinations.

Refrigeration System Screens

The screens that appear in the CIRO examination provide information about operating conditions in a refrigeration system. Some screens include information about both "NORMAL" and "ABNORMAL" operating conditions. The screens do not specify how much time has passed between these two sets of data. Several months may have passed between the time when the "NORMAL" and "ABNORMAL" readings were recorded.

The CIRO examination requires you to demonstrate that you can use these screens to:

- Determine the condition of the refrigerant at any place in the system by knowing how to use the information provided.
- Analyze the findings of the conditions and apply your knowledge to adjust system components to resolve a problem and/or achieve a better running condition.
- Determine the cost of operating under the conditions indicated in the screens. In both dollars per hour and in power demand or consumption over time.
- Use refrigerant properties tables in the CIRO References and in this CIRO Study Guide to interpret information and/or solve a problem in the system's operating conditions. CIRO references in this Study Guide will be available on screen during the examination.

A sample screen appears on the next page. This is followed by a series of questions you should consider as you prepare to take the CIRO Examination.

Other sections of this CIRO Study Guide provide similar guidance for this examination. These include a list of formulas, an Ammonia SDS, Theoretical Discharge Charts, and refrigerant properties tables. The CIRO Study Guide also includes 24 screens that provide information that may be needed to answer questions on the CIRO exam.

SAMPLE CIRO SCREEN 300 HP SCREW COMPRESSOR – NH3 NORMAL CONDITIONS				
SUCTION PRESSURE	32 PSIG		SCREW COMPRESSOR MOTOR AMPS	295 AMPS
DISCHARGE PRESSURE	154 PSIG		SCREW COMPRESSOR MOTOR VOLTAGE	480 VAC
OIL PRESSURE	55 PSID		SCREW COMPRESSOR SLIDE VALVE POSITION	100%
SUCTION TEMP	26°F		CONDENSER WATER SUMP TEMP	75°F
DISCHARGE TEMP	171°F		CONDENSED LIQUID TEMP	85°F
OIL TEMPERATURE	136°F		CONDENSER OUTLET PRESSURE	151 PSIG
OIL COOLER – OIL INLET TEMP	171°F			
OIL COOLER – REFRIGERANT OUTLET TEMP	85°F		**- THERMO SIPHON OIL COOLING** **- CONDENSER OUTLET NOT SUBCOOLED**	
NOTES: POWER FACTOR IS 0.86			**MOTOR TYPE IS 3 PHASE**	
MOTOR EFFICIENCY IS 93%				
CONDENSER TYPE IS EVAPORATIVE				

SAMPLE CIRO SCREEN 300 HP SCREW COMPRESSOR – NH3 ABNORMAL CONDITIONS				
SUCTION PRESSURE	32 PSIG		SCREW COMPRESSOR MOTOR AMPS	339 AMPS
DISCHARGE PRESSURE	184 PSIG		SCREW COMPRESSOR MOTOR VOLTAGE	480 VAC
OIL PRESSURE	55 PSID		SCREW COMPRESSOR SLIDE VALVE POSITION	100%
SUCTION TEMP	26°F		CONDENSER WATER SUMP TEMP	75°F
DISCHARGE TEMP	192°F		CONDENSED LIQUID TEMP	95°F
OIL TEMPERATURE	154°F		CONDENSER OUTLET PRESSURE	181 PSIG
OIL COOLER – OIL INLET TEMP	192°F			
OIL COOLER – REFRIGERANT OUTLET TEMP	95°F		**- THERMO SIPHON OIL COOLING** **- CONDENSER OUTLET NOT SUBCOOLED**	
NOTES: POWER FACTOR IS 0.86			**MOTOR TYPE IS 3 PHASE**	
MOTOR EFFICIENCY IS 93%				
CONDENSER TYPE IS EVAPORATIVE				

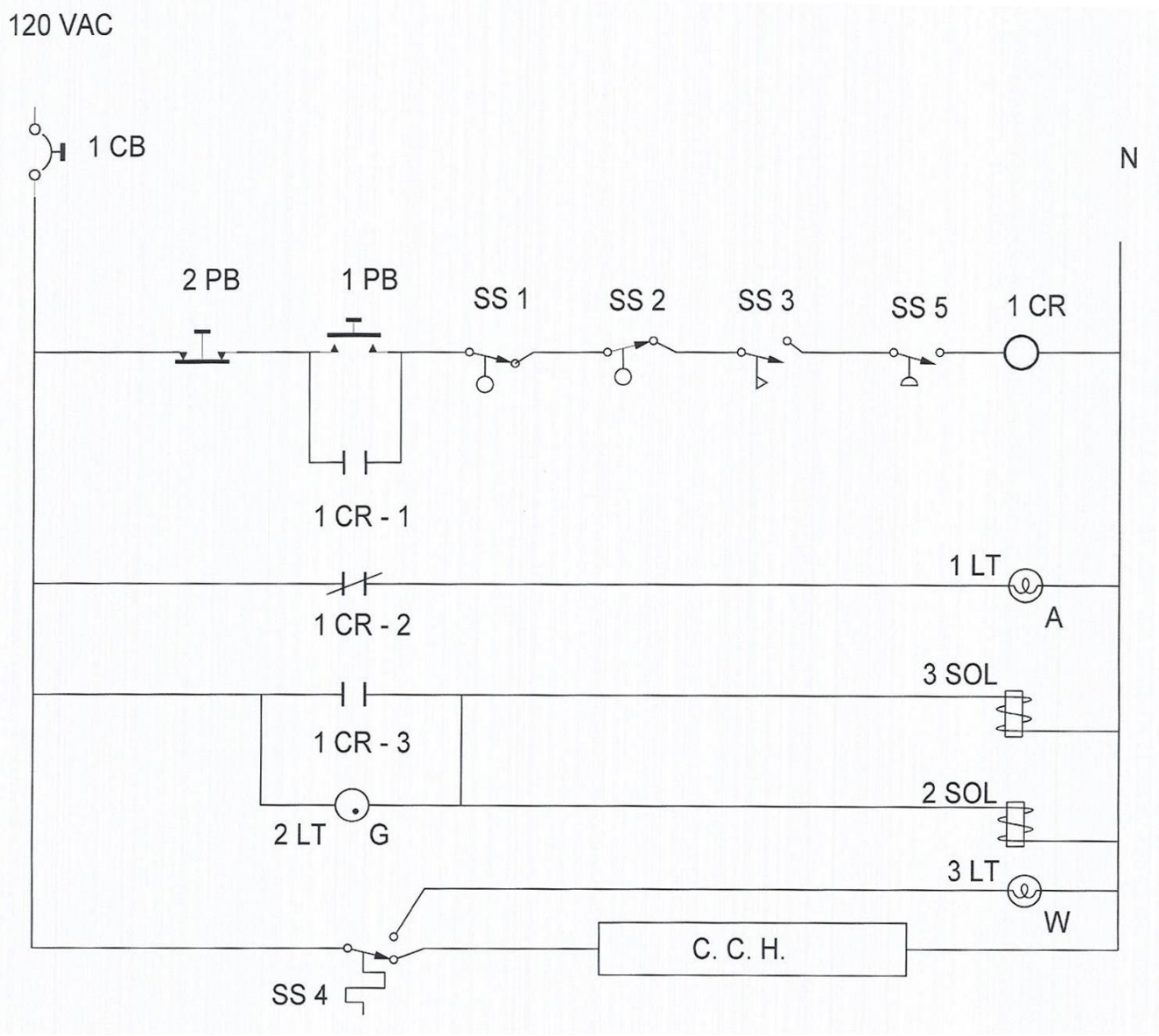
Answer the following questions based on NORMAL Conditions in the Sample CIRO Screen.

1. What is the superheat at the compressor inlet?
2. What is the temperature differential between the oil cooler oil inlet and the oil outlet?
3. What is the temperature differential between the oil cooler coolant outlet and the oil outlet?
4. What is the superheat at the compressor outlet?
5. What is the theoretical discharge temperature of the compressor under these conditions?
6. What is the pressure drop from the compressor discharge to the condenser outlet?
7. What is the excess pressure due to non-condensables in the system?
8. What is the condition of the refrigerant leaving the oil cooler?
9. How much horsepower is being developed by the compressor motor under the normal conditions?
10. What is the instantaneous Kw demand developed by the compressor motor under normal conditions?
11. If power is $0.17 per kwh, how much does it cost to run the motor under normal conditions for one hour? For one day (24 hours)? For one week? For a 5000 run-hour year?

Answer the following questions based on ABNORMAL Conditions in the Sample CIRO Screen.

12. What is the superheat at the compressor inlet?
13. What is the temperature differential between the oil cooler oil inlet and the oil outlet?
14. What is the temperature differential between the oil cooler coolant outlet and the oil outlet?
15. What is the oil cooling coolant?
16. What is the superheat at the compressor outlet?
17. What is the theoretical discharge temperature of the compressor under these conditions?
18. What is the pressure drop from the compressor discharge to the condenser outlet?
19. What is the excess pressure due to non-condensables in the “abnormal” system?
20. What is the condition of the refrigerant leaving the oil cooler?
21. How much horsepower is being developed by the compressor motor?
22. What is the instantaneous Kw demand developed by the compressor motor?
23. If power is $0.17 per kwh, how much does it cost to run the motor under normal conditions for one hour? For one day (24 hours)? For one week? For a 5000 run-time year?
24. What is the excess cost per hour for running poorly? For 24 hours? For one week? For a 5000 run-hour year?
25. What would happen to the condenser sump temperature if the fans were not running if you assume the wet bulb temperature is the same as under NORMAL conditions?
26. What would happen to the condenser sump water temperature if the pump was not running if you assume the wet bulb temperature is the same as under NORMAL conditions?
27. What might happen to the condenser sump water temperature if the coils were sealed up significantly?
28. What might be going on that causes the higher condensing conditions?

Figure 18 Electrical Diagram



Answer the following questions based on the above electrical diagram.

1. How many neon lamps are in the drawing?
2. Is there a latching circuit in the drawing?
3. Which level switch closes on “low”?
4. What does 1CR do?
5. What switch is single pole – double throw?
6. What happens if 1CB trips?
7. When is 2LT illuminated?
8. What has to happen for 1CR to be energized?

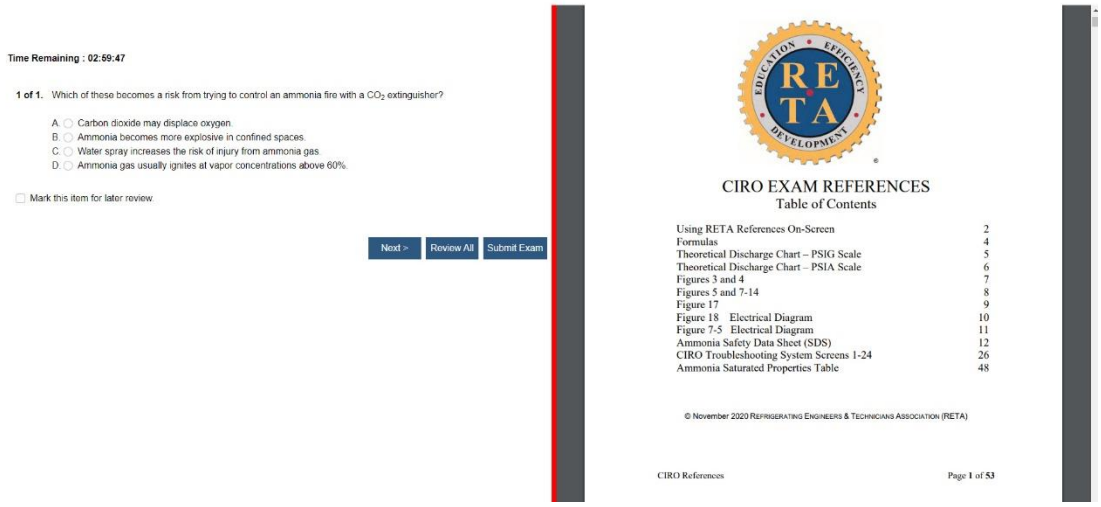
The remaining pages in this Study Guide will appear on-screen during the test. The first two pages illustrate how to navigate these references. The remaining pages provide the content that is included in these References during the test.

Using Onscreen References during the CIRO Examination

CIRO examinations taken in a proctored test center display onscreen references that appear in a PDF next to test questions. This section provides a sample question and sample screens to illustrate the tools available to find information in the onscreen references during the test.

Sample References Screen 1 shows the CIRO REFERENCES Table of Contents on the right side of the screen and a sample question on the left side. The CIRO Study Guide provides the references that appear onscreen in the CIRO practice test and during the full CIRO examination.

Sample References Screen 1



The following tools can help you use information in the CIRO References file.

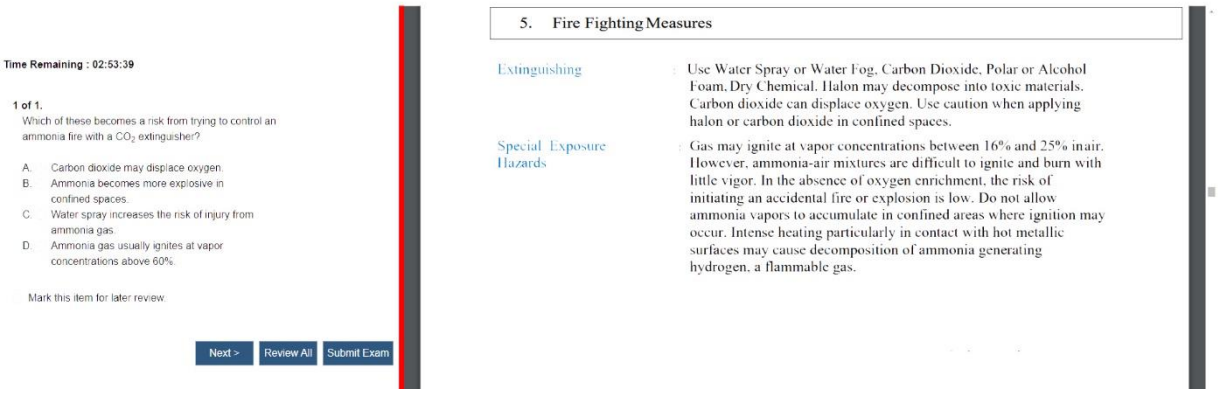
- Questions appear on the left side of the vertical line in the center of the screen.
- Time remaining appears in a countdown timer above the question.
- "Mark this item for later review" below the question lets the candidate flag the question to review later.
- Three buttons also appear below the question near the centerline:
  - Use the **Next** button to record the answer to a question and move to the next question on the test.
  - Use the **Review All** button to move to a screen that shows which questions you have answered and identifies questions you have marked for later review.
  - Use the **Submit Exam** button as the first of three steps required to end the test.

Candidates can move to each page in the onscreen references document by using one of these tools.

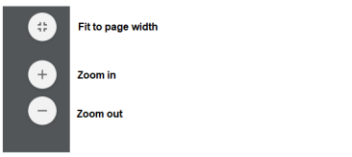
- Place the cursor on the icon in far-right column at the top of the screen, then drag it to move to the page with the desired information. ***OR***
- Use the mouse scroll wheel to move to the page with the desired information.

Candidates can expand the right side of the screen by moving the centerline to the left. **Sample References Screen 2** also shows the Fire Fighting Measures section of the Ammonia Safety Data Sheet (SDS) where the answer to the sample question appears. "Carbon dioxide can displace oxygen" parallels answer A in the sample question.

Sample References Screen 2



Three navigation buttons appear on the far right side of the screen during a test. The top button fits the image to the width of the window on the right side of the screen. Zoom in or out to make pages in the References larger or smaller by holding down the Control key and using the scroll wheel on the mouse.



The CTRL key + Mouse scroll wheel can also be used to zoom in or out.

Formulas

Area of a rectangle: $A = side1 \bullet side2$

Area of a circle: $A = Radius \bullet Radius \bullet 3.1416$

Volume of a room $V = side1 \bullet side2 \bullet side3$

Volume of a cylinder $V = Length \bullet radius \bullet radius \bullet 3.1416$

One Horsepower (HP or BHP) = 2545 BTU / HR

To find kiloWatts of power (3 phase)

$$kW = \frac{Amps \bullet Volts \bullet PowerFactor \bullet 1.73}{1000}$$

To find Brake Horsepower used by a driven device (3 phase motor)

$$bhp = \frac{Amps \bullet Volts \bullet PowerFactor \bullet Efficiency \bullet 1.73}{746}$$

To find Power Cost in Dollars per Hour:

$$Cost(\$/Hr) = (kiloWatt\,hour\ price \bullet kiloWatt\,hours) \div Hours$$

To find Power Cost in Dollars:

$$Cost(\$) = (kiloWatt\,hour\ price \bullet kiloWatt\,hours)$$

To find Brake Horsepower (used by a driven device) per TR (Ton of Refrigeration)

$$bhp\ per\ Ton = \frac{bhp}{TR}$$

To find kiloWatts per Ton of Refrigeration (TR)

$$kiloWatts\ per\ Ton = \frac{kW}{TR}$$

Heat Transfer Equations Where:

M= Mass or weight of object
Cp = Specific Heat of object
(T1-T2) = Difference in temperature before and after process
hL = Latent Heat quantity in a pound of the object

Sensible Heat Transfer: $Qsensible = M \bullet Cp \bullet (T1 - T2)$

Latent Heat Transfer: $Qlatent = M \bullet hL$

Compression Ratio Equation:

Ratio = Absolute Discharge Pressure / Absolute Suction Pressure

Vacuum Conversion: Use Saturation Tables

Flow Coefficient $C_v = GPM \sqrt{SG/PSID}$

Theoretical Discharge Temperature

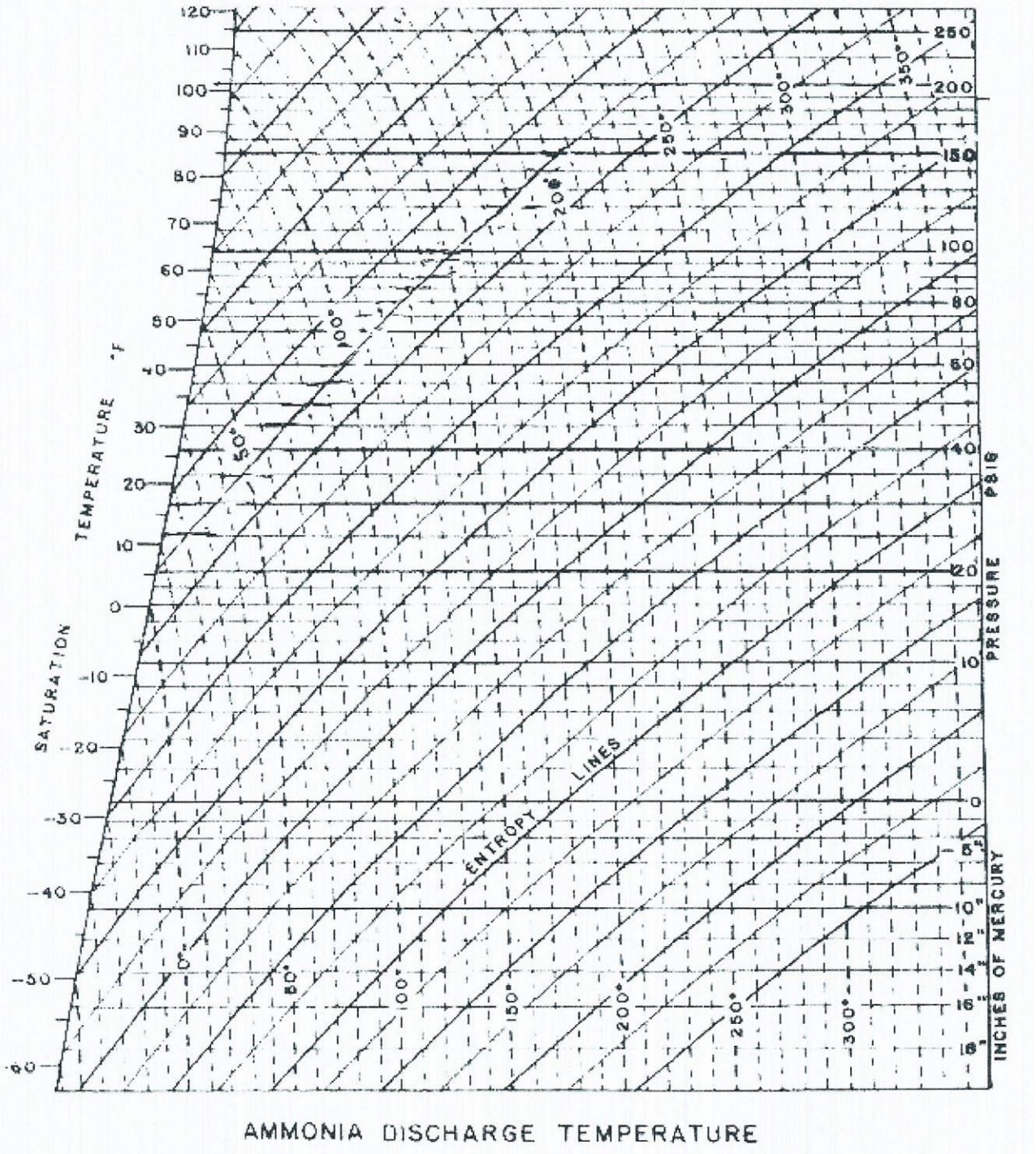


Figure 6-7 Ammonia Discharge Temperature Illustration - PSIG

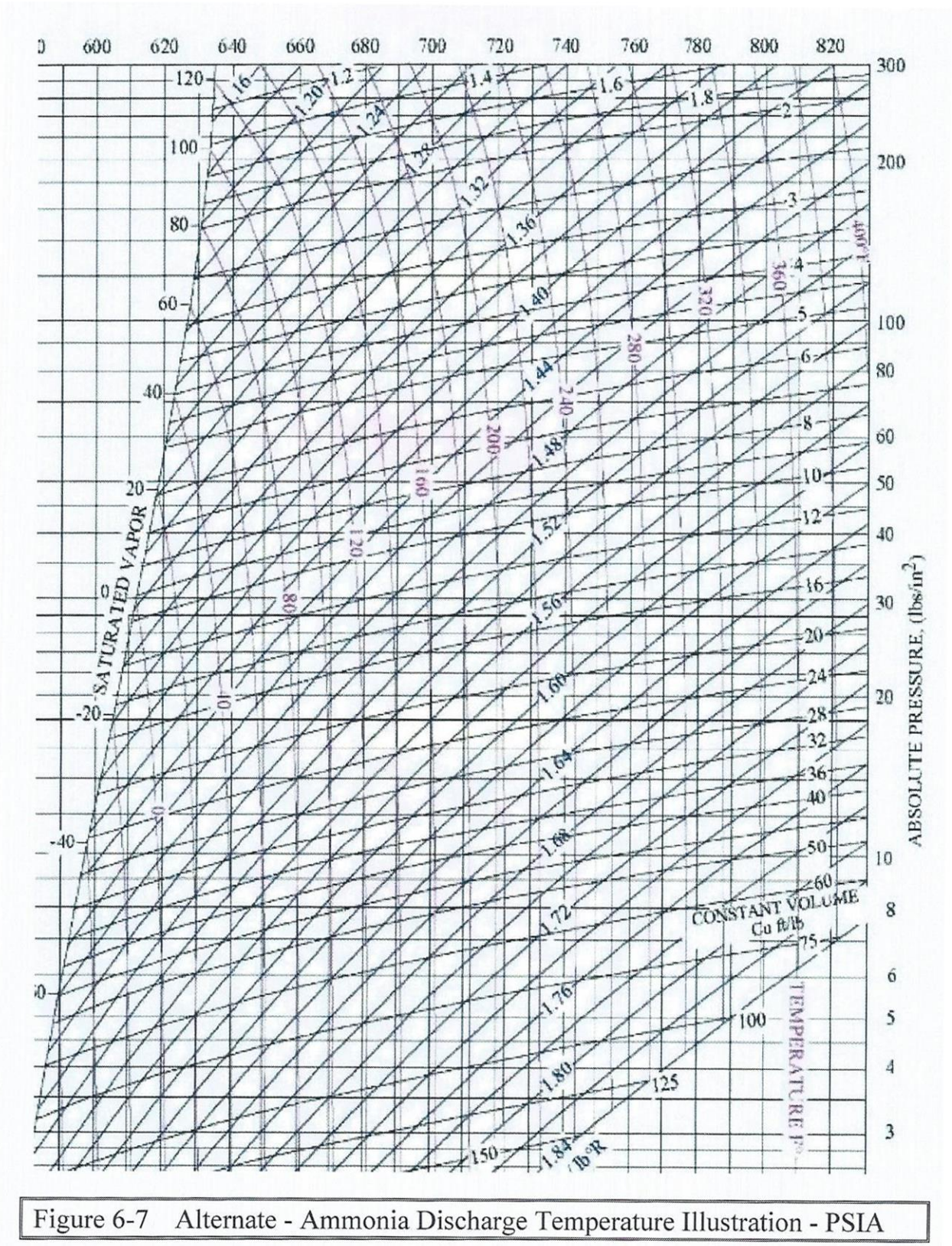


Figure 6-7 Alternate - Ammonia Discharge Temperature Illustration - PSIA

Figure 3

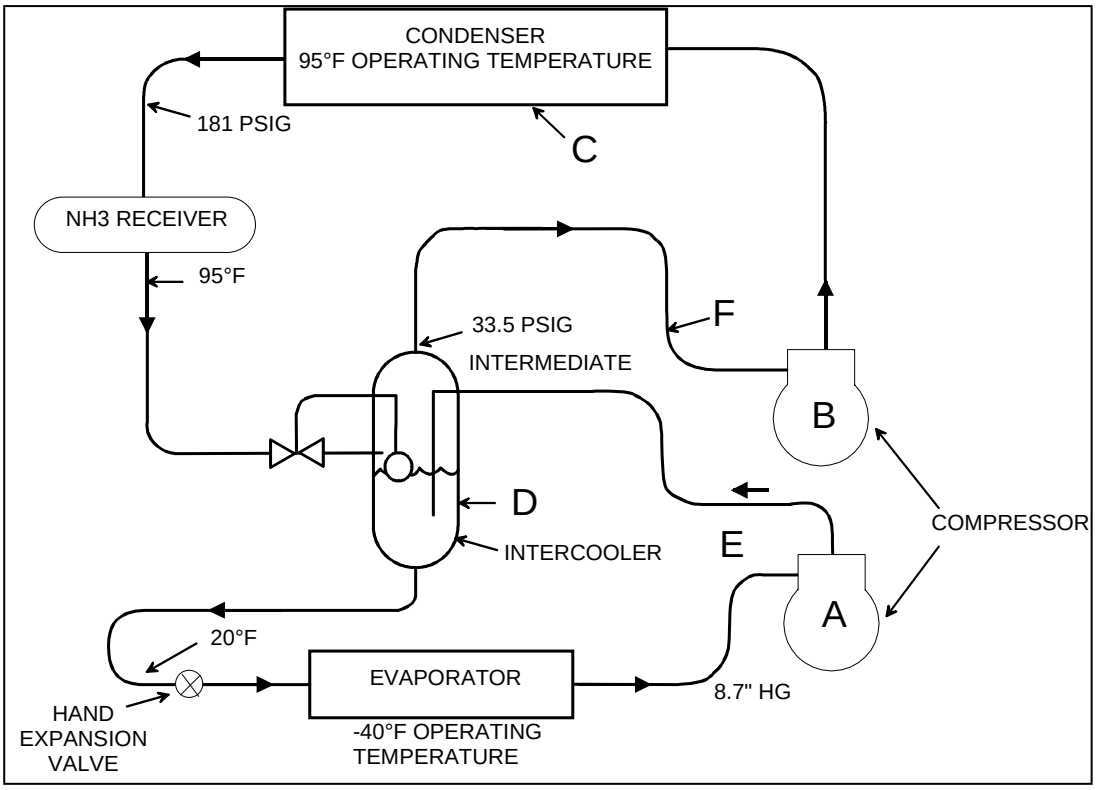
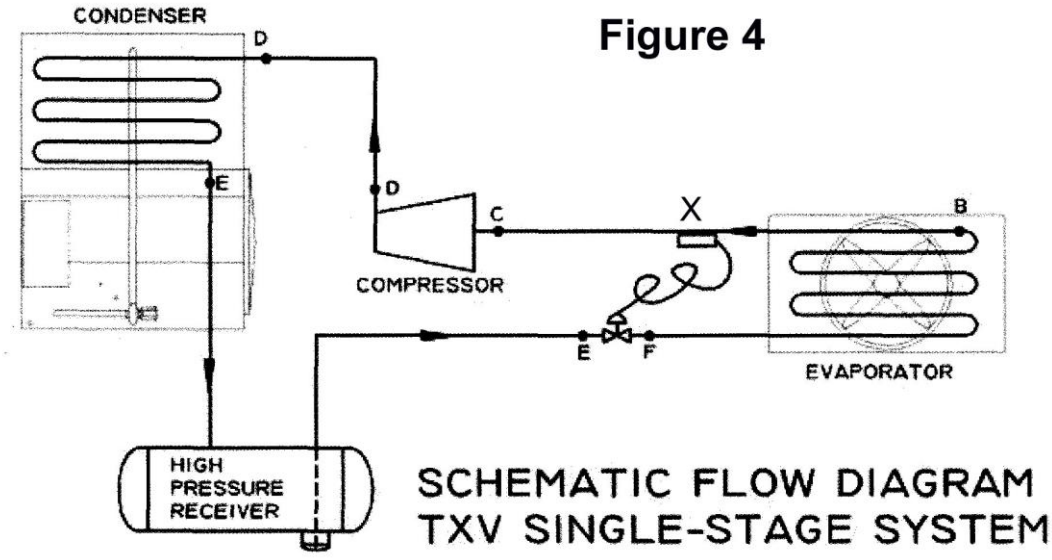


Figure 4



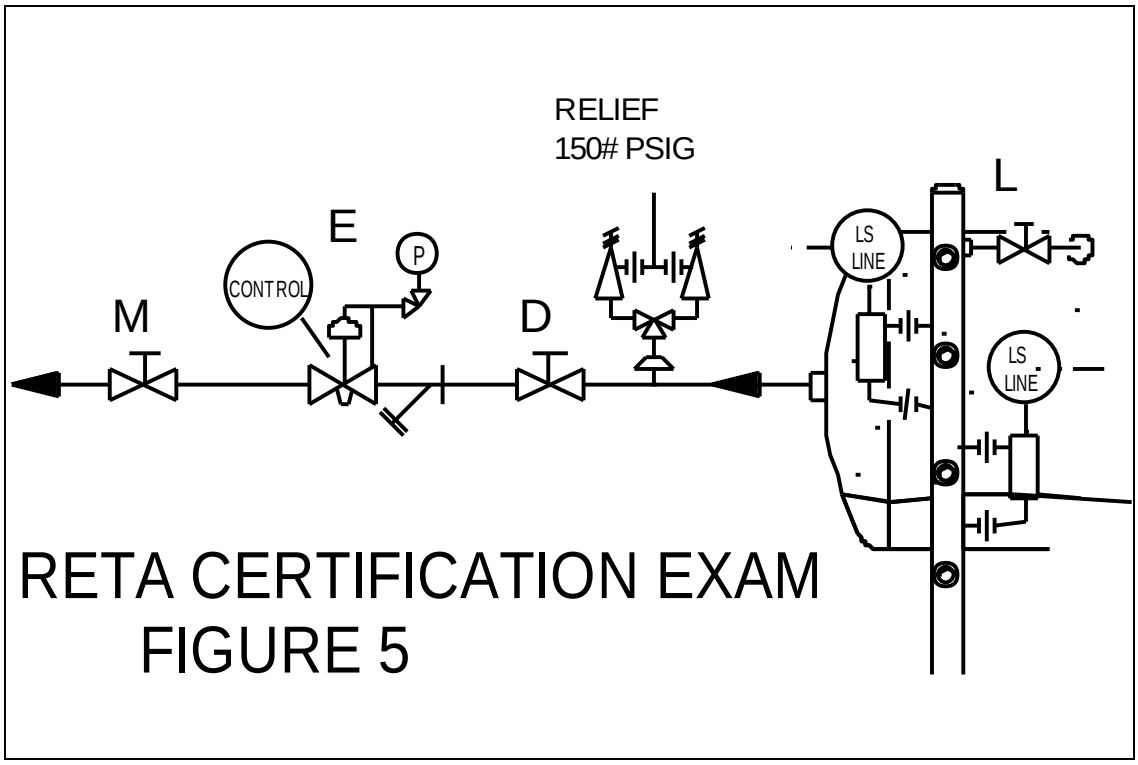
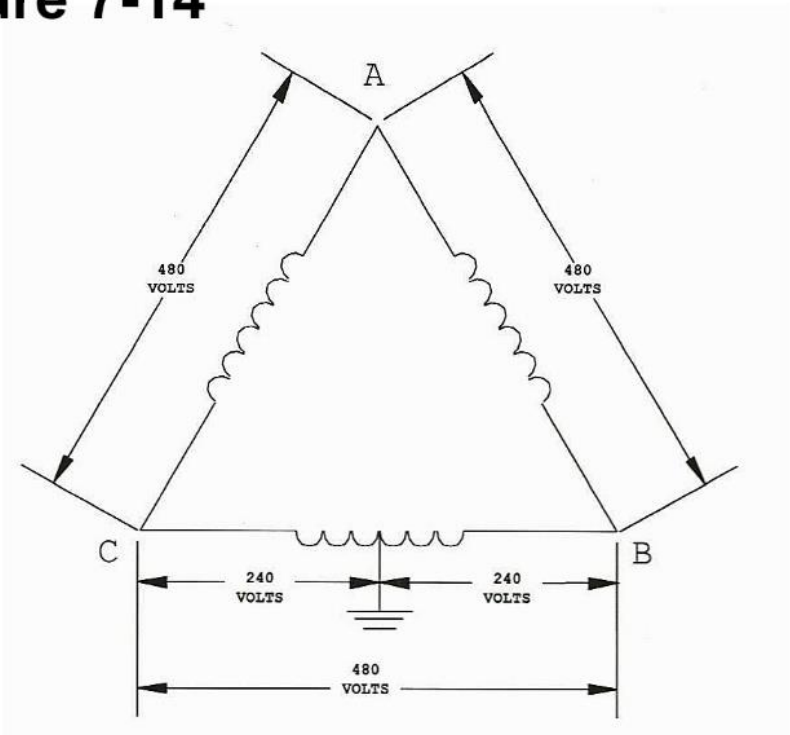

RELIEF
150# PSIG
L
E
P
CONTROL
M
D
LS
LINE
LS
LINE
RETA CERTIFICATION EXAM
FIGURE 5

Figure 7-14


A
480
VOLTS
480
VOLTS
C
B
240
VOLTS
240
VOLTS
480
VOLTS

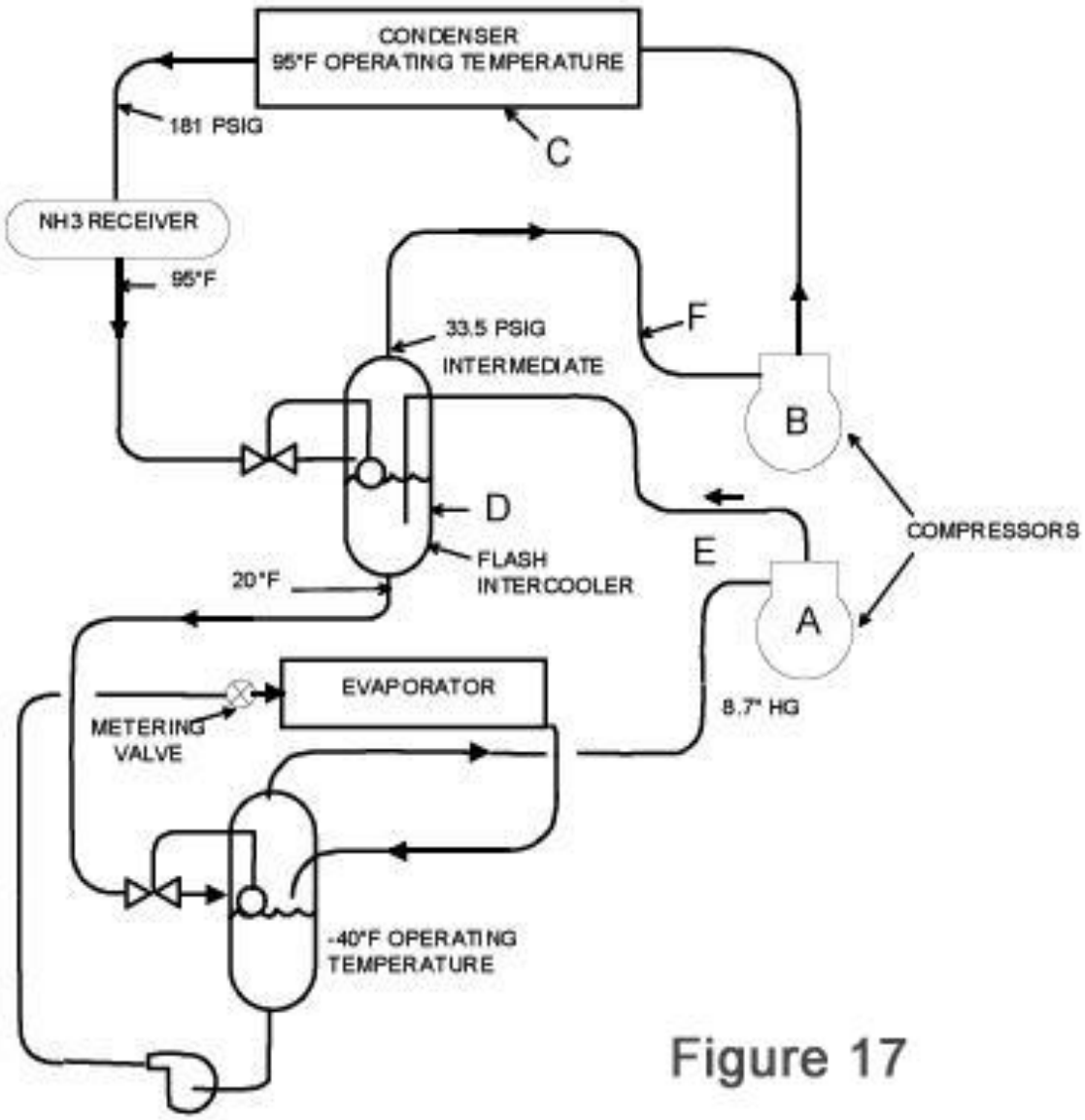

CONDENSER
95°F OPERATING TEMPERATURE
181 PSIG
C
NH3 RECEIVER
95°F
33.5 PSIG
INTERMEDIATE
F
B
D
FLASH
INTERCOOLER
COMPRESSORS
E
20°F
A
EVAPORATOR
8.7" HG
METERING
VALVE
-40°F OPERATING
TEMPERATURE

Figure 17

Figure 18 Electrical Diagram

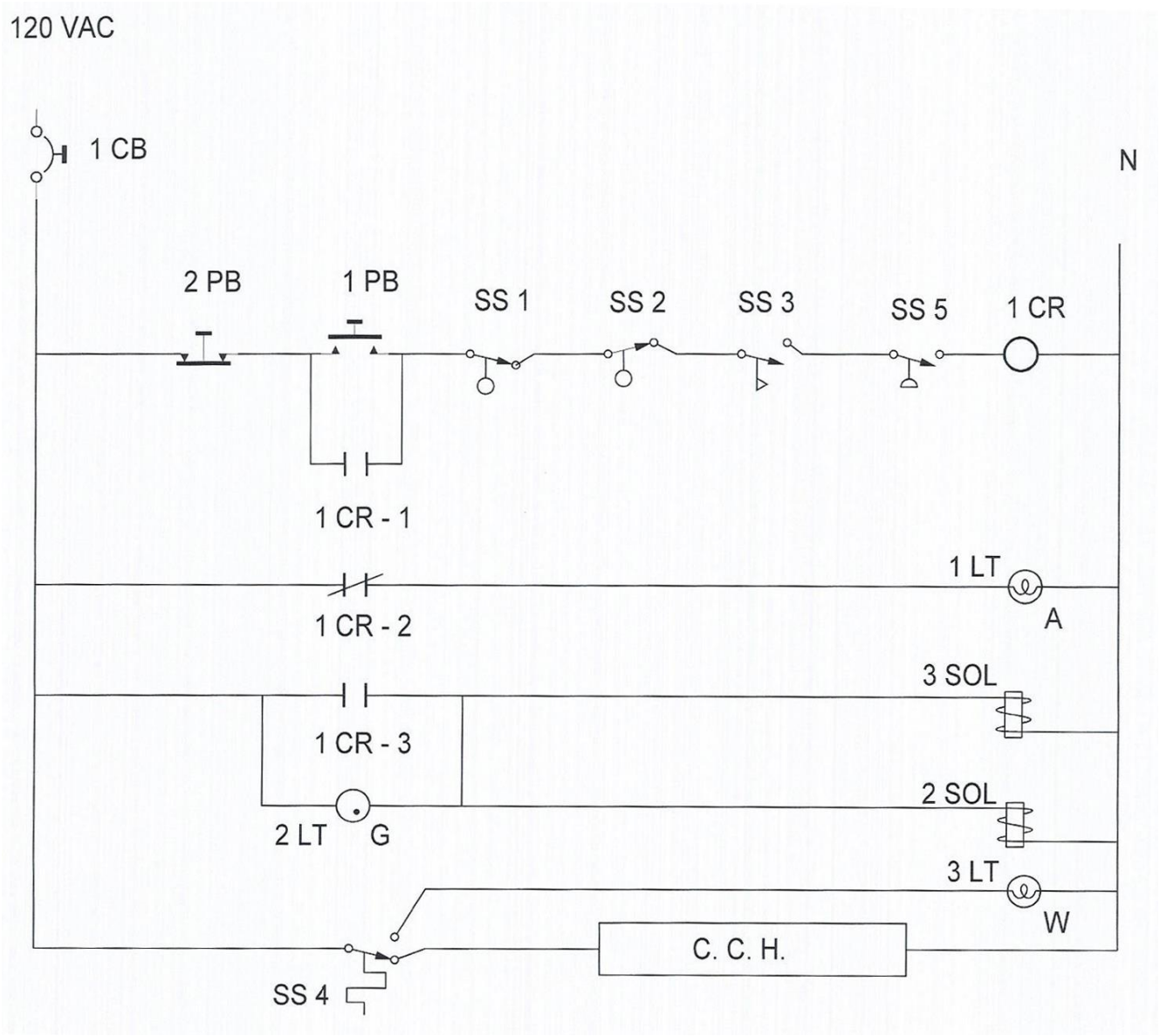
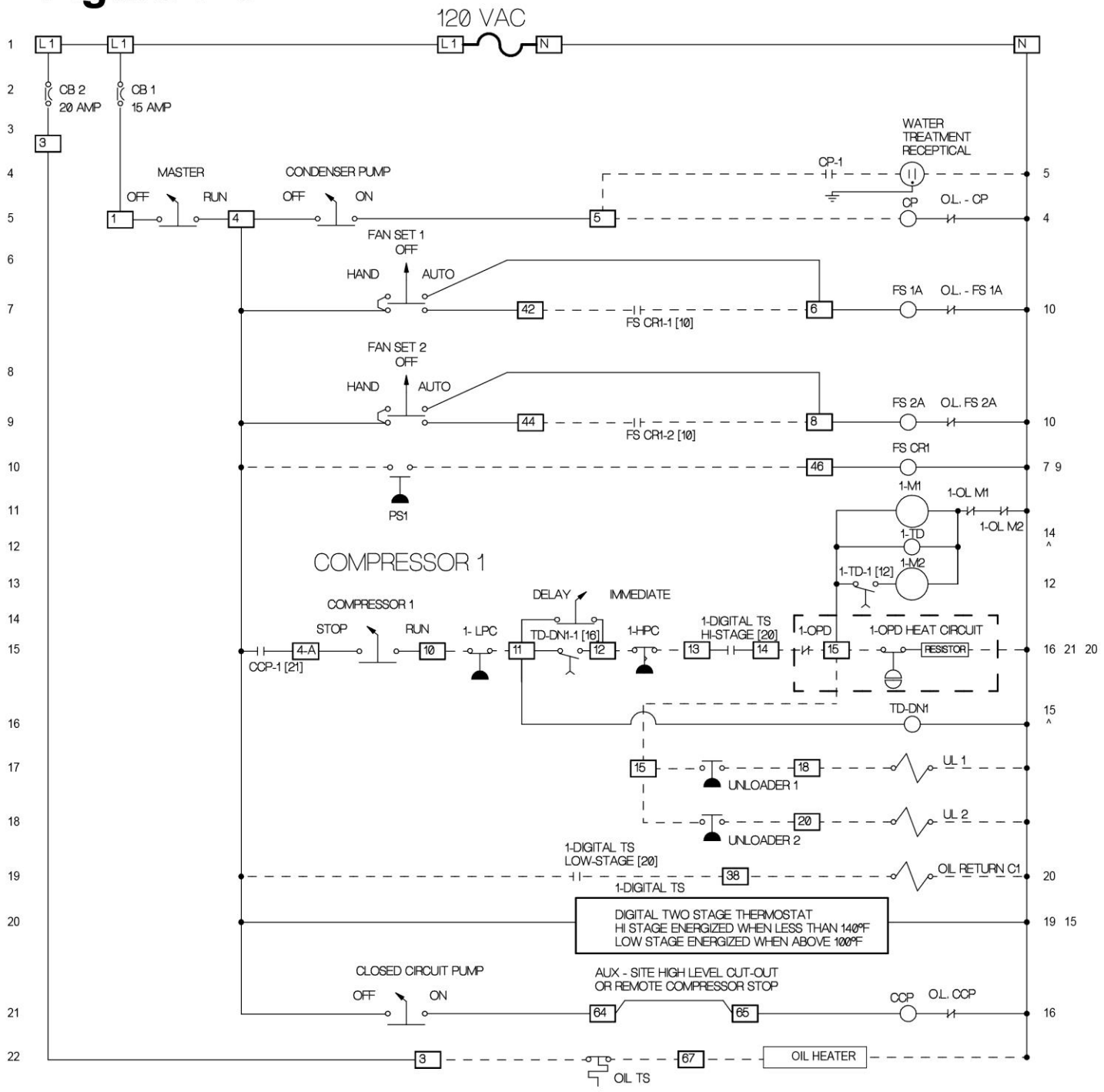


Figure 7-5


120 VAC
L1
L1
L1
N
N
CB 2
20 AMP
CB 1
15 AMP
3
MASTER
OFF
RUN
CONDENSER PUMP
OFF
ON
1
4
5
WATER
TREATMENT
RECEPTICAL
CP-1
CP
O.L. - CP
FAN SET 1
OFF
HAND
AUTO
42
6
FS 1A
O.L. - FS 1A
FS CR1-1 [10]
FAN SET 2
OFF
HAND
AUTO
44
8
FS 2A
O.L. FS 2A
FS CR1-2 [10]
46
FS CR1
PS1
1-M1
1-OL M1
1-OL M2
1-TD
1-M2
1-TD-1 [12]
COMPRESSOR 1
COMPRESSOR 1
STOP
RUN
10
1- LPC
DELAY
IMMEDIATE
TD-DN1-1 [16]
11
12
1-HPC
1-DIGITAL TS
HI-STAGE [20]
13
14
1-OPD
15
1-OPD HEAT CIRCUIT
RESISTOR
4-A
CCP-1 [21]
TD-DN1
15
18
UL 1
UNLOADER 1
20
UL 2
UNLOADER 2
1-DIGITAL TS
LOW-STAGE [20]
38
OIL RETURN C1
1-DIGITAL TS
DIGITAL TWO STAGE THERMOSTAT
HI STAGE ENERGIZED WHEN LESS THAN 140°F
LOW STAGE ENERGIZED WHEN ABOVE 100°F
CLOSED CIRCUIT PUMP
OFF
ON
AUX - SITE HIGH LEVEL CUT-OUT
OR REMOTE COMPRESSOR STOP
64
65
CCP
O.L. CCP
3
67
OIL HEATER
OIL TS

Safety Data Sheet

1. Product Identifier and CompanyIdentification

Product name	:	Anhydrous Ammonia
HBCC SDS number	:	CA10000
Synonym	:	Ammonia; NH_3
Product use and Restrictions	:	Refer to label or call
Manufacturer Contact Address	:	Corporate Headquarters Hill Brothers Chemical Company 1675 North Main Street Orange, California 92867 714-998-8800 800-821-7234
		Corporate Safety & Compliance Hill Brothers Chemical Company 7121 West Bell Road, Suite 250 Glendale, Arizona 85308 623-535-9955 - Office 623-535-9944 - Fax
Emergency telephone Number (Chemtrec)	:	800-424-9300
Website	:	http://hillbrothers.com

2. Hazard Identification

Classification : Flammable Gases – Category 2
Gases Under Pressure – Compressed Gas
Acute Toxicity: Inhalation – Category 3
Skin Corrosion/Irritation – Category 1B
Serious Eye Damage/Eye Irritation – Category 1
Aquatic Toxicity (Chronic) – Category 1

Signal Word : DANGER

Pictogram(s) :

Hazard Statements : Flammable Gas.
Contains gas under pressure; may explode if heated. Toxic if inhaled.
Causes severe skin burns and eye damage.
Very toxic to aquatic life with long lasting effects.

Precautionary Statements

Response : IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing. Immediately call a POISON CENTER or doctor.

IF SWALLOWED: Rinse mouth. Immediately call a POISON CENTER of physician. Do NOT induce vomiting.

IF ON SKIN (or hair): Take off

immediately all contaminated clothing. Rinse skin with water or shower. Wash contaminated clothing before reuse. Immediately call a POISON CENTER or doctor.

IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do.

Continue rinsing. Immediately call a POISON CENTER or doctor.

Prevention : Wear protective gloves, protective clothing, eye protection and face protection.
Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. – No Smoking.
Use only outdoors or in a well-ventilated area.
Avoid release to the environment.
Do NOT breathe gas or vapors.
Wash hands thoroughly after handling. Collect spillage.
Leaking gas fire: Do not extinguish, unless can leak be stopped safely.
In case of leakage, eliminate all ignition sources.

Storage : Store locked up.
Protect from sunlight.
Store in a well-ventilated place. Keep container tightly closed.

Disposal : Dispose of contents and container in accordance with all local, regional, national and international regulations.

3. Composition/Information on Ingredients

CAS Number	Ingredient Name	Weight %
7664-41-7	Anhydrous Ammonia (NH_3)	99.8 – 99.999% wt.
7732-18-5	Water	0.2% -.001% wt.

4. First Aid Measures

Ingestion	:	If this gas is swallowed in liquid form, keep victim warm and OBTAIN IMMEDIATE MEDICAL ATTENTION. If signs of respiratory obstruction develop, immediately transport to medical facility. Do not induce vomiting. Never give fluids or induce vomiting if patient is unconscious or having convulsions.
Inhalation	:	Remove victim to fresh air. Give oxygen if breathing is difficult. If breathing has stopped, start artificial respiration. OBTAIN IMMEDIATE MEDICAL ATTENTION.
Skin	:	Apply water immediately to exposed areas of skin and continue for at least 30 minutes. Remove contaminated clothing, shoes, and constrictive clothing while continuing to apply water, being careful not to tear the skin. If skin surface is damaged, apply a clean dressing. If skin surface is not damaged, cleanse the affected area(s) thoroughly with mild soap and water. Do not apply salves or ointments to affected areas. OBTAIN IMMEDIATE MEDICAL ATTENTION.
Eyes	:	Remove victim to fresh air. Immediately flush with plenty of water for at least 30 minutes with the eyelids held apart. OBTAIN IMMEDIATE MEDICAL ATTENTION.
Medical Conditions	:	Ammonia is a respiratory irritant. Persons with impaired pulmonary function may be at an increased risk from exposure. Also pre-existing skin disorders may be aggravated by exposure.
Effects of Overexposure	:	N/A
Summary of Acute Health Hazards	:	N/A
Ingestion	:	This material is a gas under normal atmospheric conditions and ingestion is unlikely. Ingestion of liquid ammonia may result in severe irritation or ulceration of the mouth, throat and digestive tract which may be displayed by nausea, vomiting, diarrhea and, in severe cases, collapse, shock and death.

Inhalation	:	Irritation to the mucous membranes of the nose, throat and lungs is noticeable at 100 ppm. Concentrations above 400 ppm will cause throat irritation and may destroy mucous surfaces upon prolonged contact. High concentrations can cause pulmonary edema. Breathing air containing concentrations greater than 5,000 ppm may cause sudden death from spasm or inflammation of the larynx.
Skin	:	Liquid Ammonia produces severe skin burns on contact. Ammonia gas may cause skin irritation, especially if skin is moist. The liquid can cause skin damage resulting from combined freezing and corrosive action on the skin. Atmospheric concentrations above 30,000 ppm will burn and blister skin after a few seconds of exposure.
Eyes	:	Exposure to high gas concentrations may cause temporary blindness and severe eye damage. Direct contact of the eyes with liquid ammonia will produce serious eye burns.
Note to Physicians	:	N/A
Summary of Chronic Health	:	N/A

5. Fire Fighting Measures

Extinguishing : Use Water Spray or Water Fog, Carbon Dioxide, Polar or Alcohol Foam, Dry Chemical. Halon may decompose into toxic materials. Carbon dioxide can displace oxygen. Use caution when applying halon or carbon dioxide in confined spaces.

Special Exposure Hazards : Gas may ignite at vapor concentrations between 16% and 25% in air. However, ammonia-air mixtures are difficult to ignite and burn with little vigor. In the absence of oxygen enrichment, the risk of initiating an accidental fire or explosion is low. Do not allow ammonia vapors to accumulate in confined areas where ignition may occur. Intense heating particularly in contact with hot metallic surfaces may cause decomposition of ammonia generating hydrogen, a flammable gas.

Special Protective Firefighters Equipment : Stop flow of gas. Use water fog to keep fire-exposed containers cool and to protect personnel effecting the shut-off. Wear self-contained breathing apparatus (SCBA) and encapsulating chemical protective clothing. Approach fire upwind and evacuate area downwind. Emergency responders in the danger area should wear bunker gear and self-contained breathing apparatus for fires beyond the incipient stage (29CFR 1910.156). In addition, wear other appropriate protective equipment as conditions warrant (See Section VIII). Isolate damage area, keep unauthorized personnel out. Stop spill/release if it can be done with minimal risk. If this cannot be done, allow fire to burn. Move undamaged containers from danger area if it can be done with minimal risk. Stay away from ends of container. Water spray may be useful in minimizing or dispersing vapors. Cool equipment exposed to fire with water, if it can be done with minimal risk.

Fire Fighting Procedures : Dry Chemical or carbon dioxide are recommended extinguishing media. Stop flow of gas before extinguishing fire. Use water spray to keep fire exposed containers cool. Extinguish fire using agent suitable for surrounding fire.

Combustible. Wear goggles, self-contained breathing apparatus, and rubber over clothing (including gloves). Stop flow of gas, or liquid if possible. Let fire burn.

If material involved in fire: Cool all affected containers with flooding quantities of water. Apply water from as far distance as possible. Use water spray to knock-down vapors. Solid streams of water may spread fire. Don not use water on material itself. Do not apply water to point of leak in tank car or container.

NFPA Rating : Health - 3
Flammability - 1
Instability - 0

0=Insignificant 1=Slight 2=Moderate 3=High 4=Extreme

Uniform Fire Code Rating : According to the (UFC) Uniform Fire Code Standard 79-3 (2000), the degree of Hazard is 3-3-0 in a confined space.

Additional Description Requirement : Inhalation Hazard

6. Accidental Release Measures

Personal Precautions : Note that although ammonia gas is lighter than air, sudden release may generate an aerosol of liquefied ammonia which may cling to the ground for long distances. May ignite in the presence of open flames and sparks. Narrow lower to upper combustion range (16-25%) makes ignition difficult. Keep all sources of ignition away from spill/release. Do not apply water onto leaking tank. Stop the flow of gas or liquid. Use water to protect personnel effecting the shut-off. Approach from upwind. Evacuate the area immediately. Eliminate all open flames in vicinity of indoor spills or released vapor. Water fog can be used to cleanse atmosphere of ammonia vapor.
Downwind areas can be protected by water fog nozzles positioned downwind.

Emergency Procedures : Do not enter a visible cloud of ammonia. Isolate and evacuate the leak or spill area immediately for at least 150 feet in all directions. For larger spills, isolate at least 300 feet in all directions and then evacuate area downwind at least 0.4 miles in width and at least 0.8 miles in length. Keep area isolated until gas has dispersed.

Methods of Containment And Clean-Up : Dike liquid spills to contain liquid.

7. Handling and Storage

Safe Handling	:	Contents are under pressure. The use of explosion-proof equipment is recommended and may be required (see appropriate fire codes). Do not enter confined spaces such as tanks or pits without following proper entry procedures such as ASTM D-4276. Protect against physical damage.
Storage	:	Outside shaded area or detached storage is preferred. Inside storage should be in a cool, dry, well ventilated, noncombustible location, away from all possible sources of ignition.
Work/Hygienic Practices	:	Avoid contact with skin and avoid breathing vapors. Do not eat, drink, or smoke in work area. Wash hands before eating, drinking, or using restroom. Do NOT place food, coffee or other drinks in the area where dusting or splashing of solutions is possible.
Ventilation	:	Local exhaust is essential. Spark-proof fans desirable with mechanical ventilation. Ducts should be located at ceiling level and lead upwards to the outside. Eyewash and safety shower should be available in work area.

8. Exposure Controls/Personal Protection

Occupational Exposure Limits : CAL-OSHA: 25 ppm, 18 mg/m^3 Oregon-OSHA: 25 ppm, 18 mg/m^3; STEL: 35 ppm, 27 mg/m^3

Chemical Name: Anhydrous Ammonia				
Exposure Limits (TWAs) in Air				
CAS Number	IDLH	ACGIH TLV	OSHA PEL	STEL
7664-41-7	300 ppm	25 ppm, 18 mg/m^3	50 ppm, 35 mg/m^3	35 ppm, 27 mg/m^3

Protective Equipment : Rubber or synthetic chemical gloves and boots should be worn as well as cotton clothing and underwear. Rubber or synthetic chemical coats or aprons should be available, an encapsulating chemical protective clothing garment is desirable for heavy exposures. The use of long sleeved clothing closed at the neck is advised. Change if clothing becomes contaminated.

Eye Protection : Chemical splash goggles should be worn when handling Anhydrous Ammonia to protect from liquids or mists.

A face shield can be worn over chemical splash goggles as additional protection. Do not wear contact lenses when handling Anhydrous Ammonia.

A full-face air-purifying respirator (APR) or supplied-air respirator (SAR) should be worn to protect from chemical vapors.

Respiratory Protection : Unless ventilation is adequate to keep concentration below permissible exposure limit (PEL), wear NIOSH approved ammonia chemical cartridge or canister full facepiece chin-style respirators with an air-purification factor (APF=50). In emergency or planned entry into unknown concentrations, use self-contained breathing apparatus (SCBA) or any supplied-air full facepiece chin-style respirators.

9. Physical and Chemical Properties

Appearance: Compressed Liquid Gas, clear, colorless	Odor: Sharp, penetrating
Odor Threshold: 5 ppm	pH: 11.6 for 1% NH3 solution
Melting Point/Freezing Point: -107.9°F; -78°C	Initial Boiling Point/Range: -28°F; -33.4°C
Flash Point: N/A	Evaporation Rate (BuAc=1): N/A
Flammability: 16 – 25% in air	Lower/Upper Explosive Limit: 25% by Volume/16% by Volume
Vapor Pressure (mmHg): 110 PSIG at 68°F (20°C)	Vapor Density (Air=1): 0.0549 lb./ft3 at -28°F at 1atm
Relative Density: 42.57 lbs./cu.ft @ -28°F and 1 atm	Solubility in Water: 33.10%
Partition Coefficient: N/A	Autoignition Temperature: 650°C; 1204°F
Decomposition Temperature: N/A	Viscosity: N/A
% Volatiles: 100%	Specific Gravity (Water=1): 0.6189 of liquid at -28°F and 1 atm
Molecular Weight: 17.032	VOC: N/A

10. Stability and Reactivity

Reactivity : Reacts violently and explosively with oxidizing gases such as chlorine, bromine, and other halogens. Reacts explosively with hypochlorites such as bleach. Reacts vigorously with acids. Highly reactive with reducing agents. Hazardous polymerization will not occur.

Chemical Stability : Stable

Possibility of Hazardous Reactions or Polymerizations : Avoid contact with oxidizing gases, chlorine, bromine, mineral hypochlorite, iodine, halogens, calcium, and strong acids. Avoid contact with copper, silver, zinc, and alloys of same. Mercury, silver oxide can form explosive compounds.

Conditions to Avoid : Avoid all possible sources of ignition. Heat will increase pressure in the storage tank.

Incompatible Materials : Avoid contact with strong acids, use of metals containing copper or zinc.

Hazardous Decomposition Products : Combustion will generate oxides of nitrogen. Intense heating of the gas, particularly in contact with hot metallic surfaces, may cause decomposition of ammonia to hydrogen and nitrogen.

11. Toxicological Information

Acute and Chronic Effects : Can cause irritation and burns of the skin and mucous membranes, and headache, salivation, nausea, and vomiting. Difficult or labored breathing and cough with bloody mucous discharge. Can cause bronchitis, laryngitis, hemoptysis, and pulmonary edema or pneumonitis. Death may result. Can cause ulceration of the conjunctiva and cornea, and corneal and lenticular opacities. Damage to the eyes may be permanent.

Routes of Exposure

- Ingestion : Yes
- Inhalation : Yes
- Skin : Yes
- Eyes : Yes

Symptoms related to Physical, Chemical & Toxicological Characteristics : Can cause burning of the eyes, conjunctivitis, skin irritation, swelling of the eyelids and lips, dry red mouth and tongue, burning in the throat, and coughing, and in more severe cases of exposure, difficulty in breathing, signs and symptoms of lung congestion, and, ultimately, death from respiratory failure due to pulmonary edema may occur.

Numerical Measures of Toxicity :

Oral LD50	350 mg/kg	Rat	ATSDR 1991
	96 mg/kg	Mouse	EPA 1989

Inhalation LC50	19,770 ppm	F Rat	EPA 1989
	14,140 ppm	M Rat	EPA 1989
	17,401 ppm	Rat	ATSDR 1991

Chronic Toxicity : N/A

Carcinogenicity :

Product Name: Anhydrous Ammonia					
ACGIH	IARC	EPA	NIOSH	NTP	OSHA
No	No	No	No	No	No

Target Organs : N/A

12. Ecological Information

Ecotoxicity : Even at extremely low concentrations aquatic life will be harmed by liquid ammonia.

Persistence and Degradability : N/A

Bioaccumulative Potential :

Product/Ingredient	Log $_{Pow}$	BCF	Potential
-	-	-	-

Mobility in Soil : When anhydrous ammonia is applied in the soil, ammonia reacts with organic matter, and it dissolves in water. Anhydrous Ammonia reacts with water to form ammonium. The initial reactions with water, organic matter and clays limit the mobility of ammonia.

13. Disposal Considerations

Disposal of Container : Because of the toxicity of ammonia to aquatic organisms, NEVER dispose of or allow any ammonia or ammonia contaminated water to flow into any surface water bodies. Surface water bodies include drainage ditches, storm water and sanitary sewers, wetlands, ponds, lakes and streams. Diking will contain the liquid and allow it to stabilize. Keep unprotected personnel away from area until it is free of ammonia. Do not apply water directly to ammonia liquid as this will cause boiling and splattering. Soil contaminated with ammonia or aqua ammonia may need to be excavated and properly disposed of according to local and state regulations.

Consult Federal, State, or Local Authorities for additional proper disposal procedures.

14. Transport Information

UN#	:	UN1005
Proper Shipping Name	:	Anhydrous Ammonia
Hazard Class/Division	:	2.2 [Domestic]; 2.3, (8) [International]
Packing Group	:	N/A
Marine Pollutant	:	Yes
Special Provisions	:	13, T50
Emergency Response Guidebook	:	2012 ERG, Guide 125, pages 188-189
Placard Advisory	:	

15. Regulatory Information

SARA 302 Extremely Hazardous Substances (EHS) : This product contains the following Extremely Hazardous Substance(s) (EHS) under Section 302 of EPCRA, subject to the reporting requirements of Sections 311 and 312 (Tier I/Tier II reporting) at quantities greater than or equal to 500 pounds or in excess of the substance's EHS Threshold Planning Quantity (TPQ), whichever is lower. A Safety Data Sheet (SDS) must be provided to the SERC, LEPC, and local fire department.

Ammonia, CAS #7664-41-7 Sec. 302 EHS TPQ = 500 lbs. (226.8 kg.)

SARA 304 Extremely Hazardous Substances (EHS) Release Notification : EPCRA Section 304 requires a facility to notify the SERC and LEPC in the event of a release an EHS at or exceeding the substance's RQ under Section 302 of EPCRA, or its CERCLA RQ, if applicable, whichever is lower. This product contains the following Extremely Hazardous Substance(s) (EHS) subject to the reporting requirements of Section 304.
Ammonia, CAS #7664-41-7 Sec. 304 RQ = 100 lbs. (45.4 kg.)

SARA 311/312 Hazards :

SARA 311/312 Hazards				
Acute	Chronic	Flammability	Pressure	Reactivity
Yes	No	Yes	Yes	No

SARA 313 Reportable Chemicals	:	This product contains the following chemical(s) subject to annual emissions, transfers, and/or waste management reporting under the Community-Right-to-Know provisions of EPCRA Section 313, also known as the Toxic Release Inventory (TRI) Report or Form R: Ammonia, CAS #7664-41-7
CERCLA Hazardous Substances	:	This product contains the following CERCLA hazardous substance(s) subject to the National Response Center (NRC) reporting requirements if released to the environment in quantities greater than or equal to the substance's CERCLA Reportable Quantity (RQ). Ammonia, CAS #7664-41-7 CERCLA RQ = 100 lbs. (45.4 kg.)
Clean Air Act (CAA) Section 112(r) Air Pollutants	:	This product contains the following air pollutant(s) under the U.S. Clean Air Act (CAA), Section 112(r) [40 CFR 61], which, if accidentally released to the atmosphere in quantities at or above the CAA 112(r) Threshold Quantity (TQ), is reportable. Ammonia, CAS #7664-41-7 CAA 112(r) TQ = 10,000 lbs. (4436 kg.)
California Prop 65 Chemicals	:	This product does not contain any chemicals known to the state of California to cause cancer, birth defects or other reproductive harm.
Hazard Label Warning	:	This product requires the following hazard label warning: Domestic: Non-Flammable Gas (Class 2.2) International: Poisonous Gas Inhalation (Class 2.3); Corrosive (Class 8)

ACRONYMS:

CAS # – Chemical Abstract Services Registry Number
CFR – Code of Federal Regulations
CERCLA – Comprehensive Environmental Response, Compensation, and Liability Act
EPCRA – Emergency Planning and Community Right-to-Know Act
LEPC – Local Emergency Planning Committee
SERC – State Emergency Response Commission

Maximum use level for Anhydrous Ammonia under NSF/ANSI Standard 60
Maximum Use 5 mg/l

16. Other Information

Revision date	: 05/14/2015
Supersedes	: 05/20/2014
First Issue	: 12/01/1985
Chemical Family/Type	: Hydride, (Alkaline Gas), Inorganic Base
Section(s) changed since last revision	: MSDS to First Issue SDS Conversion

IMPORTANT! Read this SDS before use or disposal of this product. Pass along the information to employees and any other persons who could be exposed to the product to be sure that they are aware of the information before use or other exposure. This SDS has been prepared in accordance with the Globally Harmonized System of Chemical and Labeling of Chemicals (GHS) Fifth Edition and the OSHA Hazard Communication Standard [29 CFR 1910.1200]. The SDS information is based on sources believed to be reliable. Available data, safety standards, and government regulations are subject to change and the conditions of handling and use, or misuse are beyond our control; Hill Brothers Chemical Company makes no warranty, either expressed or implied, with respect to the completeness or continuing accuracy of the information contained herein and disclaims all liability for reliance thereon. Additional information may be necessary or helpful for specific conditions and circumstances of use. It is the user's responsibility to determine the suitability of this product and to evaluate risks and exercise appropriate precautions for protection of employees and others prior to use.

CIRO SCREEN 1

RECIPROCATING COMPRESSOR – NH3 NORMAL CONDITIONS			
SUCTION PRESSURE	33 PSIG	COMPRESSOR MOTOR AMPS	145 AMPS
DISCHARGE PRESSURE	154 PSIG	COMPRESSOR MOTOR VOLTAGE	480 VAC
OIL PRESSURE	45 PSID	COMPRESSOR LOADING	100%
SUCTION TEMP	22°F	CONDENSER WATER SUMP TEMP	72°F
DISCHARGE TEMP	213°F	CONDENSER LIQUID TEMP	85°F
MOTOR POWER FACTOR	0.82	CONDENSER OUTLET PRESSURE	151 PSIG
NOTES: MOTOR TYPE IS 3 PHASE		**MOTOR EFFICIENCY IS 92%**	
CONDENSER TYPE IS EVAPORATIVE		**COMPRESSOR WATER COOLED**	
CONDENSER OUTLET NOT SUBCOOLED			

CIRO SCREEN 2

RECIPROCATING COMPRESSOR – NH3 NORMAL CONDITIONS			
SUCTION PRESSURE	33 PSIG	COMPRESSOR MOTOR AMPS	145 AMPS
DISCHARGE PRESSURE	154 PSIG	COMPRESSOR MOTOR VOLTAGE	480 VAC
OIL PRESSURE	45 PSID	COMPRESSOR LOADING	100%
SUCTION TEMP	22°F	CONDENSER WATER SUMP TEMP	72°F
DISCHARGE TEMP	213°F	CONDENSER LIQUID TEMP	85°F
MOTOR POWR FACTOR	0.82	CONDENSER OUTLET PRESSURE	151 PSIG
NOTES: MOTOR TYPE IS 3 PHASE		**MOTOR EFFICIENCY IS 92%**	
CONDENSER TYPE IS EVAPORATIVE		**COMPRESSOR WATER COOLED**	
CONDENSER OUTLET NOT SUBCOOLED			

RECIPROCATING COMPRESSOR – NH3 ABNORMAL CONDITIONS			
SUCTION PRESSURE	33 PSIG	COMPRESSOR MOTOR AMPS	161 AMPS
DISCHARGE PRESSURE	184 PSIG	COMPRESSOR MOTOR VOLTAGE	480 VAC
OIL PRESSURE	45 PSID	COMPRESSOR LOADING	100%
SUCTION TEMP	22°F	CONDENSER WATER SUMP TEMP	72°F
DISCHARGE TEMP	234°F	CONDENSER LIQUID TEMP	85°F
MOTOR POWR FACTOR	0.82	CONDENSER OUTLET PRESSURE	181 PSIG
NOTES: MOTOR TYPE IS 3 PHASE		**MOTOR EFFICIENCY IS 92%**	
CONDENSER TYPE IS EVAPORATIVE		**COMPRESSOR WATER COOLED**	
CONDENSER OUTLET NOT SUBCOOLED			

CIRO SCREEN 3

RECIPROCATING COMPRESSOR – NH3 NORMAL CONDITIONS			
SUCTION PRESSURE	33 PSIG	COMPRESSOR MOTOR AMPS	145 AMPS
DISCHARGE PRESSURE	154 PSIG	COMPRESSOR MOTOR VOLTAGE	480 VAC
OIL PRESSURE	45 PSID	COMPRESSOR LOADING	100%
SUCTION TEMP	22°F	CONDENSER WATER SUMP TEMP	72°F
DISCHARGE TEMP	213°F	CONDENSER LIQUID TEMP	85°F
MOTOR POWER FACTOR	0.82	CONDENSER OUTLET PRESSURE	151 PSIG
NOTES: MOTOR TYPE IS 3 PHASE		**MOTOR EFFICIENCY IS 92%**	
CONDENSER TYPE IS EVAPORATIVE		**COMPRESSOR WATER COOLED**	
CONDENSER OUTLET NOT SUBCOOLED			

RECIPROCATING COMPRESSOR – NH3 ABNORMAL CONDITIONS			
SUCTION PRESSURE	33 PSIG	COMPRESSOR MOTOR AMPS	171 AMPS
DISCHARGE PRESSURE	213 PSIG	COMPRESSOR MOTOR VOLTAGE	480 VAC
OIL PRESSURE	45 PSID	COMPRESSOR LOADING	100%
SUCTION TEMP	22°F	CONDENSER WATER SUMP TEMP	95°F
DISCHARGE TEMP	251°F	CONDENSER LIQUID TEMP	105°F
MOTOR POWER FACTOR	0.82	CONDENSER OUTLET PRESSURE	210 PSIG
NOTES: MOTOR TYPE IS 3 PHASE		**MOTOR EFFICIENCY IS 92%**	
CONDENSER TYPE IS EVAPORATIVE		**COMPRESSOR WATER COOLED**	
CONDENSER OUTLET NOT SUBCOOLED			

CIRO SCREEN 4

RECIPROCATING COMPRESSOR – NH3 NORMAL CONDITIONS			
SUCTION PRESSURE	33 PSIG	COMPRESSOR MOTOR AMPS	145 AMPS
DISCHARGE PRESSURE	154 PSIG	COMPRESSOR MOTOR VOLTAGE	480 VAC
OIL PRESSURE	45 PSID	COMPRESSOR LOADING	100%
SUCTION TEMP	22°F	CONDENSER WATER SUMP TEMP	72°F
DISCHARGE TEMP	213°F	CONDENSER LIQUID TEMP	85°F
MOTOR POWER FACTOR	0.82	CONDENSER OUTLET PRESSURE	151
NOTES: MOTOR TYPE IS 3 PHASE		**MOTOR EFFICIENCY IS 92%**	
CONDENSER TYPE IS EVAPORATIVE		**COMPRESSOR WATER COOLED**	
CONDENSER OUTLET NOT SUBCOOLED			

RECIPROCATING COMPRESSOR – NH3 ABNORMAL CONDITIONS			
SUCTION PRESSURE	33 PSIG	COMPRESSOR MOTOR AMPS	145 AMPS
DISCHARGE PRESSURE	154 PSIG	COMPRESSOR MOTOR VOLTAGE	480 VAC
OIL PRESSURE	45 PSID	COMPRESSOR LOADING	100%
SUCTION TEMP	60°F	CONDENSER WATER SUMP TEMP	72°F
DISCHARGE TEMP	269°F	CONDENSER LIQUID TEMP	85°F
MOTOR POWER FACTOR	0.82	CONDENSER OUTLET PRESSURE	151
NOTES: MOTOR TYPE IS 3 PHASE		**MOTOR EFFICIENCY IS 92%**	
CONDENSER TYPE IS EVAPORATIVE		**COMPRESSOR WATER COOLED**	
CONDENSER OUTLET NOT SUBCOOLED			

CIRO SCREEN 5

RECIPROCATING COMPRESSOR – NH3 ABNORMAL CONDITIONS			
SUCTION PRESSURE	33 PSIG	COMPRESSOR MOTOR AMPS	145 AMPS
DISCHARGE PRESSURE	154 PSIG	COMPRESSOR MOTOR VOLTAGE	480 VAC
OIL PRESSURE	45 PSID	COMPRESSOR LOADING	100%
SUCTION TEMP	60°F	CONDENSER WATER SUMP TEMP	72°F
DISCHARGE TEMP	269°F	CONDENSER LIQUID TEMP	85°F
MOTOR POWER FACTOR	0.82	CONDENSER OUTLET PRESSURE	151 PSIG
NOTES: MOTOR TYPE IS 3 PHASE		**MOTOR EFFICIENCY IS 92%**	
CONDENSER TYPE IS EVAPORATIVE		**COMPRESSOR WATER COOLED**	
CONDENSER OUTLET NOT SUBCOOLED			

CIRO SCREEN 6

500 HP SCREW COMPRESSOR – NH3 NORMAL CONDITIONS			
SUCTION PRESSURE	33 PSIG	SCREW COMPRESSOR MOTOR AMPS	464 AMPS
DISCHARGE PRESSURE	154 PSIG	SCREW COMPRESSOR MOTOR VOLTAGE	480 VAC
OIL PRESSURE	45 PSID	SCREW COMPRESSOR SLIDE VALVE POSITION	100%
SUCTION TEMP	22°F	CONDENSER WATER SUMP TEMP	75°F
DISCHARGE TEMP	166°F	CONDENSED LIQUID TEMP	85°F
OIL TEMPERATURE	136°F	CONDENSER OUTLET PRESSURE	151 PSIG
OIL COOLER – OIL INLET TEMP	156°F		
OIL COOLER – REFRIGERANT OUTLET TEMP	86°F		
MOTOR POWER FACTOR	0.82		
NOTES: MOTOR TYPE IS 3 PHASE		**MOTOR EFFICIENCY IS 92%**	
CONDENSER TYPE IS EVAPORATIVE		**THERMO SIPHON OIL COOLING**	
CONDENSER OUTLET NOT SUBCOOLED			

CIRO SCREEN 7

500 HP SCREW COMPRESSOR – NH3 NORMAL CONDITIONS			
SUCTION PRESSURE	33 PSIG	SCREW COMPRESSOR MOTOR AMPS	464 AMPS
DISCHARGE PRESSURE	154 PSIG	SCREW COMPRESSOR MOTOR VOLTAGE	480 VAC
OIL PRESSURE	45 PSID	SCREW COMPRESSOR SLIDE VALVE POSITION	100%
SUCTION TEMP	22°F	CONDENSER WATER SUMP TEMP	75°F
DISCHARGE TEMP	166°F	CONDENSED LIQUID TEMP	85°F
OIL TEMPERATURE	136°F	CONDENSER OUTLET PRESSURE	151 PSIG
OIL COOLER – OIL INLET TEMP	156°F		
OIL COOLER – REFRIGERANT OUTLET TEMP	86°F		
MOTOR POWER FACTOR	0.82		
NOTES: MOTOR TYPE IS 3 PHASE		**MOTOR EFFICIENCY IS 92%**	
CONDENSER TYPE IS EVAPORATIVE		**THERMO SIPHON OIL COOLING**	
CONDENSER OUTLET NOT SUBCOOLED			

500 HP SCREW COMPRESSOR – NH3 ABNORMAL CONDITIONS			
SUCTION PRESSURE	33 PSIG	SCREW COMPRESSOR MOTOR AMPS	503 AMPS
DISCHARGE PRESSURE	167 PSIG	SCREW COMPRESSOR MOTOR VOLTAGE	480 VAC
OIL PRESSURE	45 PSID	SCREW COMPRESSOR SLIDE VALVE POSITION	100%
SUCTION TEMP	22°F	CONDENSER WATER SUMP TEMP	75°F
DISCHARGE TEMP	171°F	CONDENSED LIQUID TEMP	85°F
OIL TEMPERATURE	145°F	CONDENSER OUTLET PRESSURE	165 PSIG
OIL COOLER – OIL INLET TEMP	165°F		
OIL COOLER – REFRIGERANT OUTLET TEMP	85°F		
MOTOR POWER FACTOR	0.82		
NOTES: MOTOR TYPE IS 3 PHASE		**MOTOR EFFICIENCY IS 92%**	
CONDENSER TYPE IS EVAPORATIVE		**THERMO SIPHON OIL COOLING**	
CONDENSER OUTLET NOT SUBCOOLED			

CIRO SCREEN 8

500 HP Screw Compressor – NH3 Normal Conditions			
Suction Pressure	33 psig	Screw Compressor Motor Amps	464 AMPS
Discharge Pressure	154 psig	Screw Compressor Motor Voltage	480 VAC
Oil Pressure	45 psid	Screw Compressor Slide Valve Position	100%
Suction Temp	22°F	Condenser Water Sump Temp	75°F
Discharge Temp	166°F	Condensed Liquid Temp	85°F
Oil Temperature	136°F	Condenser Outlet Pressure	151 psig
Oil Cooler – Oil Inlet Temp	156°F		
Oil Cooler – Refrigerant Outlet Temp	86°F		
Motor Power Factor	0.82		
NOTES: Motor Type is 3 Phase		**Motor Efficiency is 92%**	
Condenser Type is Evaporative		**Thermo Siphon Oil Cooling**	
Condenser Outlet Not Subcooled			

500 HP Screw Compressor – NH3 Abnormal Conditions			
Suction Pressure	33 psig	Screw Compressor Motor Amps	503 AMPS
Discharge Pressure	187 psig	Screw Compressor Motor Voltage	480 VAC
Oil Pressure	45 psid	Screw Compressor Slide Valve Position	100%
Suction Temp	20°F	Condenser Water Sump Temp	75°F
Discharge Temp	174°F	Condensed Liquid Temp	96°F
Oil Temperature	145°F	Condenser Outlet Pressure	184 psig
Oil Cooler – Oil Inlet Temp	165°F		
Oil Cooler – Refrigerant Outlet Temp	96°F		
Motor Power Factor	0.82		
NOTES: Motor Type is 3 Phase		**Motor Efficiency is 92%**	
Condenser Type is Evaporative		**Thermo Siphon Oil Cooling**	
Condenser Outlet Not Subcooled			

CIRO SCREEN 9

TWO -STAGE PACKAGE – NH3 NORMAL CONDITIONS			
LOW STAGE COMPRESSOR READINGS		HIGH STAGE COMPRESSOR READINGS	
SUCTION PRESSURE	9" HG	SUCTION PRESSURE	31 PSIG
DISCHARGE PRESSURE	31 PSIG	DISCHARGE PRESSURE	154 PSIG
OIL PRESSURE	45 PSID	OIL PRESSURE	45 PSID
SUCTION TEMP	-38°F	SUCTION TEMP	24°F
DISCHARGE TEMP	135°F	DISCHARGE TEMP	156°F
OIL TEMPERATURE	125°F	OIL TEMPERATURE	125°F
OIL COOLER – OIL INLET TEMP	135°F	OIL COOLER – OIL INLET TEMP	145°F
OIL COOLER – REFRIGERANT OUTLET TEMP	85°F	OIL COOLER – REFRIGERANT OUTLET TEMP	85°F
BOOSTER COMPRESSOR MOTOR AMPS	48 AMPS	HIGH STAGE COMPRESSOR MOTOR AMPS	49 AMPS
BOOSTER COMPRESSOR SLIDE VALVE POSITION	100%	HIGH STAGE COMPRESSOR SLIDE VALVE POSITION	100%
MOTOR POWER FACTOR	0.82	MOTOR POWER FACTOR	0.82
NOTES: THERMO SIPHON OIL COOLING		**MOTOR EFFICIENCY IS 92%**	
MOTOR TYPE IS 3 PHASE		**MOTOR VOLTAGE(S) IS 480 VAC**	

CIRO SCREEN 10

TWO -STAGE PACKAGE – NH3 NORMAL CONDITIONS			
LOW STAGE COMPRESSOR READINGS		HIGH STAGE COMPRESSOR READINGS	
SUCTION PRESSURE	9" HG	SUCTION PRESSURE	31 PSIG
DISCHARGE PRESSURE	31 PSIG	DISCHARGE PRESSURE	154 PSIG
OIL PRESSURE	45 PSID	OIL PRESSURE	45 PSID
SUCTION TEMP	-38°F	SUCTION TEMP	24°F
DISCHARGE TEMP	135°F	DISCHARGE TEMP	156°F
OIL TEMPERATURE	125°F	OIL TEMPERATURE	125°F
OIL COOLER – OIL INLET TEMP	135°F	OIL COOLER – OIL INLET TEMP	145°F
OIL COOLER – REFRIGERANT OUTLET TEMP	85°F	OIL COOLER – REFRIGERANT OUTLET TEMP	85°F
BOOSTER COMPRESSOR MOTOR AMPS	48 AMPS	HIGH STAGE COMPRESSOR MOTOR AMPS	49 AMPS
BOOSTER COMPRESSOR SLIDE VALVE POSITION	100%	HIGH STAGE COMPRESSOR SLIDE VALVE POSITION	100%
MOTOR POWER FACTOR	0.82	MOTOR POWER FACTOR	0.82
NOTES: THERMO SIPHON OIL COOLING		**MOTOR EFFICIENCY IS 92%**	
MOTOR TYPE IS 3 PHASE		**MOTOR VOLTAGE(S) IS 480 VAC**	

TWO -STAGE PACKAGE – NH3 ABNORMAL CONDITIONS			
LOW STAGE COMPRESSOR READINGS		HIGH STAGE COMPRESSOR READINGS	
SUCTION PRESSURE	9" HG	SUCTION PRESSURE	31 PSIG
DISCHARGE PRESSURE	31 PSIG	DISCHARGE PRESSURE	154 PSIG
OIL PRESSURE	45 PSID	OIL PRESSURE	45 PSID
SUCTION TEMP	-38°F	SUCTION TEMP	74°F
DISCHARGE TEMP	135°F	DISCHARGE TEMP	165°F
OIL TEMPERATURE	125°F	OIL TEMPERATURE	125°F
OIL COOLER – OIL INLET TEMP	135°F	OIL COOLER – OIL INLET TEMP	145°F
OIL COOLER – REFRIGERANT OUTLET TEMP	85°F	OIL COOLER – REFRIGERANT OUTLET TEMP	85°F
BOOSTER COMPRESSOR MOTOR AMPS	48 AMPS	HIGH STAGE COMPRESSOR MOTOR AMPS	52 AMPS
BOOSTER COMPRESSOR SLIDE VALVE POSITION	100%	HIGH STAGE COMPRESSOR SLIDE VALVE POSITION	100%
MOTOR POWER FACTOR	0.82	MOTOR POWER FACTOR	0.82
NOTES: THERMO SIPHON OIL COOLING		**MOTOR EFFICIENCY IS 92%**	
MOTOR TYPE IS 3 PHASE		**MOTOR VOLTAGE(S) IS 480 VAC**	

CIRO SCREEN 11

TWO -STAGE PACKAGE – NH3 NORMAL CONDITIONS			
LOW STAGE COMPRESSOR READINGS		HIGH STAGE COMPRESSOR READINGS	
SUCTION PRESSURE	9" HG	SUCTION PRESSURE	31 PSIG
DISCHARGE PRESSURE	31 PSIG	DISCHARGE PRESSURE	154 PSIG
OIL PRESSURE	45 PSID	OIL PRESSURE	45 PSID
SUCTION TEMP	-38°F	SUCTION TEMP	24°F
DISCHARGE TEMP	135°F	DISCHARGE TEMP	156°F
OIL TEMPERATURE	86°F	OIL TEMPERATURE	125°F
OIL COOLER – OIL INLET TEMP	135°F	OIL COOLER – OIL INLET TEMP	145°F
OIL COOLER – REFRIGERANT OUTLET TEMP	85°F	OIL COOLER – REFRIGERANT OUTLET TEMP	85°F
BOOSTER COMPRESSOR MOTOR AMPS	48 AMPS	HIGH STAGE COMPRESSOR MOTOR AMPS	49 AMPS
BOOSTER COMPRESSOR SLIDE VALVE POSITION	100%	HIGH STAGE COMPRESSOR SLIDE VALVE POSITION	100%
MOTOR POWER FACTOR	0.82	MOTOR POWER FACTOR	0.82
NOTES: THERMO SIPHON OIL COOLING		**MOTOR EFFICIENCY IS 92%**	
MOTOR TYPE IS 3 PHASE		**MOTOR VOLTAGE(S) IS 480 VAC**	

TWO- STAGE PACKAGE – NH3 ABNORMAL CONDITIONS			
LOW STAGE COMPRESSOR READINGS		HIGH STAGE COMPRESSOR READINGS	
SUCTION PRESSURE	37 PSIG	SUCTION PRESSURE	35 PSIG
DISCHARGE PRESSURE	37 PSIG	DISCHARGE PRESSURE	114 PSIG
OIL PRESSURE	0 PSID	OIL PRESSURE	45 PSID
SUCTION TEMP	68°F	SUCTION TEMP	32°F
DISCHARGE TEMP	68°F	DISCHARGE TEMP	150°F
OIL TEMPERATURE	86°F	OIL TEMPERATURE	125°F
OIL COOLER – OIL INLET TEMP	85°F	OIL COOLER – OIL INLET TEMP	135°F
OIL COOLER – REFRIGERANT OUTLET TEMP	85°F	OIL COOLER – REFRIGERANT OUTLET TEMP	85°F
BOOSTER COMPRESSOR MOTOR AMPS	0 AMPS	HIGH STAGE COMPRESSOR MOTOR AMPS	49 AMPS
BOOSTER COMPRESSOR SLIDE VALVE POSITION	0%	HIGH STAGE COMPRESSOR SLIDE VALVE POSITION	100%
MOTOR POWER FACTOR	0.82	MOTOR POWER FACTOR	0.82
NOTES: THERMO SIPHON OIL COOLING		**MOTOR EFFICIENCY IS 92%**	
MOTOR TYPE IS 3 PHASE		**MOTOR VOLTAGE(S) IS 480 VAC**	

CIRO SCREEN 12

TWO- STAGE PACKAGE – NH3 ABNORMAL CONDITIONS				
LOW STAGE COMPRESSOR READINGS			HIGH STAGE COMPRESSOR READINGS	
SUCTION PRESSURE	9" HG		SUCTION PRESSURE	31 PSIG
DISCHARGE PRESSURE	31 PSIG		DISCHARGE PRESSURE	154 PSIG
OIL PRESSURE	45 PSID		OIL PRESSURE	45 PSID
SUCTION TEMP	-38°F		SUCTION TEMP	74°F
DISCHARGE TEMP	135°F		DISCHARGE TEMP	165°F
OIL TEMPERATURE	125°F		OIL TEMPERATURE	125°F
OIL COOLER – OIL INLET TEMP	135°F		OIL COOLER – OIL INLET TEMP	145°F
OIL COOLER – REFRIGERANT OUTLET TEMP	85°F		OIL COOLER – REFRIGERANT OUTLET TEMP	85°F
BOOSTER COMPRESSOR MOTOR AMPS	48 AMPS		HIGH STAGE COMPRESSOR MOTOR AMPS	52 AMPS
BOOSTER COMPRESSOR SLIDE VALVE POSITION	100%		HIGH STAGE COMPRESSOR SLIDE VALVE POSITION	100%
MOTOR POWER FACTOR	0.82		MOTOR POWER FACTOR	0.82
NOTES: THERMO SIPHON OIL COOLING			**MOTOR EFFICIENCY IS 92%**	
MOTOR TYPE IS 3 PHASE			**MOTOR VOLTAGE(S) IS 480 VAC**	

CIRO SCREEN 13

MEDIUM TEMPERATURE ROOM – NH3 NORMAL CONDITIONS				
COIL SUCTION HEADER PRESSURE	33 PSIG		AIR LEAVING TEMPERATURE	31°F
COIL SUCTION HEADER TEMPERATURE	20°F		ROOM AIR TEMPERATURE	33°F
LIQUID LEVEL FEED STATUS	29% SATISFIED		**MODE: REFRIGERATING**	
EVAPORATOR FAN MOTOR AMPS	7.2 AMPS			
COMPRESSOR INLET PRESSURE	30 PSIG		PARAMETERS:	
COMPRESSOR DISCHARGE PRESSURE	154 PSIG		ROOM TEMP:	33°F
COMPRESSOR INLET TEMP	23°F		ROOM HIGH TEMP:	38°F
COMPRESSOR DISCHARGE TEMP	212°F		ROOM LOW TEMP:	32°F
			LIQUID LEVEL CALL:	25%
			LIQUID LEVEL SATISFIED:	31%
			LIQUID HIGH LEVEL:	40%
			DEFROST PUMP DOWN:	20 MIN
			DEFROST HOT GAS REG:	90 PSIG
			FAN DELAY:	2 MIN

NOTES:

- **UNIT IS A FLOODED EVAPORATOR WITH A SOLENOID ACTIVATED BACK PRESSURE REGULATOR FOR EVAPORATOR PRESSURE CONTROL.**
- **HOT GAS DEFROST METHOD USED.**
- **LIQUID FEED IS AN ELECTRIC SOLENOID VALVE IN SERIES WITH A HAND EXPANSION VALVE.**
- **ENGINE ROOM USES MULTIPLE RECIPROCATING COMPRESSORS.**

CIRO SCREEN 14

MEDIUM TEMPERATURE ROOM – NH3 NORMAL CONDITIONS			
COIL SUCTION HEADER PRESSURE	33 PSIG	AIR LEAVING TEMPERATURE	31°F
COIL SUCTION HEADER TEMPERATURE	20°F	ROOM AIR TEMPERATURE	33°F
LIQUID LEVEL FEED STATUS	29% SATISFIED	**MODE: REFRIGERATING**	
EVAPORATOR FAN MOTOR AMPS	7.2 AMPS		
COMPRESSOR INLET PRESSURE	30 PSIG	PARAMETERS:	
COMPRESSOR DISCHARGE PRESSURE	154 PSIG	ROOM TEMP: 33°F ROOM HIGH TEMP: 38°F ROOM LOW TEMP: 32°F LIQUID LEVEL CALL: 25% LIQUID LEVEL SATISFIED: 31% LIQUID HIGH LEVEL: 40%	
COMPRESSOR INLET TEMP	23°F		
COMPRESSOR DISCHARGE TEMP	212°F	DEFROST PUMP DOWN: 20 MIN DEFROST HOT GAS REG: 90 PSIG FAN DELAY: 2 MIN	
MEDIUM TEMPERATURE ROOM – NH3 ABNORMAL CONDITIONS			
COIL SUCTION HEADER PRESSURE	33 PSIG	AIR LEAVING TEMPERATURE	41°F
COIL SUCTION HEADER TEMPERATURE	40°F	ROOM AIR TEMPERATURE	41°F
LIQUID LEVEL FEED STATUS	0% CALLING	**MODE: REFRIGERATING**	
EVAPORATOR FAN MOTOR AMPS	7.2 AMPS		
COMPRESSOR INLET PRESSURE	25 PSIG	PARAMETERS:	
COMPRESSOR DISCHARGE PRESSURE	154 PSIG	ROOM TEMP: 33°F ROOM HIGH TEMP: 38°F ROOM LOW TEMP: 32°F LIQUID LEVEL CALL: 25% LIQUID LEVEL SATISFIED: 31% LIQUID HIGH LEVEL: 40%	
COMPRESSOR INLET TEMP	38°F		
COMPRESSOR DISCHARGE TEMP	260°F	DEFROST PUMP DOWN: 20 MIN DEFROST HOT GAS REG: 90 PSIG FAN DELAY: 2 MIN	

NOTES:

- **UNIT IS A FLOODED EVAPORATOR WITH A SOLENOID ACTIVATED BACK PRESSURE REGULATOR FOR EVAPORATOR PRESSURE CONTROL.**
- **HOT GAS DEFROST METHOD USED.**
- **LIQUID FEED IS AN ELECTRIC SOLENOID VALVE IN SERIES WITH A HAND EXPANSION VALVE.**
- **ENGINE ROOM USES MULTIPLE RECIPROCATING COMPRESSORS.**

CIRO SCREEN 15

MEDIUM TEMPERATURE ROOM – NH3 NORMAL CONDITIONS			
COIL SUCTION HEADER PRESSURE	33 PSIG	COMPRESSOR DISCHARGE TEMP	212°F
COIL SUCTION HEADER TEMPERATURE	20°F	AIR LEAVING TEMPERATURE	31°F
LIQUID LEVEL FEED STATUS	29% SATISFIED	ROOM AIR TEMPERATURE	33°F
EVAPORATOR FAN MOTOR AMPS	7.2 AMPS	**MODE: REFRIGERATING**	
COMPRESSOR INLET PRESSURE	30 PSIG	PARAMETERS:	
COMPRESSOR DISCHARGE PRESSURE	154 PSIG	ROOM TEMP: 33°F ROOM HIGH TEMP: 38°F ROOM LOW TEMP: 32°F LIQUID LEVEL CALL: 25% LIQUID LEVEL SATISFIED: 31%	LIQUID HIGH LEVEL: 40% DEFROST PUMP DOWN: 20 MIN DEFROST HOT GAS REG: 90 PSIG FAN DELAY: 2 MIN
COMPRESSOR INLET TEMP	23°F		
MEDIUM TEMPERATURE ROOM – NH3 ABNORMAL CONDITIONS			
COIL SUCTION HEADER PRESSURE	90 PSIG	COMPRESSOR DISCHARGE TEMP	224°F
COIL SUCTION HEADER TEMPERATURE	60°F	AIR LEAVING TEMPERATURE	34°F
LIQUID LEVEL FEED STATUS	95% HIGH	ROOM AIR TEMPERATURE	33°F
EVAPORATOR FAN MOTOR AMPS	0.0 AMPS	**MODE: DEFROST – HG "ON"**	
COMPRESSOR INLET PRESSURE	30 PSIG	PARAMETERS:	
COMPRESSOR DISCHARGE PRESSURE	154 PSIG	ROOM TEMP: 33°F ROOM HIGH TEMP: 38°F ROOM LOW TEMP: 32°F LIQUID LEVEL CALL: 25% LIQUID LEVEL SATISFIED: 31%	LIQUID HIGH LEVEL: 40% DEFROST PUMP DOWN: 20 MIN DEFROST HOT GAS REG: 90 PSIG FAN DELAY: 2 MIN
COMPRESSOR INLET TEMP	65°F		

NOTES:

- **UNIT IS A FLOODED EVAPORATOR WITH A SOLENOID ACTIVATED BACK PRESSURE REGULATOR FOR EVAPORATOR PRESSURE CONTROL.**
- **HOT GAS DEFROST METHOD USED.**
- **EVAPORATOR IS ONE OF SEVERAL IN THE SYSTEM.**
- **LIQUID FEED IS AN ELECTRIC SOLENOID VALVE IN SERIES WITH A HAND EXPANSION VALVE.**
- **ENGINE ROOM USES MULTIPLE RECIPROCATING COMPRESSORS.**

CIRO SCREEN 16

LOW TEMPERATURE ROOM – NH3 NORMAL CONDITIONS			
COIL SUCTION HEADER PRESSURE	8" HG	AIR LEAVING TEMPERATURE	-28°F
COIL SUCTION HEADER TEMPERATURE	-39°F	ROOM AIR TEMPERATURE	-25°F
RECIRCULATOR LIQUID LEVEL FEED STATUS	29% SATISFIED	**MODE: REFRIGERATING**	
EVAPORATOR FAN MOTOR AMPS	13.6 AMPS		
COMPRESSOR INLET PRESSURE	12" HG	PARAMETERS:	
COMPRESSOR DISCHARGE PRESSURE	154 PSIG	ROOM TEMP:	-25°F
COMPRESSOR INLET TEMP	-40°F	ROOM HIGH TEMP:	-20°F
COMPRESSOR DISCHARGE TEMP	153°F	ROOM LOW TEMP:	-30°F
		LIQUID LEVEL CALL:	25%
		LIQUID LEVEL SATISFIED:	31%
		LIQUID HIGH LEVEL:	40%
		DEFROST PUMP DOWN:	20 MIN
		DEFROST HOT GAS REG:	90 PSIG
		FAN DELAY:	2 MIN

NOTES:

- **ROOM IS A SMALL BOX WITH A SINGLE UNIT.**
- **UNIT IS A PUMPED LIQUID EVAPORATOR USING AXIAL PROPELLER FANS AND A GAS POWERED SUCTION OUTLET CONTROL VALVE.**
- **HOT GAS DEFROST METHOD USED.**
- **LIQUID FEED IS AN ELECTRIC SOLENOID VALVE IN SERIES WITH A HAND EXPANSION VALVE.**
- **ENGINE ROOM USES MULTIPLE SCREW COMPRESSORS ARRANGED AS A TWO STAGE SYSTEM**

CIRO SCREEN 17

LOW TEMPERATURE ROOM – NH3 NORMAL CONDITIONS			
COIL SUCTION HEADER PRESSURE	8" HG	AIR LEAVING TEMPERATURE	-28°F
COIL SUCTION HEADER TEMPERATURE	-39°F	ROOM AIR TEMPERATURE	-25°F
RECIRCULATOR LIQUID LEVEL FEED STATUS	29% SATISFIED	MODE: REFRIGERATING	
EVAPORATOR FAN MOTOR AMPS	13.6 AMPS		
COMPRESSOR INLET PRESSURE	12" HG	PARAMETERS: ROOM TEMP: -25°F ROOM HIGH TEMP: -20°F ROOM LOW TEMP: -30°F LIQUID LEVEL CALL: 25% LIQUID LEVEL SATISFIED: 31% LIQUID HIGH LEVEL: 40% DEFROST PUMP DOWN: 20 MIN DEFROST HOT GAS REG: 90 PSIG FAN DELAY: 2 MIN	
COMPRESSOR DISCHARGE PRESSURE	154 PSIG		
COMPRESSOR INLET TEMP	-40°F		
COMPRESSOR DISCHARGE TEMP	153°F		
LOW TEMPERATURE ROOM – NH3 ABNORMAL CONDITIONS			
COIL SUCTION HEADER PRESSURE	10" HG	AIR LEAVING TEMPERATURE	-18°F
COIL SUCTION HEADER TEMPERATURE	-42°F	ROOM AIR TEMPERATURE	-18°F
RECIRCULATOR LIQUID LEVEL FEED STATUS	26% SATISFIED	MODE: REFRIGERATING	
EVAPORATOR FAN MOTOR AMPS	14.9 AMPS		
COMPRESSOR INLET PRESSURE	12" HG	PARAMETERS: ROOM TEMP: -25°F ROOM HIGH TEMP: -20°F ROOM LOW TEMP: -30°F LIQUID LEVEL CALL: 25% LIQUID LEVEL SATISFIED: 31% LIQUID HIGH LEVEL: 40% DEFROST PUMP DOWN: 20 MIN DEFROST HOT GAS REG: 90 PSIG FAN DELAY: 2 MIN	
COMPRESSOR DISCHARGE PRESSURE	154 PSIG		
COMPRESSOR INLET TEMP	-46°F		
COMPRESSOR DISCHARGE TEMP	151°F		

NOTES:

- **ROOM IS A SMALL BOX WITH A SINGLE UNIT.**
- **UNIT IS A PUMPED LIQUID EVAPORATOR USING AXIAL PROPELLER FANS AND A GAS POWERED SUCTION OUTLET CONTROL VALVE.**
- **HOT GAS DEFROST METHOD USED.**
- **LIQUID FEED IS AN ELECTRIC SOLENOID VALVE IN SERIES WITH A HAND EXPANSION VALVE.**
- **ENGINE ROOM USES MULTIPLE SCREW COMPRESSORS ARRANGED AS A TWO STAGE SYSTEM**

CIRO SCREEN 18

LOW SIDE VESSELS PANEL – NH3 NORMAL CONDITIONS

LOW STAGE RECIRCULATOR READINGS	
SUCTION PRESSURE	9" HG
SUCTION TEMPERATURE	-38°F
VESSEL LIQUID LEVEL FEED STATUS	31% SATISFIED
TOTAL PUMP AMPERAGE	15.7 AMPS
PUMP DISCHARGE HEADER PRESSURE	20 PSIG

FLASH INTERCOOLER READINGS	
HIGH STAGE SUCTION PRESSURE	31 PSIG
INTERCOOLER SUCTION INLET TEMPERATURE	156°F
INTERCOOLER SUCTION OUTLET TEMPERATURE	24°F
INTERCOOLER LIQUID LEVEL LIQUID FEED STATUS	25% SATISFIED

PARAMETERS:

LOW STAGE RECIRCULATOR LIQUID CALL: 25%
LOW STAGE RECIRCULATOR LIQUID SATISFIED: 30%
LOW STAGE RECIRCULATOR LIQUID HIGH LEVEL: 40%
LOW STAGE RECIRCULATOR LIQUID LOW LEVEL: 15%

INTERCOOLER LIQUID LEVEL CALL: 23%
INTERCOOLER LIQUID LEVEL SATISFIED: 27%
INTERCOOLER LIQUID HIGH LEVEL: 34%
INTERCOOLER LIQUID LOW LEVEL: 18%
INTERCOOLER SUCTION OUTLET HIGH TEMP: 40°F

PUMP MOTOR AMPS: LOW 8.2 HIGH: 17.2
MINIMUM PUMP DISCHARGE PRESSURE DIFFERENTIAL: 22 PSID

CIRO SCREEN 19

LOW SIDE VESSELS PANEL – NH3 NORMAL CONDITIONS			
LOW STAGE RECIRCULATOR READINGS		FLASH INTERCOOLER READINGS	
SUCTION PRESSURE	9" HG	HIGH STAGE SUCTION PRESSURE	31 PSIG
SUCTION TEMPERATURE	-38°F	INTERCOOLER SUCTION INLET TEMPERATURE	156°F
VESSEL LIQUID LEVEL FEED STATUS	31% SATISFIED	INTERCOOLER SUCTION OUTLET TEMPERATURE	24°F
TOTAL PUMP AMPERAGE	15.7 AMPS	INTERCOOLER LIQUID LEVEL LIQUID FEED STATUS	25% SATISFIED
PUMP HEADER PRESSURE	20 PSIG	PARAMETERS:	
		LOW STAGE RECIRCULATOR LIQUID CALL:	25%
		LOW STAGE RECIRCULATOR LIQUID SATISFIED:	30%
		LOW STAGE RECIRCULATOR LIQUID HIGH LEVEL:	40%
		LOW STAGE RECIRCULATOR LIQUID LOW LEVEL:	15%
		INTERCOOLER LIQUID LEVEL CALL:	23%
		INTERCOOLER LIQUID LEVEL SATISFIED:	27%
		INTERCOOLER LIQUID HIGH LEVEL:	34%
		INTERCOOLER LIQUID LOW LEVEL:	18%
		INTERCOOLER SUCTION OUTLET HIGH TEMP:	40°F
		PUMP MOTOR AMPS: LOW 8.2 HIGH: 17.2	
		MINIMUM PUMP DISCHARGE PRESSURE DIFFERENTIAL:	22 PSID

LOW SIDE VESSELS PANEL – NH3 ABNORMAL CONDITIONS			
LOW STAGE RECIRCULATOR READINGS		FLASH INTERCOOLER READINGS	
SUCTION PRESSURE	11" HG	HIGH STAGE SUCTION PRESSURE	31 PSIG
SUCTION TEMPERATURE	-42°F	INTERCOOLER SUCTION INLET TEMPERATURE	156°F
VESSEL LIQUID LEVEL FEED STATUS	4% FILLING	INTERCOOLER SUCTION OUTLET TEMPERATURE	45°F
TOTAL PUMP AMPERAGE	0 AMPS	INTERCOOLER LIQUID LEVEL LIQUID FEED STATUS	5% FILLING
PUMP HEADER PRESSURE	9" HG	PARAMETERS:	
		LOW STAGE RECIRCULATOR LIQUID CALL:	25%
		LOW STAGE RECIRCULATOR LIQUID SATISFIED:	30%
		LOW STAGE RECIRCULATOR LIQUID HIGH LEVEL:	40%
		LOW STAGE RECIRCULATOR LIQUID LOW LEVEL:	15%
		INTERCOOLER LIQUID LEVEL CALL:	23%
		INTERCOOLER LIQUID LEVEL SATISFIED:	27%
		INTERCOOLER LIQUID HIGH LEVEL:	34%
		INTERCOOLER LIQUID LOW LEVEL:	18%
		INTERCOOLER SUCTION OUTLET HIGH TEMP:	40°F
		PUMP MOTOR AMPS: LOW 8.2 HIGH: 17.2	
		MINIMUM PUMP DISCHARGE PRESSURE DIFFERENTIAL:	22 PSID

CIRO SCREEN 20

LOW SIDE VESSELS PANEL – NH3 NORMAL CONDITIONS

LOW STAGE RECIRCULATOR READINGS	
SUCTION PRESSURE	9" HG
SUCTION TEMPERATURE	-38°F
VESSEL LIQUID LEVEL FEED STATUS	31% SATISFIED
TOTAL PUMP AMPERAGE	15.7 AMPS
PUMP HEADER PRESSURE	20 PSIG

FLASH INTERCOOLER READINGS	
HIGH STAGE SUCTION PRESSURE	31 PSIG
INTERCOOLER SUCTION INLET TEMPERATURE	156°F
INTERCOOLER SUCTION OUTLET TEMPERATURE	24°F
INTERCOOLER LIQUID LEVEL LIQUID FEED STATUS	25% SATISFIED

PARAMETERS:

LOW STAGE RECIRCULATOR LIQUID CALL: 25%
LOW STAGE RECIRCULATOR LIQUID SATISFIED: 30%
LOW STAGE RECIRCULATOR LIQUID HIGH LEVEL: 40%
LOW STAGE RECIRCULATOR LIQUID LOW LEVEL: 15%

INTERCOOLER LIQUID LEVEL CALL: 23%
INTERCOOLER LIQUID LEVEL SATISFIED: 27%
INTERCOOLER LIQUID HIGH LEVEL: 34%
INTERCOOLER LIQUID LOW LEVEL: 18%
INTERCOOLER SUCTION OUTLET HIGH TEMP: 40°F

PUMP MOTOR AMPS: LOW 8.2 HIGH: 17.2
MINIMUM PUMP DISCHARGE PRESSURE DIFFERENTIAL: 22 PSID

LOW SIDE VESSELS PANEL – NH3 ABNORMAL CONDITIONS

LOW STAGE RECIRCULATOR READINGS	
SUCTION PRESSURE	1" HG
SUCTION TEMPERATURE	-38°F
VESSEL LIQUID LEVEL FEED STATUS	28% SATISFIED
TOTAL PUMP AMPERAGE	0.0 AMPS
PUMP HEADER PRESSURE	0.0 PSIG

FLASH INTERCOOLER READINGS	
HIGH STAGE SUCTION PRESSURE	38 PSIG
INTERCOOLER SUCTION INLET TEMPERATURE	75°F
INTERCOOLER SUCTION OUTLET TEMPERATURE	30°F
INTERCOOLER LIQUID LEVEL LIQUID FEED STATUS	45% HIGH

PARAMETERS:

LOW STAGE RECIRCULATOR LIQUID CALL: 25%
LOW STAGE RECIRCULATOR LIQUID SATISFIED: 30%
LOW STAGE RECIRCULATOR LIQUID HIGH LEVEL: 40%
LOW STAGE RECIRCULATOR LIQUID LOW LEVEL: 15%

INTERCOOLER LIQUID LEVEL CALL: 23%
INTERCOOLER LIQUID LEVEL SATISFIED: 27%
INTERCOOLER LIQUID HIGH LEVEL: 34%
INTERCOOLER LIQUID LOW LEVEL: 18%
INTERCOOLER SUCTION OUTLET HIGH TEMP: 40°F

PUMP MOTOR AMPS: LOW 8.2 HIGH: 17.2
MINIMUM PUMP DISCHARGE PRESSURE DIFFERENTIAL: 22 PSID

CIRO SCREEN 21

DIRECT EXPANSION DOCK UNITS – NH3 NORMAL CONDITIONS				
COIL SUCTION HEADER PRESSURE	30 PSIG		AIR LEAVING TEMPERATURE	33°F
COIL SUCTION HEADER TEMPERATURE	30°F		ROOM AIR TEMPERATURE	35°F
EVAPORATOR FAN MOTOR AMPS	8.4 AMPS		**MODE: REFRIGERATING**	
COMPRESSOR INLET PRESSURE	28 PSIG		PARAMETERS: ROOM TEMP: 34°F ROOM HIGH TEMP: 40°F ROOM LOW TEMP: 32°F	
COMPRESSOR DISCHARGE PRESSURE	154 PSIG			
COMPRESSOR INLET TEMP	34°F		DEFROST PUMP DOWN: 20 MIN DEFROST HOT GAS REG: 90 PSIG FAN DELAY: 2 MIN	
COMPRESSOR DISCHARGE TEMP	235°F			

NOTES:

- **UNIT IS A DIRECT EXPANSION EVAPORATOR WITH A SOLENOID ACTIVATED BACK PRESSURE REGULATOR FOR EVAPORATOR PRESSURE CONTROL.**
- **HOT GAS DEFROST METHOD USED WHICH IS SUPPLIED FROM A COMMON CONDENSER.**
- **LIQUID FEED IS AN ELECTRIC SOLENOID VALVE IN SERIES WITH A THERMOSTATIC EXPANSION VALVE.**
- **ENGINE ROOM USES A SINGLE RECIPROCATING COMPRESSOR FOR THIS LOAD.**

CIRO SCREEN 22

DIRECT EXPANSION DOCK UNITS – NH3 NORMAL CONDITIONS			
COIL SUCTION HEADER PRESSURE	30 PSIG	AIR LEAVING TEMPERATURE	33°F
COIL SUCTION HEADER TEMPERATURE	30°F	ROOM AIR TEMPERATURE	35°F
EVAPORATOR FAN MOTOR AMPS	8.4 AMPS	**MODE: REFRIGERATING**	
COMPRESSOR INLET PRESSURE	28 PSIG	PARAMETERS:	
COMPRESSOR DISCHARGE PRESSURE	154 PSIG	ROOM TEMP: 34°F ROOM HIGH TEMP: 40°F ROOM LOW TEMP: 32°F	
COMPRESSOR INLET TEMP	34°F	DEFROST PUMP DOWN: 20 MIN DEFROST HOT GAS REG: 90 PSIG FAN DELAY: 2 MIN	
COMPRESSOR DISCHARGE TEMP	235°F		

DIRECT EXPANSION DOCK UNITS – NH3 ABNORMAL CONDITIONS			
COIL SUCTION HEADER PRESSURE	30 PSIG	AIR LEAVING TEMPERATURE	42°F
COIL SUCTION HEADER TEMPERATURE	42°F	ROOM AIR TEMPERATURE	42°F
EVAPORATOR FAN MOTOR AMPS	8.4 AMPS	**MODE: REFRIGERATING**	
COMPRESSOR INLET PRESSURE	22 PSIG	PARAMETERS:	
COMPRESSOR DISCHARGE PRESSURE	154 PSIG	ROOM TEMP: 34°F ROOM HIGH TEMP: 40°F ROOM LOW TEMP: 32°F	
COMPRESSOR INLET TEMP	44°F	DEFROST PUMP DOWN: 20 MIN DEFROST HOT GAS REG: 90 PSIG FAN DELAY: 2 MIN	
COMPRESSOR DISCHARGE TEMP	280°F		

NOTES:

- **UNIT IS A DIRECT EXPANSION EVAPORATOR WITH A SOLENOID ACTIVATED BACK PRESSURE REGULATOR FOR EVAPORATOR PRESSURE CONTROL.**
- **HOT GAS DEFROST METHOD USED WHICH IS SUPPLIED FROM A COMMON CONDENSER.**
- **LIQUID FEED IS AN ELECTRIC SOLENOID VALVE IN SERIES WITH A THERMOSTATIC EXPANSION VALVE.**
- **ENGINE ROOM USES A SINGLE RECIPROCATING COMPRESSOR FOR THIS LOAD.**

CIRO SCREEN 23

DIRECT EXPANSION DOCK UNITS – NH3 NORMAL CONDITIONS			
COIL SUCTION HEADER PRESSURE	30 PSIG	AIR LEAVING TEMPERATURE	33°F
COIL SUCTION HEADER TEMPERATURE	30°F	ROOM AIR TEMPERATURE	35°F
EVAPORATOR FAN MOTOR AMPS	8.4 AMPS	**MODE: REFRIGERATING**	
COMPRESSOR INLET PRESSURE	28 PSIG	PARAMETERS:	
COMPRESSOR DISCHARGE PRESSURE	154 PSIG	ROOM TEMP: 34°F ROOM HIGH TEMP: 40°F ROOM LOW TEMP: 32°F	
COMPRESSOR INLET TEMP	34°F		
COMPRESSOR DISCHARGE TEMP	235°F	DEFROST PUMP DOWN: 20 MIN DEFROST HOT GAS REG: 90 PSIG FAN DELAY: 2 MIN	

DIRECT EXPANSION DOCK UNITS – NH3 ABNORMAL CONDITIONS			
COIL SUCTION HEADER PRESSURE	30 PSIG	AIR LEAVING TEMPERATURE	30°F
COIL SUCTION HEADER TEMPERATURE	17°F	ROOM AIR TEMPERATURE	33°F
EVAPORATOR FAN MOTOR AMPS	8.4 AMPS	**MODE: REFRIGERATING**	
COMPRESSOR INLET PRESSURE	29 PSIG	PARAMETERS:	
COMPRESSOR DISCHARGE PRESSURE	154 PSIG	ROOM TEMP: 34°F ROOM HIGH TEMP: 40°F ROOM LOW TEMP: 32°F	
COMPRESSOR INLET TEMP	17°F		
COMPRESSOR DISCHARGE TEMP	140°F	DEFROST PUMP DOWN: 20 MIN DEFROST HOT GAS REG: 90 PSIG FAN DELAY: 2 MIN	

NOTES:

- **UNIT IS A DIRECT EXPANSION EVAPORATOR WITH A SOLENOID ACTIVATED BACK PRESSURE REGULATOR FOR EVAPORATOR PRESSURE CONTROL.**
- **HOT GAS DEFROST METHOD USED WHICH IS SUPPLIED FROM A COMMON CONDENSER.**
- **LIQUID FEED IS AN ELECTRIC SOLENOID VALVE IN SERIES WITH A THERMOSTATIC EXPANSION VALVE.**
- **ENGINE ROOM USES A SINGLE RECIPROCATING COMPRESSOR FOR THIS LOAD.**

CIRO SCREEN 24

DIRECT EXPANSION DOCK UNITS – NH3 ABNORMAL CONDITIONS			
COIL SUCTION HEADER PRESSURE	30 PSIG	AIR LEAVING TEMPERATURE	30°F
COIL SUCTION HEADER TEMPERATURE	17°F	ROOM AIR TEMPERATURE	33°F
EVAPORATOR FAN MOTOR AMPS	8.4 AMPS	**MODE: REFRIGERATING**	
COMPRESSOR INLET PRESSURE	29 PSIG	PARAMETERS:	
COMPRESSOR DISCHARGE PRESSURE	154 PSIG	ROOM TEMP: 34°F ROOM HIGH TEMP: 40°F ROOM LOW TEMP: 32°F	
COMPRESSOR INLET TEMP	17°F	DEFROST PUMP DOWN: 20 MIN DEFROST HOT GAS REG: 90 PSIG FAN DELAY: 2 MIN	
COMPRESSOR DISCHARGE TEMP	140°F		

NOTES:

- **UNIT IS A DIRECT EXPANSION EVAPORATOR WITH A SOLENOID ACTIVATED BACK PRESSURE REGULATOR FOR EVAPORATOR PRESSURE CONTROL.**
- **HOT GAS DEFROST METHOD USED WHICH IS SUPPLIED FROM A COMMON CONDENSER.**
- **LIQUID FEED IS AN ELECTRIC SOLENOID VALVE IN SERIES WITH A THERMOSTATIC EXPANSION VALVE.**
- **ENGINE ROOM USES A SINGLE RECIPROCATING COMPRESSOR FOR THIS LOAD.**

Refrigerant R717 (Ammonia)						
Temp in Degrees Fahrenheit (°f)	Gauge Pressure psig *	Absolute Pressure psia	Specific Volume liquid $ft^3/lb.$	Specific Volume Vapor $ft^3/lb.$	Density Liquid $lbs./ ft^3$	Density Vapor $lbs./ ft^3$
-65	*20.4" hg*	4.69	0.0227	52.5619	44.15	0.0190
-64	*20.0" hg*	4.84	0.0227	50.8815	44.11	0.0197
-63	*19.7" hg*	5.02	0.0227	49.3229	44.07	0.0203
-62	*19.4" hg*	5.18	0.0227	47.7644	44.03	0.0209
-61	*19.0" hg*	5.37	0.0227	46.3175	43.99	0.0216
-60	*18.6" hg*	5.53	0.0228	44.8709	43.95	0.0223
-59	*18.2" hg*	5.72	0.0228	43.5023	43.90	0.0230
-58	*17.8" hg*	5.91	0.0228	42.1830	43.86	0.0237
-57	*17.4" hg*	6.11	0.0228	40.9108	43.82	0.0244
-56	*17.0" hg*	6.31	0.0228	39.6840	43.78	0.0252
-55	*16.6" hg*	6.52	0.0229	38.5006	43.74	0.0260
-54	*16.2" hg*	6.73	0.0229	37.3589	43.69	0.0268
-53	*15.7" hg*	6.95	0.0229	36.2572	43.65	0.0276
-52	*15.3" hg*	7.18	0.0229	35.1939	43.61	0.0284
-51	*14.8" hg*	7.41	0.0230	34.1675	43.57	0.0293
-50	*14.3" hg*	7.64	0.0230	33.1765	43.53	0.0301
-49	*13.8" hg*	7.89	0.0230	32.2196	43.48	0.0310
-48	*13.3" hg*	8.14	0.0230	31.2953	43.44	0.0320
-47	*12.8" hg*	8.39	0.0230	30.4025	43.40	0.0329
-46	*12.2" hg*	8.66	0.0230	29.5398	43.46	0.0339
-45	*11.7" hg*	8.92	0.0231	28.7062	43.32	0.0348
-44	*11.1" hg*	9.20	0.0231	27.9004	43.27	0.0358
-43	*10.6" hg*	9.48	0.0231	27.1216	43.23	0.0369
-42	*10.0" hg*	9.77	0.0232	26.3685	43.19	0.0379
-41	*9.3" hg*	10.07	0.0232	25.6402	43.15	0.0390
-40	*8.7" hg*	10.38	0.0232	24.9359	43.10	0.0401
-39	*8.1" hg*	10.69	0.0232	24.2545	43.06	0.0412
-38	*7.4" hg*	11.01	0.0232	23.5953	43.02	0.0424
-37	*6.8" hg*	11.34	0.0233	22.9574	42.97	0.0436
-36	*6.1" hg*	11.67	0.0233	22.3400	42.93	0.0448
-35	*5.4" hg*	12.01	0.0233	21.7423	42.89	0.0460
-34	*4.7" hg*	12.37	0.0233	21.1637	42.85	0.0473
-33	*3.9" hg*	12.73	0.0234	20.6035	42.80	0.0485
-32	*3.2" hg*	13.10	0.0234	20.0609	42.76	0.0498

Refrigerant R717 (Ammonia)						
Temp in Degrees Fahrenheit (°f)	Gauge Pressure psig *	Absolute Pressure psia	Specific Volume liquid $ft^3/lb.$	Specific Volume Vapor $ft^3/lb.$	Density Liquid $lbs./ ft^3$	Density Vapor $lbs./ ft^3$
-31	*2.4" hg*	13.47	0.0234	19.5353	42.72	0.0512
-30	*1.6" hg*	13.86	0.0234	19.0262	42.67	0.0526
-29	*.8" hg*	14.25	0.0235	18.5328	42.63	0.0540
-28	**0 psig**	**14.66**	**0.0235**	**18.0548**	**42.59**	**0.0554**
-27	0.37	15.07	0.0235	17.5914	42.55	0.0568
-26	0.79	15.49	0.0235	17.1422	42.50	0.0583
-25	1.23	15.93	0.0236	16.7068	42.46	0.0599
-24	1.67	16.37	0.0236	16.2845	42.42	0.0614
-23	2.12	16.82	0.0236	15.8750	42.37	0.0630
-22	2.58	17.28	0.0236	15.4778	42.33	0.0646
-21	3.05	17.75	0.0236	15.0925	42.29	0.0663
-20	3.54	18.24	0.0237	14.7187	42.24	0.0679
-19	4.03	18.73	0.0237	14.3559	42.20	0.0697
-18	4.53	19.23	0.0237	14.0038	42.16	0.0714
-17	5.05	19.75	0.0237	13.6621	42.11	0.0732
-16	5.57	20.27	0.0238	13.3303	42.07	0.0750

Refrigerant R717 (Ammonia)						
Temp in Degrees Fahrenheit (°f)	Gauge Pressure psig *	Absolute Pressure psia	Specific Volume liquid $ft^3/lb.$	Specific Volume Vapor $ft^3/lb.$	Density Liquid $lbs./ ft^3$	Density Vapor $lbs./ ft^3$
-15	6.11	20.81	0.0238	13.0082	42.02	0.0769
-14	6.66	21.36	0.0238	12.6954	41.98	0.0788
-13	7.22	21.92	0.0238	12.3917	41.94	0.0807
-12	7.79	22.49	0.0239	12.0966	41.89	0.0827
-11	8.37	23.07	0.0239	11.8100	41.85	0.0847
-10	8.96	23.66	0.0239	11.5315	41.81	0.0867
-9	9.57	24.27	0.0239	11.2608	41.76	0.0888
-8	10.19	24.89	0.0240	10.9978	41.72	0.0909
-7	10.82	25.52	0.0240	10.7422	41.67	0.0931
-6	11.47	26.17	0.0240	10.4937	41.63	0.0953
-5	12.13	26.83	0.0240	10.2521	41.59	0.0975
-4	12.80	27.50	0.0241	10.0172	41.54	0.0998
-3	13.48	28.18	0.0241	9.7887	41.50	0.1022
-2	14.18	28.88	0.0241	9.5665	41.45	0.1045
-1	14.89	29.59	0.0241	9.3503	41.41	0.1069
0	**15.62**	**30.32**	**0.0242**	**9.1401**	**41.36**	**0.1094**
1	16.36	31.06	0.0242	8.9355	41.32	0.1119
2	17.11	31.81	0.0242	8.7364	41.27	0.1145
3	17.88	32.58	0.0243	8.5426	41.23	0.1171
4	18.66	33.36	0.0243	8.3540	41.19	0.1197
5	19.46	34.16	0.0243	8.1704	41.14	0.1224
6	20.28	34.98	0.0243	7.9917	41.10	0.1251
7	21.10	35.80	0.0244	7.8177	41.05	0.1279
8	21.95	36.65	0.0244	7.6482	41.01	0.1307
9	22.81	37.51	0.0244	7.4831	40.96	0.1336
10	23.68	38.38	0.0244	7.3224	40.92	0.1366

Refrigerant R717 (Ammonia)						
Temp in Degrees Fahrenheit (°f)	Gauge Pressure psig *	Absolute Pressure psia	Specific Volume liquid $ft^3/lb.$	Specific Volume Vapor $ft^3/lb.$	Density Liquid $lbs./ ft^3$	Density Vapor $lbs./ ft^3$
11	24.58	39.28	0.0245	7.1657	40.87	0.1396
12	25.48	40.18	0.0245	7.0132	40.82	0.1426
13	26.41	41.11	0.0245	6.8645	40.78	0.1457
14	27.35	42.05	0.0246	6.7196	40.73	0.1488
15	28.31	43.01	0.0246	6.5784	40.69	0.1520
16	29.28	43.98	0.0246	6.4408	40.64	0.1553
17	30.28	44.98	0.0246	6.3066	40.60	0.1586
18	31.29	45.99	0.0247	6.1758	40.55	0.1619
19	32.32	47.02	0.0247	6.0483	40.51	0.1653
20	33.36	48.06	0.0247	5.9240	40.46	0.1688
21	34.43	49.13	0.0247	5.8027	40.41	0.1723
22	35.51	50.21	0.0248	5.6844	40.37	0.1759
23	36.61	51.31	0.0248	5.5690	40.32	0.1796
24	37.73	52.43	0.0248	5.4564	40.27	0.1833
25	38.87	53.57	0.0249	5.3466	40.23	0.1870
26	40.03	54.73	0.0249	5.2395	40.18	0.1909
27	41.21	55.91	0.0249	5.1349	40.14	0.1947
28	42.41	57.11	0.0249	5.0328	40.09	0.1987
29	43.62	58.32	0.0250	4.9332	40.04	0.2027
30	44.86	59.56	0.0250	4.8360	40.00	0.2068
31	46.12	60.82	0.0250	4.7410	39.95	0.2109
32	47.40	62.10	0.0251	4.6483	39.90	0.2151
33	48.70	63.40	0.0251	4.5678	39.85	0.2189
34	50.02	64.72	0.0251	4.4695	39.81	0.2237
35	51.37	66.07	0.0252	4.3831	39.76	0.2281

Refrigerant R717 (Ammonia)						
Temp in Degrees Fahrenheit (°f)	Gauge Pressure psig *	Absolute Pressure psia	Specific Volume liquid $ft^3/lb.$	Specific Volume Vapor $ft^3/lb.$	Density Liquid $lbs./ ft^3$	Density Vapor $lbs./ ft^3$
36	52.73	67.43	0.0252	4.2988	39.71	0.2326
37	54.12	68.82	0.0252	4.2165	39.67	0.2372
38	55.53	70.23	0.0252	4.1360	39.62	0.2418
39	56.96	71.66	0.0253	4.0574	39.57	0.2465
40	58.41	73.11	0.0253	3.9806	39.52	0.2512
41	59.89	74.59	0.0253	3.9055	39.47	0.2560
42	61.39	76.09	0.0254	3.8321	39.43	0.2610
43	62.91	77.61	0.0254	3.7604	39.38	0.2659
44	64.46	79.16	0.0254	3.6903	39.33	0.2710
45	67.03	81.73	0.0255	3.6218	39.28	0.2761
46	67.63	82.33	0.0255	3.5548	39.23	0.2813
47	69.25	83.95	0.0255	3.4893	39.18	0.2866
48	70.89	85.59	0.0255	3.4253	39.14	0.2919
49	72.56	87.26	0.0256	3.3626	39.09	0.2974
50	74.25	88.95	0.0256	3.3014	39.04	0.3029
51	75.97	90.67	0.0256	3.2415	38.99	0.3085
52	77.71	92.41	0.0257	3.1828	38.94	0.3142
53	79.48	94.18	0.0257	3.1255	38.89	0.3199
54	81.28	95.98	0.0257	3.0694	38.84	0.3258
55	83.10	97.80	0.0258	3.0145	38.79	0.3317
56	84.95	99.65	0.0258	2.9608	38.74	0.3377
57	86.83	101.53	0.0258	2.9082	38.69	0.3439
58	88.73	103.43	0.0259	2.8568	38.64	0.3500
59	90.66	105.36	0.0259	2.8064	38.59	0.3563
60	92.62	107.32	0.0259	2.7571	38.54	0.3627

Refrigerant R717 (Ammonia)						
Temp in Degrees Fahrenheit (°f)	Gauge Pressure psig *	Absolute Pressure psia	Specific Volume liquid $ft^3/lb.$	Specific Volume Vapor $ft^3/lb.$	Density Liquid $lbs./ ft^3$	Density Vapor $lbs./ ft^3$
61	94.60	109.30	0.0260	2.7089	38.49	0.3692
62	96.62	111.32	0.0260	2.6616	38.44	0.3757
63	98.66	113.36	0.0260	2.6154	38.39	0.3824
64	100.73	115.43	0.0261	2.5701	38.34	0.3891
65	102.83	117.53	0.0261	2.5257	38.29	0.3959
66	104.96	119.66	0.0262	2.4823	38.24	0.4029
67	107.12	121.82	0.0262	2.4397	38.19	0.4099
68	109.31	124.01	0.0262	2.3981	38.14	0.4170
69	111.53	126.23	0.0263	2.3572	38.09	0.4242
70	113.78	128.48	0.0263	2.3173	38.04	0.4315
71	116.06	130.76	0.0263	2.2781	37.99	0.4390
72	118.37	133.07	0.0264	2.2397	37.93	0.4465
73	120.71	135.41	0.0264	2.2021	37.88	0.4541
74	123.08	137.78	0.0264	2.1652	37.83	0.4619
75	125.48	140.18	0.0265	2.1291	37.78	0.4697
76	127.92	142.62	0.0265	2.0936	37.73	0.4776
77	130.39	145.09	0.0265	2.0589	37.67	0.4857
78	132.89	147.59	0.0266	2.0249	37.62	0.4939
79	135.42	150.12	0.0266	1.9915	37.57	0.5021
80	137.99	152.69	0.0267	1.9588	37.52	0.5105
81	140.59	155.29	0.0267	1.9268	37.46	0.5190
82	143.22	157.92	0.0267	1.8953	37.41	0.5276
83	145.89	160.59	0.0268	1.8645	37.36	0.5363
84	148.59	163.29	0.0268	1.8342	37.31	0.5452
85	151.33	166.03	0.0268	1.8046	37.25	0.5541

Refrigerant R717 (Ammonia)						
Temp in Degrees Fahrenheit (°f)	Gauge Pressure psig *	Absolute Pressure psia	Specific Volume liquid $ft^3/lb.$	Specific Volume Vapor $ft^3/lb.$	Density Liquid $lbs./ ft^3$	Density Vapor $lbs./ ft^3$
86	154.10	168.80	0.0269	1.7755	37.20	0.5632
87	156.90	171.60	0.0269	1.7470	37.14	0.5724
88	159.75	174.45	0.0270	1.7190	37.09	0.5817
89	162.62	177.32	0.0270	1.6915	37.04	0.5912
90	165.54	180.24	0.0270	1.6646	36.98	0.6007
91	168.48	183.18	0.0271	1.6381	36.93	0.6105
92	171.47	186.17	0.0271	1.6122	36.87	0.6203
93	174.49	189.19	0.0272	1.5867	36.82	0.6302
94	177.55	192.25	0.0272	1.5617	36.77	0.6403
95	180.65	195.35	0.0272	1.5372	36.71	0.6505
96	183.78	198.48	0.0273	1.5131	36.66	0.6609
97	186.95	201.65	0.0273	1.4895	36.60	0.6714
98	190.16	204.86	0.0274	1.4663	36.55	0.6820
99	193.41	208.11	0.0274	1.4436	36.49	0.6927
100	196.70	211.40	0.0274	1.4212	36.43	0.7036
101	200.02	214.72	0.0275	1.3993	36.38	0.7146
102	203.39	218.09	0.0275	1.3777	36.32	0.7258
103	206.80	221.50	0.0276	1.3565	36.27	0.7372
104	210.24	224.94	0.0276	1.3358	36.21	0.7486
105	213.73	228.43	0.0277	1.3153	36.15	0.7603
106	217.25	231.95	0.0277	1.2953	36.10	0.7720
107	220.82	235.52	0.0277	1.2756	36.04	0.7839
108	224.43	239.13	0.0278	1.2563	35.98	0.7960
109	228.08	242.78	0.0278	1.2373	35.93	0.8082
110	231.77	246.47	0.0279	1.2186	35.87	0.8206

Refrigerant R717 (Ammonia)						
Temp in Degrees Fahrenheit (°f)	Gauge Pressure psig *	Absolute Pressure psia	Specific Volume liquid $ft^3/lb.$	Specific Volume Vapor $ft^3/lb.$	Density Liquid $lbs./ ft^3$	Density Vapor $lbs./ ft^3$
111	235.50	250.20	0.0279	1.2003	35.81	0.8331
112	239.28	253.98	0.0280	1.1822	35.75	0.8459
113	243.10	257.80	0.0280	1.1645	35.70	0.8587
114	246.96	261.66	0.0281	1.1471	35.64	0.8718
115	250.87	265.57	0.0281	1.1300	35.58	0.8850
116	255.40	269.52	0.0282	1.1132	35.52	0.8983
117	259.40	273.51	0.0282	1.0967	35.46	0.9118
118	263.50	277.55	0.0282	1.0805	35.41	0.9255
119	267.60	281.63	0.0283	1.0645	35.35	0.9394
120	271.70	285.76	0.0283	1.0488	35.29	0.9535
121	275.90	289.93	0.0284	1.0334	35.23	0.9677
122	280.10	294.15	0.0284	1.0183	35.17	0.9820
123	284.40	298.41	0.0285	1.0033	35.11	0.9967
124	288.70	302.72	0.0285	0.9887	35.05	1.0114
125	293.10	307.08	0.0286	0.9743	34.99	1.0264