The Ford's Procedures

Learn How To Recondition

RV Absorption Refrigeration Units

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TRAINING TECHNICIANS

FRVRTC

R101-RV Refrigerator Cooling Unit Reconditioning

FROM AROUND THE WORLD

ONLINE VOLUME I
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This manual is to be used in conjunction with the R101 RV Refrigerator Cooling Unit Repair Video (During Training), the Customized Tools, and all the products that are in the purchased package. There is information in one that is not in the other. This manual is not to be used as the sole source for repairing the RV refrigerator cooling units.

Although every effort has been made to ensure the accuracy and completeness of the information in this manual, the authors nor anyone affiliated with them, make no guarantees, stated or implied, nor will they be liable in the event of misinterpretation or human error made by the reader, or for any typographical errors that may appear.

It is recommended that no changes be made to the procedures outlined in this manual, the video, or with the customized tools. Throughout the years, every possible scenario has been tested and tried. Making changes can affect the outcome of the process or create problems along the way. The charging board, the manual, the PDF's, and the videos contain the successful methods used since 1984. These all work together to achieve that success.

THE FORD PROCEDURES

- WORK SAFELY WITH ALL OF THE TOOLS,WEAR SAFETY GLASSES AT ALL TIMES.
- FOLLOW ALL WARNINGS, CAUTIONS, AND NOTES.
- FOLLOW ALL OTHER MANUFACTURER'S INSTURCTIONS AND WARNINGS FOR ALL PRODUCTS.
- BE SURE TO FOLLOW YOUR ENTIRE LOCAL AND STATE CODES IF ANY APPLY.

- Compliance with all local safety and health directives are mandatory when performing the work specified in this manual.
- When the local directives are more stringent than those specified in this manual, the local directives shall prevail.

Things That May Not Be Known about RV Refrigerators

1. RV refrigerators are environmentally friendly.

    a. The main chemicals used in the charge are common compounds found in nature. They are water, ammonia, and hydrogen.

    b. They have great thermodynamic appeal, making it more economical.

    c. The distinct odor of the ammonia provides early leak detection.

    d. When a leak is detected, the cooling unit can be reconditioned for much less cost to the consumer, rather than it being thrown in a landfill and replaced with an expensive new one.

2. The RV Refrigerator is User-Friendly.

   a. Less maintenance
      i. The refrigerator has few moving parts.
      ii. The refrigeration unit (cooling unit) has no moving parts.

   b. The cooling unit is made of durable steel.
   c. It conveniently operates on LP gas or 110-volt AC or 12-volt DC
   e. It is insulated and designed to operated in an RV.

3. Why recondition the cooling unit?

   a. All of No. 1 and No. 2 previously stated.

   b. It is less costly to the consumer than a new cooling unit or a new refrigerator.

   c. The physical size difference in replacements.
   If there is not a replacement cooling unit available, others will suggest replacing the complete refrigerator. New model sizes can change; therefore, remodeling may be required in the RV to make it fit properly. More costs to the consumer.

   e. When you educate the consumer, the service sells itself.

   f. Keeping repairable cooling units out of our land fills.

   g. It’s a win/win for everyone!

TOP TEN REASONS

Why Domestic Refrigerators (Household) Are Not the Best Choice for the RV

1. It lowers the resale value of the RV because most people want a refrigerator that can work on LP.
2. It has many moving parts leading to more maintenance and repairs.
3. The refrigeration unit is made-up of copper and aluminum, which can be damaged when vibrated during transit.
4. The motor in the compressor is also vibration sensitive.
5. It uses more energy.
6. It is insulated to operate in a home with an approximate seventy-degree ambient temperature. If used in an RV, the ambient temperatures are higher, thus causing greater use of electricity and wear and tear on the parts of the system.
7. The chemicals are not always environmentally friendly.
8. Chemicals used have no obvious odor that helps detect leaks.
9. It operates strictly on 110-volt AC.
10. The physical size will not be the same as the original RV refrigerator, leading to the need to remodel the RV.

SAFETY & PRECAUTIONS

There are specific safety precautions contained in this manual which must be strictly followed by all personnel involved. These precautions precede hazardous operations as WARNINGS and CAUTIONS as follows:

WARNING!

A warning refers to an operational procedure or step which, if not followed, could result in bodily injury and equipment damage.

CAUTION

A caution refers to an operational procedure or step which, if not strictly adhered to, could result in equipment damage.

Anyone following the procedures outlined in this manual, should already be familiar with the appropriate Material Safety Data Sheets (MSDS) and the emergency procedures defined therein. For access to MSDS contact your local chemical supplier.

WARNING!

Unit is charged. Safety glasses and face shield should be worn at all times when utilizing force to remove heat element from sleeve.

WARNING!

Unit is charged. Safety glasses and face shield should be worn at all times. **DO NOT** weld. Explosion may occur.

When Safeties Are Followed, Problems Are Not Created!

WARNING!

Unit is charged. Safety glasses and face shield should be worn at all times.
DO NOT drill into unit. Hydrogen may ignite.

WARNING!

Unit is charged. Safety glasses and face shield should be worn at all times. **DO NOT** bend pipes. Unit could rupture causing ammonia to escape violently.

Memorize Warnings & Cautions! There here for your protection!

WARNING!

Unit is charged. Safety glasses and face shield should be worn at all times.
DO NOT strike unit with hammer. Unit could rupture causing ammonia to escape violently.

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Before contacting FRVRTC with questions, please refer to the Manual, the Videos, and the PDF's for the answer.

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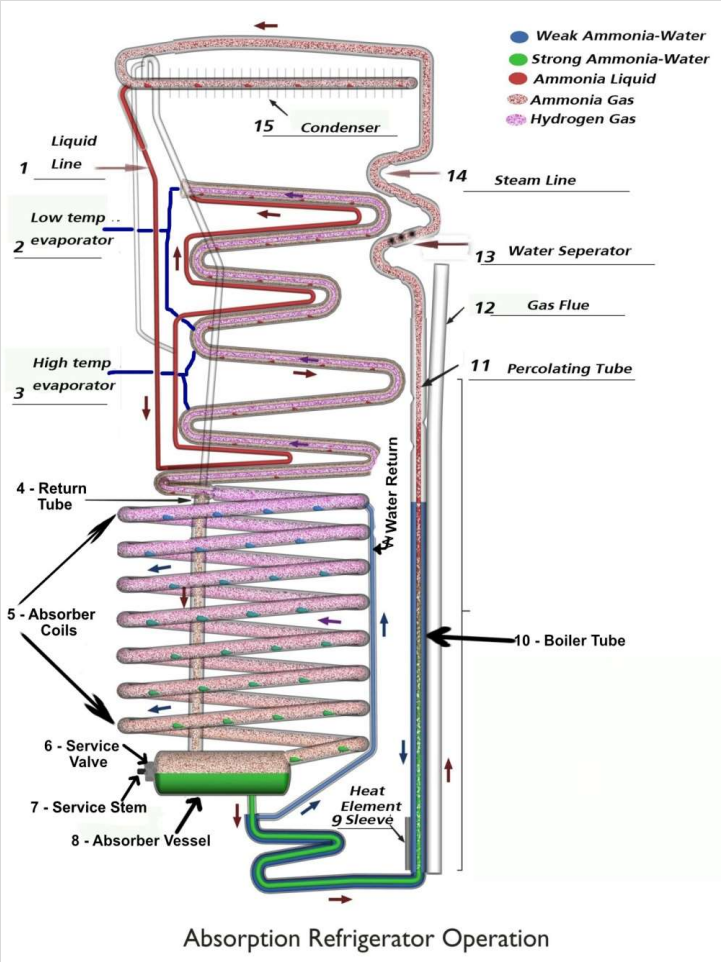
Procedure I

1.0 Absorption refrigeration

1.1 Absorption refrigeration was developed by Michael Faraday in 1824, has found its niche. While absorption refrigeration systems are found in both industrial and domestic situations, by far the fastest growing application is in recreational vehicles, motor homes, and trailers. It is also used by Amish communities, preppers and those living off the grid. This is due to the unit being small and quiet with few moving parts – the perfect refrigerator for the road. Natural gas, LP gas, kerosene, steam, or an electric heating element may be used for the heat source, allowing the user to operate the unit safely and with ease.

1.1.2 Chemicals Used are Environmentally Friendly

The liquids and gases used in Absorption Refrigeration are not harmful to our environment. Ammonia is also used for fertilizer on crops. It is economical for those of us doing recharging because when ammonia is drained from a cooling unit, it can be saved and reused later. Aqua, which is water, is also saved and reused. Hydrogen is the main chemical lost from an Absorption Refrigerator.
Small quantities of hydrogen will be released into the atmosphere where it originally came from.



Absorption Refrigerator Operation

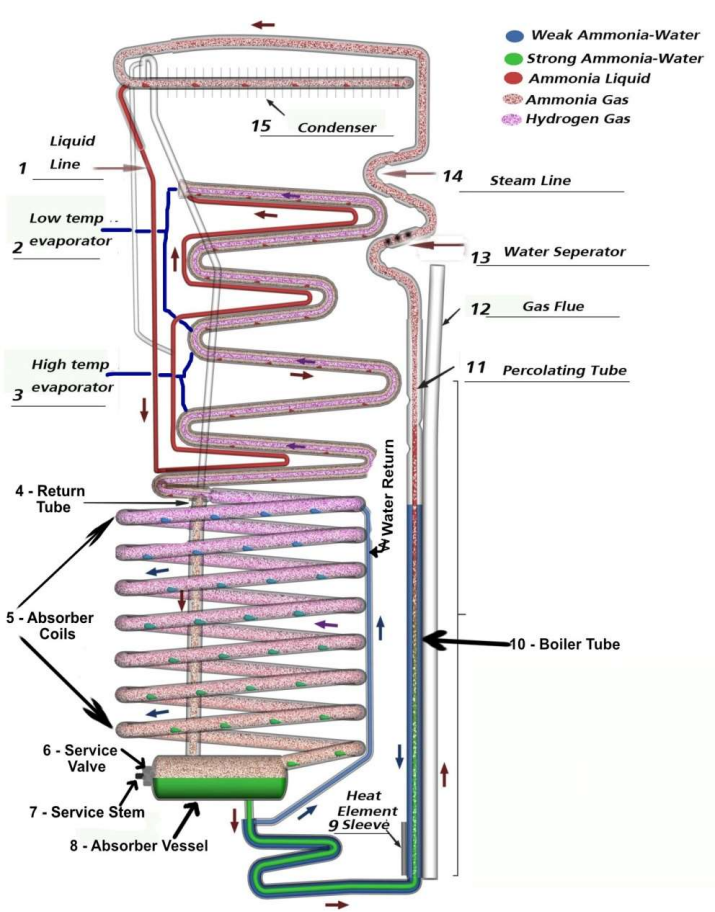
1.2 Theory of Operation

Two Cycles-Ammonia Cycle & Water Cycle

1.2.1 Heat is applied to the cooling unit either by the electric heating element or LP gas.

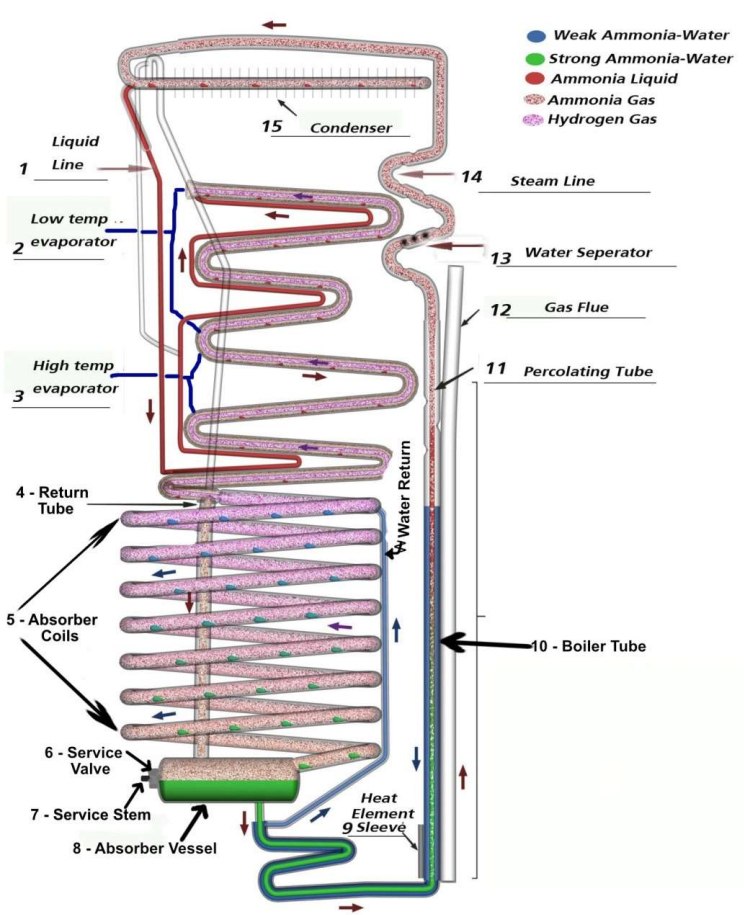
1.2.2 The **weak ammonia-water** (blue) and **the strong ammonia water** (green) in the bottom of the boiler tube begins to boil.

1.2.3 This creates a vapor (**pink** & **red**) that rises up the boiler tube, into the percolating tube and up to the water separator.



Absorption Refrigerator Operation

1.2.4 The water separator separates the water from the ammonia. The **water** drops back down to the bottom of the boiler tube and the **ammonia gas** continues to rise up through the condenser, where the vapor is cooled and changed back to an **ammonia liquid**.

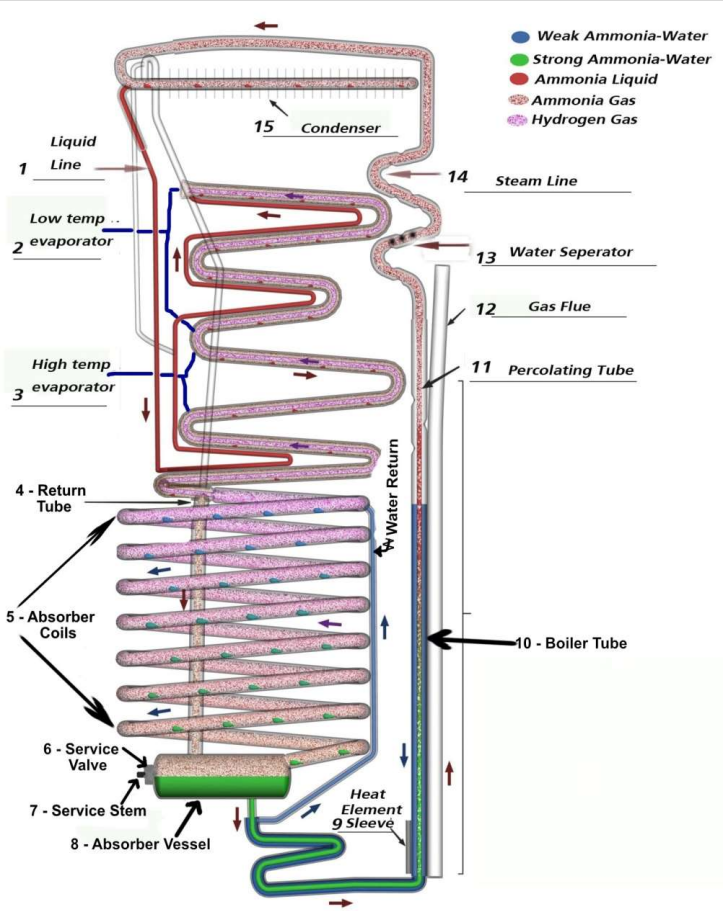


Absorption Refrigerator Operation

1.2.5 **The ammonia liquid** then drops down the liquid line and is pushed up to the low temp evaporator by gravity.

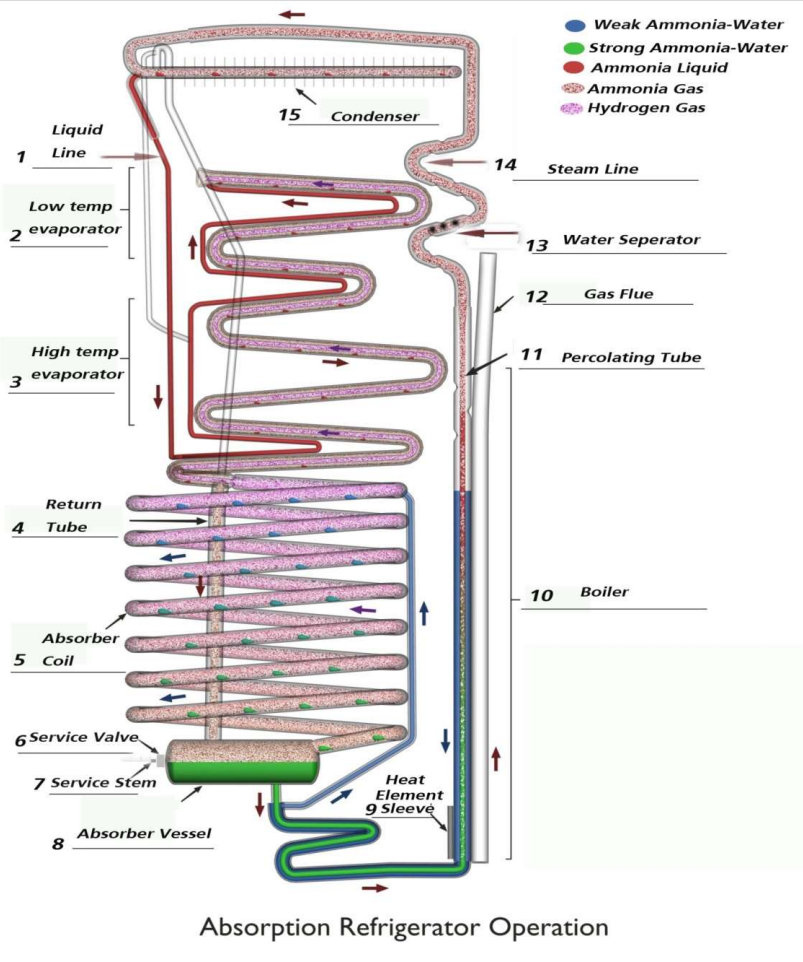
1.2.6 It then flows down through the high temp evaporator. When the **liquid ammonia** meets the **hydrogen** it causes a flash, which is a change of state.

1.2.7 This is what causes the cooling. It goes from a liquid to a gas and the **ammonia gas** is absorbed into the **hydrogen.**



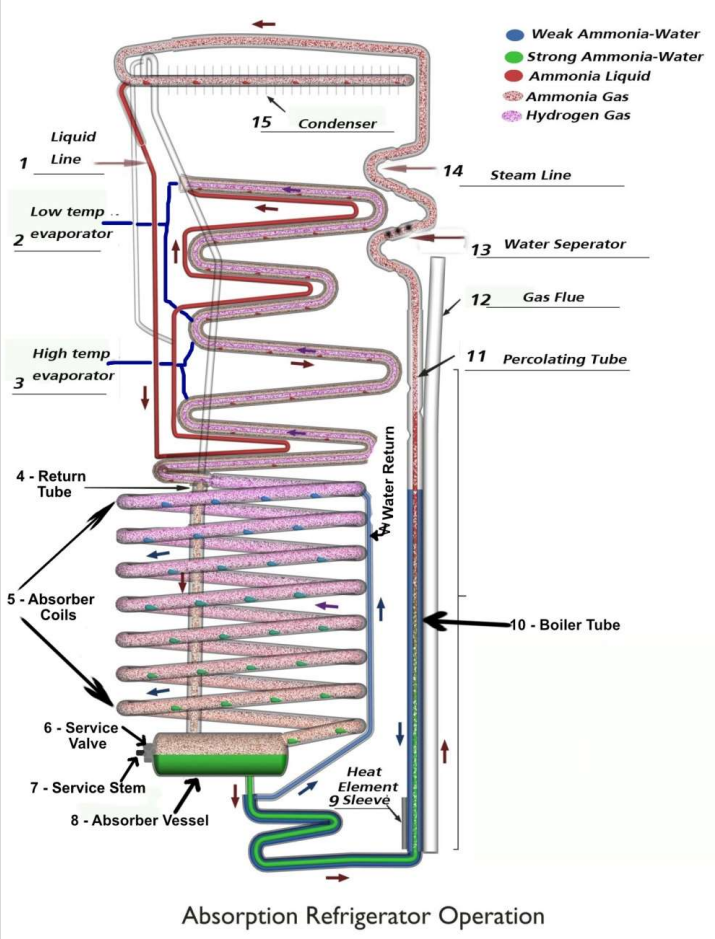
Absorption Refrigerator Operation

1.2.8 Although <u>hydrogen</u> is the lightest gas known to man, the saturation causes it to become heavy, forcing it to fall down through the evaporator where it actually <u>absorbs the heat out of the refrigerator,</u> thus, absorption refrigeration.



Absorption Refrigerator Operation

1.2.9 The **liquid** **saturated hydrogen** continues to fall into the return tube and down to the absorber vessel, then down to the bottom of the cooling unit where the process starts all over. When the **saturated** **hydrogen gas** meets the liquid in the bottom of the absorber vessel, the **hydrogen** separates and rises up through the absorber coils, then moves back up to the top of the low temp evaporator.



Absorption Refrigerator Operation

1.2.10 When the **weak ammonia water** drops back down the boiler tube, it is forced up to the water return where it goes back to the top of the absorber coil and flows down through the absorber coils, to the absorber vessel and is remixed with the **strong ammonia water**. The process starts all over again.

Procedure II
2.0 Chemicals

2.1 The four chemicals used in the charging setup must be the following.

WARNING!

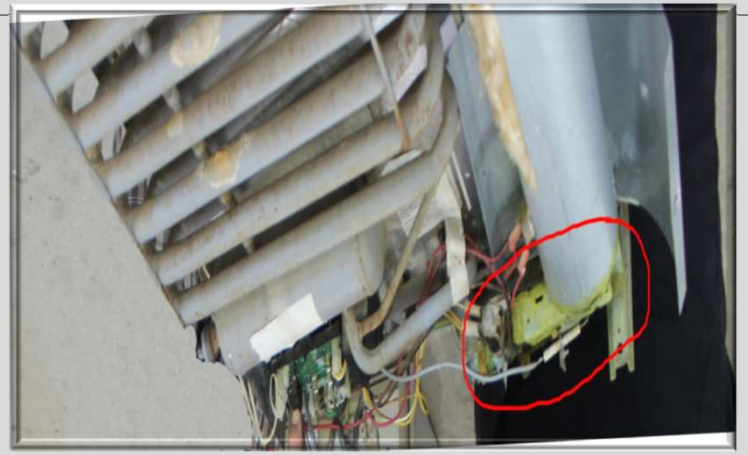
All pressure cylinders such as oxygen, acetylene, hydrogen, etc., must be chained or otherwise secured to prevent accidental falling and breakaway in the event of rupture.

Table 2-1

Chemical	Strength	Size	Lasts Approximately
Ammonia (NH3)	100%	150 lb. cylinder	5 years
Hydrogen (H)	97%	Standard size tank	20 refrigerators
Aqua Ammonia	26%	16 Gallon	1-3 years
Sodium Dichromate Crystals	NA2CRO4:H2O	1 lb.	5 years or more

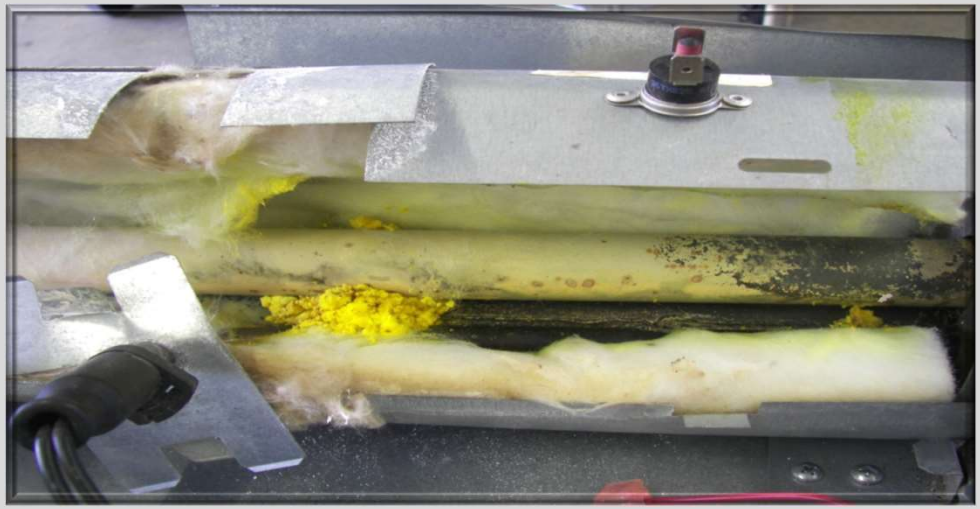
Procedure III
3.0 Troubleshooting the Cooling Unit

When Working With Cooling Units
Always assume every
Cooling unit HAS pressure!
Do all proper procedures to
Ensure Everyone's Safety!!



3.1 Visual Inspection

Inspect unit for any yellow coloring. Yellowing is caused by Sodium Dichromate. This has been added to the chemical formula and is usually found in the boiler area and under the burner (although yellowing can occur elsewhere). Yellowing indicates a leak in that area.



3.2 Nasal Inspection

Open refrigerator door and smell for an ammonia odor. If the odor is present, this indicates a leak in the high temp evaporator. If the refrigerator is a two-door model, open freezer compartment and check for ammonia odor there as well. If detected, this indicates a leak in the low temp evaporator.

3.3 Bypassing the Controls

3.3.1 Before bypassing controls do the following

3.3.2 Ensure heat element is the required wattage for the unit being serviced by checking the heat element wattage with an amp probe.

3.3.3 Do the Ohms Power Law equation at the right on the image.

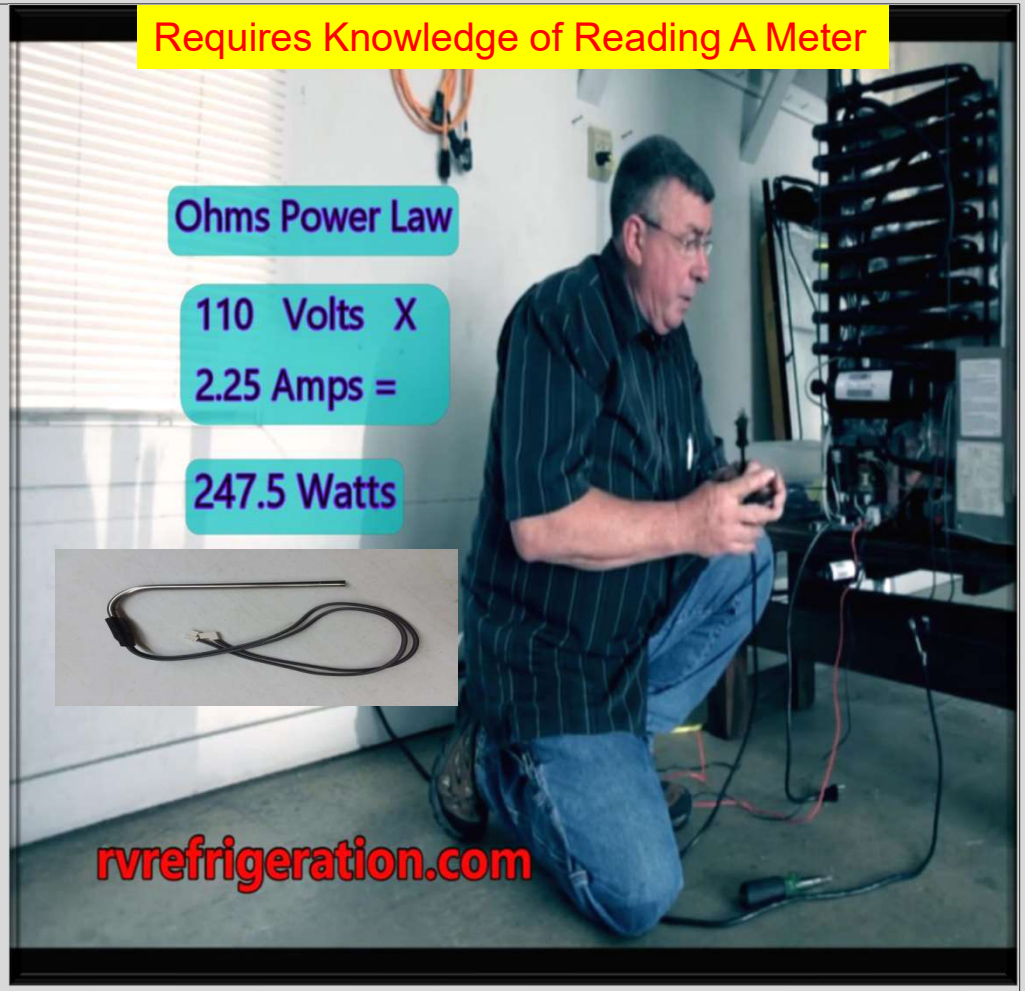
3.3.4 A 10% cushion, either way, is OK.

3.3.5 Therefore, if the heat element needs to be 250 Watts, and the numbers fall from 222.75 - 272.25, the heat element is good.

3.3.6 If not, replace it with a new one, but check it's wattage too.

3.3.7 If the wattage is wrong, the bypass will be a waste of time.

NOTE
Recommend using OEM products, not after market.



WARNING!

DO NOT LEAVE THE REFRIGERATOR WHILE DOING THE BYPASS!!
When the controls are bypassed, you are eliminating the safeties provided in the controls.

NOTE

Earlier, it was stated that a yellow discoloration would appear, or an ammonia odor would be present in the event of a leak. Even if these are not notable, a leak might still be the problem. No yellowing around the boiler indicates the leak is above the service valve. No ammonia odor indicates that odor has dissipated due to the size of the hole where the leak occurred and time allowed for ammonia to escape.

3.3.8 Make sure the unit is level side to side and front to back. Bypass all controls by connecting 110/120 VAC directly to the heating element. This allows testing of the cooling unit without interference from the controls. Make an AC adapter cord to plug the heat element into. This allows testing of the cooling unit without interference from other controls.

3.3.9 If within two minutes of bypassing the controls a rapid boil is noted coming from the boiler, the unit has a leak above the liquid line (which is in the bottom portion of the cooling unit) and has lost the gas portion (pressure) of the charge. Continue on with the reconditioning procedures.

3.3.10 If you do not hear the rapid boil, let the unit operate in bypass mode overnight. (Remember, the controls are bypassed so you have bypassed the safeties and you should not leave this unit unattended.)Then check the temperature in the refrigerator using a meter and leads so as not to open the refrigerator door. Check refrigerator temperature the next day. Regardless of ambient temperature, the thermometer in the refrigerator should read below 32° F. (United Kingdom = 0 C) . If the temperature is below freezing, after operating in the bypass mode for hours, the cooling unit is not the problem. This proves there is a control or ventilation issue, not a cooling unit issue. Find control troubleshooting and repair at www.rvrefrigeration.com-DIY RV Refrig Videos.

3.3.11 **If the cooling unit has been removed from the box,** do **Procedure 3.3.2 -3.3.3** and allow unit to run for approximately one hour. It is important that when the unit is running, it is level side-to-side and front to back. After such time some warming should be noted in bottom absorber coil, cooling observed in the freezer compartment, and considerable warming present at top of the steam line, just before condenser. If these temperatures are not present, let it run overnight, again not unattended, and check in the morning.

3.4 Other Circumstances that would cause the refrigerator temps to be 32°F or above when the controls are by-passed:

1. Unlevel – the refrigerator must be level to work properly. Place a level in freezer compartment to make sure it's level side to side and front to back.
2. Heat element – is incorrect wattage
3. Insulation – not enough between the boiler and the cabinet, and between the boiler and the flue
4. Door gasket/s – needs replaced if air is escaping from the refrigerator/freezer
5. High-pressure leak – holes so small they do not release all pressure in the cooling unit
6. Open condensation drain tube – allows air and insects to enter the condensation drain tube

NOTE

Anyone of these issues can raise the refrigerator temperature 9º F. More than one of these at a time will create even higher temps.

NOTE

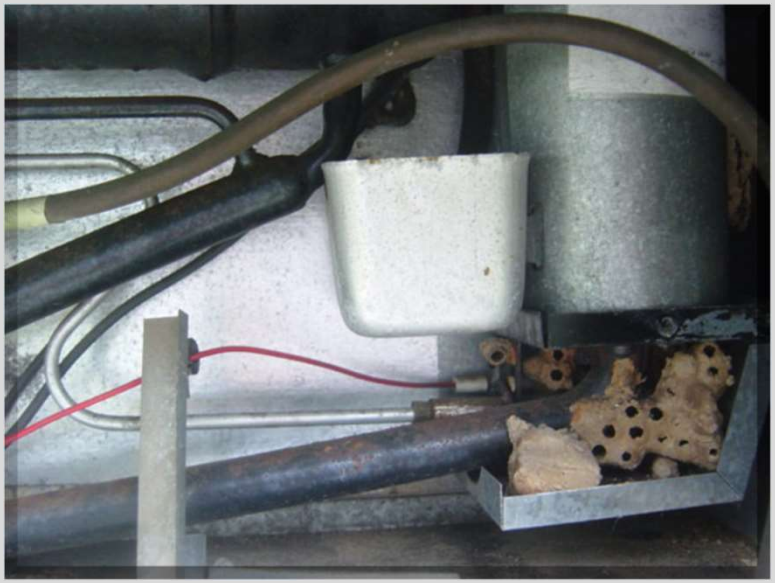
In the heat of summer, when the ambient temperature is 90° F or greater, the refrigerator temperature may only read in the high 20's. In cooler seasons, when the temperature drops significantly, that same refrigerator's temperature may read cooler. Ambient temperature plays a big part in these cooling units.

7. **Poor ventilation** - the heat must go across the condenser then escape out of the RV through the vent.

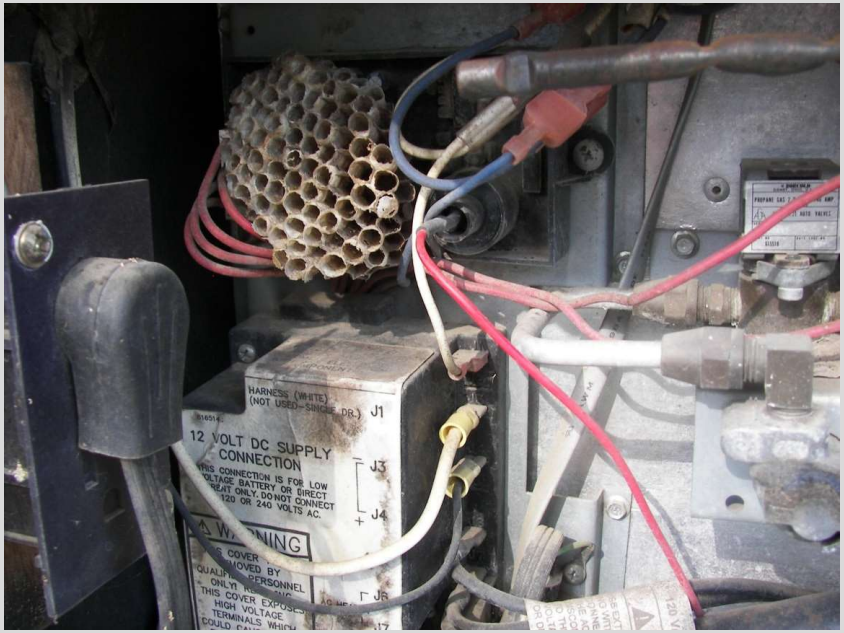
- **Vent in top of RV- should see daylight**

- **Vent on the side of RV will create issues if it's below the condenser. Fans will need to be installed to help circulate the air.**

3.4.1 When opening the access panel to the back of the refrigerator, watch for wasps and other insects.



Dirt, Debris, Mud Daubers, Spiders, Squirrels, Wasps, and other insects make homes behind the refrigerator



3.4.2 Check the **door gasket** by placing a dollar bill in between the door gasket and the cabinet. Gently pull out the dollar bill. If there is resistance, the door gasket is good. If it pulls out really easy, a new door gasket is needed. Do this procedure periodically around all the entire door/s.

If the door gasket seal is not suspect, and, after running unit overnight, the temperature inside is still above 32° F, a high-pressure leak may be present.

3.4.3 **High-pressure leaks** are holes that are so small they do not completely release all pressure. The unit should be prepared for pressure washing.

3.4.4 **A Plugged Boiler**

After the cooling unit has run for one hour in bypass mode, these symptoms would indicate the boiler tube is plugged:

- No rapid boil coming from the boiler tube
- Steam line is extremely hot where it exits the boiler pack
- No temperature at top of steam line just before it enters the condenser
- No temperature in low temp evaporator (freezer)
- Little or no temperature in bottom absorber coil

NOTE

Plugged boiler tubes were once common. However, manufacturers enlarged the boiler tube and consumers became aware of the need for the refrigerator to be level. Really old models could have this problem.

Procedure IV
4.0 Disassembly

General Procedures for Removing Refrigerator from RV

4.1 Perform an LP leak check test with a manometer. Shut off the propane at main tank valve.

4.1.1 Mark positions of 12Vdc wires.

4.1.2 Disconnect 12Vdc wires and tape positive wire.

4.1.3 Disconnect 110Vac refrigerator plug.

4.1.4 Using two wrenches, one on refrigerator connection and other on brass flare nut, disconnect LP gas line. Do not loosen this nut without a backup wrench as indicated. Plug the gas line on the camper if necessary and check for leaks.

4.1.5 Outside vehicle, remove screws or bolts in a lower rear section of the unit (if any are present).

4.1.6 Inside vehicle, cover the floor with a drop cloth.

4.1.7 Remove refrigerator doors if necessary.

4.1.8 Remove four (or six) wood screws around the frame, which holds refrigerator to the wall.

4.1.9 Slide refrigerator out of the opening and remove to the service area.

4.2 Cooling Unit Disassembly

NOTE
To ensure accurate reassembly, mark positions of any wiring and controls before beginning disassembly.

4.2.1 Remove boiler pack and electric heating element(s). (Cooling unit may first need to be removed before this step can be accomplished.)

4.2.2 Remove sheet-metal cover around burner assembly.

Caution

When accomplishing the following step, take precautions against crimping gas line, thermocouple, or thermostat capillary tubes.

4.2.3 Remove screws holding burner assembly in place and carefully set burner assembly aside.

4.2.4 Remove wiring and screws holding cooling unit to the box. (Be sure to mark where the wires go)

4.2.5 Remove thermistor from refrigerator fins.

NOTE

Prior to the removal of the cooling unit, some units require the removal of the cooling fins inside the refrigerator compartment and the removal of the screws in the freezer.

WARNING!

The following procedure could be hazardous to the eyes. Safety glasses and face shield shall be worn at all times. Have eyewash nearby.

Caution

Lift the cooling unit out of the box by pulling only on large freezer tube exiting evaporator. Such force exerted elsewhere could damage the unit.

4.2.6 Place downward pressure on the refrigerator with feet while lifting upward on cooling unit tubing that passes through urethane to and from the evaporator. (Sometimes it takes two people)

4.2.7 Cooling unit is now exposed and ready for service.

4.2.8 If boiler pack and refrigerator fins have not been removed from cooling unit, remove them at this time.

Procedure V

5.0 Is There A Charge In The Cooling Unit?

WARNING!

The following procedure could be hazardous to the eyes.
Safety glasses and face shield shall be worn at all times. Have eyewash nearby.

5.1 The following procedure is for **Dometic units** or any unit that has a factory installed service valve and service stem. More information on this procedure is in the RV Refrigerator Cooling Unit Repair Video.

5.1.1 Take unit outside to a well ventilated, no traffic area and invert (turn upside down) the cooling unit. Stand away from the service valve stem. Listen for the sound of liquid moving.

Caution

Do not use charging wrench to loosen or completely tighten valve stem.
Damage to wrench or stem could occur.

5.1.2 Remove the cap on the service valve. Using a 10-inch crescent wrench, slightly loosen service stem. If the unit has a charge in it, you will hear the hydrogen escaping. Let all of the pressure release this way or quickly close the stem and take the cooling unit to the charging .

5.1.3 The pressure in the unit can be used to save the liquid portion of the charge in the unit. **Procedure 5.3**

WARNING!

The following procedure could be hazardous to the eyes. Safety glasses and face shield shall be worn at all times. Have eyewash nearby.

5.2 The following procedure is for **Norcold units** or any unit that does not already have a factory installed service valve and service stem. More information on this procedure is in the R101-"RV Refrigerator Cooling Unit Repair & Recharging Video".

5.2.1 Take the cooling unit outside to a well ventilated, no traffic area. Invert the cooling unit. Stand away from the charging port stem.

5.2.2 Using a dull pair of bolt cutters, pinch off the charging port stem at the first pinch in the stem, that was done at the factory, which is closest to the absorber vessel.

5.2.3 Allow the unit to completely discharge all of the pressure.

5.2.4 Attach a service valve see **Procedure 22.**

5.3 Discharging Cooing Unit Through the Charging Board Example: Dometic

5.3.1 It doesn't matter what make or model the unit is, or whether it's a full charge or a partial charge, it's all the same.

WARNING!

The following procedure could be hazardous to the eyes.
Safety glasses and face shield shall be worn at all times. Have eyewash nearby.

5.3.2 Install the charging wrench onto the service valve of the cooling unit, but do not open it yet.

5.3.3 Make sure vent is open on the charging board.

5.3.4 Open the discharge valve on the charging board.

5.3.5 Lean the cooling unit over towards the service valve and charging wrench, so as to get as much liquid as possible, to the charging wrench.

5.3.6 Slowly open the wrench just a small amount, just enough to hear the flow of liquid passing through the service stem and into the charging wrench, and into the site glass.

Caution

If the wrench is not closed immediately in the next step, there will be too much hydrogen pressure going into the liquid. This can violently toss the hydrometer and break it.

5.3.7 When the liquid stops and the vapor starts coming out, there will be a very distinctive "**hiss**" sound.

5.3.8 IMMEDIATELY close the wrench.

5.3.9 Close the Vent valve

5.3.10 Close the Discharge valve

5.3.11 Open the Pressure valve

5.3.12 Open the Aqua valve and the pressure from the top of the Aqua tank will push the Aqua to the bottom of the Aqua tank

5.3.13 When the liquid is all of the site glass, close the Aqua valve.

5.3.14 Close the Pressure valve & open the Vent valve immediately to allow the pressure left in the site glass to vent off. Leave the vent open.

5.3.15 Now it's time to release the hydrogen that is still in the cooling unit.

5.3.16 Close the Pressure valve & open the Vent valve immediately to allow the pressure left in the site glass to vent off. Leave the vent open.

5.3.17 Open the Discharge valve.

Caution
If the wrench is opened to much to quickly, the hydrometer could break

5.3.18 Slowly open the charging wrench just a little, allowing the hydrogen to go through the Discharge, into the cooling unit and out the vent. Most likely, additional liquid will enter the site glass.

5.3.19 Just allow the hydrogen to completely release from the cooling unit.

5.3.20 When the liquid stops bubbling, close the wrench.

5.3.21 Repeat **Procedures 5.3.9-5.3.14** to put any liquid in the site glass back in the Aqua tank for later use.

5.3.22 Should it be required to discharge an, **EXAMPLE: Norcold**, through the charging board, it could only be accomplished after **Procedure 22** has been completed.

Procedure VI

6.0 Seized or Cracked Service Stem (See RV Refrigerator Cooling Unit Repair Video)

NOTE
Assemble all tools required for service.
Outside in no traffic area.

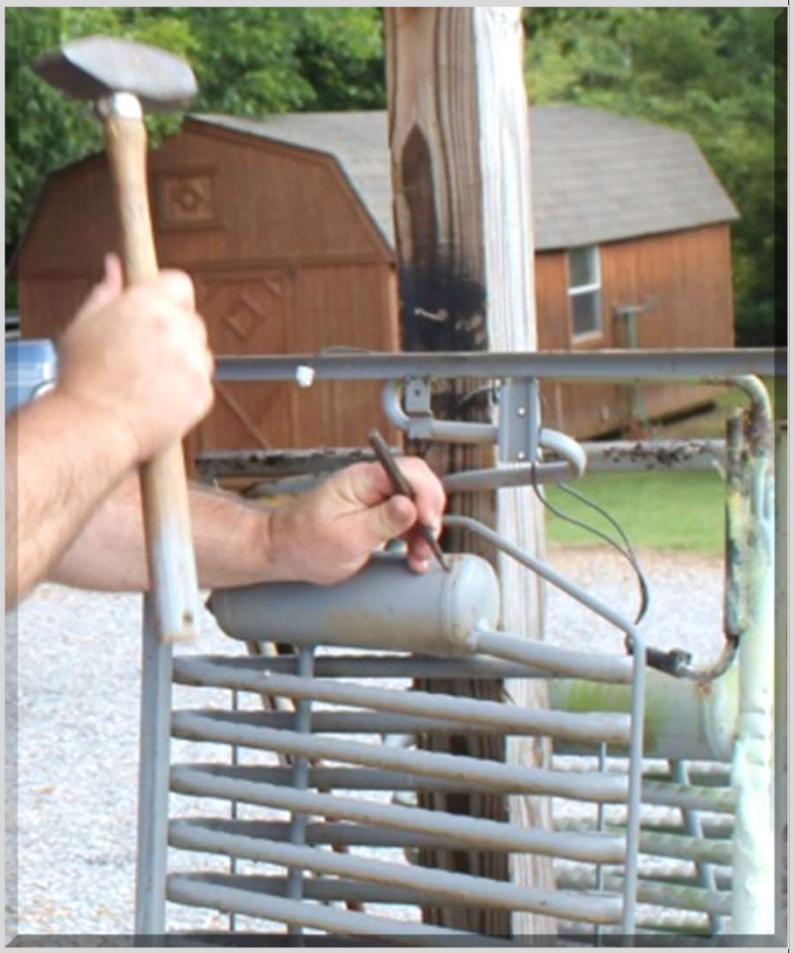
Table 6-1

TOOL	QUANTITY
Charging wrench	1
Hammer	1
Center Punch	1
Crescent Wrench (10-inch)	1

WARNING!

The following procedure could be hazardous to the eyes. Safety glasses and face shield shall be worn at all times. Have eyewash nearby.

Also, in the next step, once the punch penetrates the absorber vessel and pressure is being released, no matter how small the hole is, DO NOT strike the punch again. Doing so may cause a spark which will ignite the hydrogen. NEVER USE A DRILL!



6.1 If service stem cracks or breaks, do not use excessive force.

6.1.1 Instead, remove outdoors to a well ventilated no-traffic area.

6.1.2 Invert the unit and turn around so Absorber Vessel is accessible.

6.1.3 Stand away from the service stem where the pressure will release.

6.1.4 Using a sharp center punch and hammer, punch a small hole at a high point in the absorber vessel

6.1.5 **Move away**, and allow hydrogen pressure to bleed-off.

6.1.6 The liquid will be in the lower portion of the unit.

6.1.7 After all pressure has been released, move unit to welding area. Again, stand away from the service stem.

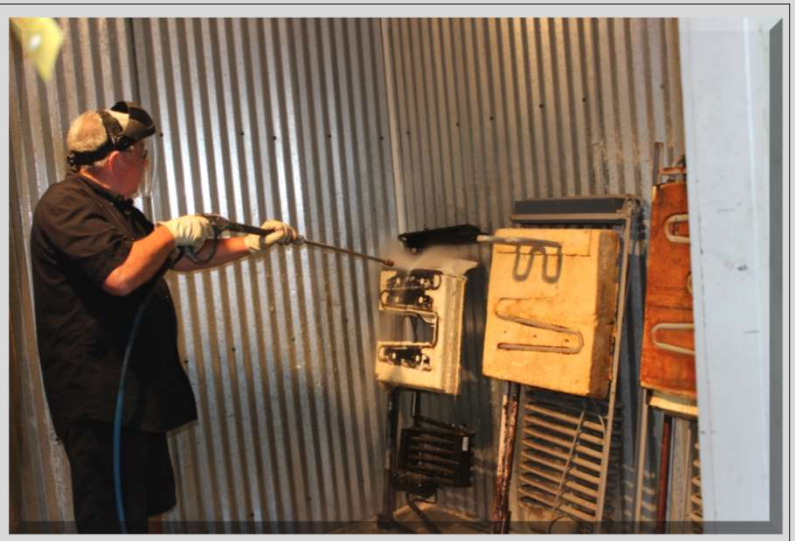
6.1.8 With the torch on a low setting, heat the service valve behind the threads, making sure not to get on the threads.

6.1.9 Continue until this area is cherry red. With a crescent wrench, gently turn the stem and continue heating the back of the service valve, until the service stem unscrews completely. After the stem has completely cooled, discard the stem.

6.1.10 Weld hole in the vessel.

6.1.11 Once the service valve is completely cooled, install the correct replacement service stem.

Procedure VII 7.0 Pressure Washing



7.1 Pressure washing the entire cooling unit is necessary because it removes the urethane and any loose paint, dirt or rust from the unit. **ALWAYS BE SURE THERE IS NO CHARGE IN UNIT!**

7.1.2 Remove urethane using a pressure washer with a high-pressure stream of water (a 0 tip works well). In addition, pressure wash the entire cooling unit. (A 1,700 lb. or greater pressure washer is adequate for completely removing the urethane. The higher the pressure, the quicker and greater the result.

7.1.3 The tip used on the pressure washer should provide a fine stream of water. The 0 tip works best for cutting off the urethane.

7.1.4 Rotate the cooling unit in all positions necessary as you spray to remove 100% of the urethane. Then spray the entire cooling unit to remove loose paint, dirt, and rust.

7.1.5 When completed, rinse and allow cooling unit to dry.

Procedure VIII

8.0 Painting Cooling Unit With Gray Primer

NOTE

Use rust-prevention paint.

8.1 Paint entire cooling unit with gray primer. Allow unit to dry. Repeat. (Best to use at least 5 aerosol cans of gray primer)

8.1.2 Apply multiple coats to the entire cooling unit. Then add a few extra coats to the evaporator area.

Procedure IX

9.0 Leak Check-Phase One

Table 9-1

TOOL & MATERIALS	QUANTITY
Leak Check Manifold	1
Compressed Air	1
Nitrogen	100% strength - 1 cylinder
Charging Wrench & Hose	1
Soap & Water Mixed or W.A.P. Formula	1 spray bottle
Chalk	1stick

CAUTION

The cooling unit should be free of charge and pressure. (See Procedures 5.0- 5.3.22) Set the nitrogen regulator at 50 lbs. greater than the amount of pressure actually needed. If the regulator is set to the exact amount indicated, gases could flow either direction after the pressure equalizes. This could damage the brass regulator.

NOTE

On the charging wrench, the handle turns the socket that sits over the service stem. Line the socket up with the discharge line that is attached to the charging wrench. That tells you how to line it up on the valve so that it sits on the stem properly. Attach the charging wrench to the valve on the cooling unit. Be sure that it is on straight and tight. You may have one thread showing once it's tight and that's ok. The handle will have a small amount of free movement. If so, it is installed correctly. If not, try again.

NOTE

This procedure is accomplished at the Leak Check Manifold

WARNING!

The following procedure could be hazardous to the eyes. Safety glasses and face shield shall be worn at all times. Have eyewash nearby.

9.1 Attach the charging wrench to the cooling unit. Open the wrench ¼ of a turn. Pressurize the cooling unit with approximately 100 lbs. of compressed air or nitrogen (compressed air the first time just saves nitrogen).

9.1.1 Check for leaks using the soap mixture or Ford RV's special W.A.P. formula (**See Glossary**).

9.1.2 If no obvious leaks are present, add 200 lbs. of nitrogen pressure. Check for leaks with W.A.P. or soap. Continue adding 200 lbs. of nitrogen pressure at each interval until a leak is found. Leak check between each addition. However, **Never exceed 1,000 lbs. of Nitrogen pressure in the cooling unit.**

NOTE

The 1,000 lbs. of Nitrogen pressure not only forces high pressure leaks to appear, it also tests the integrity of the entire cooing unit. The standing pressure is 300 lbs. of Hydrogen, so 1,000 lbs. of Nitrogen is 3 times the standing pressure.

NOTE

The most likely areas for a leak to occur are in the boiler area and/or evaporator area.

9.1.3 If no leak appears, skip to **Procedure 11, Leak Check Phase Two**

9.1.4 If a leak appears, mark it with the chalk. Then go to **Procedure 11.2, Discharging Nitrogen. Then return to this page.**

NOTE

If there was inadequate pressure in the cooling unit to blow the charge before pressure washing was accomplished, and if there is no more than 300 lbs. of nitrogen in the cooling unit for Leak Check, any liquid left in the cooling unit can be transferred to the Aqua Tank via the charging board for later use. Then slowly release the remaining pressure from the cooling unit through the vent in the charging board. The difference in the procedure will be that this time, Nitrogen is used in place of Hydrogen. Still the same method though. **Procedure 5.0 - 5.3.22**

9.1.5 Once all the Nitrogen has been discharged from the cooling unit, remove the charging wrench and the service stem. Now it's ready to be repaired.

WARNING!

The following procedure requires that safety glasses and face shield shall be worn at all times. Have eyewash nearby.

9.2 Remove Burner Bracket

After releasing all the Nitrogen pressure in the cooling unit, remove the two tack welds on the burner bracket at the bottom of the flue tube with a cutting wheel. Best to use a 3" x 1/16" cutting wheel. Once the two tack welds are cut, you can slide the bracket up the flue tube to get it out of the way. Be careful not to cut into the burner bracket or the flue tube.

9.3 Remove Heat Element Sleeve

To remove the heat element sleeve, cut the weld that's holding the heat element sleeve to the boiler tube. with a 3" cutting wheel. Put the cutting wheel close to the heat element sleeve, but be sure the angle is correct so that the wheel doesn't cut into the boiler tube. Start at one end and work to the other end until the heat element sleeve is completely removed from the cooling unit.

Procedure X

10.0 Repairing the Leak in the Cooling Unit

10.1 Welding

NOTE

The following tasks require a prior knowledge of welding. Welding technique is not considered within the scope of this manual. As is customary, employ appropriate safety measures.

The following works well for the welding process:

* Pressure regulator for oxygen set at 11 psi
* Pressure regulator for acetylene set at 7 psi
* 3/32-inch mild steel welding rod
* Welding goggles
* MIG Welder (optional) .024

WARNING

Completely remove service stem before welding on the cooling unit to prevent pressure from building up.

10.1.1 Clean the area/s to be welded with a wire brush to remove any debris.

10.1.2 Position cooling unit so hole (leak) is on the top side of the pipe. Gravity will aid in welding

10.1.3 Weld the hole where the leak was found.

10.1.4 After welding is completed and the weld has cooled, replace service stem, and charging wrench and repeat all of **Procedure 9, Leak Check Phase One.**

10.1.5 If additional leaks are noted, mark them, release the pressure, **Procedure 11.2, Discharging Nitrogen.** Remove the charging wrench and the service stem and repair any leaks found. Then repeat **Procedure 9, Leak Check Phase One again**. Repeat these procedures as many times as necessary until any and all leaks are repaired. It's rare that there will be more than one hole.

NOTE

To speed up cool down time after welding, use a spray bottle of water or a wet rag. **However**, **do not apply the water or the wet rag directly on the weld**. Start away from the weld and slowly work toward the weld from all directions.

10.1.6 When there are no leaks, clean the repaired area and paint with gray primer. Move on to **Procedure 11, Leak Check Phase Two.**

Procedure XI

11.0 Leak Check - Phase Two

NOTE
This step is completed after Leak Check-Phase One proves there are no leaks in the cooling unit.

11.1 Bagatizing

11.1.1 With 1,000 lbs. of nitrogen still left in the cooling unit, dry the evaporator area.

11.1.2 Put a large common garbage bag over the entire evaporator, roll the ends of the bag up to enclose the area, and use snap close pins to completely seal the bag shut.

11.1.3 With no power applied to the unit, let the unit sit for 24 hours.

11.1.4 After 24 hours, using the WAP spray, leak check the repaired area in the boiler,. If there is no red, the leak has been successfully repaired.

11.1.5 Cut a small hole in the bag and check for ammonia odor in the evaporator area. If no odor, remove bag and leak check evaporator with W.A.P.

11.1.6 If ammonia odor is detected or red from the W.A.P, go back to **Procedure 9, Leak Check Phase One** and repeat the process again. If no ammonia odor or yellow coloring is detected, continue to **11.2**.

11.2 Discharge Nitrogen Pressure

WARNING!

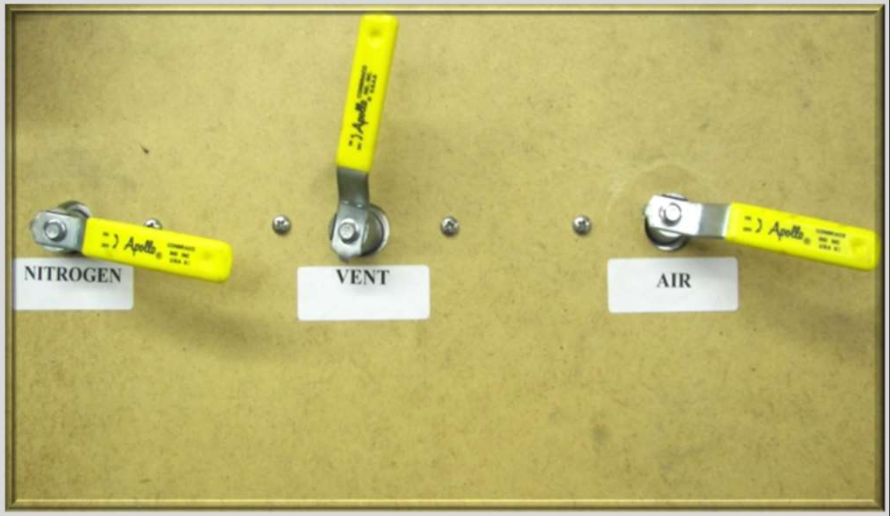
The following procedure requires the use of a gas. Safety glasses and face shield shall be worn at all times. Have eyewash nearby.

11.2.1 If you don't have the leak check manifold, **(See Specs for Building-PDF)** take the cooling unit outside to a no traffic area, invert the unit, and using a crescent wrench, slowly open the service stem to release the nitrogen pressure. Allow the Nitrogen to bleed off completely. Once completed, move on to **Procedure 11.3**

11.2.2 If you have the leak check manifold, the vent should be in the open position. 1,000 lbs. of pressure is a lot to release so open the charging wrench very slowly and very little.

11.2.3 After a good amount of pressure has been released, you can open the wrench up a little more to speed up the process but **DO NOT** open completely or too fast!

11.2.4 Once all of the pressure has been released, remove the charging wrench from the cooling unit service valve.



11.3 Reattaching Burner Bracket

11.3.1 Once the 1,000 lbs. of Nitrogen has been completely released from the cooling unit, remove the charging wrench.

11.3.2 Remove the service stem. Always remove the service stem before welding or doing any procedure that requires the unit to be completely void of pressure.

11.3.3 Slide the burner bracket forward. In order to reattach it in the correct position, attach the burner assembly where it should be.

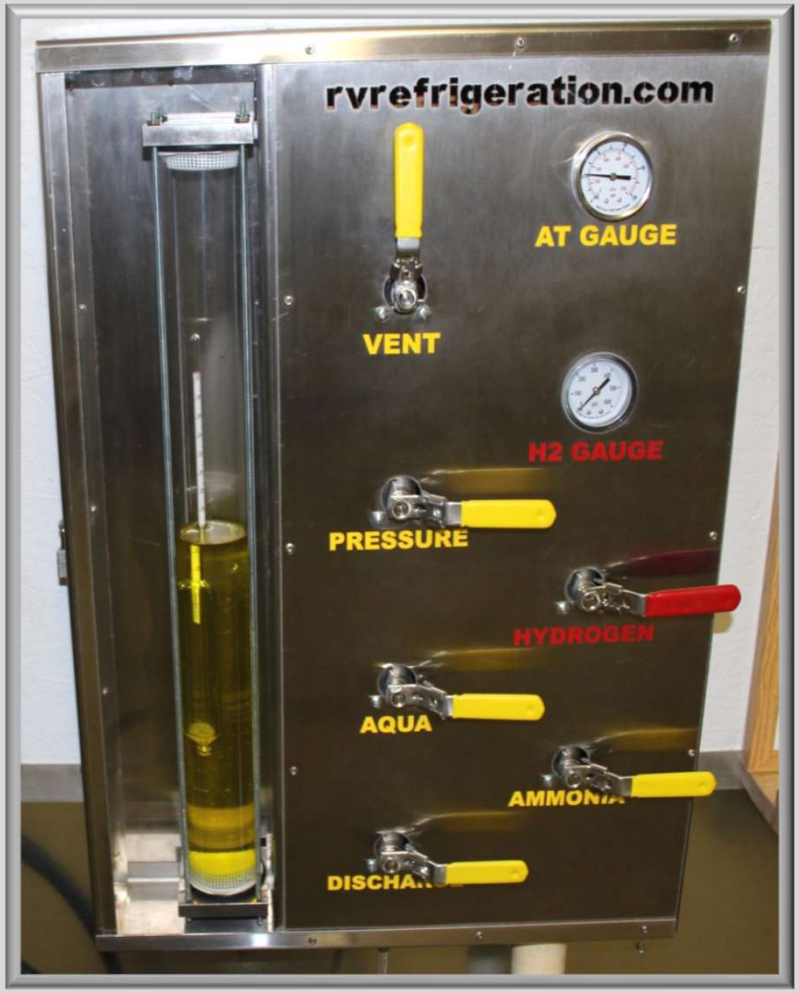
11.3.4 Place the screws in the burner assembly to hold it in place. Make sure it is exactly where it is supposed to be.

11.3.5 Tack weld the burner bracket in place, being careful not to put a hole in the flue tube or damaging the bracket. (A MIG welder works well for this procedure)

11.3.6 Once completed, remove the burner assembly so the unit can be painted.

11.4 Painting the Cooling Unit Black

11.4.1 Completely paint the entire cooling unit using at least 7 cans of rust prevention black paint. Again, aerosol cans work best. Remember, turn the cooling unit every direction possible in order to get good coverage on every part of the unit. Always allow each coat to dry thoroughly before turning the unit. (With the 5 cans of gray paint and the 7 cans of black paint, a total of 12 cans is usually sufficient.



Procedure XII

12.0 The Model SS-1113 Charging Board

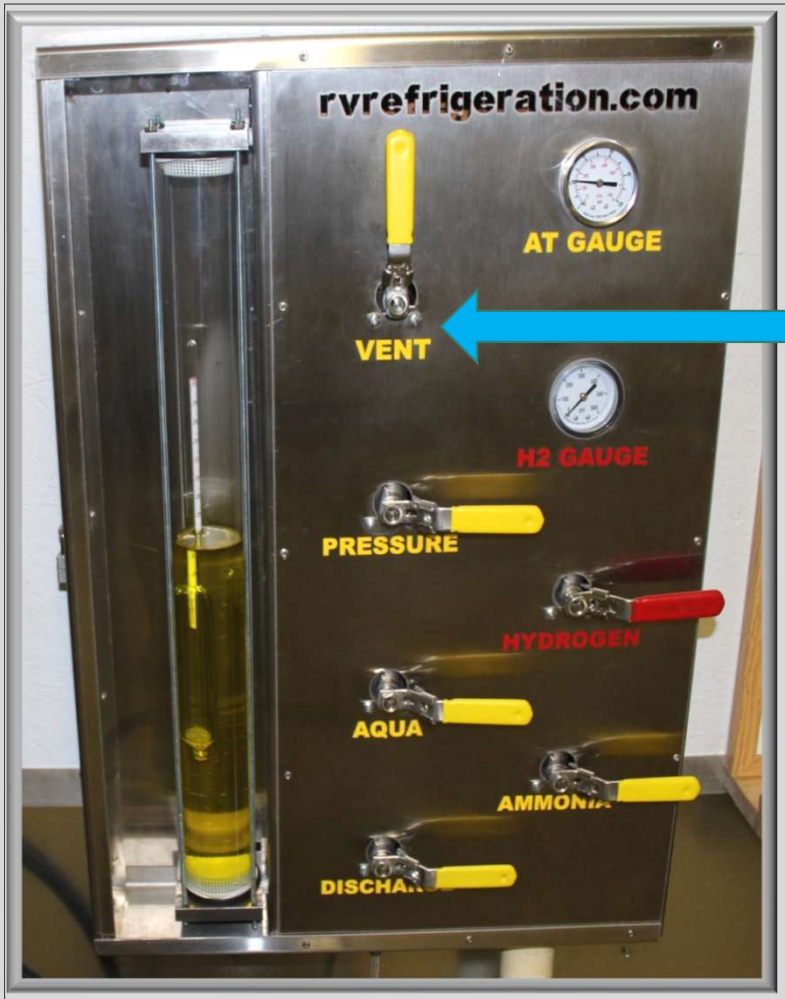
12.1 The body is made of Stainless Steel. The rest of this models parts are mostly stainless steel as well.

WARNING!

Never use anything but stainless steel on this charging board where it can come in contact with the Ammonia.
Ammonia will eat up brass, copper and other alloys which will create a disaster for you and your .

12.1.1 This is the Charging board where the correct formula for each brand of refrigerator is created.

12.1.2 It is also a Discharging station used to recover the liquid portion of a charge.



NOTE
All Valves on the Charging Board should be opened slowly and very little at a time.

12.2 Vent Valve

12.2.1 **Should ALWAYS be in the open position except** when performing a procedure that it needs to be closed.

12.2.2 The Vent allows for the release of gases into the air outside the servicing area. A stainless-steel braided hose is attached Vent valve on the charging board. This needs to run to a no-traffic area where no one will be around for safety purposes. Preferably in the top of the eve of the building. The only thing that is escaping through the vent is hydrogen and it is going back into the atmosphere where it came from. There is a very small amount of Ammonia vapor escaping but it's environmentally friendly also.

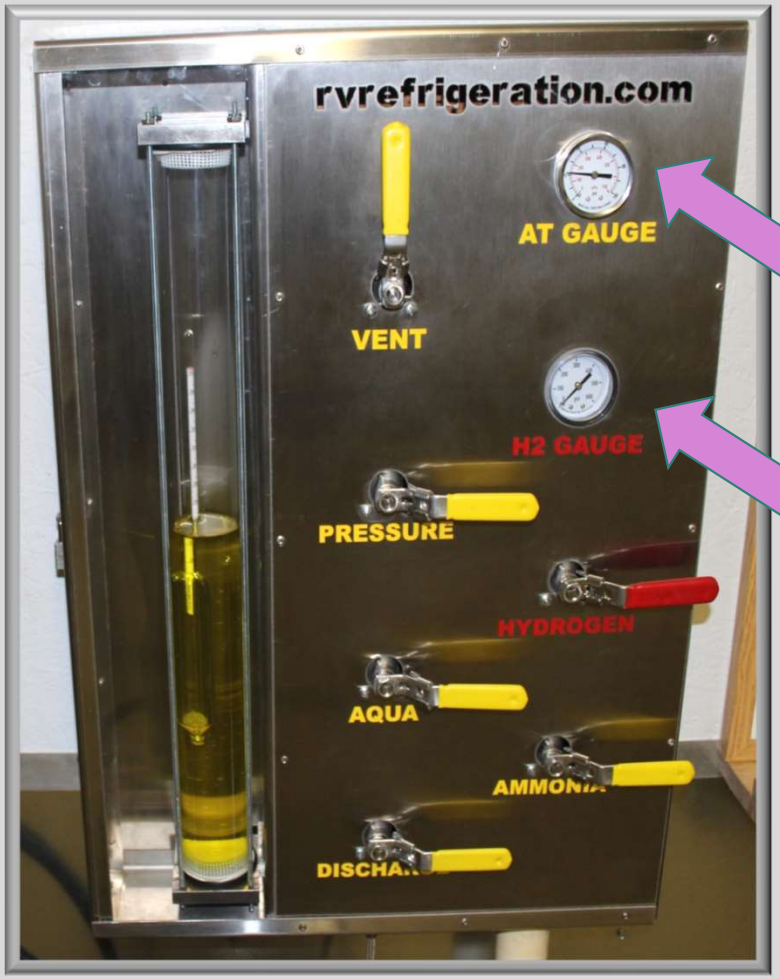
PRACTICE SAFETY IN EVERYTHING YOU DO!

12.3 150 Pound Safety Pop-Off Valve

12.3.1 This charging board requires a 150 lb. safety pop-off valve (See Vendor List).

12.3.2 This is also attached at the vent valve with a steel braided hose that also ends in a no traffic area. **See Procedure 12.2.2**.

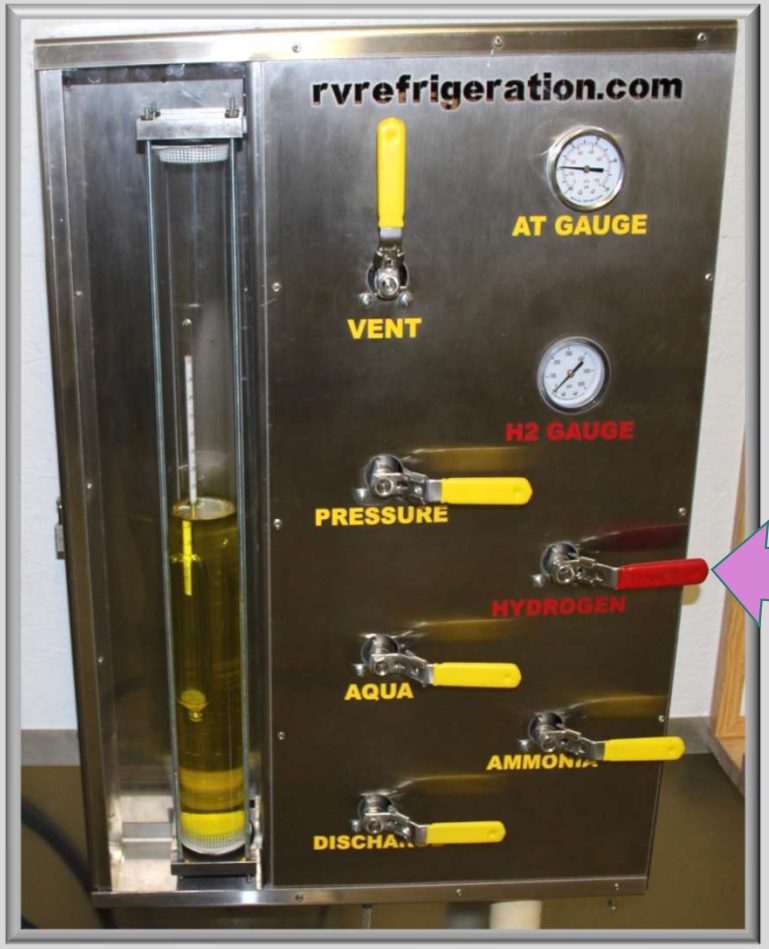
12.3.3 Though there should never be more than about 100 lbs. of hydrogen pressure in the site glass of the charging board, this is the charging board safety. Should more than 150 lbs. ever get into the site glass, the safety pop-off valve will release, thus preventing damage to the charging board or anyone nearby.



12.4 Aqua Tank Gauge & Hydrogen Gauge

12.4.1 The AT Gauge tells how much pressure is in the Aqua Tank (AT)

12.4.2 The H2 Gauge tells how much Hydrogen pressure is coming in from the hydrogen (H2) tank and being sent to the cooling unit or into the aqua tank.

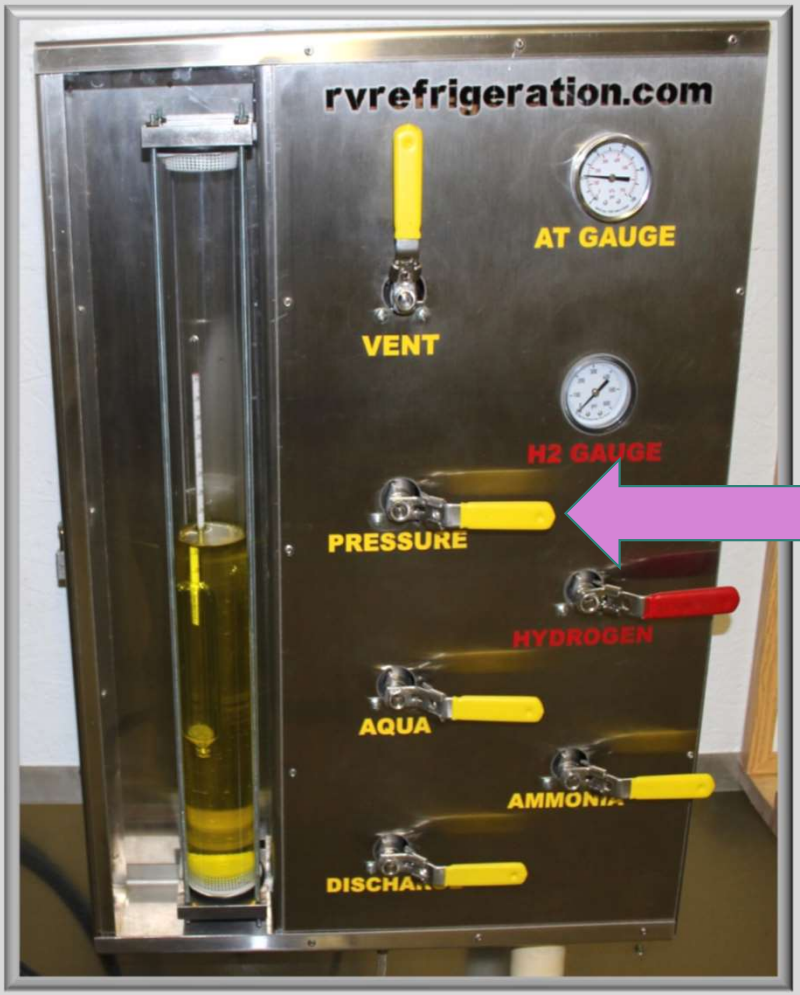


12.5 Hydrogen Valve

12.5.1 The Hydrogen valve works with the (H2) hydrogen gauge.

12.5.2 The Hydrogen enters the discharge line through a high-pressure hose attached to a hydrogen regulator on the Hydrogen Cylinder. The Hydrogen passes through the discharge hose and into the cooling unit.

12.5.3 Different pressures of Hydrogen are used to pressurize the aqua tank, the site glass and the cooling unit.

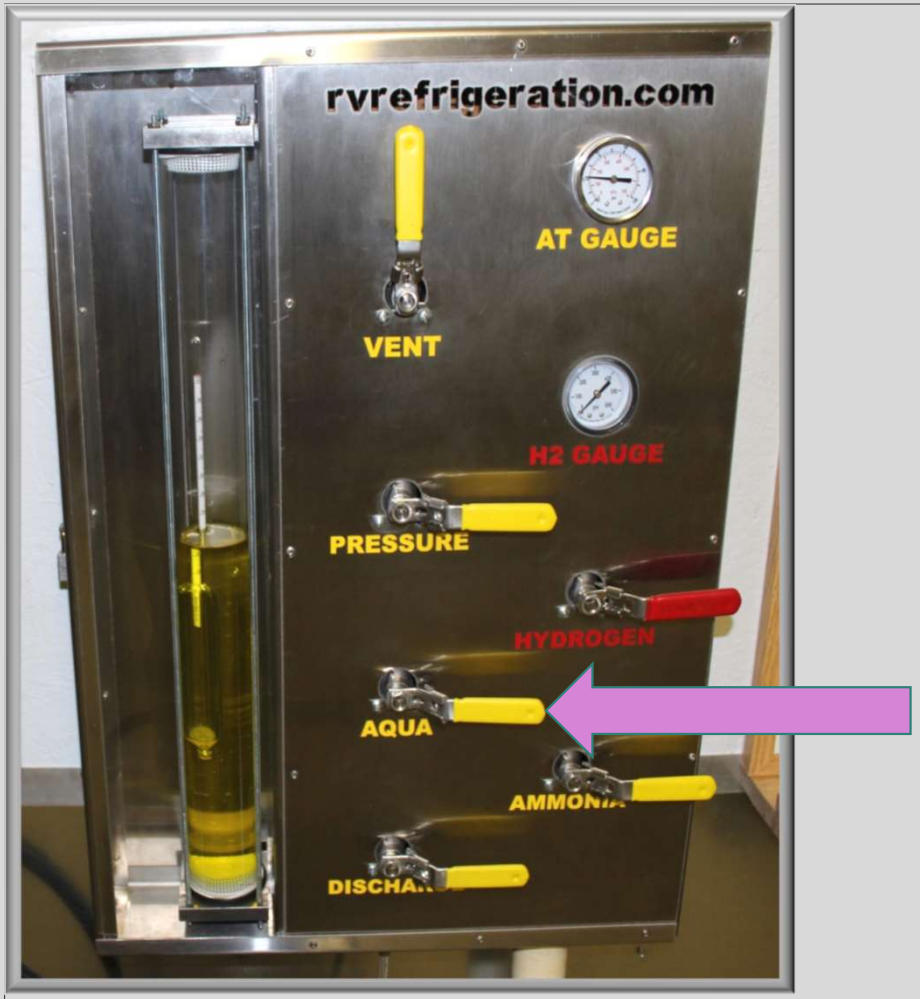


12.6 Pressure Valve

12.6.1 The pressure valve opens into a Stainless steel braided hose that runs to the top (gas) portion of the aqua tank.

12.6.2 **This valve:**

- Allows pressure to be brought into the site glass from the top portion of the aqua tank.
- It is used to equalize the pressure in the site glass which makes the hydrometer stop bouncing. Also helps to get the hydrometer off the side of the site glass.
- Used with the Aqua Ammonia Valve to push chemicals and pressure from the site glass into the aqua tank.



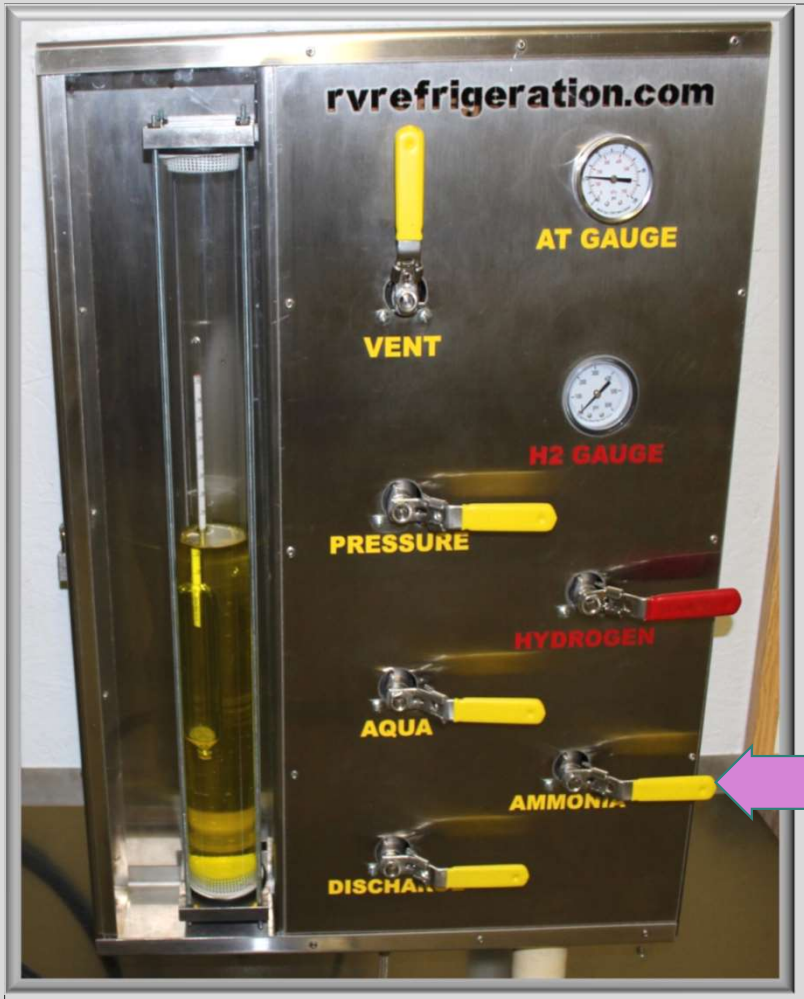
12.7 Aqua Ammonia Valve

12.7.1 The aqua ammonia valve provides the flow of aqua ammonia through piping to and from the aqua tank and the site glass. Attached approximately 1" from the bottom (liquid) portion of the aqua tank.

12.7.2 The aqua ammonia is coming from the bottom portion of the Aqua tank

.

12.7.3 It works with the pressure valve to send chemical from the site glass, back to the Aqua Tank for reuse.



12.8 Ammonia Valve

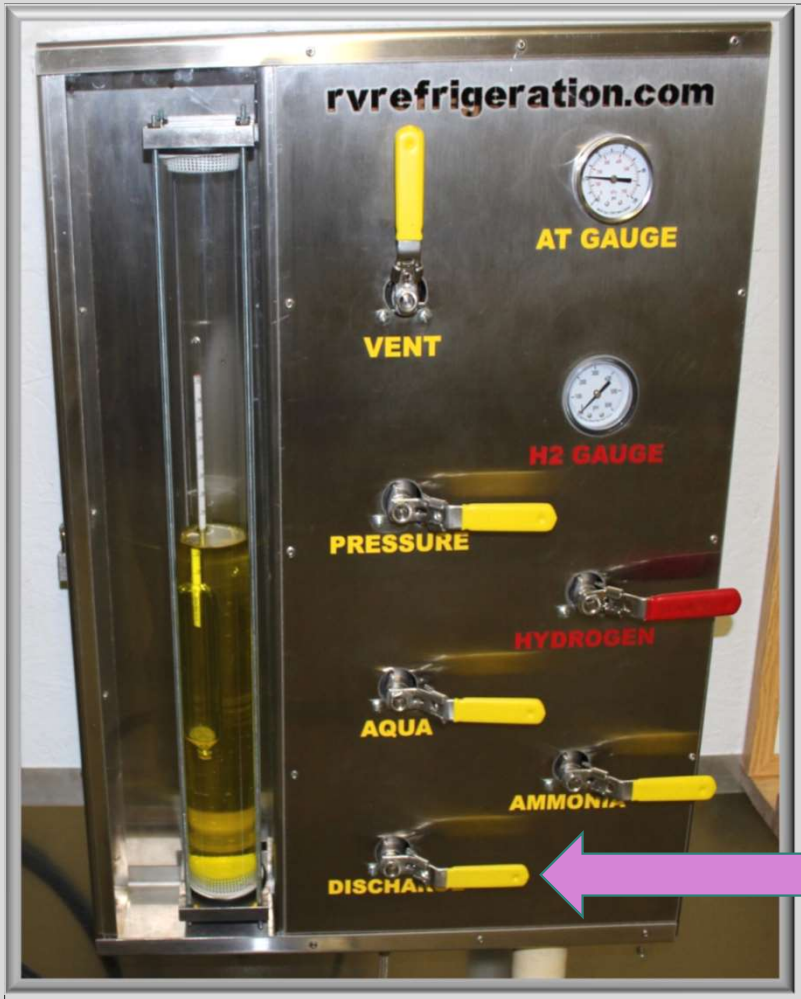
12.8.1 The Ammonia valve allows the flow of Anhydrous Ammonia, liquid or vapor, to move from the Ammonia cylinder into the site glass. Any size cylinder will do. Must have a regulator attached to the ammonia cylinder.

12.8.2 It is used to raise the formula percentage.

12.8.3 Open slowly and very little at a time. Otherwise it will come in too quickly and could cause damage to the hydrometer

NOTE

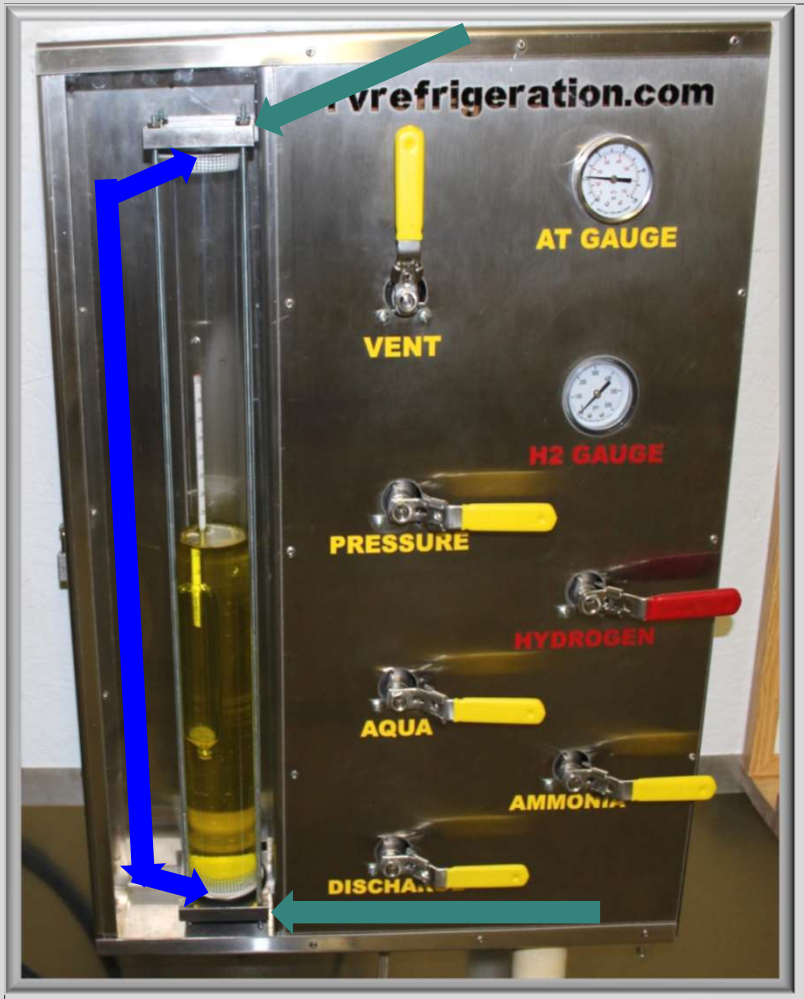
Because the liquid is so concentrated, faster results are obtained using liquid ammonia as opposed to ammonia in vaporous form.



12.9 Discharge Valve

12.9.1 **When open**, the discharge valve allows the chemical mixture to flow from the charging board to the cooling unit and vice versa.

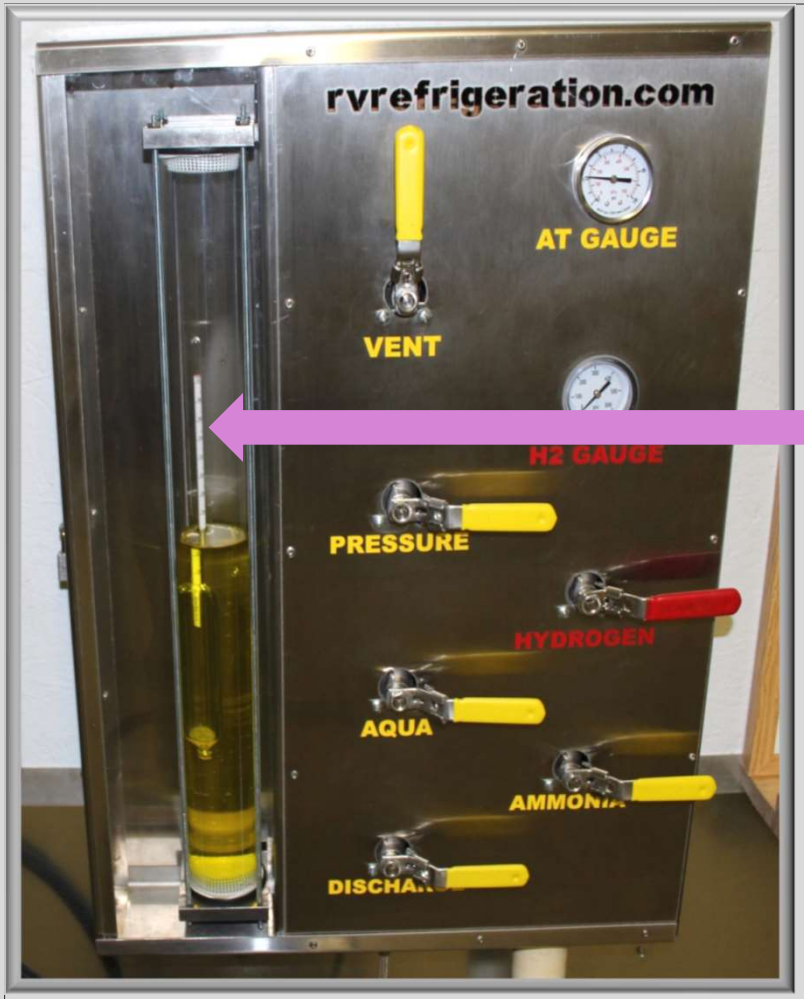
12.9.2 **When closed**, it prevents the hydrogen from entering the Site glass. This forces the hydrogen to go directly to the cooling unit.



12.10 Site Glass

12.10.1 Acrylic tube where correct formula mixture is created.

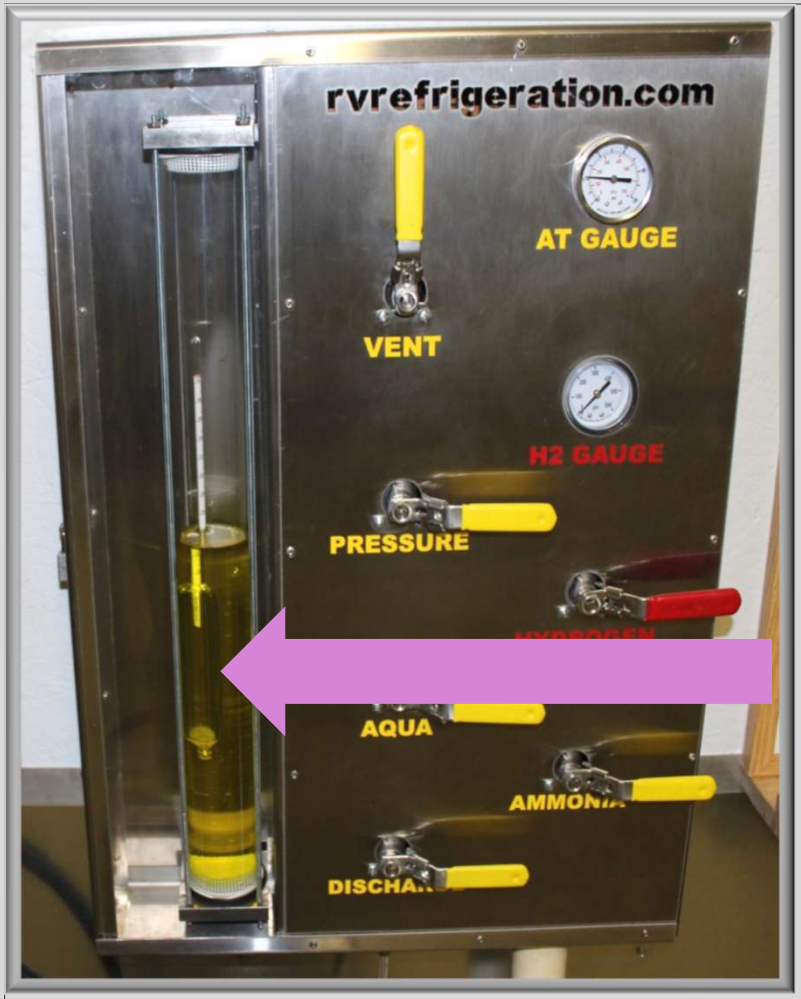
12.10.2 The site glass sits between two end caps, one at the top, one at the bottom.



12.11 **<u>Hydrometer H-1118</u>**

12.11.1 Measures the ammonia percentage of the chemical formula.

12.11.2 Is very fragile. Recommend having an extra one on hand at all times. Without it, a formula cannot be created. All charging will be stopped until replaced.



12.12 Chemical Mixture

12.12.1 Ammonia, Aqua Ammonia and Sodium Dichromate mixture, combined to created the correct formula percentage and volume.

NOTE

Anhydrous Ammonia and Aqua Ammonia are both clear. The yellow in the formula mixture is caused by Sodium Dichromate (A Rust Inhibitor) that is mixed with the Aqua Ammonia.

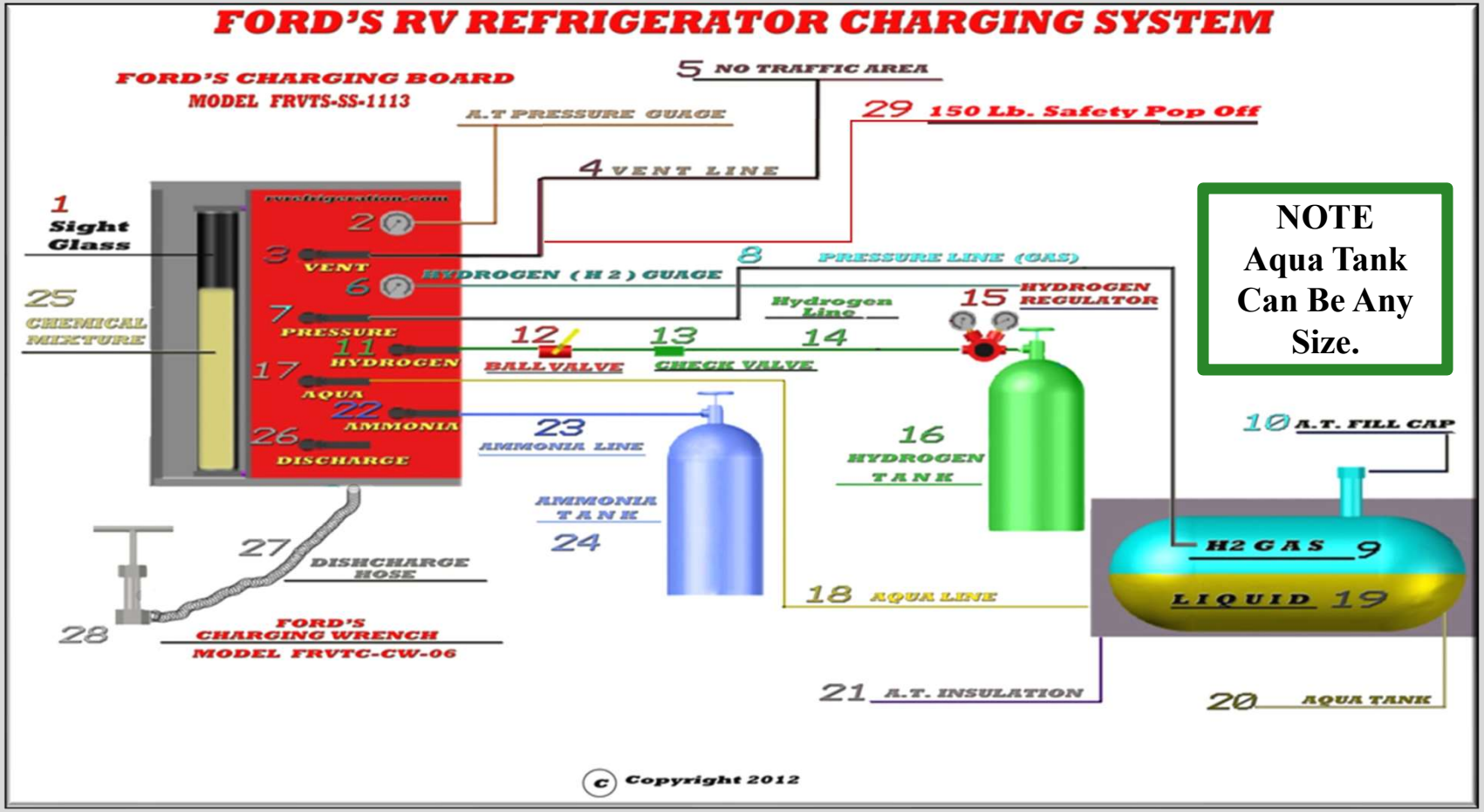
WARNING

After setting up the charging board these two things are a **must** before use.

a. The charging **must have a ground wire** running to a **ground rod**.

b. **All fittings must be tightened and leak checked** with air pressure or nitrogen, **prior to preparing the first formula mixture** for charging a cooling unit.

Procedure VIII 13.0 Charging and Chemical Connections



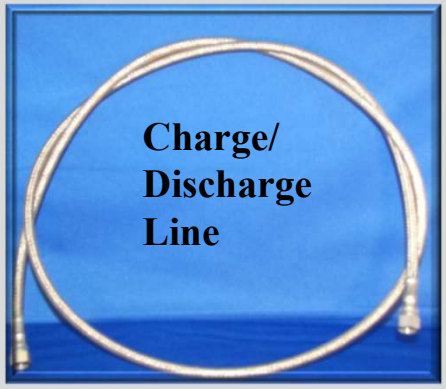
13.1 Charging and Chemical Labels

1. Site Glass	9. H2 Gas	17. Aqua Ammonia Valve	25. Chemical Mixture
2. A.T. Pressure Gauge	10. A.T Fill Cap	18. Aqua Ammonia Line	26. Discharge Valve
3. Vent Valve	11. Hydrogen Valve	19. Aqua Ammonia Liquid	27. Discharge Hose
4. Vent Line	12. Ball Valve	20. Aqua Tank	28. Charging Wrench
5. No Traffic Area	13. Check Valve	21. Aqua Tank Insulation	29. 150 lb. Safety Pop Off
6. H2 Gauge	14. Hydrogen Line	22. Ammonia Valve	
7. Pressure Valve	15. Regulators	23. Ammonia Line	
8. Pressure Line	16. Hydrogen tank	24. Ammonia Tank	

13.2 Charging Wrench & Discharge Hose

13.2.1 The **MS-1114 Charging Wrench** is specially designed. It fits the Dometic Service Valve and The Norcold Service Valve. The service stem fits into the wrench. It is also attached to the /discharge line. The wrench handle turns to open the service stem, thus allowing liquid and Gas to flow from the discharge line to the cooling unit or back to the charging board.

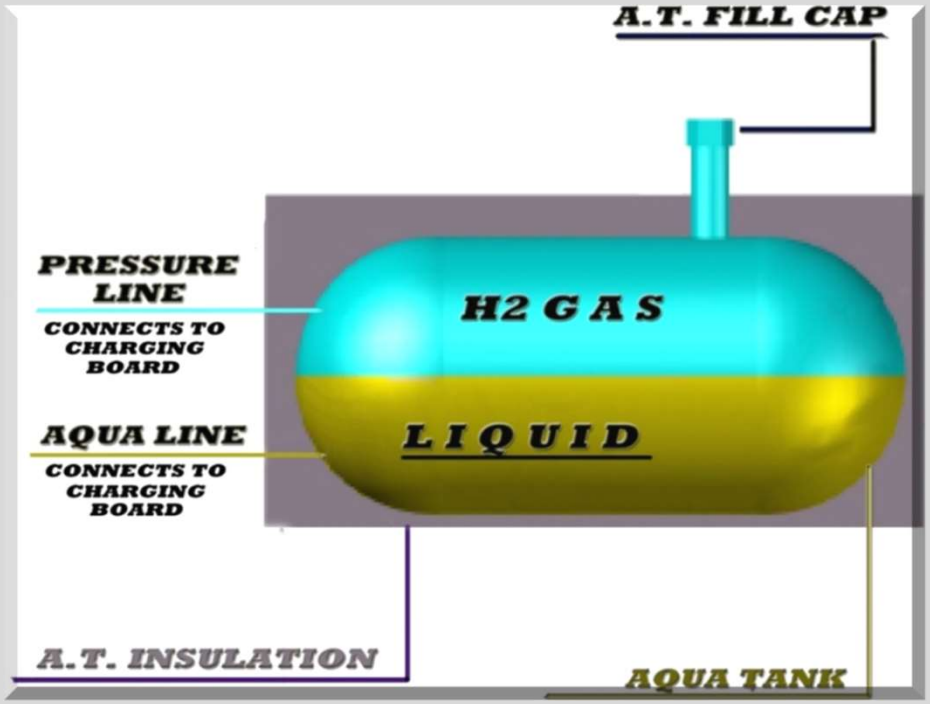
13.2.2 The discharge line allows the flow of Nitrogen to exit the cooling unit through the Vent on the leak check manifold.



13.2.3 The discharge line allows the flow of chemical mixture to exit the site glass, go through the charging wrench and into the cooling unit.

It also allows chemicals to go from the cooling unit back to the site glass.

13.2.4 This hose also transports the Hydrogen to the cooling unit.



Procedure XIV

14.0 Aqua Ammonia Tank.

14.1 The aqua tank is a steel tank that houses the aqua ammonia as well as recycled liquid chemicals.

14.1.2 Though not required, this tank can be buried twelve inches underground. If above ground, it needs to be insulated.

14.1.3 It is important that this tank maintain a constant temperature, which ensures a constant pressure.

14.1.4 The fill cap at ground level provides access to the tank.

14.1.5 This tank can be any size but the larger it is, the fewer times it has to be filled. An old compressor works very well.

14.2 Filling Aqua Ammonia Tank

WARNING!

The following procedure requires the use of ammonia. Safety glasses and a face shield must be worn at all times. Have eyewash nearby. This procedure should be done in a well-ventilated area. If it takes your breath, shut off the valve and **GET AWAY** until you can breath easily again, then proceed.

14.2.1 Open vent on charging .

14.2.2 Slowly open pressure valve on charging . Allow the valve to remain open in order to release any pressure in the aqua tank.

14.2.3 Remove fill tube cap or plug from the top of the aqua tank.

14.2.4 Place one level teaspoon of Sodium Dichromate in a clean, one-gallon plastic container.

14.2.5 Add one gallon of Aqua Ammonia. If liquid is coming out to slowly, there's a vacuum and the container needs to be vented.

14.2.6 Open the access to the aqua tank, insert a funnel and slowly pour mixture into the aqua tank. Again, if it takes your breath just move away as instructed above.

14.2.7 Repeat **Procedures 14.2.4 - 14.2.6** until the aqua tank is half-full.

14.2.8 Seal by wrapping the threads with **Ammonia Rated Teflon tape** and put the cap back on the tank and tighten.

14.3 Pressurizing Aqua Tank

WARNING!

The following procedure requires the use of a liquid. Safety glasses and face shield must be worn at all times. Have eyewash nearby. Always stand to the side of the hydrogen regulator when opening the hydrogen.

14.3.1 Starting with hydrogen regulator at 0 lbs. Set the hydrogen regulator to 400 lbs.

14.3.2 Slowly open the hydrogen ball valve.

14.3.3 Slowly open the anhydrous ammonia tank, generally three turns should be plenty.

14.3.4 Go to the charging board and close the pressure valve.

14.3.5 Connect charging wrench to service valve on any cooling unit. Make sure the wrench is closed.

14.3.6 Close the vent valve. Open discharge valve, then open the pressure valve on charging .

Caution

Opening hydrogen too quickly could damage the Hydrometer.

14.3.7 Slowly open hydrogen valve. When the hydrogen (H2) gauge reaches 75 lbs., close hydrogen valve.

14.3.8 Close pressure valve.

14.3.9 Close discharge valve.

14.3.10 Open vent to release pressure in sight glass.

14.3.11 Open discharge valve to release any pressure in hose, then close discharge valve.

14.3.12 Aqua tank is now pressurized to 75 lbs. of pressure.

14.3.13 Leave vent on charging board open. All other valves should be closed

WARNING!

The following procedure requires the use of a gas. Safety glasses and face shield shall be worn at all times. Have eyewash nearby.

Procedure XV

15.0 Charging the Cooling Unit

Using the SS-1113 Charging Board and the specialized wrench

NOTE
The FC-1119 Chemical Formulas Chart is part of the customized tool package

15.1 There are three (3) things you must know in order to determine the correct formula to use.

- Make and cubic feet of the unit determine the formula percentage. The model # tells the cubic feet.
  - Refer to the FC-1119 formula chart for correct percentages and pressures.

EXAMPLE
DM2652 is 6 cu. Ft.
N841 is 8 cu. Ft.

- The size of the absorber coils determines the total volume of liquid.
  - Determine diameter of absorber coils (3/4" or 1/2").
  - Absorber coils with a diameter of 3/4" require a formula which fills the sight glass to 3/4 total capacity.
  - Absorber coils with a diameter of 1/2" require a formula which fills the sight glass to 1/2 total capacity.

NOTE
For a side by side-by-side refrigerator, the site glass will have to be filled 1 ½ times.

15.1.1 Cooling Unit should have no charge or pressure in it.

15.1.2 Ensure **all valves** on the charging board are **closed**.

15.1.3 Attach charging wrench to service valve. The wrench must be attached properly, straight and tight. Turn the handle on the wrench counter-clockwise (approximately 1/4 turn) so that it is in the open position.

CAUTION

Always open the ammonia valve slowly and very little at a time. Opening it too fast could cause the hydrometer to hit the top of the site glass and break.

WARNING!

The following procedure requires the use of liquids and gas.
NEVER leave any of the Valves open on the Charging Board while unattended except for the Vent Valve.
The Vent should always be open when the board is not in use.

15.1.4 Aqua – Open aqua valve on charging board, until the liquid is even with the pressure valve, then close the aqua valve. At this time, the hydrometer should read at approximately 26% ammonia.

15.1.5 Anhydrous ammonia – Slowly open ammonia valve very little. Once the ammonia vapor starts coming in, you can open it a little more. Just make sure it doesn't come in too quickly or throwing the hydrometer violently as that will break the hydrometer. After a little ammonia has come in, close the valve.

15.1.6 Pressurize the sight glass by opening and closing the pressure valve one time. This procedure puts pressure from the top of the aqua tank into the top of the site glass. This works to keep the hydrometer from getting thrown around when bringing in the ammonia and allows for an accurate reading on the hydrometer

15.1.7 Slowly open the ammonia valve until you reach the correct percentage. Close ammonia valve.

NOTE

In order to get an accurate reading on the hydrometer, all the valves must be closed and the site glass must be pressurized.

See Procedure 15.1.1-15.1.3 and 15.1.6.

NOTE
When mixing the formula in the site glass,
"overshooting" the percentage may occur.
(Example: Desired =32% but Hydrometer is reading 34%)
If "overshooting" occurs,
follow **ONE** of the procedure below.

1. – Slowly open the vent slightly for three seconds, allowing ammonia to boil off, therefore lowering the percentage. This may be repeated as many times as necessary. Refer to **Procedure 15.1.6** to obtain an accurate reading.

OR

2. – (recommended) – Open pressure valve and allow to remain open, thereby pressurizing the top portion of the sight glass. Next, open aqua valve. The pressure in the top portion of the sight glass will force some of the aqua back into the tank. Repeat **Procedures 15.1.4** through **15.1.7** as necessary.

15.1.8 Before the next step can be completed, the pressure in the top portion of the site glass needs to be vented off. Otherwise, when the aqua valve is opened, the pressure will push the formula in the site glass back to the aqua tank. Open the vent slowly. Listen for pressure to release and watch for the liquid line to move. At that moment, close the vent.

15.1.9 Slowly open the aqua valve to bring aqua from the bottom portion of the aqua tank. Doing so is the first step in raising the volume of the liquid.

15.1.10 If before the desired volume is reached, the liquid stops rising in the site glass, close the aqua valve. Slowly open and close the vent to vent off some of the pressure.

15.1.11 Repeat **Procedures 15.1.9** and **15.1.10** until the correct volume is reached.

15.1.12 When the hydrometer touches the top of the site glass, the correct volume has been reached. (for 2-door refrigerator cooling units 6-8 cubic foot)

15.1.13 In order to obtain an accurate percentage reading, all valves on the charging should now be closed, the site glass should be pressurized, and the charging wrench should still be open ¼ of a turn.

15.2 Moving Formula Liquid into the Cooling Unit.

15.2.1 Open the discharge valve to release the chemical from the site glass, into the discharge hose and into the cooling unit.

15.2.2 Open the pressure valve. This will bring in pressure to help push the chemical out of the site glass.

15.2.3 When the hydrometer touches the bottom of the site glass, close the pressure valve.

15.2.4 When all the formula has entered the cooling unit:

a. A gurgling sound will be heard.
b. With your hand on the steam line, a vibration can be felt.

> **NOTE**
> This sound and vibration both indicate that the vapor has entered the cooling unit and no formula remains in the sight glass or the discharge line.

15.2.5 As soon as the gurgling/vibration stops, close discharge valve.

15.2.6 Open the vent and release any pressure remaining in the sight glass. Leave the vent open.

15.2.6 Charging the cooling unit with the liquid portion of the charge is now completed.

15.3 Pressurizing the Cooling Unit With Hydrogen.

WARNING!

Open hydrogen valve slowly.
The hydrogen comes in under the discharge valve so that it can't enter the site glass. Safety glasses and face shield to be worn at all times. Have eyewash nearby

NOTE
Pressures are listed on the FC-1119 formula chart

CAUTION

Always set the regulators 50 lbs. greater than what is actually called for. If the regulator is set to the exact amount indicated on the FC-1119 Formula chart, gases could flow either direction after the pressure equalizes. This could damage the brass regulator.

15.3.1 Be certain the vent is open and all of the other valves are closed. Especially the discharge valve.

15.3.2 Slowly open hydrogen valve. The needle will move on H2 gauge which is saying there is flow through the valve. Continue slowly opening the hydrogen valve all the way. When the desired pressure is reached, immediately close the hydrogen valve then immediately close the charging wrench.

15.3.3 Open the discharge valve for a moment to release hydrogen pressure still in the discharge line and then close again. Leave vent valve open.

15.3.4 Remove the charging wrench if you are going to immediately charge another unit. Otherwise you can leave the wrench on for tapping.

15.4 After a Boiler Repair

15.4.1 Depending on where the leak was, there may have been total loss of liquid in the unit. If so, do this step before going on to **Procedure 15.5**

15.4.2 After charging the unit, for the first time, remove the charging wrench.

15.4.3 Lean the cooling unit over onto it's side putting the boiler on the low side.

15.4.3 Lift the bottom end of the cooling unit up so the liquid in the bottom of the cooling unit moves up to the top of the cooling unit, into the steam line and into the perk tube.

15.4.4 Set it back down on it's side and leave it that way for a minute or two.

15.4.5 Install the correct wattage heat element

15.4.6 Install the boiler pack.

15.4.7 Make sure the unit is level, plug in the heat element. Write down the time.

15.4.8 In one hour, the cooling unit should be:

- Hot where the steam line enters the condenser
- Cooling in the low temp evaporator (freezer)

15.4.9 If not, **Procedures 15.4.2 -15.4.6** may have been forgotten. There isn't enough liquid where it needs to be that will turn to steam. Just unplug the unit and do the procedures.

NOTE

If the cooling unit has been flushed, (see plugged cooling units **Procedure 23).** There are steps that **must be taken** for a flushed unit. Otherwise, the unit will not work properly.

15.5 Testing the Charge

Table 15-1

TOOL	QUANTITY
Pocket Level	1
Amp Meter	1

15.5.1 Install the correct wattage heat element .

15.5.2 Install the boiler pack. It's not necessary to worry about where the insulation is in the boiler pack at this time.

15.5.3 Level the cooling unit. If there is a frame on the cooling unit, it's ok side to side. Check it front to back by placing a small torpedo level on the top of the flue tube. As long as most of the bubble is between the lines it's good. If there is no frame, check side to side as well.

15.5.4 Using an adapter, plug the heat element into 110/120 Voltage.

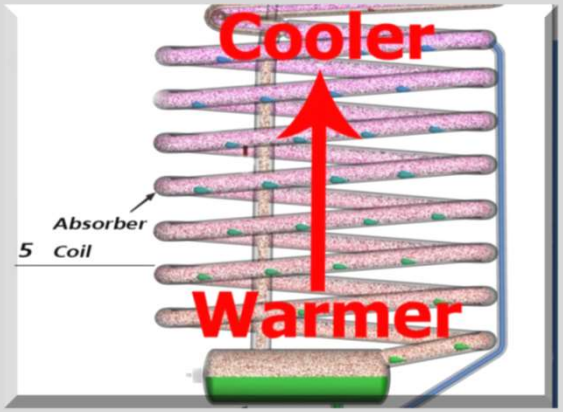
15.5.5 **W**rite down the time and set a timer for one hour.

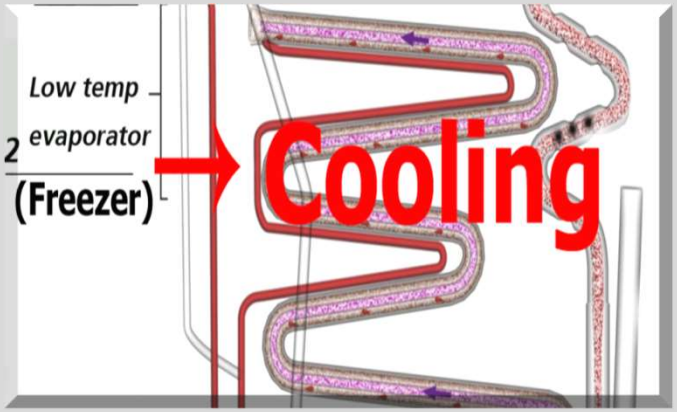
NOTE

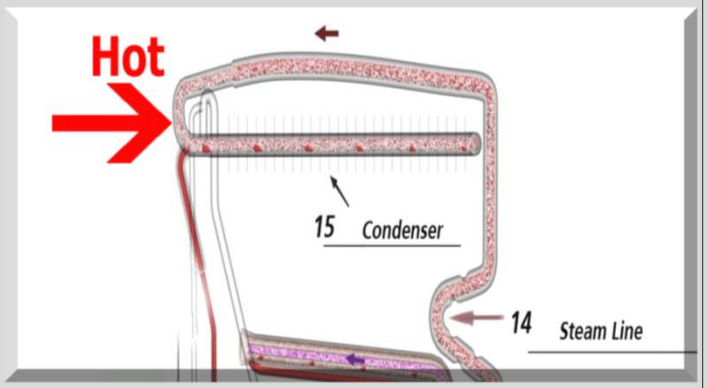
If charging a group of cooling units at once, it's a good idea to tag them and write the time on it's tag.

15.5.6 In one hour, the temperatures should be:

- **<u>Absorber coils-</u>** warmer at the bottom, cooler moving up to the top
- **<u>Low Temp Evaporator</u>**-cooling
- **<u>Steam line where it enters the condenser</u>**-hot to the touch







15.5.7 If any of **Procedure 15.5.6** is not what it should be, and **Procedures** in **15.4** were not forgotten or not necessary, the unit is overcharged and needs to be tapped. Go to **Procedure 16.**

16.0 Tapping the Cooling Unit

NOTE

There are two ways to tap a unit. Hose tapping & Hiss tapping.

The method used depends on the make of the cooling unit being serviced.

16.1 Anything that has a service valve already welded on can be Hose tapped or Hiss Tapped. Example: Dometic

16.1.1 Anything that requires a service valve to be welded on requires the Hose tap. Example: Norcold

WARNING!

The following, Procedures 16.2, requires technicians have safety glasses and face shield on at all times. Have eyewash nearby.

16.2. Hose Tapping – Dometic & Norcold or any other make

16.2.1 Open the charging wrench on the cooling unit and fill the discharge hose with liquid from the cooling unit.

16.2.2 The vent on the charging board should be open. All other valves on the charging board should be closed.

16.2.3 Listen for the discharge hose to fill. Close the charging wrench.

16.2.4 Open the discharge valve on the charging board to release the pressure in the discharge hose.

16.2.5 Close the discharge valve.

16.2.6 Check the low temp evaporator for a change in temperature. If frost is developing, leave the unit for fifteen minutes and recheck temperatures.

16.2.7 If temperatures are still not correct, repeat **Procedures 16.2.1 – 16.2.7** every fifteen minutes until cooling in the evaporator coils is noted.

16.2.8 Once cooling is noted in evaporator, let unit operate for one hour. If within one hour, the unit is working great and suddenly loses all cooling, repeat tap.

16.2.9 When all of the temperatures are correct **(See: Procedure 15.5.6),** let unit continue to operate.

16.2.10 When the evaporator maintains frost for at least one hour, depending on ambient temperature, the charge appears to be correct at this stage.

16.2.11 Once the charge is correct, move to **Procedure 16.4**

<u>Tapping to the Hiss.</u> (Dometic - or any cooling unit with a factory installed service valve)

16.3 Vent should be open on charging board and all other valves should be closed.

16.3.1 Install charging wrench on service valve. Do not open the wrench yet.

16.3.2 Open discharge valve on the charging .

16.3.3 Be in a position to view the sight glass while also controlling the charging wrench.

NOTE
Be prepared to close the charging wrench quickly when hiss is noted.

16.3.4 Open the service stem on the charging wrench approximately one-quarter turn. Liquid from the cooling unit will be forced into the site glass on the charging board.

16.3.5 When the liquid in the absorber vessel reaches the liquid level, which is even with the opening in the service stem, the liquid will be replaced by vapor. Vapor escaping from the service stem will cause a distinct "**hiss**" sound.

16.3.6 When hiss is noted, immediately close the charging wrench. Otherwise, hydrogen will enter the site glass and the hydrometer could be damaged.

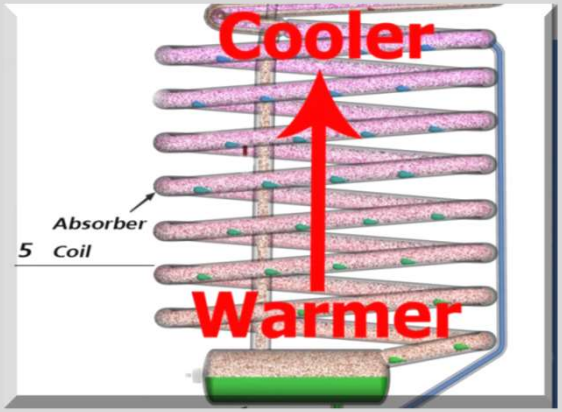
16.3.7 Close the discharge valve. Allow the vent to remain open.

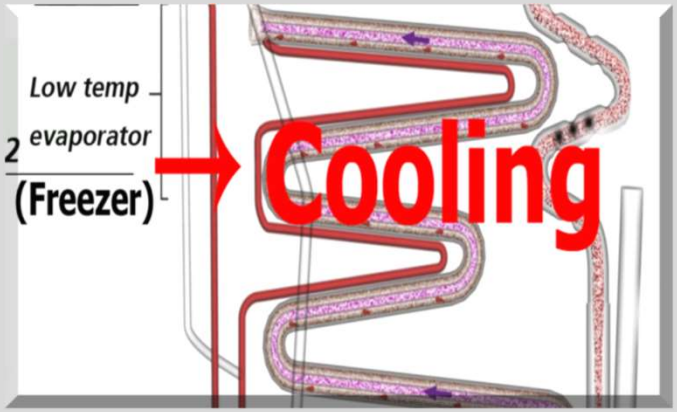
NOTE

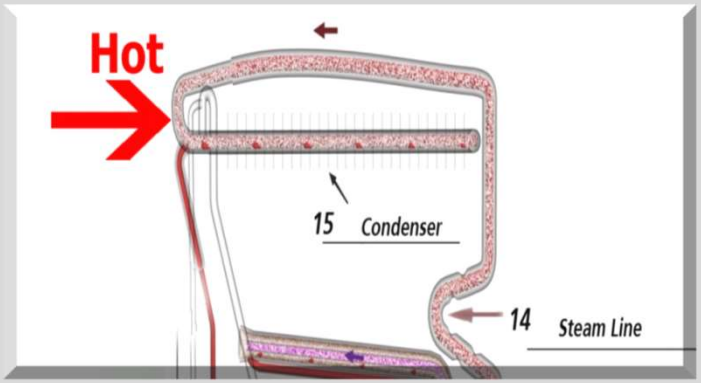
With Hiss tapping, once the sweet spot is reached, the evaporator will immediately begin to frost up.

16.3.8 When the charge is correct, the cooling unit should have these temperatures.

- **Absorber coils-** warm at the bottom, cooler moving to the top
- **Low Temp Evaporator**-some freezing
- **Steam line enters condenser**-hot to the touch







16.3.9 If within one hour after tapping, the unit is working great and suddenly loses all cooling, repeat tap. Do as many times as needed.

16.3.10 When all temps remain correct for one hour, the charge is complete.

16.4 Moving the liquid remaining in the Site Glass from Tapping Procedure to the Aqua Tank

16.4.1 All valves on the charging board should be closed.

16.4.2 Open pressure valve then open the Aqua valve. The pressure from the top of the Aqua tank will push the liquid back to the aqua tank to store for the next use.

16.4.3 Due to the head pressure in the Aqua tank, the liquid will move slower going back to the tank than it does when it's coming in from the Aqua tank to the Site Glass.

16.4.4 When all the liquid is out of the site glass, close the aqua valve, close the pressure valve and open the vent valve. Leave vent open.

16.4.5 Remove the charging wrench from the service valve.

16.5 Leak Check – Phase III (Running in the Raw)

16.5.1 With the heat element still plugged in, put a large common garbage bag over the entire evaporator, roll the ends of the bag up to enclose the area, and use snap close pins to completely seal the bag shut.

16.5.2 Leave unit bagatized for 24 hours.

16.5.3 After 24 hours, unplug the heat element, tear a hole in the bag, and smell for ammonia.

16.5.4 Smell for ammonia at the top of the boiler pack. If no odor exists, remove the boiler pack and check for yellow discoloration where the leak was repaired in the boiler tube.

16.5.5 If there is any indication of a leak, discharge the unit (see **Procedure 5.0 - 5.3.22** then start back at **Procedure 9.0, Leak Check Phase One**, and follow the procedures in order from there.

16.5.6 If cooling unit proves to be free of leaks, move on to **Procedure 17**.

NOTE

If after completing Leak Check Phase Three, the unit shows no signs of a leak, yet still does not cool properly, the first step would be to try recharging the unit.

If the unit still does not cool properly, there is an **Inner Tube Rupture (ITR).**

INNER **T**UBE **R**UPTURES are very rare but they are possible. The image here shows where some of the inner tubes are located. Making this diagnosis is only done as a last resort. Though it can be repaired, it is not worth all the time and effort it would take since they are so rare.

Procedure XVII - Urethaning

NOTE
The only way to know for sure that the charge is 100% correct, is to put it in the cabinet, urethane it and check the refrigerator temperature.

Equipment Needed	
Scrap Carpet Size of the Cabinet	Utility Knife
Paint Scraper	Thermal Mastic
Spray Adhesive	Refrigerator Parts
1mm or less-Plastic Drop Cloth	2 garbage bags or pieces of plastic
Extension Lighter	Old Rags
Painter's tape	Small sheets Newspaper or magazine

17.0 Set Up

17.1 Lay refrigerator down on its front side leaving the refrigerator back exposed. Always have a piece of scrap carpeting or something underneath the refrigerator that will protect the front of the doors.

17.1.1 Remove any old urethane or thermal mastic, with a scraper and vacuum, in the back of the cabinet where the cooling unit evaporator will be placed.

17.1.2 Using a common spray adhesive, spray a generous amount inside the area where the cooling unit evaporator will be placed. Be sure to get all the corners and lip edges as well. Try not to spray directly into the holes.

17.1.3 Lay the thin plastic drop cloth in the area to be urethaned sticking it to the adhesive. Be sure there are no air pockets around the perimeter or in the corners. (This can be purchased at any hardware store.)

17.1.4 With an extension lighter, remove the plastic in the holes where the screws will go in the refrigerator evaporator to prevent plastic from binding when the screws are installed.

17.1.5 With a utility knife, remove the excess plastic around the outer edges of the back of the refrigerator. Leave about 1/2" of the plastic on top.

17.1.6 Lay repaired cooling unit on the refrigerator or on the workbench, with the evaporator facing up.

17.1.7 Apply a generous bead of thermal mastic, about the width of your finger, to the refrigerator evaporator coils wherever they will make contact with the metal plates in the cabinet. This insures the cooling transfer

17.1.8 Lay the cooling unit into the cabinet so the frame meets the cabinet on the corners. Make sure all wires are out of the way.

17.1.9 Insert one screw at the top of the cooling unit and one screw at the opposite corner at the bottom of the cooling unit. This secures the cooling unit to the cabinet.

17.1.10 Set refrigerator up and insert screws into refrigerator low temp evaporator (freezer compartment) just enough to hold in place. Start with the longest screw to pull the cooling unit to the cabinet.

17.1.11 Insert the four screws into the high temp evaporator fins (refrigerator compartment) just enough to hold in place. Then tighten all the screws by hand so you don't over tighten and strip the screws.

17.1.12 Slide a common garbage bag over the freezer door. This protects the freezer door liner in case of urethane leaks past the urethaning plastic sheet when urethane is poured.

17.1.13 Stuff another garbage bag around refrigerator evaporator fins inside the refrigerator. Friction should hold it in place. Close the refrigerator door. This will protect the refrigerator door liner when pouring urethane.

17.1.14 Lay the refrigerator face down on the carpet again.

17.1.15 Where the evaporator has been screwed to the cabinet, apply thermal mastic to seal any possible opening. With finger, press mastic anywhere there is an opening under the cooling unit to seal all openings. This includes around the screws. The purpose is to keep any urethane from entering the cabinet.

NOTE

With Norcolds, be sure to apply the thermal mastic around the perimeter of the plates between the evaporator tubing and around every hole in the plate.

17.1.16 Apply painter's tape to condenser fins (use 2-3 layers) to prevent urethane from coming into contact with them. Apply to underneath side of pipes.

17.1.17 Slide paper underneath the absorber coils. Tear where pipes are in the way. Wrap the excess around the pipe.

17.1.18 Double check for tears in plastic and gaps in thermal mastic before mixing urethane. If a tear happens, just put scotch tape on it.

17.2 The Pour

NOTE

Pouring the urethane Directly into the cabinet ensures a **PERFECT SEAL.**

NOTE

Urethane base and catalyst are purchased in separate containers (parts A & B). Its technical name is **Isocyanate A & B** and has a **density of 2 lbs**. Keep urethane in a **constant temperature** area. This will help keep a **constant raise** from the urethane. **Procedures 17.1- 17.1.18** must be accomplished **prior to mixing the urethane**.

NOTE

Ambient temperature and the age or the urethane plays a huge part in how quickly the urethane rises and sets. The higher the ambient temperature and the newer the urethane, the quicker it rises and sets. The colder the ambient temperature and the older the urethane, the slower it rises and sets.

Caution

Do not mix part A and part B together until you are absolutely sure the cabinet is ready.

Equipment needed	
4-16 oz. Styrofoam cups	Urethane Part A
Clean 1 gallon container	Urethane Part B
Beater from a kitchen mixer	Drill-preferably cordless

17.2.1 For an average two-door refrigerator, mix approximately 32-ounces of Part A and 32-ounces of Part B together in a clean container.

17.2.2 Mix thoroughly with mixing paddle (the beater from a kitchen mixer works well) and a drill.

WARNING

DO NOT remove beater with the drill running. Urethane will splatter everywhere. It will not come off of clothing, skin or hair. It has to wear off.

NOTE

To remove urethane from the beater, run the beater around the inside of a plastic garbage can. After it dries the rest can be removed with a putty knife. Eventually it will have to be replaced. Yard sales are a good place to get these.

17.2.3 When properly mixed, urethane should be a uniform color and begin to rise within a few seconds.

17.2.4 Quickly pour mixture evenly throughout the area to be urethaned, primarily focusing on the evaporator tubing and perimeter.

17.2.5 After approximately fifteen minutes (or until firm), if more urethane is required, mix up more – D**O NOT** mix another 32 ounces each. Only mix equal parts of what it will take to finish it up. It will take practice to determine how much more is needed.

17.2.6 Pour until the area is completely filled with urethane. (Knowing how much more to add comes with practice, but it will always be equal parts.)

WARNING

While urethane is setting up, **do not touch** the urethane. It gets very hot and it will not come off of skin.

17.3 Removing Excess Urethane

Equipment Needed To Remove Excess Urethane	
SS-1115 36" Specially Designed Saw (Included in Package)	Small Hand Saw
Two hand held screw drivers	Shop Vac or small sweeper

17.3.1 When the area is full and firm, remove the newspapers, tape and screws that were installed at the top of the cooling unit to hold it in place.

17.3.2 Place a couple of screw driver handles underneath the cooling unit frame to raise it up. This will make sawing easier.

17.3.3 Saw urethane flush with the back of the refrigerator cabinet using the Specially designed, **SS-1115, 36" steel saw** included in the customized tool package. A smaller hand saw will be needed around the pipes (not included).

17.3.4 Using a vacuum or compressor, clean excess urethane shavings.

Procedure XVIII

18.0 Foil Backing

Equipment Needed	
Large putty knife	Foil Backing
Box Cutter	Silver Foil Tape
Thumb Tape	Scissors

18.1 Measure from the bar at the condenser down to the end of the urethane to the top of the absorber coils and cut. Plus, it should be cut to fit under the cooling unit frame on all three sides, which creates a seal.

18.1.1 Notch foil backing to go around tubes exiting the urethane.

18.1.2 Cut the foil to the size that was originally on the urethane when the unit was disassembled.

18.1.3 Depending on the make and model of the refrigerator, seal the edges of the foil backing using the three sides of the frame on the cooling unit.

18.1.4 Seal the fourth side (nearest the top of the absorber coils, using aluminum foil tape.

18.1.5 Reinstall the screws on the upper frame of the cooling unit.

18.1.6 Put thumb tape wherever the pipes pass through the urethane.

18.1.7 Install the heat element and attach the adapter so as to plug it into 110/120 Volts.

18.1.8 Install the boiler pack.

18.8.9 Attach a temperature probe to the refrigerator fins where the thermistor belongs. Extend leads to the meter out the top of the refrigerator door.

18.1.10 Operate in bypass mode on 110/120 Volts all day.

18.1.11 Moisture coming out of the exit line of the evaporator on the cooling unit says the unit is working great.

18.1.12 To keep this moisture from dripping down onto the floor of the RV, put 3/4” common piping insulation and secure with wire ties.

Procedure XIX

19.0 Semi Final Temperature Check

19.1 Without opening the refrigerator door, attach temperature probe to the meter. Check Fahrenheit temperature. It should be in the single digits depending on the ambient temperature. If so, the charge is good.

19.1.1 If the job has been done correctly, regardless of the ambient temperature in the refrigerator will be below freezing.

19.1.2 If not, discharge the cooling unit **Procedure 5.3,** and recharge the cooling unit beginning at: **Procedure 15.**

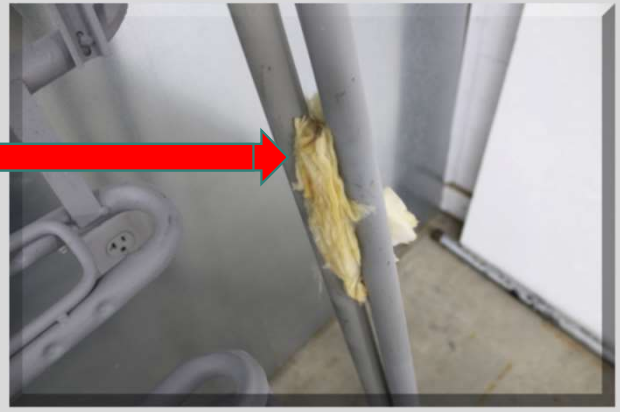
19.1.3 If the temperature is satisfactory, reassemble the cooling unit to cabinet and reconnect the controls.

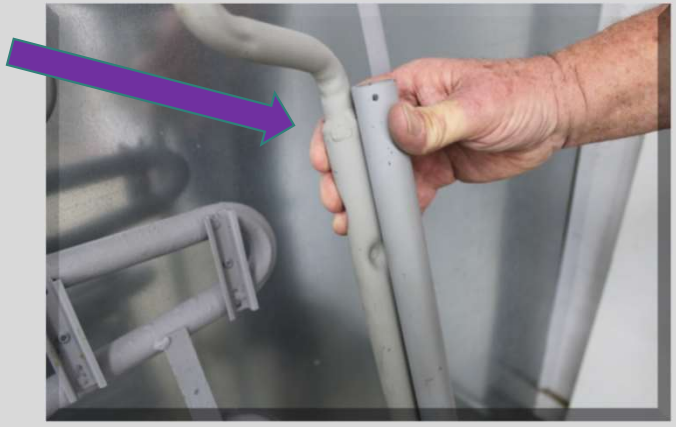
Procedure XX **20.0 Reassembly**

20.1 Install the rest of the screws that hold the cooling unit to the cabinet.

20.1.1 Accurately reassemble burner assembly, controls, and wires.

20.1.2 **It is critical that enough insulation is installed between the flue tube and the steamline. Place a small piece of fiberglass insulation between the flue tube and the steamline and push it down just enough so that when the boiler pack is placed on it, it cannot squeeze the two together. If not, the flue tube will heat up the steamline when operating in gas mode, which will greatly affect the proper function of the cooling unit.**





20.1.3 **It is also critical that insulation be properly installed between the back of the refrigerator cabinet and the boiler tube.**

20.1.4 **If there is not enough insulation as sated in Procedure 20.1.3, the heat from the boiler tube can increase refrigerator temperatures. It can melt the plastic on the inside of the refrigerator and it can even create a hole in the back of the refrigerator cabinet.**

20.1.5 **Just add some extra fiberglass insulation on the backside of the boiler tube.**

20.1.6 When all the gas connections have been made, leak check all the connections. Operate on gas and leak check again until there are no gas leaks.

Procedure XXI

21.0 Final Temp Check

21.1. Once everything has been properly reassembled, once again, attach a temperature probe to the refrigerator fins where the thermistor belongs. Extend leads to the meter out the top of the refrigerator door.

21.1.1 Let the refrigerator operate 24 hours on electric. In the morning, attach the temperature probe leads to the meter and see what the Fahrenheit temperature is. If the temperatures are good, switch to LP.

21.1.2 Let the refrigerator operate throughout the rest of the day on LP. At the end of the day, attach the temperature probe leads to the meter and see what the Fahrenheit temperature is.

WARNING!

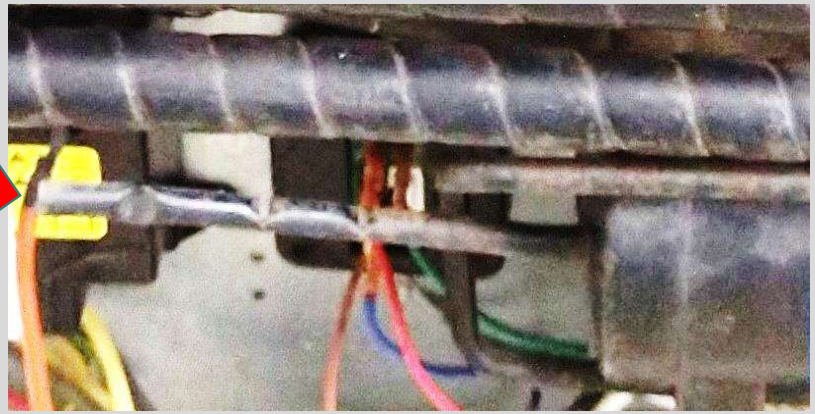
Recommend turning off LP when it will be unattended over night.

21.1.3 If temperatures in the refrigerator compartment are below 40 degrees in both modes, the refrigerator has been properly repaired and charged and is completed.

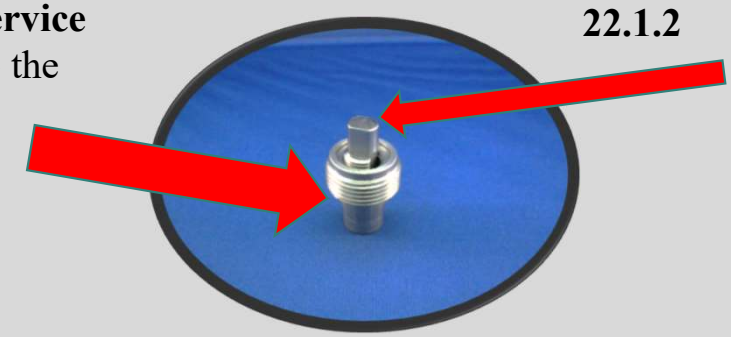
Procedure XXII

22.0 MS-1116 Service Valve & MS-1117 Service Stem

22.1 Norcolds and other units have a long **charging port** instead of a service valve and service stem. For this training we will use Norcolds as our example.



22.1.1 In order to attach the charging wrench to these cooling units, the specially made **MS-1116 Service Valve**, must be welded on to the cooling unit.



22.1.2 Even more specially made is the – **MS-1117 Service Stem** which will be inserted into the **MS-1116 Service Valve**. But first, it's vital to know what can be done with this service stem and what cannot.

What makes this Service Stem so extra special?

22.1.3 **Norcolds** have a safety made of a bimetal in the end of the loop that is on the top of the absorber coils. This **bimetal plug** will melt and release all pressure in case the RV were to ever catch on fire, to help prevent an explosion.

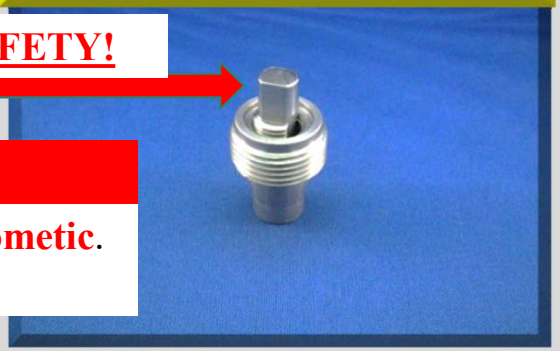
Norcold Safety

Dometic Safety

22.1.4 **Dometics** also have a safety **bimetal plug** that will melt and release all pressure under the same circumstances as **Procedure 22.1.3.** However, this is found throughout the center of the **Dometic Service Stem.**

22.1.5 This service stem designed for used on the Norcolds, **DOES NOT** have a **SAFETY!**

Norcold Stem-NO SAFETY



WARNING

These specially made service stems for Norcold, can NEVER be installed on a Dometic.
Doing so will eliminate the safety on the Dometic cooling unit.

Installing
MS-1116 Service Valve &
MS-1117 Service Stem
to a Norcold Cooling Unit

22.2 Remove cooling unit from the cabinet.

22.2.1 Take to a well-ventilated, no traffic area and invert the cooling unit so the liquid goes to the bottom. This way, when the pressure is released, the only part of the charge that's escaping is hydrogen gas and not ammonia liquid.

22.2.2 With dulled bolt cutters, (to create a pinch, not a clean cut), stand away from the side of the service port where pressure is going to be released and cut the charging stem to create a pinch in the stem. (see video)

22.2.3 Once all the pressure has been released, pressure wash **Procedure 7** and then paint the cooling unit gray **Procedure 8**.

WARNING!

Safety glasses and face shield shall be worn at all times. Have eyewash nearby.

22.2.4 With cutting wheel, cut the tip off where it was pinched together.

22.2.5 Clean up any paint around the charging port where the valve is to be welded on.

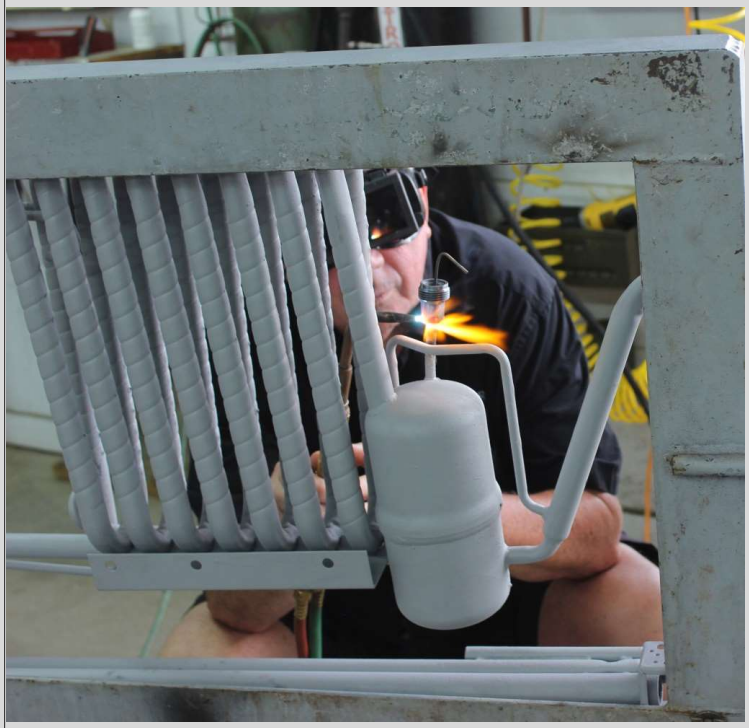
22.2.5 Place a 3/32” welding rod inside the service valve. Then place the welding rod into the charging port on the cooling unit and tack weld into place.

CAUTION

Do not weld completely or the welding rod will adhere to the valve.

22.2.6 Once tack weld is complete, remove the welding rod.

22.2.7 Weld the MS-1116 service valve onto the charging port. Allow to cool.



CAUTION

Do not paint the service valve threads or the service stem.

22.2.8 Insert the MS-1117 service stem into the MS-1116 service valve.

22.2.9 Paint the area gray. It should look like this.

22.2.10 Proceed to Leak Check Phase One **Procedure 9.** Be sure to leak check the service valve weld.

XXIII 23.0 Plugged Cooling Unit

NOTE

Plugged Cooling Unit

(Seldom seen but possible in older units)

Materials in the cooling unit accumulate. These are collected in the boiler tube. When the unit is run in an un-level position, these are unable to move through the system, causing overheating.

As the unit is allowed to overheat, this "plug" of materials bakes until it is rock-hard. Units which most commonly plug are equipped with a ½" boiler tube. Today's larger ¾" boiler tubes will seemingly not plug. Plugged cooling units are a rare condition and usually apply to some units that are approximately over 20 years of age. This could change down the road so it is included in the training program.

If the cooling unit displays the following, it is plugged.	
No rapid boil in the boiler	Little or no temperature in the bottom absorber coils
No temperature where the steamline enters the condenser	Steamline is extremely hot where exits the boiler pack
No temperature in the low temp evaporator	

Tools Needed

Table 23-1

TOOL & MATERIALS	QUANTITY
Vice Grips	1
Hammer	1
1/8 “ or 3/32-inch X 36” Welding Rod	1
Flushing Hose	1
Adaptor for Flushing	1
Hack Saw	1
Drill	1/8-inch Bit
Bolt Cutter	1

WARNING!

The following procedure requires the use of a gas. Safety glasses and face shield shall be worn at all times. Have eyewash nearby.

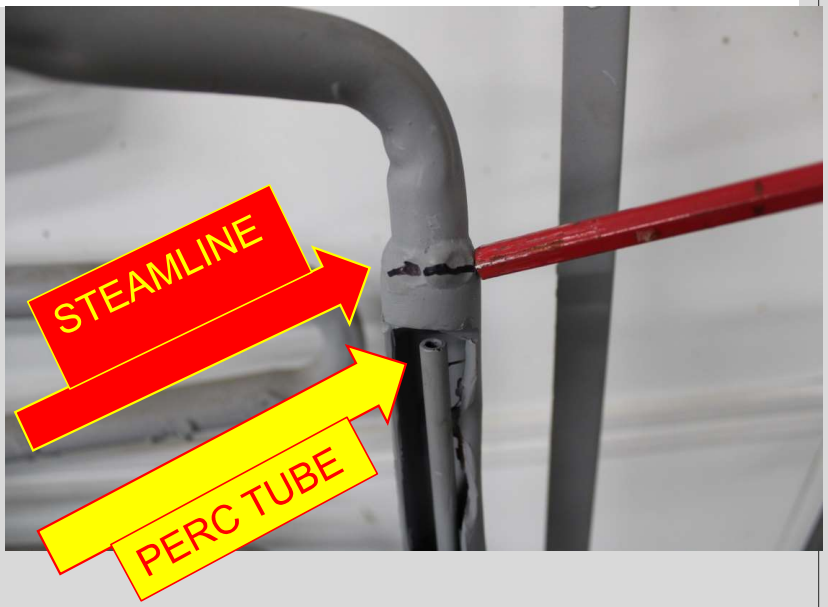
WARNING!

BEFORE PROCEEDING –
MAKE SURE THERE IS NO CHARGE IN THE COOLING UNIT!
SEE: DISCHARGING COOLING UNIT Procedure 5.3 – 5.3.22.

23.1 Cutting the Cooling Unit

23.1.1 **Once the unit has been fully discharged!**

On a **Dometic cooling unit**, cut all the way through the **steamline,** at the TOP of the first weld, where it comes out of the boiler pack.

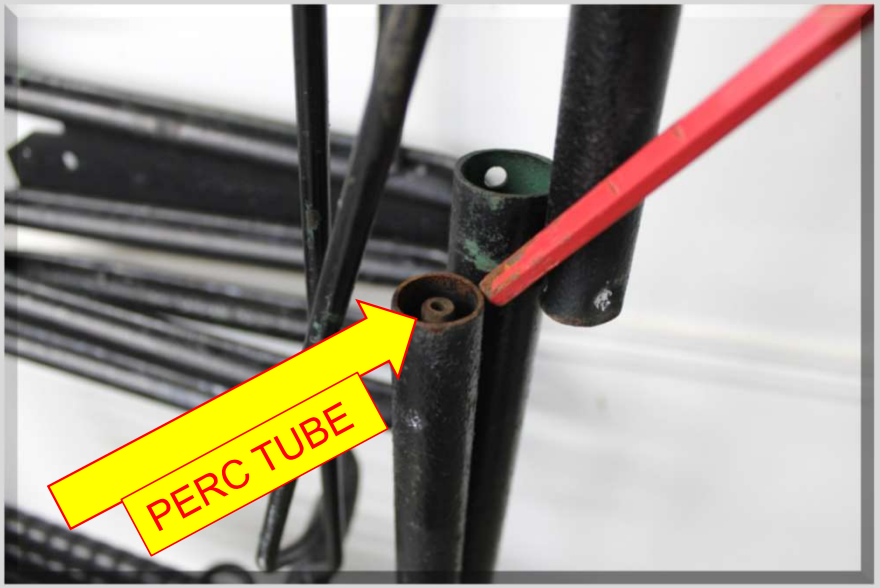


CAUTION

This cooling unit shows where the percolator tube is. Be careful NOT to cut into it. Doing so will make the cooling unit unrepairable.

23.1.2 **Once the unit has been fully discharged!**

On a **Norcold cooling unit**, cut all the way through the steamline, just below the dimple in the steamline.



CAUTION

This cooling unit shows where the percolator tube is. Be careful NOT to cut into it or the water separator. Doing so will make the cooling unit unrepairable.

23.2 Unplugging the Cooling Unit

23.2.1 Take a long welding rod and measure from the 90 ° turn at the bottom of the unit, up to the top where the unit was cut.

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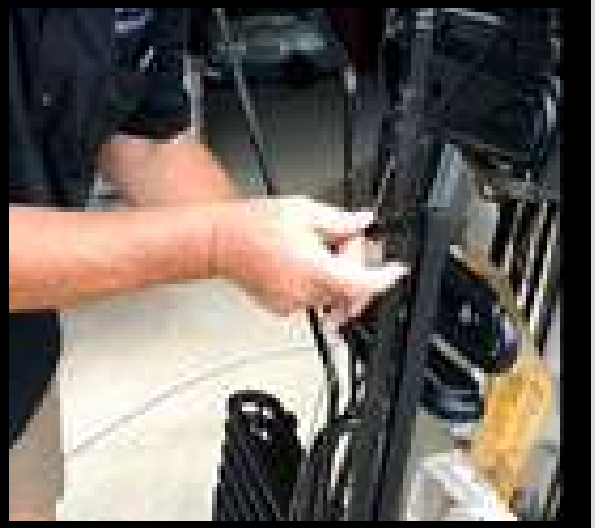
23.2.2 Mark the top of the welding rod with a piece of tape. This tells how far down to drill.



NOTE

Using a bolt cutter, cut off one end of the welding rod to create an edge. This will make it easier to penetrate through the plug.

23.2.3 Put the rod into the perc tube.

23.2. 4 The rod will stop when it reaches the plug.

23.2.5 Attach the drill motor to the other end of the welding rod, and drill down through the plug.

23.3 Flushing the Cooling Unit

Tools Needed

Table 23-1

TOOL & MATERIALS	QUANTITY
Adapter for Flushing	1
Garden Hose	1
Water Supply	standard pressure

NOTE
This procedure is to be done after unplugging a plugged cooling unit.

WARNING!

The following procedure requires the use of a gas. Safety glasses and face shield shall be worn at all times. Have eyewash nearby.

23.3.1 Remove the unit to the flushing area.

23.3.2 Remove the service stem from the service valve.

23.3.3 Cut a small piece of garden hose and attach a female end that will attach to a garden hose attached to a water supply.

23.3.4 On the other end of the small piece of hose, insert the ¼" nipple that is coming out of the ball valve and secure it with a clamp.

23.3.5 Insert another ¼" nipple on the other end of the ball valve.

23.3.6 Screw the threads on the ¼" nipple into the service valve on the cooling unit. Make sure the handle on the ball valve is closed.

23.3.7 Connect the male end of the garden hose from the water source to the female end of the hose adapter.

23.3.8 It will leak some, but that's ok.

23.3.9 Lay the cooling unit down so that the evaporator is on the ground.

23.3.10 Using wire ties, pull the cut sections apart and wire tie the lower section to the cooling unit so that it and the upper section are away from each other.

23.3.11 Put the steamline in the low position so the big opening is on the bottom.

23.3.12 Open the handle on the ball valve.

23.3.13 Flush until the water runs clear.

23.3.14 Rotate the cooling unit on all six sides, flushing each side until water is clear.

23.3.15 Rotation is complete when, all six sides of the cooling unit, are void of any black in the water.

23.3.16 Turn off the water and remove the adapter.

23.3.17 Place an air hose into the service valve and wrap with a rag.

23.3.18 Blow out as much water as possible.

23.3.19 Weld the two sections back together.

23.3.20 Go to Leak Check Phase One. **Procedure 9.** Be sure to leak check this weld too.

NOTE

<u>FOR CHARGING A FLUSHED UNIT</u>

After unit has been flushed, some water will still remain in the inner tubes. When charging flushed units, be sure to:

1. Charge unit 5% over required formula
2. Operate in bypass mode for one hour
3. Tap unit until there's cooling in the evaporator
4. Unplug unit for approximately 15 minutes to allow the steam to condense and fall to the bottom of the unit
5. Discharge the unit
6. Recharge the unit to the normal percentage required
7. Resume normal procedures

Otherwise, the charge will be diluted by water left in inner tubes and unit will not work properly

XXIV

24.0 Evaporator Leak

NOTE
If during Leak Check Phase One or Phase Two, a leak is found in the liquid line of the evaporator, remove any pressure in the unit and follow these steps.

24.1 It is possible to have a leak in the evaporator, though it's rare in today's newer models. We've only seen them in the very old models.

24.1.1 Check for holes everywhere in the evaporator, but especially in the liquid line. Sometimes they will be obvious, sometimes not.

24.1.2 If there are a lot of holes in the liquid line, it's best to re-pipe the section.

WARNING!

The following procedure requires cutting. Safety glasses and face shield shall be worn at all times.
Have eyewash nearby.

A model from the late 1990's or early 2000's

24.1.3 Remove the spot welds that tack the liquid line to the evaporator, which is used as a heat exchanger.

24.1.4 Pull the liquid line off of the evaporator and cut out the bad section of the liquid line.

24.1.5 Have a piece of schedule 40 seamless steel piping which is just a little larger than the liquid line to use as a coupling.

24.1.6 Weld the coupling on to both sides of the liquid line.

24.1.7 Repair any other leaks found in the evaporator or liquid line by welding them.

24.1.8 Paint the areas repaired

24.1.9 Go to: Leak Check Phase One **Procedure 9** and proceed from there.

XXV
25.0 Helpful Hints & Reminders

25.1 When checking the wattage on a heating element, you are allowed a 10% fluctuation either way.

EX. If the required wattage is 250, a heating element ranging from 225-275w will work. If it is out of this range, replace heat element. (See our DIY RV Frig Repair videos for more details on this and other maintenance on RV Refrigerators.

25.1.1 Always try to make cuts in the cooling unit in a pre-welded area. This will give you a thicker area of metal to re-weld to.

25.1.2 For proper operation when checking voltage:
AC should read 101-129 volts
DC should read 11-15 volts

25.1.3 After setting up the charging board these two things are a **must** before use.

a. The charging must have a ground wire running to a ground rod.

b. All fittings must be tightened and leak checked with air pressure or nitrogen, prior to preparing the first formula mixture for charging a cooling unit.

25.1.4 The site glass in the charging board should be cleaned as needed. Overtime it will become cloudy.

25.1.5 The site glass in the charging should be changed after it has been used for one year.

25.1.6 Recommend not purchasing after market heat elements that have red/white or blue/white wires. These have proven to have the incorrect wattage. Recommend staying with OEM for heat elements.

Caution
When cutting into a pipe on the cooling unit, once the outer wall has been cut in one side, **STOP** and make sure there is not an inner tube in this pipe before cutting any further. **NEVER CUT THROUGH AN INNER TUBE!!!!!!!!!! Doing so will result in an unrepairable cooling unit.**

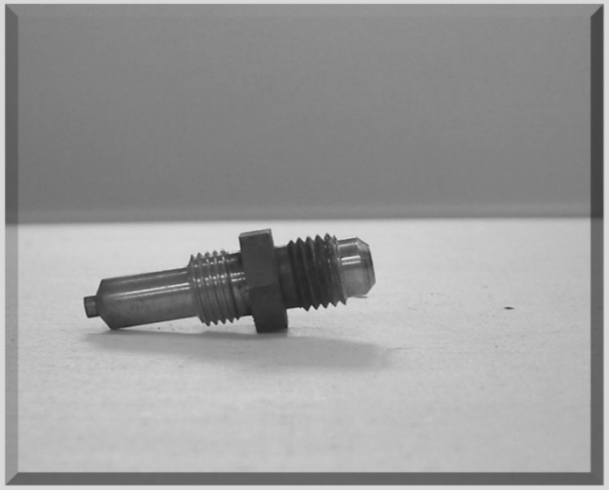
XXVI
26.0 Myths & Truths

MYTH	TRUTH
Chemical has separated.	When the unit has remained idle for a long period of time, chemicals will separate. However, once heat is applied to boiler, chemicals remix and normal operation will resume.
Chemical has jelled.	There are no chemicals in the unit that can jell.
Chemical has crystallized.	Chemicals cannot crystallize as long as the unit is fully charged and sealed.
Air pocket has formed in the unit.	Air cannot enter unit unless a hole is present, in which case pressure inside unit would be released. The problem would then be a leak, not an air pocket.
Working with ammonia and hydrogen is dangerous	When the proper procedures are followed, it is no more dangerous than working with common household chemicals, LP, gasoline etc..

SECTION XXVII

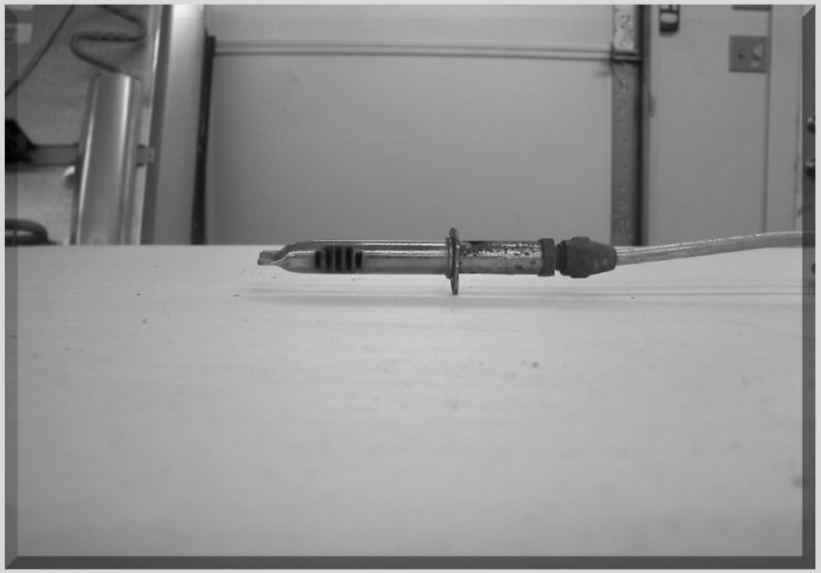
27.0 RV REFRIGERATOR PARTS

27.1 **Orifice—**Sometimes the orifice gets dirty. Soak the orifice in an alcohol based solvent for a few minutes, then allow to air dry. The size of the orifice is also an important factor. **DO NOT PUT ANY TYPE OF FOREIGN OBJECT INTO THE HOLE OF THE ORIFICE.**

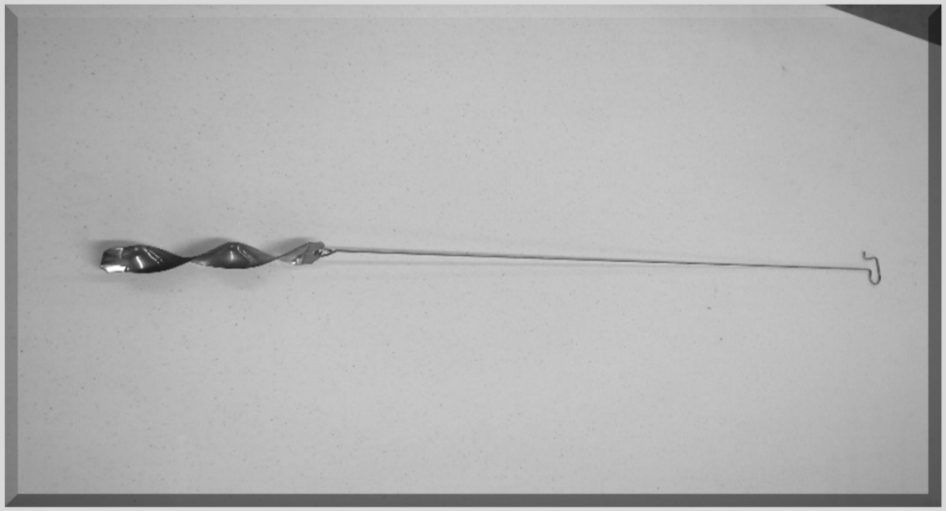


27.1.1 **Thermocouple—**should generate 25-35 millivolts. If it does not, replace thermocouple. (Check with a meter that reads millivolts.)

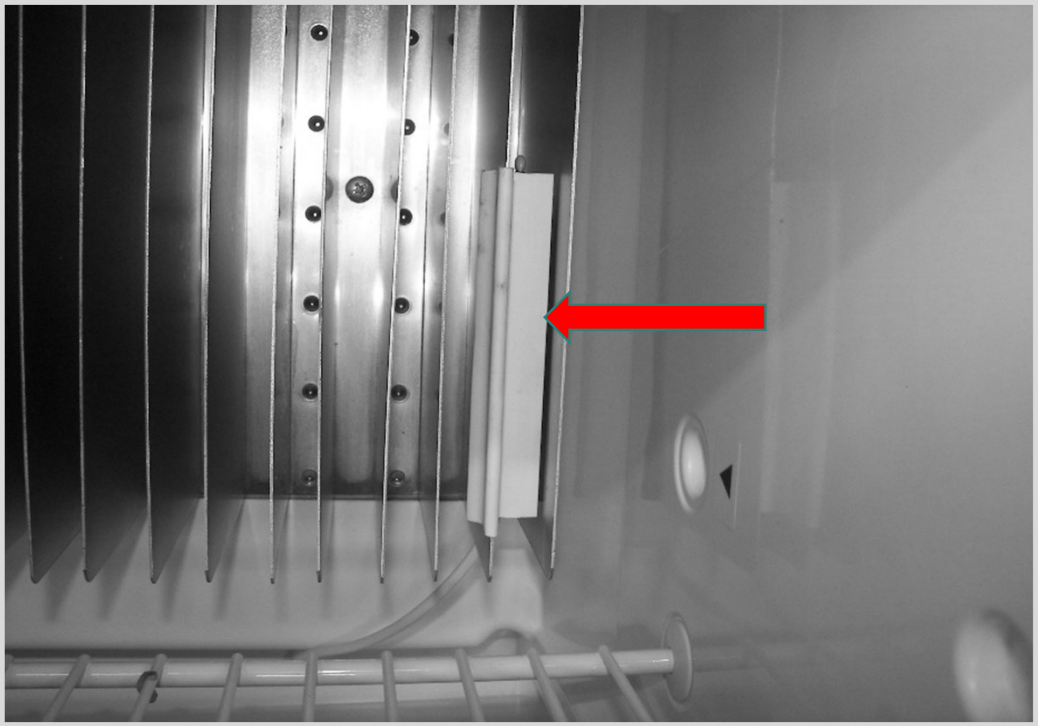
27.1.2 **Burner—**The slots in the burner must be located right below the flu tube. It needs to be cleaned at least once a year.



27.1.3 **Flue Baffle—**The flue baffle, which is located inside the flue, requires cleaning at least once a year, depending on LP usage in that year. The position of the baffle is critical to the operation of the refrigerator when in the LP mode.



27.1.4 **Thermistor—**To check the correct function of the Thermistor, ohm out the Thermistor. Ohm Readings are available at rvrefrigeration.com on the DIY RV Frig Repair page.



27.1.5 **Model and Serial Numbers** will be located in one of three locations.

1. Inside Freezer (bottom or either side) **(Figure 27.1)**
2. Inside Refrigerator (on either side)
3. On back of refrigerator **(Figure 27.2)**

Figure 27-1

Figure 27-2

GLOSSARY

absorbent	A substance with a natural tendency to take up or absorb another substance.
absorption refrigeration	Refrigeration which creates temperatures by using the cooling effect of a refrigerant being absorbed by a chemical substance.
adapter (electrical)	The instrument used to facilitate the connection of a 110Vac receptacle to a heating element.
adapter (flushing)	The instrument used to facilitate the connection of a common garden hose to the service valve on a cooling unit.
Air-cooled condenser	The heat of compression is transferred from condenser coils to surrounding air.
alternating current (ac)	The electrical current in which direction of flow alternates or reverses. In the case of 60-cycle (Hertz) current, for example, the direction of flow reverses every 1/120th of a second.
ambient temperature	The temperature of the surrounding air or fluid.
ammeter	An electrical meter calibrated in amperes used to measure current.

Bagatize	To take a common plastic garbage bag and wrap the area that is being leak checked – normally the evaporator or boiler. Using snap close pins to seal the bag. Used in leak checking.
ball valve	A valve assembly (ball) which permits flow of fluid or gas in either direction.
boiler	The closed container in which a liquid may be heated and vaporized.
charged	Cooling unit has the correct formula needed to operate properly.
charging	Specially-designed panel or cabinet fitted with gauges, valves, and refrigerant cylinders used for charging refrigerant into refrigerating mechanisms.
charging wrench	A special tool which is attached to the charging hose on the charging . Charging wrench connects to the service valve, allowing the formula to flow from the charging into or out of the cooling unit.
condense	To change a gas into a liquid
condenser	The fins on the cooling unit that changes the gas back to a liquid.
cooling unit (core)	Metal piping on the back of the RV refrigerator which houses the chemicals used to create the cooling system.

Dalton's law	Vapor pressure created in a container by a mixture of gases is equal to the sum of the individual vapor pressures of the gases contained in the mixture.
direct current (dc)	An electric current flowing in one direction.
flush	To remove any material or fluids from refrigeration system parts by purging them to the atmosphere using other fluids.
formula chart	A chart listing the correct percentages required to re-charge various makes and models of absorption refrigerators.
freezer bars	The low-temperature evaporator coil that protrudes into the freezer compartment. This is where a shelf or the bottom of the freezer sits when the refrigerator is completely together. This is also where the level should be placed when leveling the refrigerator.
gas	Vapor phase or state of a substance.
heat element	A heat-producing, electrical device which operates off 12Vdc or 110Vac.
heat exchanger	A device used to transfer heat from a warm surface to a cold or cooler surface. (Evaporators and condensers are heat exchangers.)

High temp evaporator	The refrigerator section of the cooling unit
hydrometer	An instrument used to read the percentages of the formulas in the sight glass.
invert	To turn upside down.
innertube	A pipe inside another pipe.
level refrigerator	Placing a level on the freezer bars or the flue.
liquid	A substance whose molecules move freely but do not tend to separate indefinitely, as do those of a gas.
LP fuel	Liquefied petroleum. Used as a fuel gas.
Low temp evaporator	The freezer section of the cooling unit
manometer	An instrument for measuring the pressure of gases and vapors.
natural convection	Movement of a fluid caused only by temperature differences (density changes).
No-traffic area	An isolated area away from other people, cars, RV's, etc., that is well ventilated.

odor	That property of air contaminants that affect the sense of smell.
Ohm's Power law	The mathematical relationship between voltage, current, and resistance in an electric circuit. Discovered by George Simon Ohm, the law is stated as follows: Voltage (E) equals amperes (I) times ohms (R), or E = I x R.
Ohmmeter	An instrument for measuring resistance in ohms.
orifice	Accurate-sized opening for controlling flow.
plug	A condition caused in the boiler tube when the unit is run un-level.
pressure	Energy impact on a unit area; force or thrust on a surface.
propane	Volatile hydrocarbon used as a fuel.
psi	Abbreviation for pounds per square inch.
refrigerant	A substance used in refrigerating mechanisms, specifically, any of various liquids that vaporize at a low temperature. In the case of absorption refrigeration, the refrigerant absorbs heat in the evaporator by a change of state from a liquid to a gas and releases its heat in a condenser as the substance returns from the gaseous state back to a liquid.

refrigerant charge	The quantity of refrigerant in a system.
regulator	A device which regulates a desired constant pressure.
relief valve	Safety device on a sealed system. The valve opens to release the charge before dangerous pressure is reached.
running in the raw	To run the cooling unit outside the cabinet without any urethane on it. Accomplished between the "leak check" and "bagatizing" procedures.
safety plug	A device which will release the contents of a container before rupture pressures are reached. In case of a fire in the camper, the safety fuse will release the hydrogen, feeding the fire tremendously. However, this will prevent an explosion.
separator	Device to separate one substance from another.
service stem	A small stem which fits into the service valve, the actual apparatus used to open and close the service valve.
service valve	Opening used to remove or install the formula charge.

sight glass	The clear tube in the charging . Chemicals are put into the sight glass when creating a formula.
Sodium Dichromate	Rust Inhibitor added to the Aqua Ammonia.
temperature	The degree of hotness or coldness as measured by a thermometer.
thermometer	Device for measuring temperatures.
thermostat	Device which senses ambient temperature conditions and, in turn, acts to control a circuit.
urethane	Type of insulation which is foamed in between inner and outer walls of a container. Comes in A & B containers, sold separately by the pound. A & B are to be mixed 50/50.
urethaning plastic sheet	Plastic sheeting used to prevent urethane from adhering to refrigerator cabinet.
WAP	A mixture of chemicals used in leak checking.
watt	Unit of electrical power.

If you have any suggestions for this program, please let us know. We are always happy to hear others suggestions.

Contact Information

fordrv@rvrefrigeration.com

If you have any questions, please refer to the information provided in the package before contacting FRVRTC.

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