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List of Parts: Complete List (included with Kit)

Item	Part No.	Qty	Description
1	010-1120	1	Mounting Kit for Danfoss Compressor
2	010-1170	1	Danfoss BD50F Compressor (mm)
3	010-1175*	1	12/24v Power Module for BD50F (3-pin)
4	012-1001	1	Air-Cooled Condenser 7" x 9" - 2 row
5	015-0280	1	SS Mounting Bracket for Danfoss Thermostat
6	015-0282	1	Danfoss Refrigerator Thermostat Service Pack
7	019-0150**	1	Small Evaporator Box - 12 1/2" x 11 1/2" x 5 1/4"
8	020-0500	1	Spun Copper Filter-Dryer
9	025-0031	1'	Copper Tubing - 3/16" OD
10	025-0032	16'	Copper Tubing - 1/4" OD
11	025-0201	3	Copper Union - 1/4"
12	025-0205	1	Copper Union - 3/16"
13	025-0301	1	Fitting Reducing Copper Union - 3/8" x 1/4"
14	027-0001	4	Heavy Duty Flare Nut - 1/4"
15	055-0036	3'	3/8" ID x 3/8" Thick Tube Insulation
16	055-0104	1	SS Mounting Plate
17	055-0181	1	SS Fan Shroud
18	071-0100	1	12vdc Condenser Fan - 4.68" Sq.
19	079-0661	1	Swaging Tool - 1/4"
20	079-0803	1	Stay-Brite #8 Solder - 2'
21	079-0806	1	Stay Clean Flux Paste - 4 oz Jar
22	079-2001	1	SS Tube/Fitting Brush - 1/4" OD
23	079-2010	1	Abrasive Cleaning Pad - 6" L x 4" W
24	096-0034	1	Schrader Valve - 1/4" OD Stem
25	096-0040	2	Base Valve - 1/4" Male Flare
26	096-0111	1	Capillary Tube Strainer - 1/4"
27	240-0001	12'	Safety Duplex Tinned Cable - 18/2
28	290-0001	6	Insulated Female Spade Electrical Terminal - 22-18 ga.
29	290-0011	2	Insulated Female Spade Electrical Terminal - 12-10 ga.
30	400-0004	4	Phillips Pan Head Machine Screw - 18-8 SS, 6-32 x 2"
31	400-0010	2	Hex Head Mounting Bolt - 18-8 SS, 5/16-24 x 1/2"
32	400-0011	2	Flat Washer - 18-8 SS, 5/16"
33	400-0012	2	Lock Washer - 18-8 SS, 5/16"
34	400-0111	9	Nylock Nut - 18-8 SS, 6-32
35	400-0300	5	Phillips Pan Head Machine Screw - 18-8 SS, 6-32 x 1/2"
36	400-0900	1	Saddle Mount - #8
37	400-0911	10	Standard Cable Tie - 7 1/2"
38	NA	1	CD Manual

*** Upgrade for this item is part number 010-1176. Upgrade part number is interchangeable with 010-1175 in the manual.**

**** Upgrade for this item is part number 019-0350. Upgrade part number is interchangeable with 019-0150 in the manual.**

Required Tools

The following tools are required and are not included with the kit.

- #11 X-acto™ blade and handle
- Assorted open end and adjustable open end wrenches
- Bubble solution leak detector
- Electric drill and assorted drill bits
- Flaring tool and tubing vise
- Locking pliers
- Medium Phillips screwdriver
- Nitrogen or CO2 tank with regulator
- Pencil
- Propane torch
- Refrigeration service manifold gauge set
- Service wrench (1/4" square opening)
- Small hammer
- Small triangular file
- Tape measure
- Tubing cutter
- Vacuum pump
- Wire crimping pliers
- Wire cutter and stripper

Preparation: Tubing and Fitting Procedures

Please read the following section carefully before proceeding with the assembly and installation of the kit. Proper understanding of copper tubing and fitting preparation is essential for the successful building of this kit.

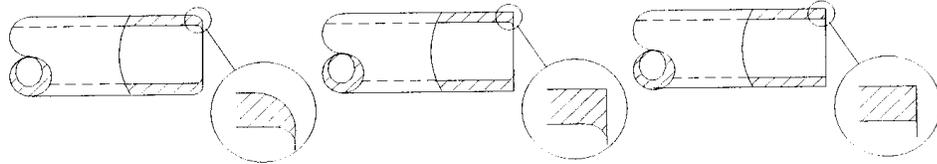
Procedure for **Cutting** tubing:

The copper tubing should be unrolled, and the cut should be made on a straight section. Place the tubing cutter around the tubing and tighten the blade adjustment knob until the cutting blade begins to bite into the tubing. Roll the cutter around the tubing once or twice, and then tighten the knob about a half turn. Repeat rolling the cutter around the tubing, tightening the knob each turn or two until the tubing is cut through.

Procedure for **De-burring** tubing:

Use the tip of a #11 X-acto™ blade to reach inside the end of the copper tubing and cut out the ridge or burr by rotating the blade around the inside of the tubing. Keep the shavings out of the tubing. When completed, there should not be any ridges around the rim of the cut edge of the tubing.

De-burring



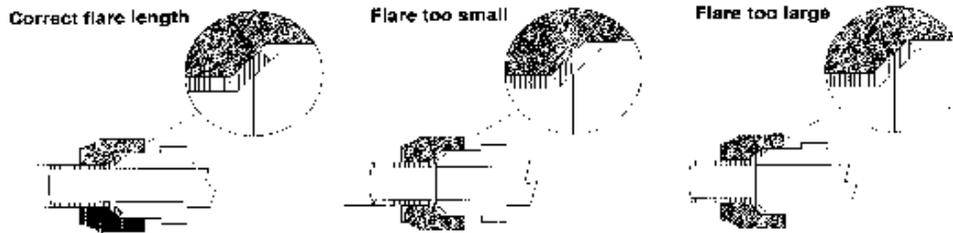
The proper de-burred tubing should resemble the diagram on the right (pictured above).

Procedure for **Bending** tubing:

The tubing should be straightened by holding one end on a flat surface and unrolling the vertically positioned coil against the flat surface. Tubing benders are available, but the small diameter tubing included in the kit is relatively easy to bend by hand. Try to make large radius bends, and decrease the radius gradually and evenly until the bend is a good fit in the installation. Avoid over-bending and re-bending any section excessively. Often it is better to solder a straight section to the compressor and then bend it, using the compressor solder fitting to hold one end of the tube being bent. The copper tubing should be bent carefully, and as little as possible. Re-bending the tubing will cause it to “work harden” and resist further bending. With repeated bending in the same location, the tubing will get very stiff and will reach a point that it will kink or break.

Procedure for **Flaring** tubing:

After the copper tubing has been cut and de-burred, fit a flare nut over the end of the tubing with the open or large side of the nut facing the end of the tubing. Place the end of the tubing in the tubing vise, with about 3/16" of the tubing extending past the end of the vise. Tighten the vise firmly so the tubing cannot move. Attach the flaring tool over the tubing in the vise so that the cone will enter the tubing as the handle tightens. Tighten the flaring tool until the cone is against the end of the tubing. Tighten another two turns, and remove the flaring tool. Inspect the flare for size. A proper sized flare will just cover the entire bevel of the male flare fitting. If the flare is not large enough, slightly enlarge the flare using the flaring tool until it is the right size. Remove the flaring tool and tubing vise.



The proper flared tubing should resemble the diagram on the left (pictured above).

Procedure for **Cleaning** tubing and fittings:

Clean the copper tubing after cutting and de-burring by using a piece of abrasive cleaning pad (also known as Scotch-Brite™ pad). Wrap the pad around the end of the tubing, and rotate the pad back and forth until the copper is shiny, bright, and clean. Avoid having dust from the pad enter the tubing end.

Use the SS tube/fitting brush to clean the inside of the female copper solder fittings. Insert the brush into the fitting while rotating the brush clockwise. Always turn the brush clockwise, and scrub the inside of the fitting with the brush until it is shiny, bright, and clean. Avoid having contaminants enter the end.

Procedure for **Fluxing** tubing:

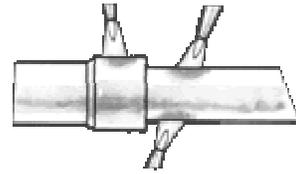
Once the copper tubing is clean, wipe a very small amount of flux over the end of the male tubing being soldered. Only the smallest film of flux is required to protect the tubing until soldering. No flux is applied inside the female fitting; there will be enough flux from the male fitting.

Procedure for **Soldering** tubing:

After the copper tubing has been cut, de-burred, cleaned, and fluxed, fit the pieces together. Light the propane torch and adjust to a "medium" flame. The point of the inner blue flame is where the torch is hottest.

Start heating the tubing, first applying the flame at a point just adjacent to the fitting. Work the flame alternately around the tubing and fitting until both reach soldering temperature (as indicated by the flux becoming clear and fluid) before applying the solder.

Move the flame to the fitting and apply solder with a wiping motion directly on the connection to ensure that it flows evenly into the joint. The molten solder should be spread evenly around the entire fitting. Do not keep adding solder and heat in an attempt to "fill the joint" as this can allow liquid solder to flow into the system. A properly soldered joint requires very little solder.



Sweep the flame back and forth along the axis of assembled joint...tubing and fitting...to achieve uniform heat in both parts. Avoid overheating the copper tubing. If the tubing starts turning a dark color and/or begins smoking, it is best to let it cool, re-clean and re-flux the fittings before re-soldering. After the joint is soldered, with the tubing still warm, thoroughly clean the joint of all excess flux using a water moistened rag.

In the following Assembly Instructions, some of the photos show lines on the tubing. These lines are one inch apart, and are useful as a visual reference for bending and routing of the tubing.

Introduction to the Condensing Unit

The condensing unit houses the most essential component of the refrigeration system, the compressor. The compressor is the most vital component as it is the heart of the system that pumps the refrigerant throughout the system. A Danfoss BD series compressor powers our DC DIY Kit as it has proven to be the most reliable compressor for constant cycling DC refrigeration systems.



Paired together with the compressor on the base plate is the condenser. The fan moves air through the condenser, cooling the hot compressed refrigerant gas supplied from the discharge port of the compressor. This cooling causes the refrigerant vapor to condense into a liquid that will evaporate and remove heat from the insulated refrigerator box. The fan that pulls cool air through the condenser also blows air across the electronic module heat sink, cooling it and assuring reliable operation of the electronic module.

List of Parts: Condensing Unit

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1	010-1120	1	Mounting Kit for Danfoss Compressor
2	010-1170	1	Danfoss BD50F Compressor (mm)
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4	012-1001	1	Air-Cooled Condenser 7" x 9" – 2 row
5	020-0500	1	Spun Copper Filter-Dryer
6	025-0031	1'	Copper Tubing – 3/16" OD
7	025-0032	16'	Copper Tubing – 1/4" OD
8	025-0201	2	Copper Union - 1/4"
9	025-0205	1	Copper Union - 3/16"
10	025-0301	1	Fitting Reducing Copper Union - 3/8" x 1/4"
11	027-0001	4	Heavy Duty Flare Nut - 1/4"
12	055-0104	1	SS Mounting Plate
13	055-0181	1	SS Fan Shroud
14	071-0100	1	12vdc Condenser Fan – 4.68" Sq.
15	079-0661	1	Swaging Tool - 1/4"
16	079-0803	1	Stay-Brite #8 Solder – 2'
17	079-0806	1	Stay Clean Flux Paste – 4 oz Jar
18	079-2001	1	SS Tube/Fitting Brush – 1/4" OD
19	079-2010	1	Abrasive Cleaning Pad – 6" L x 4" W
20	096-0034	1	Schrader Valve – 1/4" OD Stem
21	096-0040	2	Base Valve – 1/4" Male Flare
22	290-0001	2	Insulated Female Spade Electrical Terminal – 22-18 ga.
23	400-0004	4	Phillips Pan Head Machine Screw – 18-8 SS 6-32 x 2"
24	400-0010	2	Hex Head Mounting Bolt – 18-8 SS, 5/16-24 x 1/2"
25	400-0011	2	Flat Washer – 18-8 SS, 5/16"
26	400-0012	2	Lock Washer – 18-8 SS, 5/16"
27	400-0111	9	Nylock Nut – 18-8 SS, 6-32
28	400-0300	5	Phillips Pan Head Machine Screw – 18-8 SS, 6-32 x 1/2"
29	400-0900	1	Saddle Mount - #8
30	400-0911	1	Standard Cable Tie – 7 1/2"

*** Upgrade for this item is part number 010-1176. Upgrade part number is interchangeable with 010-1175 in the manual.**

Assembly Instructions: Condensing Unit

1. Place the air-cooled condenser (012-1001) on top of the base plate (055-0104) and be sure that the condenser connection tubes are facing the center of the base plate. The end of the condenser with the connection tubes should match up to the mounting tab of the base plate that is furthest away from the two square holes located on the base plate. Make sure that the side brackets on the condenser line up with the holes in the mounting tabs on the base plate. Mark where the mounting holes are to be drilled on the side brackets on the condenser.



2. Remove the condenser (012-1001) and drill 5/32" diameter mounting holes in the side brackets to match up with the mounting tab holes of the base plate (055-0104).

***** Make sure that a piece of metal or wood is placed behind the side bracket so that when the drill goes through the side bracket it does not put a hole in the condenser tubing. The condenser tubing is very thin. *****



Damaging the condenser tubing will make the condenser unusable. Damage of this sort is not warranted in any way by Rparts. A new condenser must be purchased before kit building continues.

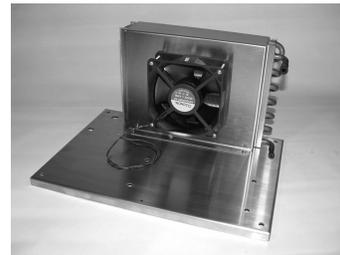
3. Attach the condenser (012-1001) using two 1/2" Phillips Pan head machine screws (400-0300) and two Nylock nuts (400-0111). Make sure that the screws do not touch the condenser connection tubes. The condenser will seem loose at this time but it will be further supported by the fan shroud (055-0181) in a following step.



4. Mount the 12vdc condenser fan (071-0100) onto the fan shroud (055-0181) using four 2" Phillips Pan head machine screws (400-0004) and four Nylock nuts (400-0111). Check the airflow direction arrows on the side of the fan and install it so that the air is pulled through the condenser and discharged out over the compressor. The wires for the fan should be in the lower left hand corner as shown.



5. Place the fan shroud (055-0181) over the condenser (012-1001). The circular opening of the fan shroud should be on the compressor side with the top of the shroud slipping over the top of the condenser. Line up the two holes in the bottom mounting flange of the fan shroud with the two holes in the base plate (055-0104) and attach with two 1/2" Phillips Pan head machine screws (400-0300) and two Nylock nuts (400-0111). This will capture the condenser and hold it firmly in place.



6. Mount the suction side base valve (096-0040) in the square hole on the base plate (055-0104) that is closest to the condenser (012-1001). Label the valve with "S" to identify as the suction valve before mounting. The base of the valve has a square cutout on the bottom that fits in the square hole of the base plate and prevents the valve from turning on the base. Position the valve so the two flare fittings are pointing as shown. Attach the valve using the hex head mounting bolt (400-0010), lock washer (400-0012), and flat washer (400-0011) to hold it in place from underneath the plate. Tighten firmly using an appropriately sized wrench.



7. Locate the mounting kit for the compressor (010-1120) and remove the contents from the bag. Install the four rubber feet into the four large holes in the metal base welded to the bottom of the compressor (010-1170). Install the rubber grommets with a twisting motion. The thicker side of the rubber feet will be on the bottom. Retain the bolts, sleeves and nuts for mounting of the compressor to the base plate in the next step.



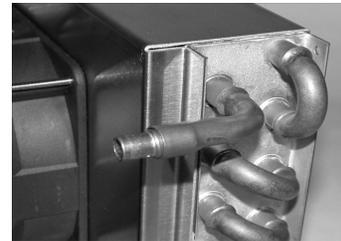
8. Mount the compressor (010-1170) on the base plate (055-0104) using the fasteners retained from Step 7. Position the compressor so that the access tubes (3 in total) are pointing away from the condenser side of the unit. This will position the electrical connections on the compressor to the left as shown in the photo. The sleeves fit into the rubber mounting feet from the top, and the flat washers go on top of the rubber mounting feet and sleeves. Insert the bolts through the washers, sleeves and base, attach the nuts and tighten firmly using two wrenches.



9. Locate the saddle mount (400-0900), and attach it through the hole in the middle of the back edge of the base plate (055-0104) with a 1/2" Phillips Pan head machine screw (400-0300) and Nylock nut (400-0111). Align the saddle mount as shown. This will be used to hold down the filter/drier in a later step.



10. Place the 3/8" to 1/4" fitting reducing copper union (025-0301) into the 3/8" connection tube at the top of the condenser (012-1001). This will be soldered in place after all other fittings are in position. Clean and flux this fitting according to preparation procedures mentioned previously in the Preparation Section before soldering.



11. Place the 3/16" copper union (025-0205) into the 3/8" to 1/4" fitting reducing copper union (025-0301 from the previous step) at the top of the condenser (012-1001). This will be soldered in place once the appropriate copper tubing has been positioned. Clean and flux this fitting according to preparation procedures mentioned previously in the Preparation Section before final soldering.

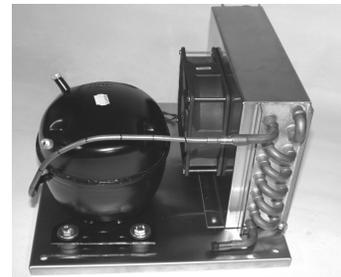
12. Cut a length of 3/16" copper tubing (025-0031) 9" long and de-burr both ends according to preparation procedures mentioned previously in the Preparation Section. Clean both ends with the abrasive cleaning pad (079-2010), and apply a small amount of flux (079-0806) to one end. Remove the cap covering the compressor discharge tube (closest to the label) and use the round wire tube/fitting brush (079-2001) to clean the inside of the compressor discharge tube. Only twist the round wire brush clockwise. Use the abrasive cleaning pad to clean the shoulder of the discharge tube on the compressor.



13. Lift the short side of the base plate (055-0104) that is opposite of the compressor (010-1170) and rest it on a box or other object about four inches high which will tilt the compressor so that the compressor discharge tube is horizontal. This will prevent excess solder from running down into the compressor and plugging it. Now insert the cleaned, fluxed end of the 3/16" tubing from the previous step into the compressor discharge tube and solder according to the preparation procedures mentioned previously in the Preparation Section. Only use a minimum amount of solder to make this connection.



14. Rest the base plate (055-0104) flat after soldering. When the solder joint on the compressor (010-1170) has cooled, gently bend the discharge copper tubing up vertically, and then bend it horizontally towards the top connection tube of the condenser (012-1001). Make large diameter bends and avoid kinking the tubing. Route the tubing within the footprint of the base plate (055-0104).



15. Flux the end of the discharge copper tubing and insert into the 3/16" copper union (025-0205) that is protruding from the top connection tube of the condenser (012-1001). Solder all the joints according to the preparation procedures mentioned previously in the Preparation Section.

16. Cut a piece of 1/4" copper tubing (025-0032) 15" long to be used to connect the suction base valve (096-0040) to the suction fitting on the compressor (010-1170) nearest the end that has the electrical contacts. De-burr both ends of the tubing, place a 1/4" flare nut (027-0001) over one end of the tube, and flare the end according to the preparation procedures mentioned previously in the Preparation Section.



17. **Skip this step if a 010-1171 compressor was supplied with the kit.** Remove the cap on the compressor suction tube nearest the end with the electrical contacts. Use a hammer and the 1/4" swaging tool (079-0661) to enlarge the tube to 1/4", the size of the copper tubing that will be soldered to it. Align the swaging tool carefully and strike firmly and squarely with the hammer several times until the swage tool bottoms out against the shoulder of the tube. Remove the swage tool from the tube.



18. Clean the inside of the compressor suction tube with the round wire tube/fitting brush (079-2001) as in Step 12. Clean the edge or shoulder of the suction tube with the abrasive cleaning pad (079-2010). Clean the un-flared end of the 1/4" tubing flared in Step 16 with the abrasive cleaning pad and apply a small amount of flux (079-0806) to the tubing.

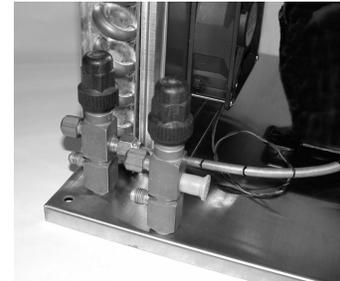
19. Insert the 1/4" copper tubing from the previous step into the compressor suction tube and solder in place using preparation procedures mentioned previously in the Preparation Section. Do not allow excess solder to run down into the compressor suction tube.



20. After the solder connection has cooled, gently bend the attached 1/4" copper tubing to route it in place to mate it with the male flare fitting on the suction base valve (096-0040) as shown in the photo. Make large diameter bends and avoid kinking the tubing. Tighten the flare nut firmly to the suction base valve with two wrenches.



21. Mount the discharge base valve (096-0040) in the remaining square hole on the base plate (055-0104). Label the valve with "D" to identify as the discharge valve before mounting. The base of the valve has a square cutout on the bottom that fits in the square hole of the base plate and prevents the valve from turning on the base. Position the valve so the two flare fittings are pointing as shown. Attach the valve using the hex head mounting bolt (400-0010), lock washer (400-0012), and flat washer (400-0011) to hold it in place from underneath the base plate. Tighten firmly using an appropriately sized wrench.



22. Cut both ends off the spun copper filter/drier (020-0500) so that it is 7" long. De-burr, clean and flux both ends of the filter/drier according to preparation procedures mentioned previously in the Preparation Section. Clean the insides of two 1/4" copper unions (025-0201) with the round wire tube/fitting brush (079-2001). Place a union on each end of the filter/drier.



23. Cut a piece of 1/4" copper tubing (025-0032) 7" long, de-burr and clean both ends. Place a 1/4" flare nut (027-0001) over one of the ends and flare the end using preparation procedures mentioned previously in the Preparation Section. Flux the other end and insert into the 1/4" copper union on one of the ends of the filter/drier (020-0500). If there is an arrow on the filter/drier, it should point to the end that has the flare nut. Solder the copper union to the tubing and the filter/drier.

24. Cut a piece of 1/4" copper tubing (025-0032) 9" long, de-burr and clean both ends. Flux one end and insert into the 1/4" copper union (025-0201) on the other end of the filter/drier (020-0500). Solder the copper union to the tubing and filter/drier.



25. Position the completed filter/drier and tubing assembly with the filter/drier in the middle of the saddle mount (400-0900) behind the compressor (010-1170). Gently bend the tubing with the flare nut (027-0001) attached around the base of the compressor to line up with the male flare fitting on the discharge base valve (096-0040). Align the tubing and thread the flare nut onto the base valve hand tight. Adjust the bends in the 1/4" copper tubing between the base valve and the filter/drier. When finished, the tubing should route as shown in the photo above.



26. Bend the other 1/4" copper tubing end attached to the filter/drier around the other side of the compressor base so that the end will fit into the bottom connection tube on the condenser (012-1001). Bend the tubing carefully to clear the base of the compressor without contacting it. Adjust the bend until the tubing lines up with the lower condenser connection tube, and will insert about 1/4" into this tube.



27. Remove the flare nut on the discharge base valve (096-0040) and set the filter/drier and attached tubing assembly aside. Clean the inside of the 1/4" connection tube on the bottom of the condenser (012-1001). Retrieve the filter/drier and attached tubing assembly and insert the unflared end into the condenser connection tube resting the filter/dryer on the saddle mount (400-0900). Leave the other end loose, but close to the flare connection on the base side. The tubing bends can be slightly adjusted after soldering in the next step.



28. Solder this connection using preparation procedures mentioned previously in the Preparation Section. After the tubing has cooled, adjust it so the filter/drier (020-0500) is centered in the saddle mount (400-0900) and the bends are a good fit around the base. Thread the flare nut (027-0001) onto the discharge base valve (096-0040) and tighten firmly with two wrenches.

29. Thread a 7 1/2" standard cable tie (400-0911) through the saddle mount (400-0900) and around the filter/drier (020-0500) and cinch it tight. Cut off the remainder flush with the holder. Assure that the tubing does not contact the compressor or condensing unit base.



30. **Skip this step if a 010-1171 compressor was supplied with the kit.** Remove the cap on the remaining compressor suction tube. Use a hammer and the 1/4" swaging tool (079-0661) to enlarge this connection tube to 1/4" as in Step 17. Align the swaging tool carefully and strike firmly and squarely with the hammer several times until the swage tool bottoms out against the shoulder of the tube. Remove the swage tool from the tube.

31. Cut the copper stem on the 1/4" Schrader valve service port (096-0034) so that 1/2" of stem remains beyond the end of the brass fitting. Remove the cap and the Schrader valve core with the valve core removing tool and set aside. De-burr, clean and flux the end of the copper tubing according to preparation procedures mentioned previously in the Preparation Section. This fitting serves to plug the hole in the compressor and can act as a second suction access port.



32. Clean the compressor connection tube with the round wire tube/fitting brush (079-2001) as in Steps 12 and 18. Clean the shoulder of the compressor connection tube with the abrasive cleaning pad (079-2010). Insert the cut Schrader valve service port from Step 31 into the compressor connection tube and solder according to preparations procedures mentioned previously in the Preparation Section.



33. After the connection has cooled, install the Schrader valve core from Step 31 back into place, and screw the cap on the valve.
34. Attach the compressor power module (010-1175) plug to the three compressor pins on the end of the compressor that has the module mounting bracket. Orient the plug so that the wires come off the top of the plug. Push this plug firmly onto the pins of the compressor. Tighten the module mounting screw located on the front of the module mounting bracket all the way into the flange of the bracket on the compressor. Orient the plastic housing of the module over the flange on the condenser side of the module mounting bracket. The module will fit around this flange, and the screw hole on the compressor will align with the screw on the compressor module mounting bracket. Snap the module housing over this screw so that the hole surrounds the screw head.



This completes the assembly of the condensing unit. Proceed to the evaporator box and thermostat assembly instructions.

When moving the condensing unit, lift by the base, or lift by the compressor itself. Never attempt to lift the condensing unit by the tubing.

Introduction to the Evaporator

Assembly of the evaporator consists of preparing the evaporator box for connecting to the condensing unit with two lengths of 1/4" copper tubing to allow the liquid refrigerant to travel to the evaporator and the refrigerant gas to return from the evaporator to the condensing unit.



The compressor pushes liquid refrigerant from the high side (discharge) base valve on the condensing unit through the 1/4" copper tubing to the capillary tube. The capillary tube is the very thin tube attached to the 1/4" tubing on the evaporator. This capillary tube is the restricting device, which regulates the amount of refrigerant flowing into the evaporator. This creates high pressure on the condensing unit side of the capillary tube and low pressure on the evaporator side of the capillary tube. The compressor pulls the refrigerant vapor back from the evaporator through the suction side base valve and into the compressor, which compresses it again. The high-pressure vapor is cooled and condenses into a liquid in the condenser and the process continues. This difference in pressure is the key to the whole refrigeration process.

List of Parts: Evaporator & Thermostat Assembly

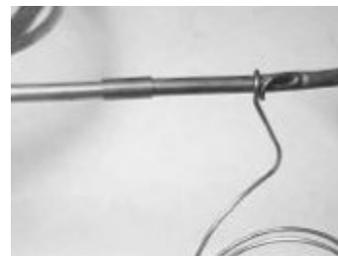
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3	019-0150**	1	Small Evaporator Box – 12 1/2" x 11 1/2" x 5 1/4"
4	025-0032	12'	Copper Tubing - 1/4" OD
5	025-0201	1	Copper Union – 1/4"
6	027-0001	2	Heavy Duty Flare Nut – 1/4"
7	055-0036	1	3/8" ID x 3/8" Thick Tube Insulation – 3'
8	096-0111	1	Capillary Tube Strainer – 1/4"
9	400-0911	2	Standard Cable Tie – 7 1/2"
10	Not Included	2	#8 x 1/2" SS Screws for Thermostat Bracket

**** Upgrade for this item is part number 019-0350. Upgrade part number is interchangeable with 019-0150 in the manual.**

Assembly Instructions: Evaporator Box & Thermostat

1. Determine the length of 1/4" copper tubing (025-0032) necessary to make the run from the condensing unit location to the evaporator location in the insulated box. The tubing that is already part of the evaporator box (019-0150) is about 5' long so two additional lengths of tubing should be added to extend the evaporator lines to the condensing unit mounting location. It is better to have it a little too long than too short as any excess can be coiled and located out of the way. An extra couple of feet of length will make no difference to the performance of the system. Once the length has been determined, cut two lengths of 1/4" tubing. One length will be used for the evaporator suction line and the other length for the liquid line to the evaporator capillary tube. Avoid bending as much as possible to keep the tubing from work hardening. De-burr the ends of the tubing according to preparations procedures mentioned previously in the Preparation Section.

2. Assemble the suction line by connecting one length of the 1/4" copper tubing cut in the previous step to the 1/4" copper tubing attached to the evaporator (019-0150) with one of the 1/4" copper unions (025-0201). Clean the union and clean and flux the tubing ending that is to be connected. Solder the tubing together with the fitting as shown to the right. Label the end of the tubing "S", for suction line, as it will need identification later.



3. Once the 1/4" suction line from Step 2 has been soldered, coil the capillary tube from the evaporator (019-0150) tightly around the 1/4" suction line as shown to the right. The spacing is not critical as this is being done to support the capillary tube and take advantage of any heat exchange between the warm discharge line and the cool suction return line. Coil the capillary tube around the 1/4" suction line until there is only approximately 3" of the capillary tube left.



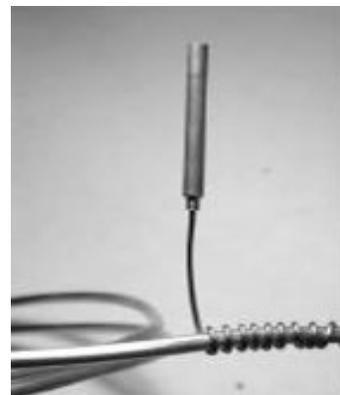
4. Now take the corner edge of a small fine triangular file and file a notch part way through the capillary tube on both sides. File this notch within an inch or two of the end of the capillary tube as shortening the capillary tube too much will affect the performance of the unit. The capillary tube is what regulates the amount of refrigerant entering the evaporator.



5. After the V notch has been filed into the capillary tube take a pair of pliers and bend the end of the capillary tube at the notch so the end of the capillary tube breaks off. Assure that the end of the tube is open to allow the refrigerant to flow through to the evaporator. The inside diameter of the capillary tube is very small (.022 inch).



6. Use the capillary tube strainer (096-0111) to adapt the size of the capillary tube to the other length of 1/4" copper tubing cut in Step 1. The capillary tube strainer has a fine mesh screen in it to prevent any foreign matter from entering the capillary tube and blocking it. Clean and flux the capillary tube, and insert it about 1/4" into the small end of the capillary tube strainer. Inserting the capillary tube too far into the strainer will rip the fine screen inside the strainer. When soldering it in place keep it in an upright position so that the solder will not flow down and block the capillary tube. Solder from the bottom end, and allow capillary action to draw the solder up into the joint. Clean and flux one end of the other length of 1/4" tubing from Step 1. Clean the inside of the capillary tube strainer with the round



wire tube/fitting brush (079-2001). Insert the cleaned and fluxed 1/4" tubing into the strainer and solder according to preparation procedures mentioned previously in the Preparation Section. Wrap a wet rag over the end of the strainer that has the capillary tube soldered to it to prevent it from overheating. Avoid using too much solder. Label the end of this piece of 1/4" tubing "D", for discharge line, as it will need identification later.

7. After soldering the capillary tube strainer (096-0111) to the 1/4" copper tubing, finish winding the capillary tube around the 1/4" suction line. Wrap a wet rag over the end of the strainer that has the capillary tube soldered to it to prevent it from overheating. Clean and flux the discharge line and strainer and solder them together to the suction line to support the cap tube strainer. Hold them together with locking pliers while soldering as shown to the right.



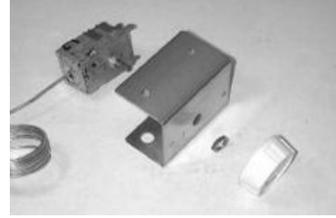
8. Before flaring the ends of the evaporator lines for attachment to the base valves, insulate the lines with the tubing insulation (055-0036) to prevent sweating. Cap the ends of the tubing before sliding the insulation over the tubing to prevent any foreign matter from entering as the tubing slides through the insulation.



9. Slide a 1/4" flare nut (027-0001) onto 1/4" suction line tubing, "S" with the wider end the nut facing the end of the tubing, and flare the end of the tubing according to the preparation procedures mentioned previously in the Preparation Section. This flare nut will attach to the 1/4" suction side base valve on the condensing unit. Slide the last 1/4" flare nut onto the end of the 1/4" tubing that is attached to the cap tube strainer, "D". Flare the end of the tubing. This flare nut will attach to the 1/4" discharge base valve on the condensing unit.



10. Now mount the thermostat bracket (015-0280). There are two sets of holes in the stainless steel bracket. The larger ones are for screwdriver access to tighten the screws that mount the bracket on the wall or inner liner of the refrigerator box. The thermostat assembly can also be mounted outside the box as long as the capillary tube attached to the thermostat reaches inside the box and can be attached to the evaporator. Once the bracket is mounted, the thermostat (015-0282) can be attached to the bracket. Mount the thermostat so that the small indexing pin next to the knob shaft enters the small indexing hole in the bracket next to the hole for the shaft. **The indexing pin on the thermostat must enter the indexing hole.** If the pin is bent, the thermostat will be damaged and may not work. Damage of this sort is not warranted in any way by RParts. Tighten the nut with a wrench, mount the knob on the shaft and affix the index label to the knob. Assure that the knob is turned fully anti-clockwise where it clicks to the "off" position.



11. Prepare for the attachment of the capillary tube from the thermostat to the evaporator. This will be attached after mounting the evaporator in the refrigerator box, but the holes should be drilled in the evaporator before mounting. Drill two 7/32" diameter holes to mount the capillary tube anywhere on the evaporator as long as they are well away from the refrigerant tubes. Insert the cable ties (400-0911) into the holes to tighten up later. In the photos to the right, it is mounted along the back topside but it could be mounted down one side of the box as well. It is important to mount the capillary tube on a flat portion of the evaporator, without the capillary tube crossing over any of the tubes. There should be about 6" of capillary tube contacting the evaporator, thus sensing the evaporator temperature.



This completes the assembly of the evaporator box and thermostat. It is now ready to be connected to the condensing unit and leak tested. Proceed to the installation instructions.

Introduction to Installation

Before installing the completed condensing unit and evaporator assembly, leak test both to determine if there are any leaks that need to be fixed before installing.



In addition, understanding the operation of the base valves is important before starting the installation process. Read the base valve section below before proceeding to the installation instructions.

Base Valve Operation

When the stem on the base valve is turned fully counter-clockwise (CCW), (referred to being "back-seated"), the top fitting (service port) is closed. When the stem is turned fully clockwise (CW), (referred to being "fore-seated"), the bottom fitting is closed. When the valve is between the fore-seated and back-seated positions, (referred to being in the "service position"), all three fittings are open to each other.

To prevent the escape of refrigerant do not move the base valve stem from the back seated position unless there is a cap or a service hose fitting

over the end of the service port (upper) fitting. Do not move the base valve from fore seated unless the line set or a cap is over the end of the lower fitting, again, to prevent the escape of refrigerant.

After the unit is assembled, the base valves should be fore-seated, and caps put on the top fittings. This will prevent excessive exposure to the air as well as keeping foreign objects from entering the system.

When the unit is being leak tested, evacuated, charged, or otherwise being serviced, the base valve stem cover should be removed, the valve should be back seated (fully CCW), the base valve service port caps removed, and the gauge set hoses attached. Then the base valves should be turned one turn (CW) from back seated (CCW), to the service position. The system can be pressurized for leak testing, evacuated with the vacuum pump, and charged with refrigerant when the valve is in the service position and the service manifold hoses are attached.

When the system is installed and running, both service valves should be back seated. The service port caps and the valve stem caps should be in place and tight.

List of Parts: Installation

Item	Part No.	Qty	Description
1	---	1	Completed Condensing Unit
2	---	1	Completed Evaporator Assembly
3	---	1	Completed Thermostat Assembly
4	240-0001	12'	Safety Duplex Tinned Cable – 18/2
5	290-0001	4	Insulated Female Spade Electrical Terminal – 22-18 ga.
6	290-0011	2	Insulated Female Spade Electrical Terminal – 12-10 ga.
7	400-0911	7	Standard Cable Tie – 7 1/2"
8	---	4	Plastic spacers (included with evaporator box)
9	Not Included	tbd	Electrical Supply Wiring
10	Not Included	tbd	Heat Shrink Tubing
11	Not Included	4	Long wood or sheet metal screws (to mount evaporator)
12	Not Included	4	1/4" diameter bolts, washers and nuts for condensing unit mounting
13	Not Included	1	15 amp DC breaker, labeled "Refrigeration"

Installation Instructions: Leak Testing

1. Connect the completed evaporator assembly suction line (labeled "S") to the lower male flare fitting on the condensing unit suction base valve (labeled "S"). Connect the evaporator liquid line (labeled "D") to the lower male flare fitting condensing unit discharge base valve (labeled "D"). Tighten the flare nuts firmly with the appropriate open-end wrench while holding the base valve with an adjustable wrench.
2. Assure that both valves on the refrigeration manifold gauge set are shut (fully clockwise). Attach the suction hose (blue) of the refrigeration manifold gauge set to the service port (top connection) on the condensing unit suction base valve. Attach the discharge hose (red) of the refrigeration manifold gauge set to the service port (top connection) on the condensing unit discharge base valve. Remove the black plastic service valve caps and open the service valves by turning the 1/4" square valve stem fully counter clockwise (CCW) to the back-seated position, and then 1 full turn clockwise (CW) from fully back-seated (service position). Attach the center service hose (yellow) of the refrigeration manifold gauge set to the low-pressure side of the regulator attached to the nitrogen bottle. Open the valve on the nitrogen tank (CCW), and adjust the regulator to allow 125 psig to enter the yellow hose.
3. Slowly open both knobs of the refrigeration manifold gauge set (CCW) and allow the nitrogen to enter the refrigeration circuit. Allow the nitrogen to enter until the pressures equalize and both gauges read the same. If necessary, adjust the nitrogen regulator pressure so the gauges read 125 psig. Close both manifold valves and observe the pressures. Close the valve on the nitrogen tank (CW).
4. If either gauge quickly loses pressure, listen and try to hear where the leak is. If a gauge slowly loses pressure, apply a soap bubble solution leak detector to all solder and flare joints to try to find the source of the leak. Tighten the fitting or re-solder the connection to fix the leak(s). The nitrogen pressure must be released before solder repairs are attempted. Re-pressurize and leak test again after repairing leak(s).
5. If the gauge readings remain the same for an hour or so, the system is probably leak-free. If the nitrogen pressure is left in the system overnight, and there is a temperature drop, some of the nitrogen will dissolve in the refrigerant oil and the pressure on the gauges will drop slightly, usually only a pound or two.

6. Once the leaks have been found and repaired and the system is known to be leak-free, then the pressure should be released through the hose connections. The base valves should be fully back-seated (CCW), the hoses removed, and the service port caps attached and tightened. Then the base valves should be fore-seated (CW), and the evaporator flare nuts removed.

Once the system has been verified as leak-free, the system can be installed in the boat. Proceed to the next section.

Installation Instructions: Condensing Unit

Mount the condensing unit on a dry, level, and sturdy platform that is solidly attached to the vessel where vibrations will not resonate or amplify noise. Securely bolt the unit to the platform through the four holes on the corners of the base plate. It may be mounted in any alignment, either fore and aft or athwart ship. The base must be horizontal and parallel to the waterline when the boat is at rest. Be sure that the unit is positioned to allow access for attachment of the refrigerant lines and service gauge hoses.

Assure that the area is well ventilated. It is important to have a way for the cool air to flow in and the warm air to flow out of small spaces.

Installation Instructions: Evaporator Box

The evaporator box should be mounted near the top in the insulated refrigerator box. Mounting the evaporator high in the box takes advantage of the convection currents that are created when cold air sinks and warm air rises. It may be mounted vertically on a wall, or horizontally, on the ceiling. It is held away from the surface of the wall or ceiling by spacers, which improves air circulation.

1. If the insulated refrigerator box does not already have a designated hole for the evaporator lines, create the hole before mounting the evaporator box. It is best to exit the lines near the top of the refrigerator box. Once the hole is in place, feed the evaporator lines through the hole in the insulated box. Place the evaporator into position and mark the position of the mounting holes by using the holes in the evaporator as a guide. Remove the evaporator and drill the necessary pilot holes. Spacers should go between the wall or ceiling and the evaporator. This will allow airflow on all sides of the evaporator and increase the effectiveness of the unit. Use bronze or stainless steel screws to attach the evaporator to the wall or ceiling of the box.

2. The copper refrigerant tubing needs to be run out of the refrigerator box to the condensing unit. It is best to exit the refrigerator box near the top. After running the refrigerant lines through the hole, be sure to seal the hole to prevent leakage of cold air. The hole may be sealed with a small quantity of spray foam insulation from a can, or with plumber's putty.

Installation Instructions: System Connection

1. Run the tubing from the evaporator box to the two base valves on the condensing unit.
2. The suction line from the evaporator to the condensing unit may sweat in humid weather unless it is insulated. The insulation tube should be pushed up against the tubing access hole butted against the outside of the insulated box. The frost line should not extend much beyond this insulation in a properly charged system.
3. Attach the 1/4" suction line tubing to the suction (low-pressure side) base valve on the condensing unit. This is the valve (labeled "S") nearest to the air-cooled condenser with the tube running to the top of the compressor. The suction line flare nut should be connected to the bottom 1/4" male flare fitting of the suction base valve. Hold the base valve with a large adjustable wrench while tightening the flare nut firmly using the correct size open-end wrench.
4. Attach the 1/4" discharge line tubing to the discharge (high-pressure side) base valve (labeled "D") on the condensing unit. This is the valve farthest from the air-cooled condenser with the tube running to the filter-drier. The discharge line flare nut should be connected to the bottom 1/4" male flare fitting of the discharge base valve. Hold the base valve with a large adjustable wrench while tightening the flare nut firmly using the correct size open-end wrench.

Installation Instructions: Electrical Connections

Pick the correct gauge for the supply wiring from the following chart based on the round trip distance from the distribution panel breaker to the condensing unit location and back.

0-10'	10'-20'	20'-30'	30'-40'
14 AWG	12 AWG	10 AWG	8 AWG

Longer runs will require heavier wire. To retain the reliability of this RParts system, it is important that all connections be done in proper fashion using a high strand count, 100% tinned, marine-grade wire.

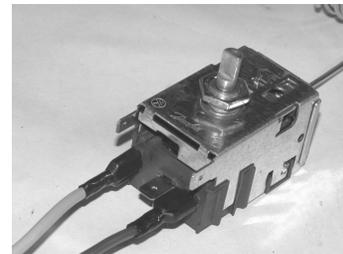
Use appropriate sized terminals for all connections and make good crimp connections. It is advisable to use adhesive lined heat shrink tubing over marine grade terminals.

1. Supply Wiring

Attach the appropriate wire terminal to the correct gauge red wire and connect to the load side of an unused 15-amp breaker in the distribution panel of the boat. Attach the appropriate wire terminal and connect the yellow or black wire to an appropriate 12-volt DC negative connection at the distribution panel. Run these wires in a professional manner through the boat to the condensing unit. Strip the wire ends and attach the 12-10 insulated female spade terminals (290-0011) to the wires. Connect the terminal on the red wire to the tab on the Power Module (010-1175) marked with the large "+". Connect the terminal on the yellow or black wire to the top tab on the Power Module marked with the large "-".

2. Thermostat Wiring

Remove three inches of the outer insulation from both ends of the 18/2 thermostat wire (240-0001) that is supplied with the kit. Strip 3/8" of the inner insulation off the 18 gauge wires on both ends for each wire (total of four). Crimp two 22-18 insulated female spade terminals (290-0001) on one end of the stripped wire ends. Attach one of the female spade terminals to the tab on the thermostat (015-0282) marked "3" and the other female spade terminal to either of the two thermostat tabs marked "4". Run the wire along the same route as the copper tubing to the condensing unit. Attach two more female spade terminals (290-0001) to the stripped ends of the 18/2 wire. Attach these terminals to the Power Module "T" and "C" tabs. Tie the thermostat wiring to the refrigerant line set with cable ties (400-0911) every 18 inches.



3. **Condenser Fan Wiring**

Strip 3/8" of insulation from each of the two wires from the condenser fan (071-0100). Crimp a 22-18 gauge insulated female spade crimp terminal (290-0001) on the end of each wire. These terminals have two crimp connections, one for the electrical connection, and one for a mechanical connection to the insulation on the wire. Use the correct part of the wire tool to crimp each connection. Twist the fan wires together. The red wire terminal attaches to the small "+" connection on the compressor power module, and the black wire terminal attaches to the "F" connection on the power module. Push the terminals firmly onto the appropriate connections on the module.



4. **Electronic Control Module Wiring**

Be sure that the red wire from the fan is connected to the small "+" terminal and the black wire is connected to the "F" terminal. The other wires connected to the control module are the thermostat wires connected in Step 2, ("T" and "C") and the supply wires, connected in Step 1 ("+" and "-").



Now that the complete system is installed and connected, it should again be leak tested, using the same procedure as before. When this is completed, it is time to evacuate and charge the system. Please see the section on evacuating and charging and read it completely before beginning.

REFRIGERATION PARTS SOLUTION

"Do It Yourself" Kit Evacuating and Charging Manual



**For all DIY Kits with a Roll Bond Evaporator
(Capillary Tube Systems)**

List of Parts: Charging System

Item	Part No.	Qty	Description
1	Not Included	1	Refrigerant R134a – less than 6 oz

Required Tools

- Bubble solution leak detector
- Nitrogen or CO₂ tank with regulator
- Refrigeration service manifold gauge set
- Vacuum pump

Evacuating Instructions

1. Connect the suction hose (blue) of the refrigeration manifold gauge set to the service port (top connection) on the suction base valve of the condensing unit. Connect the discharge hose (red) of the refrigeration manifold gauge set to the service port (top connection) on the discharge base valve of the condensing unit.
2. Open the both base valves on the condensing unit 1 turn clockwise (CW) from fully back-seated (CCW).
3. Connect the middle service hose (yellow) of the refrigeration manifold gauge set to the vacuum pump. Plug in the vacuum pump and switch it on. Open the vacuum pump valve between the pump and the yellow hose.
4. Open both knobs of the manifold gauge set and allow the vacuum pump to evacuate the refrigerant circuit. The pressure readings on both gauges should go down, the blue gauge should soon show a vacuum, eventually down to 30" Hg.

5. Allow the vacuum pump to run for the amount of time according to the ambient temperature of the refrigeration system environment. Refer to the table below for the recommended evacuation time.

Ambient Temperature	Evacuation Time
Above 80° F./27° C.	1 hour
70° F./21° C.	2 hours
65° F./18° C.	6 hours
60° F./15° C.	24 hours
50° F./10° C.	48 hours

It may be necessary to warm the boat so that the evacuation process can occur in a reasonable amount of time.

6. When the evacuation process is finished, close both valves on the service manifold. Back seat the condensing unit discharge base valve and remove the red hose from the base valve. Replace and tighten the cap for this valve. Remove the yellow hose from the vacuum pump and proceed to the next section.

Charging Instructions

1. Begin by assuring that the thermostat is set to off ("0"), and that the refrigeration service breaker on the electrical distribution panel is "on".
2. Attach the service hose (yellow) of the refrigeration manifold gauge set to the refrigerant source. Orient the refrigerant container to discharge vapor, and open the valve on the refrigerant container.
3. Slowly open the service manifold valve next to the blue hose and gauge and allow refrigerant vapor to enter the refrigerant circuit. Allow the pressure to equalize through the gauge set. Close the gauge set valve.
4. Turn the thermostat knob to its middle position, about "3" or "4". The fan should come on and a few seconds later the compressor should start. When the compressor starts, the suction pressure gauge (blue) reading will go down.

5. When the gauge reading approaches zero, open the service manifold valve briefly to allow more refrigerant vapor to enter the system. Keep regulating the valve to try to maintain about 10 psig on the gauge. Add refrigerant slowly (a few seconds at a time) and allow the pressure to stabilize before adding more. Only add refrigerant when the pressure is below 10 psig.
6. Check the evaporator near where the tubing enters it to see if there is frost forming. At some point, frost will begin to form and slowly spread around the evaporator.
7. Keep adding refrigerant slowly until about 1/4 of the evaporator is frosted. The low-pressure reading should be about 8 to 10 psig when the evaporator is 1/4 frosted.
8. Allow the system to run until the thermostat turns it off. The evaporator should be fully frosted, and the suction pressure reading should be around 4 to 6 psig.
9. Close the refrigerant cylinder valve, back seat the condensing unit suction base valve and remove the hoses from the refrigerant cylinder and base valve. Install the base valve stem covers (plastic) on the base valves and tighten with an appropriate wrench. Install the caps (brass) on the upper ports of the condensing unit base valves and tighten with a wrench.

Congratulations!! You have just completed assembling and installing your Rparts refrigeration system. You'll soon be enjoying a nice refreshing, cold drink as you proudly admire your accomplishment of building the system yourself and mastering the basics of refrigeration.

Should you encounter any problems with your system or if you want to share your experience with others, please visit the DIY Support Forum at <http://www.rparts.com/forum/list.php?f=4>.