GE Appliances

Technical Service Guide

October 2011

R-600a Refrigerant

Charging and Recovery Process

31-9214

GE Appliances
General Electric Company
Louisville, Kentucky 40225

SYSTEM PRESSURES

Technicians with R-134a experience will need to become familiar working with high and low-side pressures that are much lower when using R-600a. A typical R-600a system operates normally with a high-side pressure of approximately 125 psi at a 90°F condensing temperature and a low-side negative pressure of approximately -5 to -18 vacuum. These low operating pressures require different service procedures for sealed system diagnosis. Once standard diagnostic procedures have been completed, proper refrigerant charge can only be determined by an equalized pressure check of the system.

IMPORTANT SAFETY NOTICE

The information in this service guide is intended for use by individuals possessing adequate backgrounds of refrigeration and heat pump experience. Any attempt to repair a refrigeration or heat pump system may result in personal injury and property damage. The manufacturer or seller cannot be responsible for the interpretation of this information, nor can it assume any liability in connection with its use.

WARNING

To avoid personal injury, disconnect power before servicing refrigeration. If electrical power is required for diagnosis or test purposes, disconnect the power immediately after performing the necessary checks.

RECONNECT ALL GROUNDING DEVICES

If grounding wires, screws, straps, clips, nuts, or washers used to complete a path to ground are removed for service, they must be returned to their original position and properly fastened.

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Personal Safety Equipment

WARNING: GE factory service employees are required to use safety glasses with side shields, cut-resistant (Dyneema®) gloves, and steel toe shoes for all repairs.

Safety Glasses must be compliant with ANSI Z87.1-2003

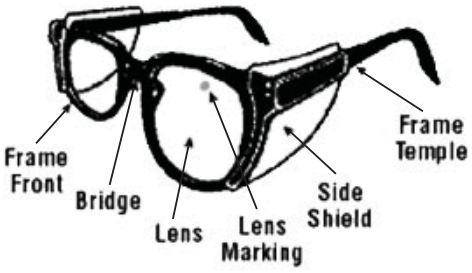
Dyneema®
Cut Resistant Glove

Electrically Rated Glove
and Dyneema® Cut Resistant
Glove Keeper

Plano Type Safety Glasses

Steel Toe Shoes

Brazing Glasses



Prescription Safety Glasses
Safety Glasses must be
ANSI Z87.1-2003 compliant

Common Questions About R-600a

R-600a is a hydrocarbon refrigerant.

Q: What are hydrocarbons (HC)?

Hydrocarbon refrigerants are environmentally friendly, nontoxic, and a nonozone-depleting replacement for chlorofluorocarbons (CFCs).

From a chemical point of view, a hydrocarbon is the simplest organic compound, consisting entirely of hydrogen and carbon. Hydrocarbons (HC) are naturally occurring substances. The majority can be found in crude oil, where decomposed organic matter provides an abundance of carbon and hydrogen.

Hydrocarbons are one of the most climate-friendly and cost-efficient refrigerants to heat, cool, and freeze.

- Not ozone depleting: Ozone depletion potential = 0
- Not climate damaging: Global Warming Potential = for most HCs below 3 (HFC 134a = 14)
- Nontoxic
- Safe: with proper handling
- Energy efficient: usually better energy efficiency than CFC or HFC systems
- Cost efficient: lower refrigerant purchase price, as well as lower system running costs

Q: Are hydrocarbons safe?

Yes, with proper handling. Since hydrocarbons are flammable (See *R-600a Introduction*, WARNING), some basic safety rules need to be respected by manufacturers, installers, and users, which may differ slightly, depending on the application. As long as these rules are respected, it is perfectly safe to use hydrocarbons as refrigerants. Propane, for example, is used universally for heating and cooking. As a result, its safe handling is widely understood and practiced by the general global population. This makes it an appropriate alternative to climate-damaging chemical refrigerants in developing countries.

Q: Are hydrocarbons flammable?

Yes. However, keeping to the safety guidelines existing for any application using flammable refrigerants, the risks of using hydrocarbons can be kept to a minimum, avoiding any threat to human health and safety. Many components for commercial refrigerated appliances using hydrocarbons already meet safety standard requirements.

Q: Are HCs toxic?

No. Hydrocarbons are not toxic for human beings and other living organisms. They could cause asphyxiation at high concentrations.

Q: How does an HC system work?

A system using hydrocarbons works in exactly the same way as systems currently using synthetic refrigerants. The basic refrigeration cycle remains the same, and only the charge of the system (exact amount of refrigerant) varies.

WARNING: It is very unlikely that combustion will occur inside a sealed system, as there will be insufficient air. However, if the hydorcarbon refrigerant leaks out of the system, combustion will occur if the correct mixture exists and there is an ignition source. This is dangerous and must be avoided.

R-600a Introduction

WARNING: Servicing and repair of R-600a refrigerators should only be performed by skilled and well-trained service technicians. R-600a requires very careful handling because of the flammability of the gas, which is a potential danger during work on the refrigeration system. A well-ventilated room is necessary and there should be no open flame or combustion source within 6 feet of the work area, in case of accidental discharge.

Note: The first big difference between R-600a and R-134a or R-12 is found in the system pressures, which operate at lower levels. This leads to operating pressures being very much lower than previous refrigerators utilizing R-12 or R-134a. Evaporators of R-600a refrigerators will operate well below normal atmospheric pressure, typically in a 5- to 18-inch vacuum.

Relative Refrigerant Pressures (PSIG)				
Temp. in °F	R-12	R-600a	R-134a	Temp. in °C
-40	-5.2	-10.5	-6.9	-40
-22	0.1	-7.9	-2.1	-30
-4	7.4	-4.1	4.9	-20
14	17.2	1.1	14.6	-10
32	30.2	8.1	27.9	0
50	46.8	17.2	45.4	10
68	67.7	28.9	68.2	20
86	93.5	43.6	97.0	30
104	124.7	61.5	132.8	40
122	162.1	83.2	176.6	50

All R-600a leak checking must be performed in open air or a well-ventilated room, or the technicians could risk injury to themselves or others. Leak checking should be performed on a powered-off (equalized), sealed system. Bubble solution (WX05X10507) or equivalent is the approved leak detection method. Open-flame leak detectors are not recommended with hydrocarbon products. Some sniffer-type leak detectors work with hydrocarbons. Special detection equipment is available for use with hydrocarbon products. If in doubt, check with the leak detector manufacturer.

Conversion of an R-12 or R-134a refrigerator to R-600a is not recommended because R-12 and R-134a appliances are not approved for flammable refrigerant use. Electrical safety in these units are not proven to acceptable safety standards. The normal risks a CFC or other toxic refrigerant would have when it escapes are mainly related to depletion of breathable air and frosting at the point of escape.

Hydrocarbons have an explosion risk associated also (in addition to depletion of breathable air and frosting). Explosion risk is more dangerous directly to anyone in the vicinity, should it accumulate and come into contact with any ignition source.

R-600a Service Tools and R-600a Refrigerant Kit

R-600a Service Tool Kit - WR86X10072

Piercing Valves (2)
WR86X10086

Charging Hose

Vacuum Gauge

Pressure Gauge

Nitrogen Regulator Assembly

Recovery/Sweep Hose

R-600a Refrigerant Kit - Check part list for specific model

R-600a Refrigerant Canisters

Nitrogen Canister

Collection Canister

Access Valve
WR86X10085

Refrigerant Drier
WR86X10084

* Two-stage
Refrigerant Drier
WR86X10073

Note:

- These service tools are to be used ONLY with R-600a refrigerant.
- Individual parts with part numbers can be ordered separately.

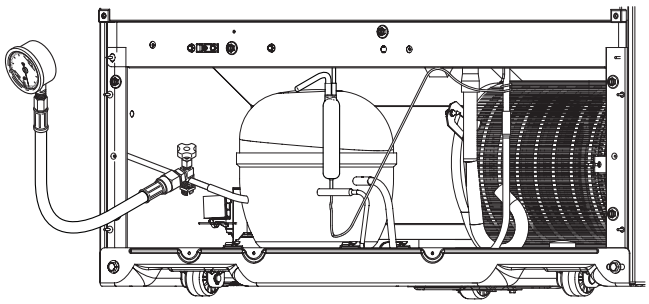
* Two-stage refrigerant drier used for contaminated system repair is not included in refrigerant kit.

Instructions - R-600a Equalized Pressure Check

Since an R600a sealed system operates with much lower system pressures, it will be more difficult to diagnose over other conventional R-12 or R-134a systems.

Once all other causes for poor cooling or no cool performance have been eliminated, perform an equalized (power-off) pressure test on the system.

Install a service valve to the low-side access stub and install the positive pressure gauge from the service tool kit.



Once the system is tapped, refer to the mini manual or service guide for the minimum equalized pressure table. Monitor the low-side pressure until it stabilizes at its highest pressure.

Example:

@ 70°F.....28 PSI

@ 90°F.....31.8 PSI

If the equalized pressure is low, check the sealed system for leaks.

Leak checks can be performed with a hydrocarbon-approved electronic detector or the use of nitrogen and soap bubbles.

If the equalized pressure checks are within specifications, close the service valve and replace the positive pressure gauge with the vacuum gauge from the service kit. Turn on the refrigerator and observe the low-side pressure. The pressure should drop into a vacuum if the compressor is pumping the R-600a through the system.

If the pressure drops quickly to the minimum compressor capacity, suspect a restriction in the sealed system. Refer to the mini manual or service guide for the minimum compressor capacity.

Example:

Minimum Vacuum @ 22 Minutes.....21 inches

If there is no change in low-side pressure and the compressor is running, suspect a failed compressor. If the low-side pressure is slow to drop or does not drop into a vacuum, perform a compressor capacity pinch-off test and check for minimum compressor vacuum according to the chart included in the mini-manual.

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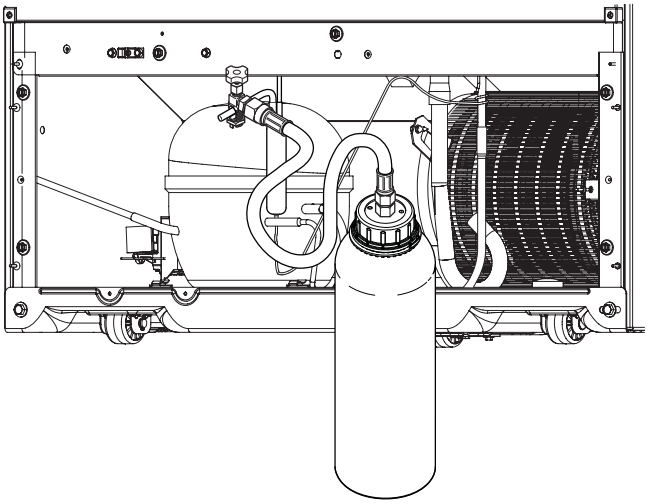
Instructions - R-600a Recovery

1. Disconnect power to unit using proper lockout/tagout (LOTO) procedures.
2. Gain access to the high-side drier process tube having a red identification mark or flag and attach intrinsically safe piercing valve.
3. Connect recovery/sweep hose to the high-side piercing valve and collection canister. The collection canister is capable of recovering the original charge and the sweep charge.



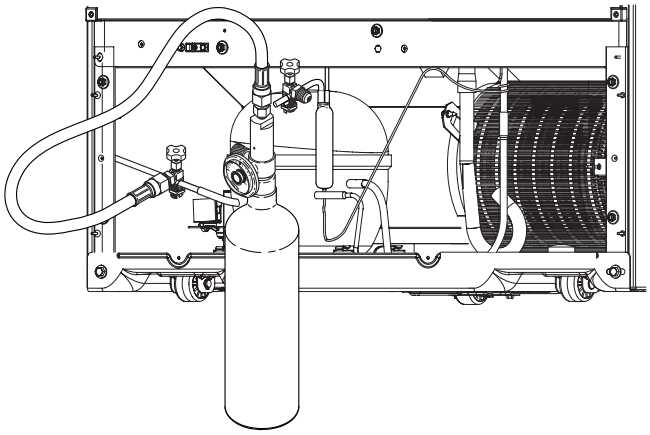
4. Open the high-side piercing valve to recover the R-600a refrigerant in the system. Recover for 15 minutes in a 70°F room (allow for longer times in a colder environment). The collection canister will be warm to the touch during recovery.

Note: If the compressor operates, running the compressor during this time will reduce recovery time.

5. Close the high-side piercing valve and remove the collection canister and recovery/sweep hose.

Instructions - Prepare System for Repair (Nitrogen Purge)

6. Gain access to the low-side compressor process tube having a red identification mark or flag and attach intrinsically safe piercing valve.
7. If the compressor was operated during recovery, disconnect power using proper lockout/tagout (LOTO) procedures.
8. Ensure the flow valve for the nitrogen regulator assembly is OFF and assemble it to the nitrogen canister.
9. Connect the sweep/recovery hose to the nitrogen canister/regulator assembly and to the low-side piercing valve.



10. Turn the nitrogen regulator assembly flow valve to ON, open the low-side piercing valve and charge the system for 60 seconds. This will introduce 3 liters of nitrogen at 50 psi into the system.
11. Turn the flow valve OFF on the nitrogen regulator, open the high-side piercing valve, and slowly allow the nitrogen to vent from the system into a shop towel. This may take up to 5 minutes. Releasing the nitrogen slowly helps prevent compressor oil loss. Disconnect hoses and remove both piercing valves. The system is ready now for repair.

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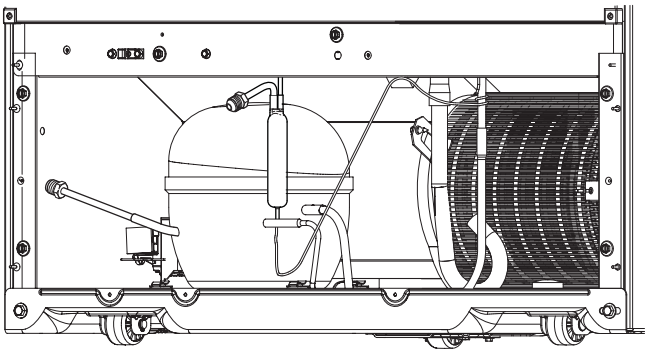
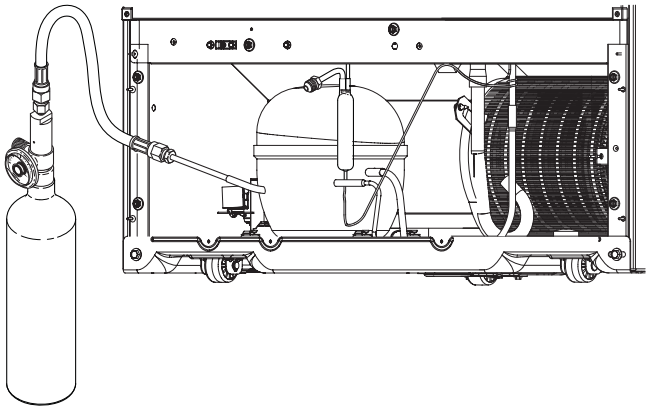
Instructions - Repair and Check for Leaks

12. After repairs have been made, ensure the valve cores are removed, then braze the permanent access valve to the low-side (compressor) process tube and replace the factory drier with the drier included in the kit. Replace valve cores into valve bodies.



13. Charge the system with nitrogen through the low-side access valve according to instructions in the gas kit, then turn the flow valve OFF on the nitrogen regulator. Check all repair joints for leaks.

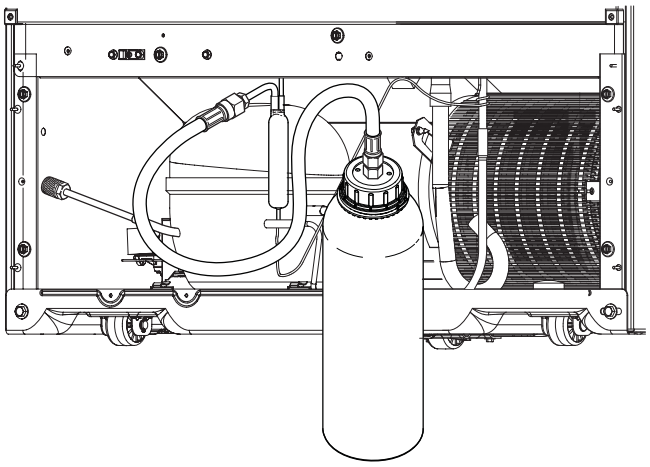


14. If there are any leaks, repair and repeat step 13. Note: There is only enough nitrogen for 3 system charges.

15. If there are no leaks, slowly vent the nitrogen through the high-side drier's access valve. Disconnect the sweep/recovery hose from the low-side piercing valve.

Instructions - R-600a Sweep and Final Charge

16. Attach the collection canister to the high-side drier with the recovery/sweep hose.

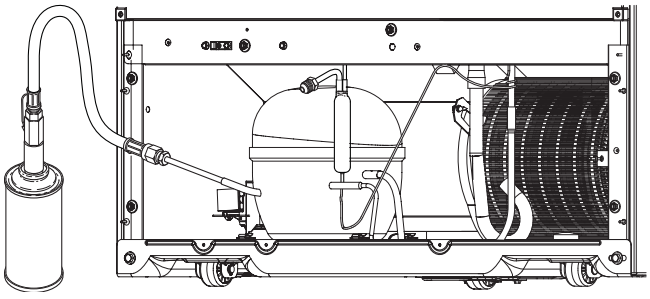


17. Connect power to the unit and allow the compressor to run for the remaining steps.

18. Allow 1 minute of compressor run time to help evacuate any remaining nitrogen. Disconnect the recovery/sweep hose and collection canister from the high-side drier.

19. Ensure the flow valve on the charging hose is CLOSED and connect hose to the low-side access valve.

20. Connect one R-600a refrigerant canister to the charging hose, keeping the canister in its upright position. After canister is sealed tightly, open the valve of the charging hose to begin charging the system. DO NOT INVERT THE REFRIGERANT CANISTER.



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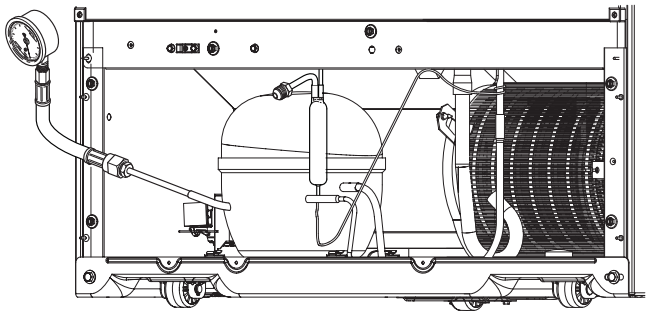
21. The R-600a canister will frost while charging. Charging, with the compressor running, will take about 20 minutes in a 70°F room. This can be accelerated by placing the R-600a refrigerant canister in a warm water bath.

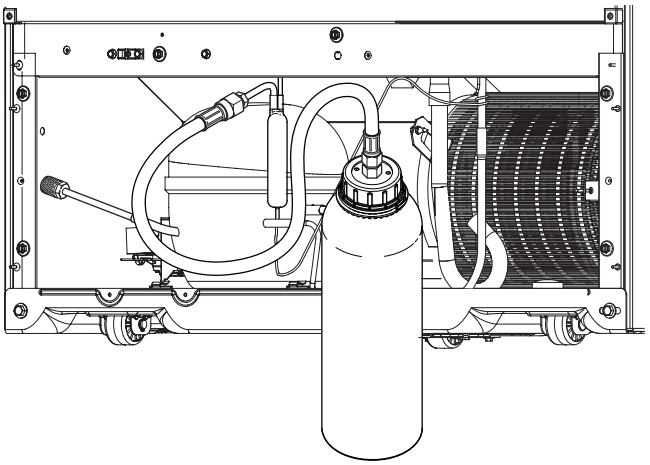
22. Once the frost disappears from the refrigerant canister, it is empty. DO NOT INVERT THE REFRIGERANT CANISTER.

23. Close the flow valve on the charging hose, then remove the hose from the low-side access valve.

24. Attach vacuum gauge and hose assembly to the low-side access valve.



25. Attach the collection canister to the high-side drier with the recovery/sweep hose.



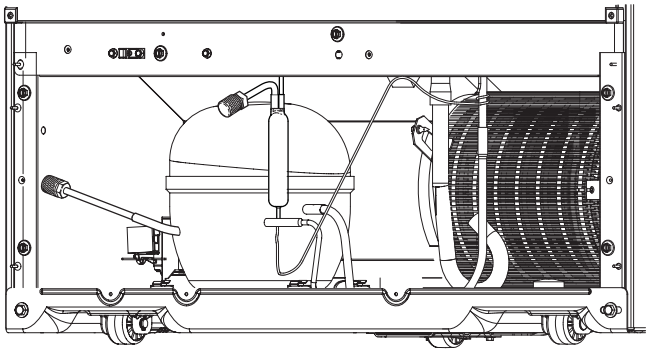
26. Recover the sweep charge until a minimum vacuum of -20 in. Hg is reached. This will take about 10 minutes.

R-600a Final Charge

27. Disconnect vacuum gauge and hose assembly from the low-side access valve, ensure flow valve on the charging hose is CLOSED, and connect the hose to the low-side access valve. Allow 1 minute of compressor run time to evacuate any remaining air from the system.

28. Disconnect the recover/sweep hose and collection canister from the high-side drier. Place brass sealing cap on the high-side drier.

29. Repeat steps 20 through 23 to place the final R-600a charge in the system. Place brass sealing cap on low-side access valve.



Part E - Kit Repack/Return

30. If any nitrogen gas remains in the nitrogen canister, vent to the atmosphere outside the home.

31. Deface all labels on the two empty R-600a canisters and the empty nitrogen canister with a black permanent marker or completely remove the label.

32. Dispose of the two empty R-600a canisters and the empty nitrogen canister.

33. Retain tool kit for future use.

34. Repack the collection canister in the original packing with the return shipping label on the outside of the box.

35. Return the recovery canister to the supplier.