GE Appliances

TECHNICIAN MANUAL

REFRIGERATION 201

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CONSUMER SATISFACTION

Success in satisfying the consumer should begin with paying close attention to the consumer's complaint. Ask questions to find out exactly why the consumer is dissatisfied. Then, write the consumer's complaint on the invoice (or a note pad) and keep it in mind until the call is completed. It could be that the product is not actually at fault — but, rather, the consumer does not understand how to use the product or how it should perform. Accordingly, many complaints require only an explanation or reassurance that the product is operating properly. Thus, consumer satisfaction is dependent upon a correct diagnosis.

PRELIMINARY EXAMINATION

On every call, when the consumer complains of "poor performance", a 10-point preliminary examination should first be made to determine if the cause is external to the refrigeration system. Most often, the cause is not within the refrigeration system. With the compressor running long enough for the system to be stabilized, answers to the following questions will provide guidance for an accurate diagnosis.

1. **Food Temperatures** — Are the fresh food and freezer temperatures normal?

The primary function of a refrigerator (or freezer) is to preserve perishable foods by providing satisfactory temperatures. Thus, accurate temperature measurements of food stored in the fresh food and freezer compartments are extremely important in determining if the product is performing normally. Generally, the expected range of temperatures are:

- fresh food 34 - 42° F,
- frozen food 0 - 8° F.

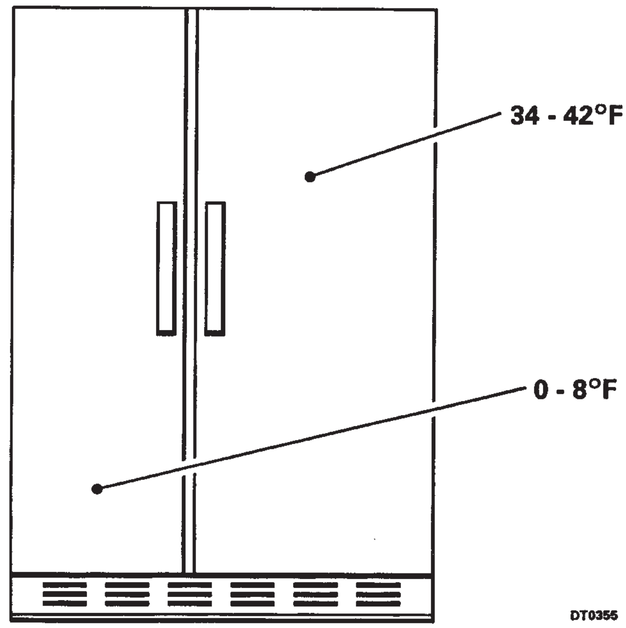

Figure 1 - Expected Food Temperatures

2. **Temperature Control Settings** — Are the controls set for the desired temperatures?

Satisfactory temperatures should be expected when the controls are positioned at the mid settings. Controls positioned at extreme settings (either high or low) usually indicate the consumer is attempting to achieve either colder or warmer temperatures.

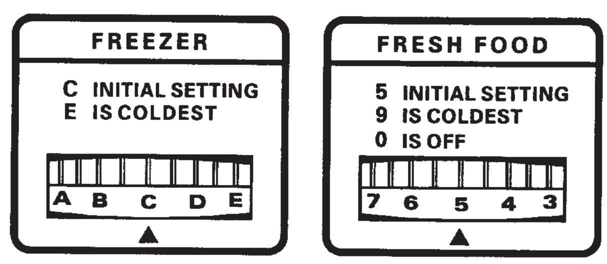

Figure 2 - Controls At Mid Settings

3. **Ambient Temperature** — Is the room temperature either too warm or too cool?

Warmer than normal kitchen temperature will cause the compressor to run longer to maintain satisfactory fresh food temperature. With cooler than normal kitchen temperature (below 60° F), the compressor may not run frequently enough to maintain satisfactory temperatures.

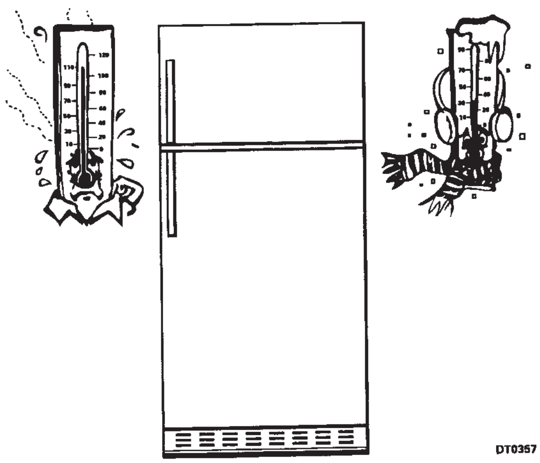

Figure 3 - Extreme Ambient Temperatures

NOTE: When the room temperature is warmer than normal, the refrigeration system pressures will likely be higher than normal. Conversely, when the room temperature is cooler than normal, the refrigeration system pressures may be slightly lower than normal.

4. **Door Gaskets** — Are the gaskets sealing adequately?

Gaskets that are torn or not sealing adequately will allow warm moisture-laden air to enter the food compartments. This will result in longer compressor run time and additional frost accumulation on the evaporator.

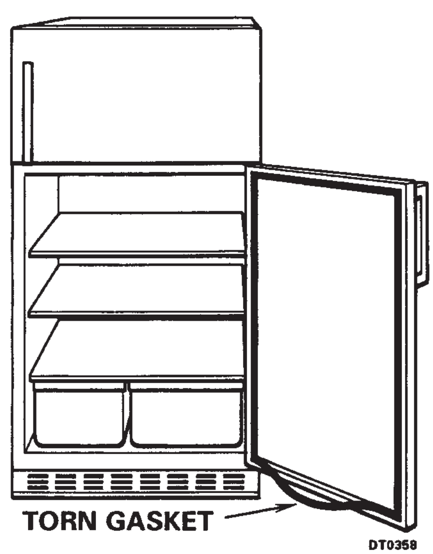

Figure 4 - Inadequate Door Seal

NOTE: When the door gasket is badly torn, the added heat load entering the food compartments may cause the refrigeration system pressures to be slightly higher than normal.

5. **Frost Accumulation** — Does the evaporator have an excessive frost accumulation? Is the defrost system operating properly?

Frost forming on the evaporator cover usually indicates the evaporator has an excessive frost accumulation. This may be due to a defrost system failure but it can also be caused by the fresh food or freezer door ajar for several hours. An excessive accumulation of frost on the evaporator will restrict air flow over the evaporator — resulting in longer compressor run time and warm food temperatures.

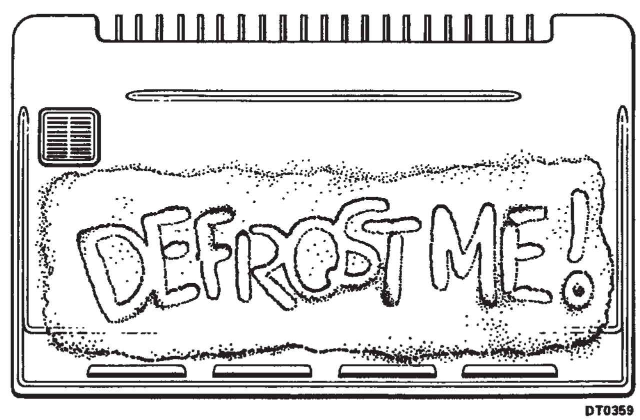

Figure 5 - Excessively Frosted Evaporator

NOTE: When the evaporator has an excessive accumulation of frost (to the extent frost can be observed on the evaporator cover), the refrigeration system pressures will be much lower than normal.

6. **Evaporator Air Flow** — Is the fan operating? Are air supply and return ducts obstructed?

The evaporator fan should operate while the compressor is running to circulate air over the evaporator and into both food compartments. If the fan is inoperative, food temperatures in both compartments will be much higher than normal.

If the air supply to the fresh food compartment is closed or the return duct is obstructed, cold air will not circulate into the fresh food compartment and fresh food temperature will be warm.

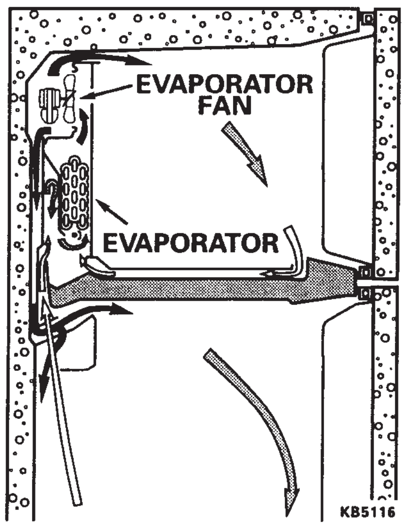

Figure 6 - Air Circulation Over Evaporator

NOTE: When the evaporator fan is inoperative, or when either the air supply or return duct is obstructed, the refrigeration system pressures will be lower than normal.

7. **Unusual Heat Load** — Do the interior lights remain on when the doors are closed? Is the icemaker stalled?

An unusual heat load (such as the interior lights remaining on when the doors are closed or the icemaker stalled) will result in longer compressor run time and warmer than normal food temperatures.

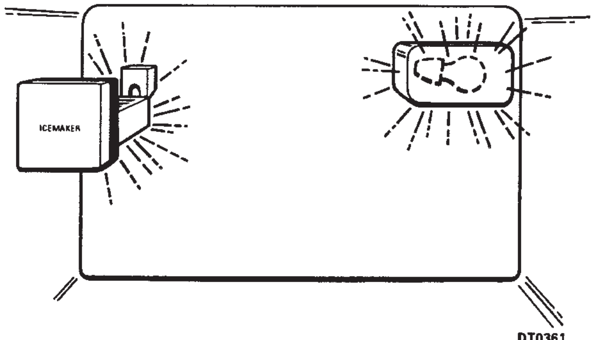

Figure 7 - Unusual Heat Load

NOTE: When the interior lights remain on or the icemaker is stalled, the heat produced will cause the refrigeration system pressures to be higher than normal.

8. **Consumer Usage** — Is the usage either heavy or light? Is the freezer compartment mostly full or lightly loaded?

Under heavy usage conditions (hot kitchen, greater demand for ice, frequent and/or long door openings), compressor run time will be longer than normal and fresh food temperature higher than normal — especially if the freezer compartment is lightly loaded.

Figure 8a- Heavy Usage

With light usage conditions (cool kitchen, less demand for ice, infrequent and/or brief door openings) compressor run time will be shorter than normal and off-cycles longer than normal. Consequently, this may result in vegetables freezing, excessive moisture in the fresh food compartment, soft ice cream and frost on the freezer shelves.

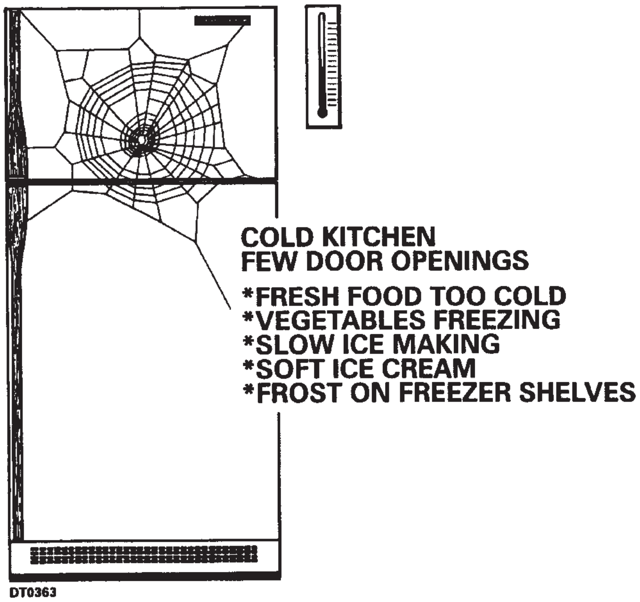

Figure 8b - Light Usage

NOTE: When consumer usage is heavy, the added heat load will cause the refrigeration system pressures to be higher than normal. Conversely, when consumer usage is light, the refrigeration system pressures will be slightly lower than normal.

9. **Condenser** — Is it clogged with dust? Is the fan operating? Are clearances at the top, sides, and rear of the cabinet sufficient for air circulation? Are air baffles or the rear access cover missing?

Poor air circulation over the condenser (due to excessive dust, inoperative fan, insufficient clearances, missing air baffles or rear cover) will result in longer compressor run time and warmer than normal food temperatures — most noticeably the fresh food.

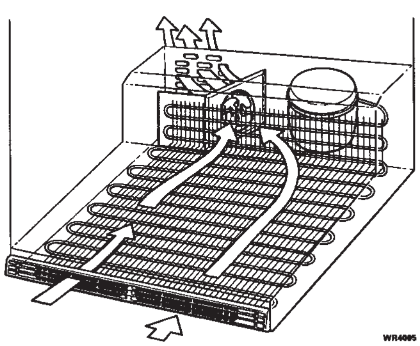

Figure 9 - Air Circulation Over Condenser

NOTE: When (for any cause) air circulation over the condenser is significantly reduced, the refrigeration system pressures will be higher than normal.

10. **Compressor** — Is it operating? Is the sound level normal?

The compressor must operate periodically to provide satisfactory food temperatures. The operating sound will vary from one model to another. When the sound level is determined to be normal, the consumer should be so advised (rather than replacing the compressor) because the replacement compressor will most likely produce the same sound as the original.

Preliminary Conclusion

As stated in each *NOTE* above, external factors can drive the refrigeration system pressures either higher or lower than normal. Thus, for an accurate diagnosis, a 10-point preliminary examination must be made before even suspecting that the refrigeration system is at fault. When the cause of a "poor performance" complaint is discovered during the 10-point preliminary examination, an appropriate repair or adjustment should be made — unless the need for customer education is discovered (due to improper use and care practices or installation deficiencies).

However, when a cause of the complaint is not discovered, temperature measurements of food stored in the fresh food and freezer compartments will provide the most reliable guidance.

• If the food temperatures are normal in both compartments, obviously, the refrigeration system is performing normally. But, the consumer should be advised of a possible intermittent condition that may recur.

• If the frozen food temperature is 0° F or colder, even though the fresh food is warmer than normal, a refrigeration system failure must not be suspected. Instead, recheck the evaporator air flow (fan, air supply and return ducts) for poor air circulation through the fresh food compartment.

- If the frozen food and fresh food temperatures are both warmer than normal, examine the heat exchanger for separation of the capillary from the suction tube along the length of the solder contact area. (Models that have the heat exchanger routed out the back of the cabinet are susceptible to capillary separation — unless the heat exchanger is covered with heat-shrink material.) Usually, a green coating on the lower end of the suction tube is evidence of capillary separation. Although separation of the capillary will adversely affect performance, it can be easily repaired without opening the refrigeration system.

- If the food temperatures in both compartments are excessively warm, and the compressor is not running, first determine why it is not running. Are the temperature control contacts closed? Is the defrost control in the compressor-run mode? Will the compressor run under a direct start test? (The refrigeration system may be restricted if the compressor will not run under a direct start test.)

When no possible cause of a "poor performance" complaint is discovered, during the 10-point preliminary examination, a failure within the refrigeration system should then be suspected.

SYSTEM OBSERVATIONS

The refrigeration system should be carefully examined after all other possible causes of a "poor performance" complaint have been explored and eliminated. However, before connecting a gauge to the system, make an observation of system components that are easily accessible in the machine compartment to distinguish between normal and abnormal circumstances. Using only the senses of looking and feeling, inspect the condenser, dryer, capillary, and suction tube. When the compressor has been running long enough for the system to stabilize (depending upon the condition of the system), the following characteristics should be observed.

In a normal operating system, liquid refrigerant is present in the last pass of the condenser, in the dryer, in the capillary, and in the evaporator. Thus, the condenser is warm throughout — but much warmer (hot) at the inlet than at the outlet. The dryer and capillary are slightly warmer than room temperature. The suction tube is slightly cooler than room temperature, but not sweating or frosted. However, it is normal for the suction tube to momentarily frost or sweat for a few seconds when the compressor resumes operation after an off cycle.

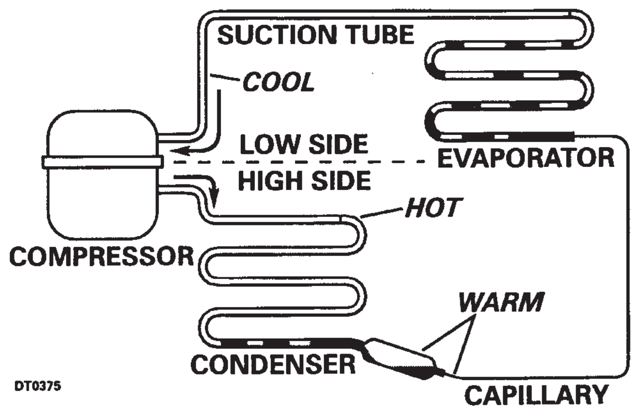

Figure 10 - Normal System

In an undercharged system (or a system that has a leak), a lesser amount of liquid refrigerant is present in the condenser and evaporator. Thus, the condenser is warm but not as warm as normal. The dryer and capillary may be slightly warmer than room temperature (depending upon the extent of the undercharge). The suction tube is cool (room temperature).

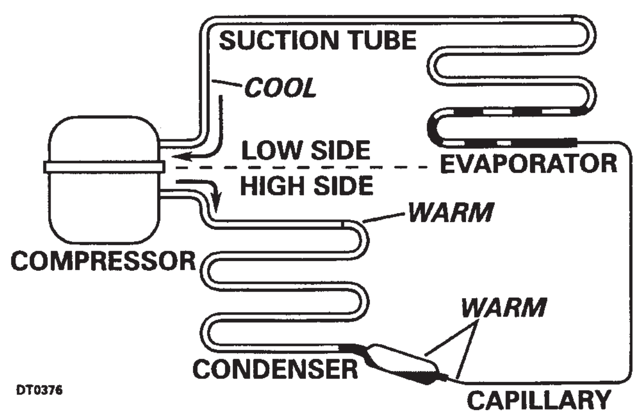

Figure 11 - Undercharged System

In an overcharged system, a greater amount of liquid refrigerant is in the condenser, overflowing the evaporator, and spilling into the suction tube. Thus, the condenser is warm but the lower portion is not as warm as normal. The dryer and capillary are cool (room temperature) — due to the additional liquid refrigerant accumulating in the lower portion of the condenser. The suction tube is cold and possibly sweating or frosted (depending upon the extent of the overcharge).

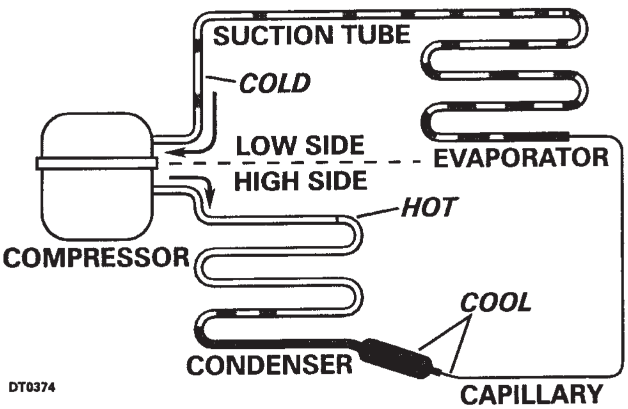

Figure 12 - Overcharged System

In a partially restricted system (usually at the capillary inlet), a greater amount of liquid refrigerant remains in the condenser but a lesser amount is present in the evaporator — due to a reduced flow through the capillary. Thus, the condenser inlet is warm but the outlet is cool (room temperature) — due to the unusual amount of liquid that remains in the condenser. Consequently, the dryer, capillary, and suction tube are also cool (room temperature). A partial restriction will cause a pressure drop, resulting in sweating or frosting that can be observed at the point of the restriction.

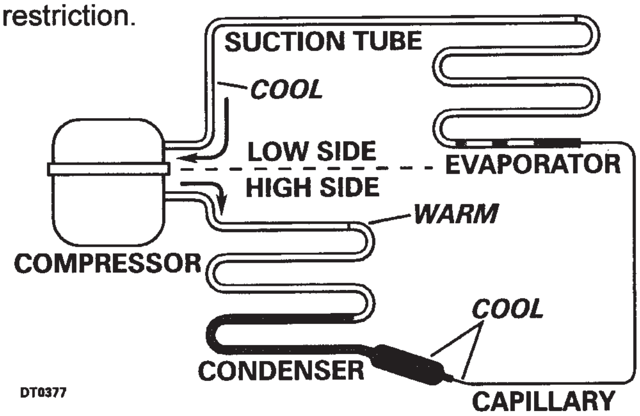

Figure 13 - Partially Restricted System

In a completely restricted system (assuming at the capillary inlet), almost all of the refrigerant is in the condenser and under high pressure — due to a completely restricted flow through the capillary. Accordingly, all of the remaining system components (from the point of the restriction back to the compressor) are in a deep vacuum. Thus, the condenser, dryer, capillary, and suction tube are cool (room temperature) due to the trapped refrigerant in the condenser.

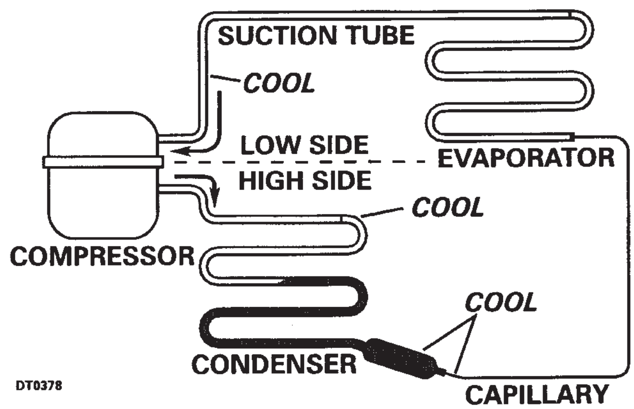

Figure 14 - Completely Restricted System

Tentative Conclusion

After carefully observing the refrigeration system (condenser, dryer, capillary, and suction tube), if no abnormal condition is observed, check the power cord and electrical receptacle for a possible intermittent or high resistance connection. Also, ask the consumer if a long electrical power outage has occurred, if a heavy food load was added, or if a door was ajar for a long time.

If the suction tube is either sweating or frosted, indicating an overcharged system, remove the evaporator cover and inspect the evaporator for an excessive frost accumulation. An excessively frosted evaporator can cause the suction tube to sweat or frost when there is no failure within the refrigeration system. However, when an evaporator has a light accumulation of frost, it is not unusual to observe an incomplete (short) frost pattern. This is not evidence of an undercharge but, rather, a normal circumstance from the heat load that is imposed on the evaporator — while unloading the frozen food and removing the evaporator cover.

When observations indicate an abnormal condition (either undercharged, overcharged, partially restricted, or completely restricted), the tentative conclusion is: a failure in the refrigeration system is the cause of the consumer's complaint.

SYSTEM ANALYSIS

After it has been determined that a failure in the refrigeration system is the cause of the "poor performance" complaint, the system must be carefully analyzed to determine what has failed. Accordingly, a gauge must be connected to check the system pressure and the compressor running long enough for the system to be stabilized. **[CAUTION: When handling or working with refrigerants, safety goggles must be worn for eye protection.]**

System Access

Before the refrigeration system pressure can be checked, a service valve must be accessible on the low side of the system. When a compressor is not equipped with a valve, one must be installed on the low pressure process tube.

As a temporary measure, a self-piercing valve can be installed. However, to avoid an eventual leak, a self-piercing valve must never remain on the system at the completion of the repair. For a permanent installation, a braze-on service valve must be installed by brazing it to the low pressure process tube. The WR86X0010 service valve, for use on R12 systems, has a spline core and is accessed with a special valve adapter. When installing this valve, the spline core must be loosened before brazing to prevent increasing pressure in the system. The WR86X0097 service valve, for use on R134a systems, has a depressor core and ½" ACME threads to prevent contamination by inadvertently connecting equipment that is used with other refrigerants. When installing this valve, the depressor core must be removed before brazing to prevent heat from damaging the core and increasing pressure in the system. Reinstall the core when the valve body is cool enough to touch.

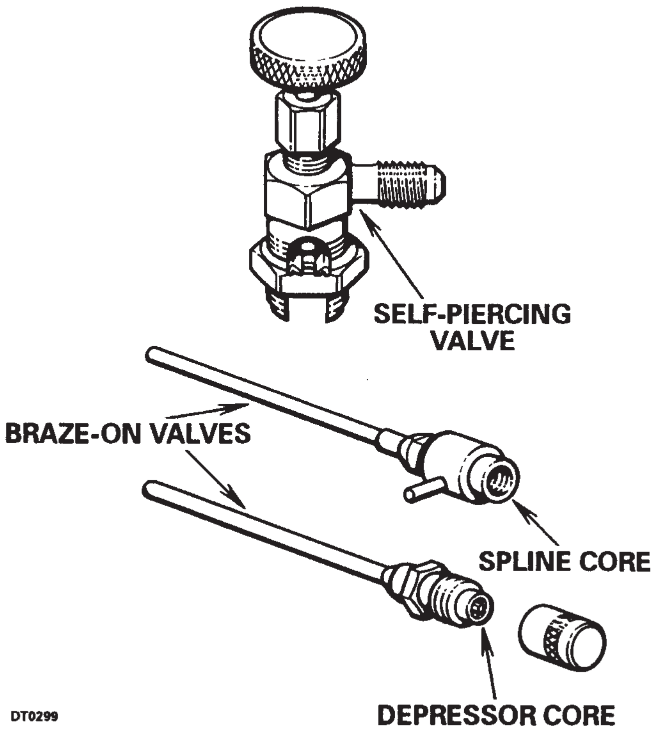

Figure 15 - Service Valves

Gauge Connection

Before connecting a gauge to the low pressure service valve, first determine the refrigerant type (R12 or R134a) that is used in the refrigeration system. The refrigerant type and charge quantity are specified on the rating plate and on the Mini-Manual.

Use only a compound gauge that is designed for the type of refrigerant that is used in the system. The gauge must be in good condition to provide accurate pressure and vacuum readings. If the gauge is not calibrated to 0 PSI at atmospheric pressure, remove the lens and turn the slotted screw in the face of the gauge to align the pointer exactly at 0 (zero) on the outer scale. The inner scale, corresponding to the refrigerant in the system, provides an indication of the evaporator temperature.

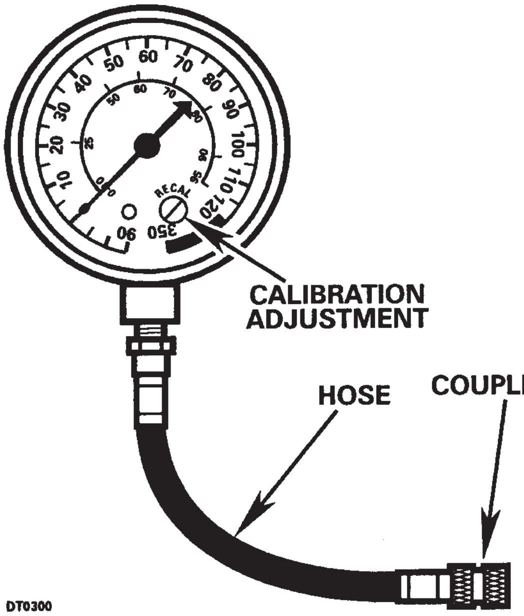

Figure 16 - Compound Gauge

The hose, couplings, and sealing gaskets must be in good condition to prevent leaks. The coupling that connects to a depressor core valve must have an internal pin to depress the valve core. The hose coupling will connect to the valve fitting of either a self-piercing valve or a depressor core valve, depending upon whether the threads are the same size and type (¼" SAE or ½" ACME). Make sure all connections are tight to prevent leaks.

On R12 systems, with a spline core valve on the compressor process tube, a WX05X0157 valve adapter must be used to connect the gauge to the system. The seal in the end of the adapter must be in good condition to prevent a leak. After the adapter is tightly clamped to the valve, push the handle inward (to engage the spline into the core) and tighten the stem packing nut. Then, connect the gauge hose to the fitting on the adapter and open the valve.

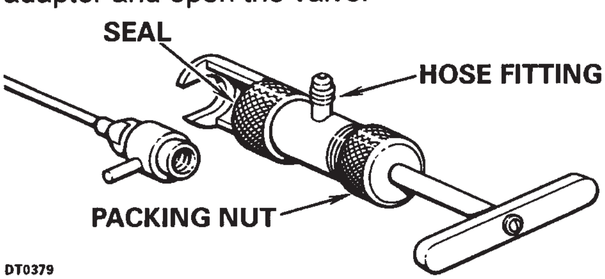

Figure 17 - Spline Core Valve and Adapter

System Operating Pressures

When the compressor is operating and providing a pressure difference within the system, a direct relationship is maintained between the low side and high side pressures. For example: if the high side pressure is increased, due to a stalled condenser fan, the low side pressure will increase also. Conversely, if the low side pressure is reduced, due to a stalled evaporator fan, the high side pressure will be reduced also. Accordingly, the high side pressure can be predicted when the low side pressure is known. Thus, it is not necessary to connect a gauge on the high pressure side of the system. Furthermore, since there is a direct relationship between temperature and pressure within the system, it is the evaporator (low side) temperature and pressure that is of primary concern.

° F	R12	R134a
-22	0.3 in Hg	5.6 in Hg
-20	0.6 PSIG	4.5 in Hg
-18	1.3 PSIG	3.5 in Hg
-16	2.1 PSIG	2.4 in Hg
-14	2.8 PSIG	0.3 PSIG
-12	3.7 PSIG	1.2 PSIG
-10	4.5 PSIG	2.1 PSIG

Figure 18 - Temperature and Pressure

In a normal system, typical low side pressure for R12 systems is 0 to 5 PSIG. Low side operating pressure for R134a systems is slightly lower. Thus, on recent models, it is normal for the low side to operate in a slight vacuum (0 to 5 in Hg).

In an undercharged system (or a system that has a leak), low side pressure is lower than normal and usually in a vacuum (depending upon the extent of the undercharge).

In an overcharged system, low side pressure is higher than normal (depending upon the extent of the overcharge).

In a partially restricted system, low side pressure is slightly lower, or much lower, than normal (depending upon the severity of the restriction). Thus, from the gauge reading only, it is not possible to distinguish a partial restriction from an undercharge.

In a completely restricted system (assuming at the capillary inlet), the low side is in a deep vacuum, the high side is under high pressure, and the pressures will not equalize if the compressor is stopped. Accordingly, the compressor may not restart (even under a direct start test) until the restriction is cleared. To determine if the compressor will run, and to confirm that the system is restricted, the pressures can be equalized by connecting a temporary bypass. Using two self-piercing valves, connect a hose from the compressor discharge tube to the low pressure process tube. Open both valves to allow the pressures to equalize. As the valve on the high pressure side is opened, a refrigerant boiling sound should be heard if the system is restricted. The compressor should not be replaced if it will run when voltage is applied. Recover the refrigerant from the system before removing the temporary bypass.

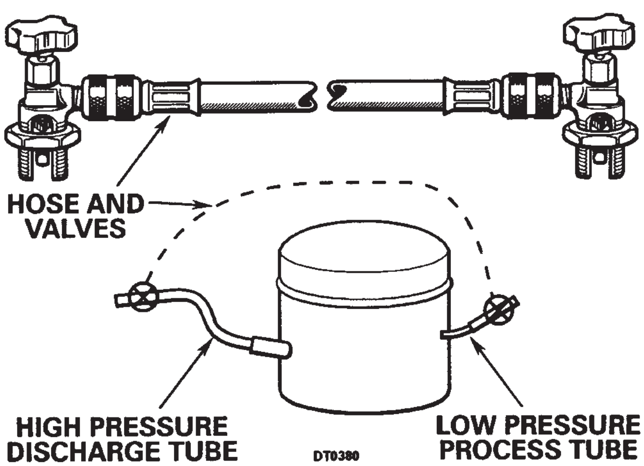

Figure 19 - Temporary Bypass

Moisture Restriction

Moisture in the refrigeration system can cause an intermittent restriction. Usually, any moisture in the system is trapped in the dryer as it passes through the desiccant (molecular sieve beads). But, if the desiccant is totally saturated, any excess moisture passes through the dryer and circulates in the system along with the refrigerant and oil. As the moisture reaches the evaporator inlet, ice forms in the capillary outlet due to the cold temperature. Accordingly, the refrigeration process is interrupted and, eventually, the evaporator becomes warm enough to melt the ice in the capillary. Then, the pressure in the condenser and capillary pushes the moisture into the evaporator, temporarily clearing the restriction, and the refrigeration process resumes. However, with the desiccant totally saturated, the moisture will continue to circulate in the system and the restriction will recur.

System Failures

There are only three failures that can necessitate a refrigeration system repair: an inoperative compressor, a leak, or a restriction. After the compound gauge is connected to an operating system, the low side pressure or vacuum should be indicated on the gauge dial.

- If the gauge reading remains at 0 PSIG, it may be either inoperative, improperly connected, or correctly indicating the system is operating at 0 PSIG. To determine if the gauge is correctly indicating the system pressure, open the freezer door for a couple of minutes and observe whether the gauge reading increases. If the pressure increases, the system is operating normally. However, if the pressure remains the same, check the gauge, hose, service valve, and adapter connections.

- If the gauge reading is significantly high (above 10 PSIG), this is an indication of either a low capacity compressor or the system is contaminated with air (or other non-condensible gases). Make a compressor capacity test to determine whether the compressor is performing normally. If the compressor passes the test, recover the refrigerant, install a new dryer, and recharge the system.

• If the gauge reading is significantly low (below 5 in Hg), the system is either restricted or has a low refrigerant charge (leak). Make a leak-restriction test to determine the cause.

Compressor Capacity Test

The compressor capacity test is a quick and accurate method for testing a compressor that is suspected of low capacity. The test will only distinguish between a normal compressor and one that is low capacity — it will not identify other faults. Accordingly, this test should be performed only when symptoms indicate a possible low capacity compressor.

To perform the test, the compressor must be running and a compound gauge tightly connected to prevent leaks. If air is drawn into the system, it will cause the compressor to fail the test and may also cause the compressor to stall. A pinch-off tool is also required. It must be capable of completely closing (restricting) the suction tube — otherwise, the compressor will invariably fail the test.

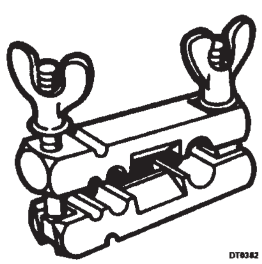

Figure 20 - Pinch-Off Tool

Select a location on the copper suction tube to position the pinch-off tool — between the compressor and the heat exchanger. The location must allow for clearance to reopen the tube after the test.

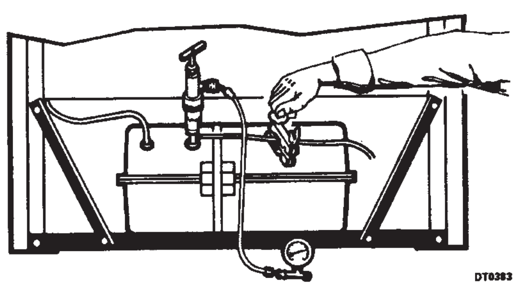

Figure 21 - Pinch Suction Tube Closed

Tighten the wing nuts on the pinch-off tool and observe the gauge. If the gauge reading remains constant after a few seconds, tighten the wing nuts more. Time the test for two minutes from the moment the suction pressure first begins to drop. At the end of two minutes, observe the gauge and compare the reading with the test data in the Mini-Manual. If the vacuum reading from the test is as good as (or better than) the specified test data, the compressor is performing normally. But, if the reading is not as good as the test data, the compressor is low capacity.

Remove the pinch-off tool from the suction tube and reposition it to open the pinched tube. Tighten the wing nuts as tight as possible by hand to open the tube.

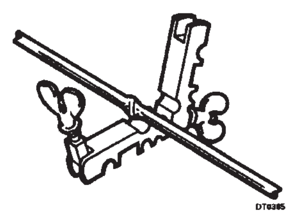

Figure 22 - Open Pinched Tube

Leak-Restriction Test

The leak-restriction test is a quick and positive means for distinguishing between a refrigerant leak and a restriction in the refrigeration system. The symptoms produced by a leak and a restriction are similar — either condition will cause the low side pressure (vacuum) to be lower than normal.

To perform the test, the compressor must be running with a compound gauge connected to the low side of the system. If the gauge reading is significantly low (below 5 in Hg), proceed with the test.

Add a half-charge to the system to increase the refrigerant charge by 50%. For example: if the original charge is 6 ounces, add 3 ounces of the same type (R12 or R134a).

Allow four minutes for the added refrigerant to pass through the compressor and into the condenser. Then, observe the condenser for a change in temperature. If the condenser is warm throughout, the system has a leak. But, if the lower two-thirds of the condenser remains at room temperature, the system is restricted.

Restrictions in the system generally occur as a result of either: excessive moisture, a plugged capillary, or a clogged screen. Therefore, replacing the dryer will usually correct the restriction.

Leak Detection

When searching for the location of a leak in the refrigeration system, refrigerant should be added to increase the system pressures. **[CAUTION: To prevent a possible safety hazard, never overcharge a refrigeration system by more than 50% of the original charge quantity.]** The compressor should be running, but the condenser fan should be stopped, while looking for a leak in the high pressure side of the system. While checking for a leak in the low pressure side of the system, the compressor should be stopped (temperature control turned off). Check all tubing joints, including (especially) the closed ends of process tubes, and the service valves (if used).

Leak Detection Methods

Coloration dyes must never be added to the refrigeration system to enhance the search for a leak. Such products will contaminate the system.

Soap bubble solutions are not recommended for use in detecting leaks in the refrigeration system — primarily because they contain water that can contaminate the system. Furthermore, soap bubble solutions are ineffective when the leaks are very small.

Electronic leak detectors are very sensitive to a variety of gasses (including R12 and R134a) and, therefore, the most effective method for locating leaks in the refrigeration system. Refrigerant that is drawn into the detector probe will be acknowledged by an audible sound and/or a flashing light.

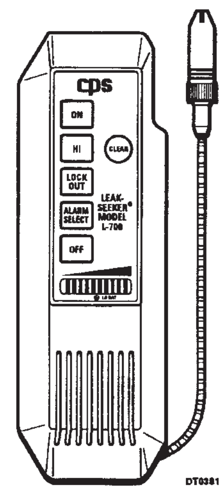

Figure 23 - Electronic Leak Detector

Gas traps, when used in conjunction with an electronic leak detector, enhance the effectiveness in localizing refrigerant leaks. The WX05X0550 gas trap is a simple device that can be clamped around refrigerant tubing joints to collect escaping refrigerant — thereby eliminating ambient influences from foam insulation, smoke, and air drafts. The time required to collect a detectable amount of refrigerant is dependent upon the size of the leak and pressure inside the tubing. A large leak can be detected immediately, however, extremely small leaks may require leaving the trap positioned over the joint for 2 or 3 minutes. Accordingly, a minimum of 3 traps are recommended to effectively reduce the time for checking all joints in the system.

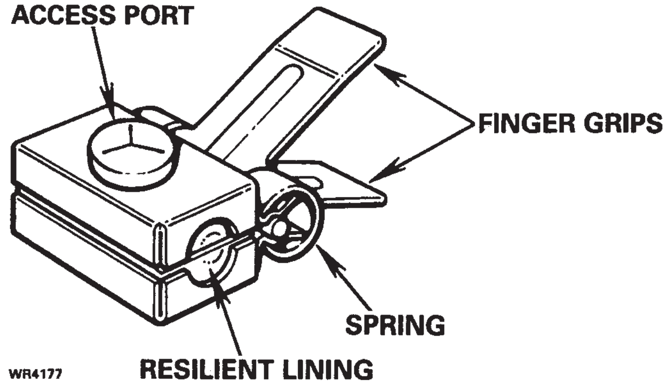

Figure 24 - Gas Trap

CONCLUSIONS

Most causes of a "poor performance" complaint will be discovered by making the 10-point preliminary examination — without any need for further diagnosis. Often the cause of the complaint will require only customer education, rather than a repair or adjustment, to complete the call and satisfy the consumer. However, when a cause of the complaint is not discovered, the refrigeration system should then be suspected.

Some causes of the consumer's complaint will be discovered by making careful observations of the condenser, dryer, capillary, and suction tube — before even connecting a gauge to the refrigeration system. Occasionally a cause external to the system will be detected after questioning the consumer about unusual occurrences and user practices. Although the actual cause of the complaint is not discovered, it should be known whether the failure is within the refrigeration system.

Only a few causes of the consumer's complaint will be found in the refrigeration system. But, after connecting a gauge and carefully analyzing the system, the cause of failure will be identified.

KNOWLEDGE EXERCISE #1

Complete the following. For multiple choice statements, select only one response.

1. What is the primary purpose of a refrigerator or freezer? ________________________________
____.

2. What range of temperatures should generally be expected:
In the fresh food compartment? ____________°F. In the freezer compartment? ___________°F.

3. How can refrigerator or freezer temperatures best be determined? ________________________
____.

4. Temperature measurements, in the fresh food or freezer compartment, should never be taken of:
____ a. The air.
____ b. The water.
____ c. Any food containing sugar.
____ d. Any food containing vinegar.

5. A refrigerator should not be installed in a location where the ambient temperature will be lower than 60°F, because:
____ a. The fresh food will likely freeze.
____ b. The oil in the compressor will likely gel.
____ c. The compressor may not run frequently enough.
____ d. The compressor may run too frequently.

6. A refrigerator is operating under "heavy usage" when:
____ a. The fresh food compartment is mostly full.
____ b. The freezer compartment is mostly full.
____ c. The kitchen is hot and the door openings are frequent.
____ d. The kitchen is cool and the door openings are infrequent.

7. A refrigerator operating under "light usage" conditions may result in temperatures such that:
____ a. Fresh food is too cold, and frozen food is too cold.
____ b. Fresh food is too warm, and frozen food is too cold.
____ c. Fresh food is too warm, and frozen food is too warm.
____ d. Fresh food is too cold, and frozen food is too warm.

8. If the frozen food temperature is 0° F or colder, but the fresh food is warmer than normal, a refrigeration system failure should be suspected. True? ____, False? ____.

KNOWLEDGE EXERCISE #2

Complete the following. For multiple choice statements, select only one response.

1. After completing the 10-point preliminary examination, and no cause of the consumer's complaint is discovered, a gauge should then be connected to the system. True? ____, False? ____.

2. It is normal for the suction tube to momentarily frost or sweat for a few seconds when the compressor resumes operation after an off cycle. True? ____, False? ____.

3. In a system that is slightly undercharged (has a leak), the condenser inlet should feel:
   ____ a. Hot to the touch.
   ____ b. Warm to the touch.
   ____ c. Cool to the touch.
   ____ d. Cold to the touch.

4. A suction tube that is either sweating or frosted, after the compressor has been running for several minutes, is a symptom of:
   ____ a. An undercharged system.
   ____ b. An overcharged system.
   ____ c. A partially restricted system.
   ____ d. A completely restricted system.

5. A capillary that is either sweating or frosted, at a point near the dryer, is a symptom of:
   ____ a. An undercharged system.
   ____ b. An overcharged system.
   ____ c. A partially restricted system.
   ____ d. A completely restricted system.

6. In a system that is completely restricted, the condenser, dryer, capillary, and suction tube will feel cool to the touch. True? ____, False? ____.

7. An incomplete (short) frost pattern is positive evidence of an undercharged system. True? ____, False? ____.

KNOWLEDGE EXERCISE #3

Complete the following. For multiple choice statements, select only one response.

1. From the gauge reading only, it is not possible to distinguish a partial restriction from an under-charge (leak). True? ____, False? ____.

2. If the capillary inlet is completely restricted, the system pressures will not equalize if the compressor is stopped. True? ____, False? ____.

3. An intermittent restriction is most likely caused by excessive:
   ____ a. Moisture in the system.
   ____ b. Refrigerant in the system.
   ____ c. Oil in the system.
   ____ d. Non-condensible gas in the system.

4. List the failures that can require a refrigeration system repair:
   ____
   ____
   ____.

5. The compressor capacity test will only distinguish between a normal compressor and one that is low capacity — it will not identify other faults. True? ____, False? ____.

6. The symptoms produced by a leak and a restriction are similar — either condition will cause the low side pressure (vacuum) to be higher than normal. True? ____, False? ____.

7. The most efficient method for detecting a small leak in the system is to use ________________ ______________________ and ______________________.