SECTION 3

THEORY OF OPERATION

OPERATING SYSTEMS

There are three operating systems in the icemaker:

- *Refrigeration System*
- *Water System*
- *Electrical System*

Refrigeration System

The following components have been listed in the order of refrigerant flow, with an explanation of their function as part of the refrigeration system. Without delving too deeply into the operating cycles, which will be covered later, for our purposes the ice making cycle is used. (See Figure 3-1)

- ***Compressor:*** The compressor creates a high side and low side pressure difference in the refrigeration system by compressing the refrigerant gas, thus raising the pressure and temperature. During the ice making cycle the compressor pushes this high-pressure/high-heat gas to the condenser.
- ***Condenser:*** The high-pressure/high-heat gas travels through the condenser, where the heat is dissipated by cooler air being drawn over the condenser tubing by the condenser fan. This changes the gas into a high-pressure/warm liquid that then enters the filter-drier.
- ***Filter-Drier:*** The high-pressure/warm liquid travels through the filter-drier, which removes moisture from the refrigerant before it enters the capillary tube.
- ***Capillary Tube:*** The warm liquid refrigerant travels through the skinny capillary tube which is wrapped around the suction line and accumulator. As the warm liquid refrigerant travels through the capillary tube it gives up heat to the cool vapor refrigerant in the accumulator and to the cool refrigerant gas traveling through the suction line. As the refrigerant in the capillary tube gives up heat, the pressure drops, so it is a low-pressure/cool liquid before it enters the evaporator.
- ***Evaporator:*** A dramatic pressure drop occurs as the low-pressure/cool liquid refrigerant leaves the small diameter capillary tube and enters the larger diameter evaporator tubing, and the refrigerant begins to vaporize. This vapor travels through the evaporator absorbing heat from the water being sprayed on the evaporator. This cool vapor then enters the accumulator.
- ***Accumulator:*** Another pressure drop occurs as the cool vaporized refrigerant leaves the evaporator tubing and enters the larger diameter accumulator tubing. Any liquid or vaporized refrigerant that may remain at this point is converted to gas. The capillary tube is wrapped around the accumulator to give up heat to the refrigerant in the accumulator before it enters the suction line.
- ***Suction Line:*** The cool gas travels through the suction line which is also partially wrapped with the capillary tube. As this cool refrigerant gas travels through the suction line it too absorbs heat from the warm liquid refrigerant traveling through the capillary tube. This assures that it is a luke warm gas before it enters the compressor, where the process begins again.

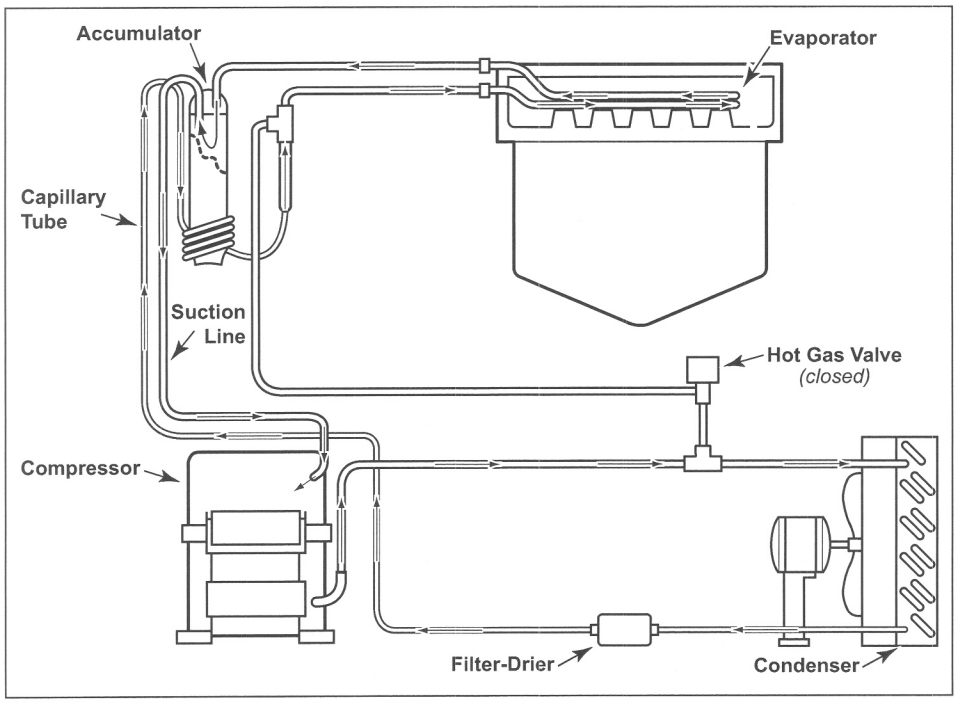

Figure 3-1. Refrigeration System *(During Ice Making Cycle)*

NOTE: *There is an additional component in the ice maker refrigeration system which is used during the harvest cycle, this component is called the hot gas valve. Its function is described below:*

- ***Hot Gas Valve:*** During a harvest cycle, the hot gas valve interrupts the flow of high-pressure/high-heat gas from the compressor, diverting it past the condenser, filter-drier and capillary tube, directly to the evaporator. This high-pressure/high-heat gas warms the evaporator so that the ice cubes release from the cube molds.

Water System

The water system provides and recirculates the water for ice production. It also provides a means of drainage. After the ice is produced, the water system flushes the impurities and minerals that were in the water, down the drain. During routine cleaning, the water system will circulate the ice machine cleaning solution. (See Figure 3-2)

Electrical System

Power for the refrigeration system and the water system is provided by the electrical system. The electrical system also controls the operational cycles of the ice maker. The electrical schematic in figure 3-3 below illustrates the electrical system of a model 315I during the ice making cycle.

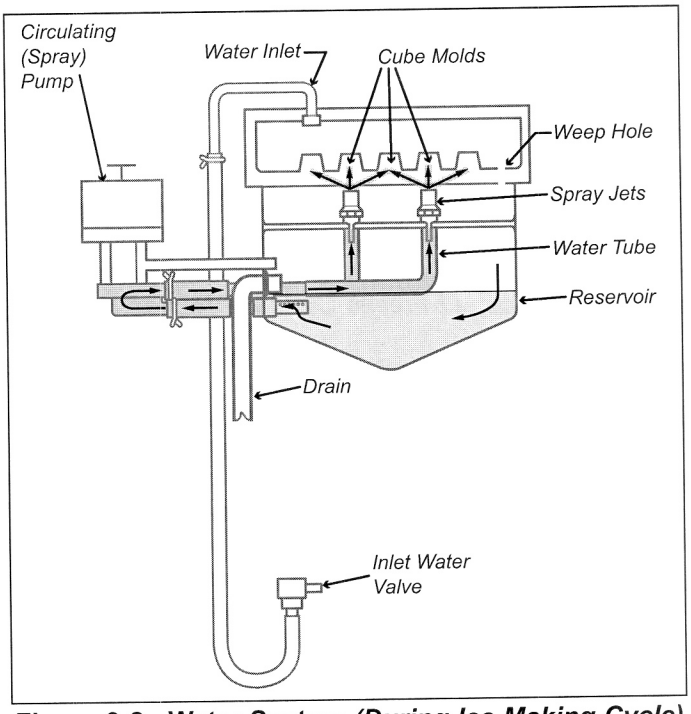

Figure 3-2. Water System *(During Ice Making Cycle)*

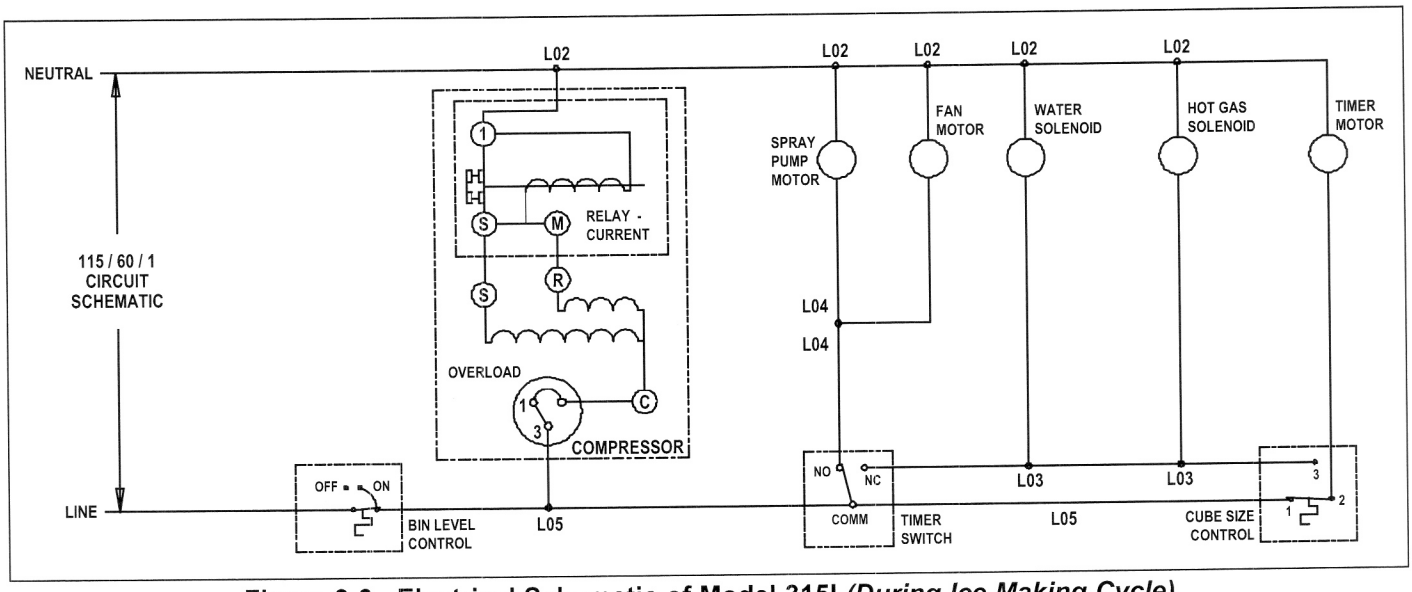

Figure 3-3. Electrical Schematic of Model 315I *(During Ice Making Cycle)*

OPERATIONAL CYCLES

There are two operational cycles of the icemaker:

- *Ice Making (Freeze) Cycle*
- *Harvest Cycle*

The ice making (freeze) cycle happens when water from the reservoir is sprayed into the ice cube molds at the bottom of the evaporator and the water freezes into cubes. The harvest cycle is when the ice cubes are released from the cube molds and fresh water enters the reservoir. The complete process takes approximately 30 minutes for each batch of ice. *(1 Freeze Cycle + 1 Harvest Cycle = 1 Batch of 8 Cubes.)*

Ice Making (Freeze) Cycle

During the ice making cycle the compressor pumps refrigerant through the system, the condenser fan draws air over the condenser, and the circulating spray pump sprays water into the cube molds. The refrigerant running through the evaporator absorbs heat from the water being sprayed into the cube molds and the water begins to freeze. The heat that the refrigerant absorbs from the water is carried in the refrigerant back to the compressor and then through the condenser where the heat is transferred from the refrigerant to the air being drown over the condenser tubing by the condenser fan. This warm air is discharged out through the louvered kickplate. When the cube molds become cold enough, the ice machine's timer begins to turn. When the timer turns far enough, it stops the ice making (freeze) cycle and begins the harvest cycle.

NOTE: The Water System During Ice Making (Freeze) Cycle - *The water system initially fills the reservoir with approximately two quarts of water. During the ice making cycle, water is taken from the reservoir and sprayed into the cube molds where it begins to freeze. But, due to the fact that water containing mineral impurities needs a lower temperature to freeze, the impure water falls back into the reservoir and the purer water freezes in the cube molds. This causes the water in the reservoir to become highly concentrated with mineral impurities towards the end of the ice making (freeze) cycle.*

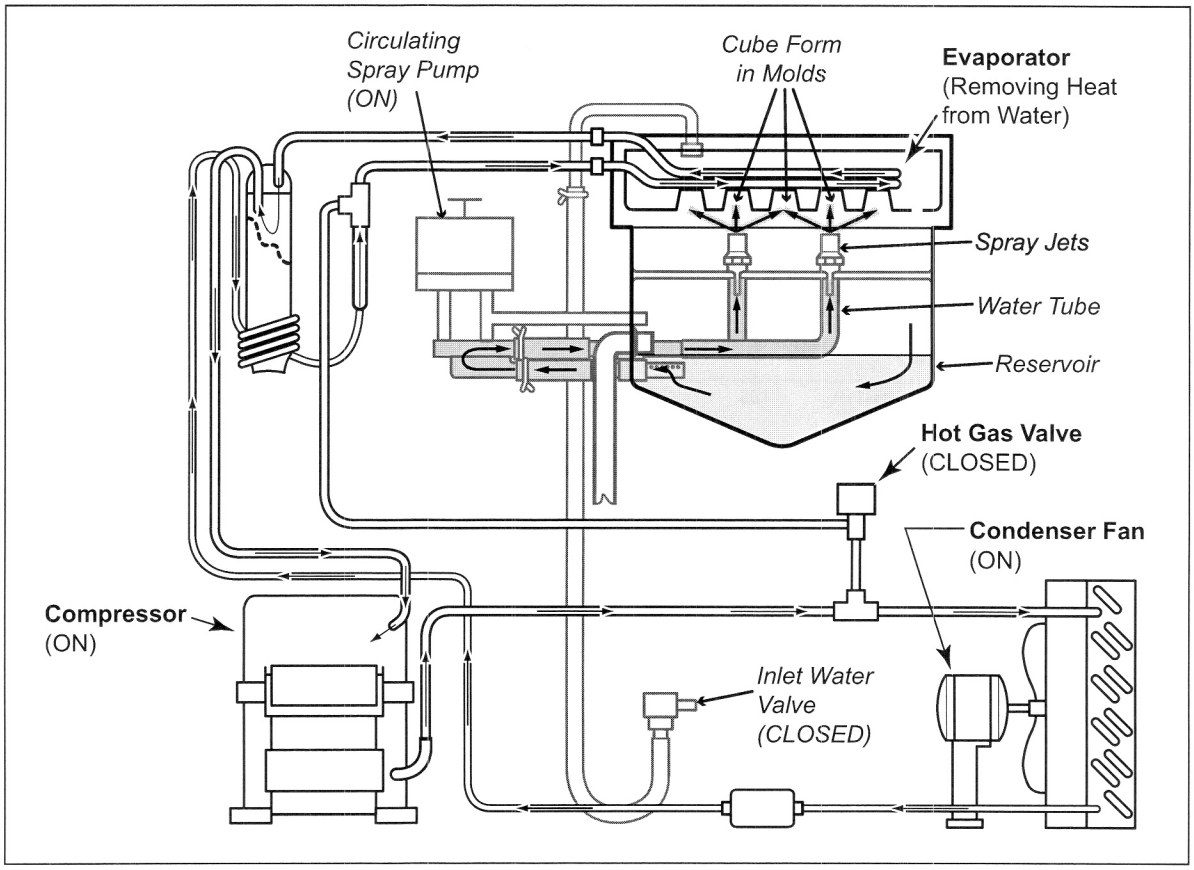

Figure 3-4. Ice Making (Freeze) Cycle

Harvest Cycle

During the harvest cycle the compressor is still operating, but the condenser fan and circulating spray pump are switched off. The hot gas valve opens, interrupting the flow of warm refrigerant from the compressor to the condenser, diverting it to the evaporator. The water valve also opens, pouring water over the top of the evaporator and into the reservoir. The warm gas in the evaporator, along with the water pouring over the top of the evaporator, causes the ice cubes to release from the cube molds and fall into the bin. The ice machine timer continues turning, and when it turns far enough, it stops the harvest cycle and the freeze cycle begins again.

NOTE: The Water System During Harvest Cycles - *During the harvest cycle, approximately three quarts of water are added to the reservoir, over-filling the reservoir by approximately one quart. The extra quart of water rinses the reservoir and goes down the drain carrying the mineral impurities.*

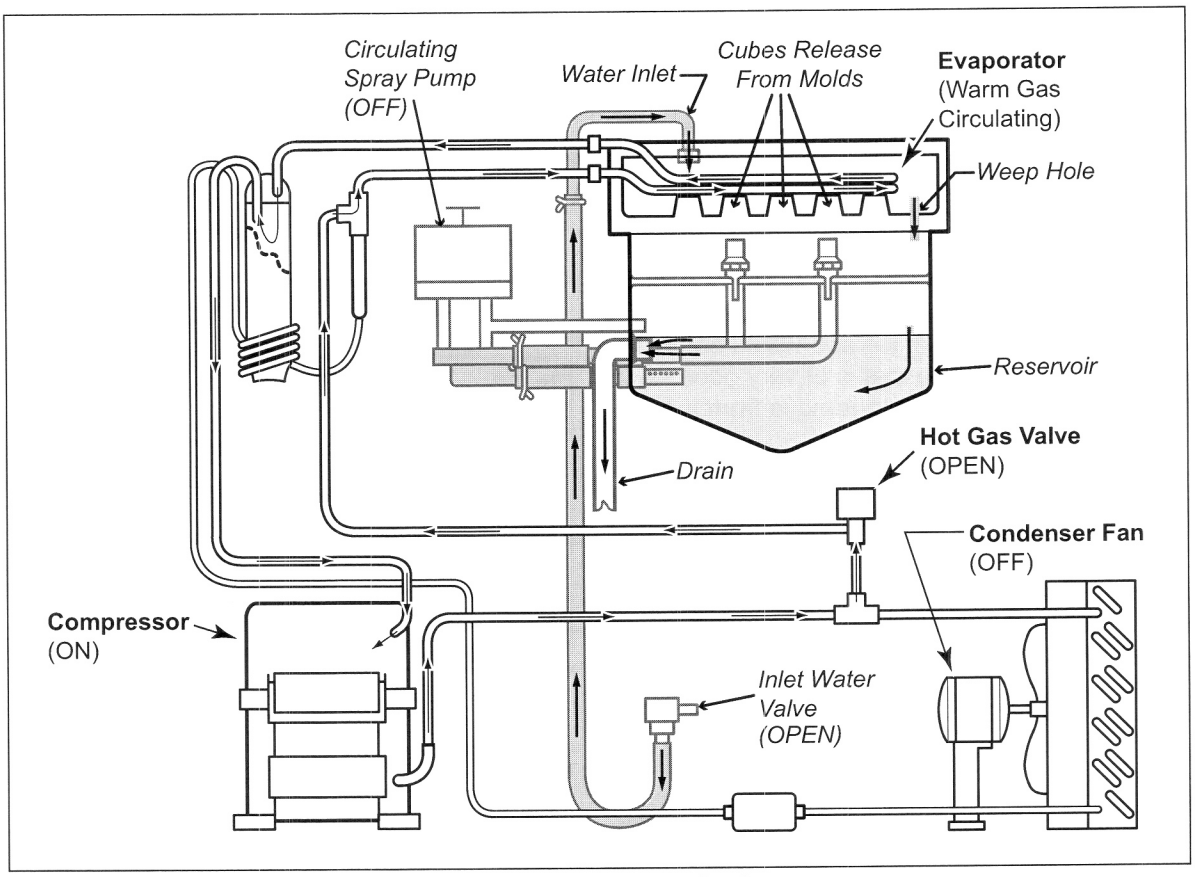

Figure 3-5. Harvest Cycle

WHAT TO EXPECT FROM THE MODEL 315I

The model 315I will release a batch of eight ice cubes approximately every thirty minutes. At the same time the cubes fall into the bin, water will be filling the reservoir and carrying the mineral impurities down the drain.

Ice

The ice cubes are tapered cylinders approximately 1-1/4" in diameter at the widest end; tapered down to 1" at the other end; and are 1-1/8" high. (See Figure 3-6) When the machine is adjusted properly, there should be a 1/4" indentation in the base of the cube. The cubes will appear wet when fresh, which is normal. The cubes may also develop frost on the outside and look cloudy, this is also normal. (The frost will disappear when liquid is poured over the cubes.)

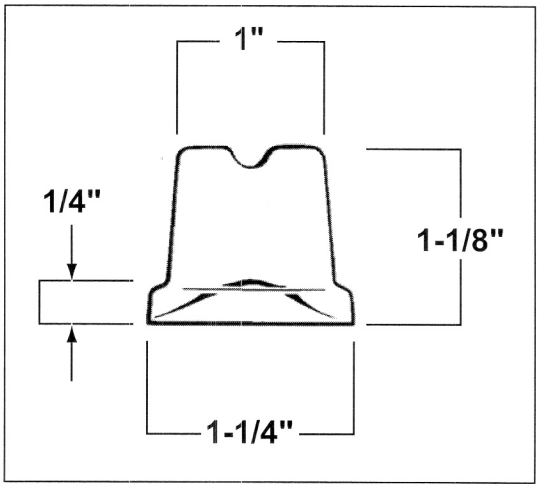

Figure 3-6. Proper Cube Dimensions

Storage

The ice storage bin is not refrigerated. Instead, it is heavily insulated, much like an ice chest or picnic cooler. If the ice bin were refrigerated, the ice would freeze together into one large cluster of ice and would begin to evaporate. This would yield ice that is of very poor quality and would be very difficult to remove from the machine.

The model 315I will continue to operate until the ice builds up high enough to contact the bin thermostat sensor tube, then it will shut off. (See Figure 3-7)

NOTE: *The model 315IP will continue to pump the water from the melted cubes even when the unit is off. The pump will only be on for a few seconds.*

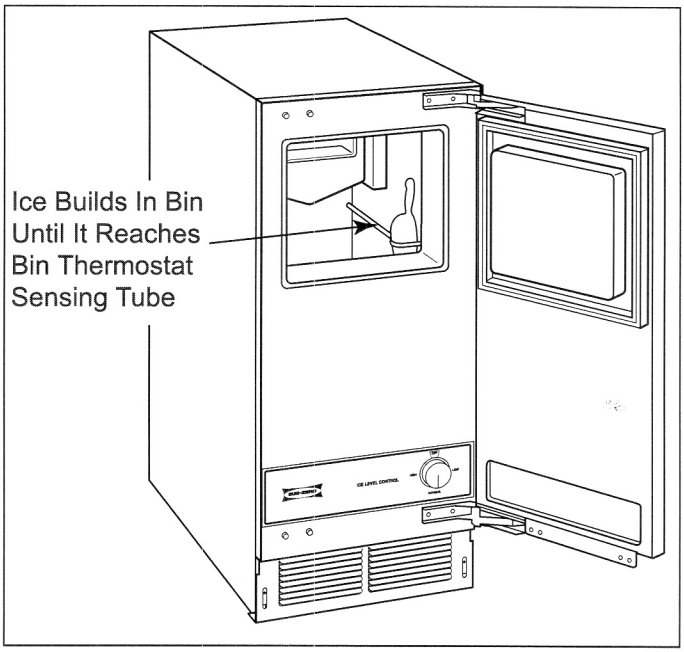

Figure 3-7. Ice Bin Storage Level

Run Time

The amount of time that the model 315I will run to replace melted ice (without the door being opened) is approximately two hours per day. The amount of time that the ice machine will run to replace ice removed during use will depend upon how much ice is removed, how often ice is removed, how clean the ice machine is and how hot the ambient air and water supplied to the ice machine are. An empty ice bin will usually take twenty-four to thirty-six hours to refill.