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ICE MAKER LIMITED WARRANTY

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GEAR LUBRICANTS CROSS REFERENCE CHART

MANUFACTURERS DESCRIPTIVE BULLETINS
PREFACE

ADDRESSED TO THE OWNER OF NORTH STAR ICE MAKER

Your NORTH STAR ice maker will give you many years of trouble free and efficient production if you give it the very little care it requires. You supply the electricity for power, refrigerant for cooling, and water to be converted into ice. These three elements are not perfect, so no matter how perfect the machine may be, its performance depends upon the quality of these elements supplied to it. For completely satisfactory performance, some personnel in your organization should be responsible for the ice maker operation. This manual is written in uncomplicated, straight forward language so that it can be thoroughly understood. Our experience has been that those who follow the instructions in the manual enjoy many years of efficient and trouble free operation.

SAFETY PROCEDURES AND DESIGN

North Star has designed into all of its products many very important safety features to insure you and your employees many years of safe operation. However, it is impossible to make automatic industrial equipment completely safe for personnel who have no regard for their own safety or who have no knowledge of the possible dangers of this equipment. The purchaser of any North Star product is responsible for its proper installation and operation in accordance with the information provided. Any modification of a North Star product or the non-conformance to North Star's installation and operating instructions will be at the owner's risk.

Included with your North Star product is a list of Safety Procedures that must be easily visible to anyone working near or on the equipment. It is the owner's responsibility to properly post these Safety Procedures and to instruct all personnel about these Safety Procedures. If for any reason you need additional copies of these procedures please contact North Star immediately.

The ice maker has been provided with an access cover safety switch which will stop the machine if the cover is removed while the machine is running. It is also provided with an emergency stop pushbutton near the inspection hatch which will stop the machine immediately when pushed. Under no circumstances should anyone insert their hands or any other items through the inspection hatch while the ice maker is running. It is the responsibility of the owner to see that the access cover safety switch is kept in good operating condition and that personnel having access to the ice maker are aware of this safety precaution.

For maintenance purposes the JOG pushbutton is operable while the access cover is removed.

January, 2002
WARNING LABELS AND SAFETY INSTRUCTIONS

Be sure you understand all safety messages and always follow recommended precautions and safe operating practices.

NOTICE TO OWNERS:

You must make sure that everyone who installs, uses or services your NORTH STAR ice maker is thoroughly familiar with all safety information and procedures.

Important safety information is presented in this section and throughout the manual. The following signal words are used in the warnings and safety messages:

DANGER: Severe injury or death will occur if you ignore the message.

WARNING: Severe injury or death can occur if you ignore the message.

CAUTION: Minor injury or damage to your ice maker can occur if you ignore the message.

NOTICE: This is important installation, operation or service information. If you ignore the message, you may damage your ice maker.

Warning and safety labels are placed on various pieces of NORTH STAR ICE EQUIPMENT at the factory. Follow all warning label instructions. If any warning or safety labels or posters become lost or damaged, call NORTH STAR ICE EQUIPMENT CORP. at 1-800-321-1381 or 1-206-763-7300 for replacements.
MACHINE INSPECTION

Immediately upon receipt of your ice maker, check carefully for evidence of damage during shipment. If damage is apparent, notify the carrier’s agent immediately and request inspection of the damage sustained. Also notify the NORTH STAR shipping department. Remove the packing list from the water tank and check carefully to assure that all parts were received in good condition. Immediately register claims with the carrier for missing or damaged parts and notify the NORTH STAR shipping department.

INSTALLATION

NOTICE:
THE ICE MAKER MUST BE INSTALLED IN A WEATHER PROTECTED AREA WHICH IS MAINTAINED ABOVE 32° F. (0° C.).

REFER TO INSTALLATION DRAWINGS IN BACK OF THIS MANUAL.

MOUNTING

NOTICE:
ALWAYS USE A SPREADER BAR WHEN LIFTING THE ICE MAKER.

THE ICE MAKER BASE MUST BE SUPPORTED UNDER ALL FOUR SIDES.

Use care when handling the unit to avoid marring or rupturing the fiberglass cover. If the cover is damaged, contact the factory for instructions.

The machine can be lifted by using the lifting rings and a spreader bar. The net weight of the machine is shown on the installation drawing. Apply a waterproof sealant to the top of the ice maker supports before setting the machine in place so there is an airtight seal between the two. The base must be level. After the machine is in place, remove the lifting rings, fill the holes with insulation and seal over the top with waterproof sealant to prevent water from getting under the fiberglass cover.

The discharge opening under the ice maker may be either square or round and must be at least the minimum size shown on the installation drawing. The base of the machine should be elevated as shown to provide room for the water tank and drain line connection.

We do not recommend placing the ice maker over chutes or conveyors unless an overfeed detector switch is installed to ensure that the ice is being carried away. If the ice maker becomes filled with ice, the internal components could be damaged. Rotating paddle type switches such as those manufactured by Bin-o-matic or Bindicator work well for overfeed detectors as do some photoelectric switches and capacitive sensors.

Several items such as the refrigeration valves, driven sheave, belt guard and the water supply system components are shipped loose to prevent damage during transit and must be installed after the ice maker is placed. Refer to the installation instructions in this manual and the installation drawings in the back of this manual.
REFRIGERATION SYSTEM

REFER TO PIPING AND WIRING DIAGRAM 10PW-0 AND DRAWING TDS-0. ITEMS NOT MARKED WITH AN ASTERISK (*) CAN BE OBTAINED FROM REFRIGERATION EQUIPMENT SUPPLIERS.

Note: ASME pressure vessel code requires that ice makers be hydrotested so it is important to evacuate the system using the deep vacuum method to remove all residual water from the system prior to charging with refrigerant. Polyol ester oil (POE) used with many of the environmentally friendly refrigerants is hygroscopic (moisture absorbent) and will cause many undesirable effects if exposed to water.

FLOODED ICE MAKERS

The ice maker evaporator vessel is flooded and the refrigerant liquid level is controlled by either a Sporlan Levelmaster (LMC), a Thermal Differential Switch (TDS) or a float switch level control. The refrigerant liquid inlet and outlet (suction) pipes are in the accumulator, which separates liquid refrigerant from the gas. Refer to drawing 10PW-0(LMC) for LMC piping diagrams, 10PW-0(TDS) and TDS-0 for TDS piping diagrams and 10PW-0(RFS) and RFS-0 for float switch piping diagrams.

The expansion valve should be installed as close as possible to the accumulator. The liquid line must be increased to full accumulator inlet nozzle size between the expansion valve and the accumulator. With LMC expansion valves, be careful not to kink or damage the capillary tube between the valve body and the thermal bulb. The bulb is inserted into a nozzle located at the bottom of one end of the accumulator. Install the expansion valve equalizer line if required as shown.

With TDS or float switch systems, a hand expansion valve is required along with a liquid line solenoid valve with a pilot light. With TDS systems install the telltale standpipe supplied with the ice maker as shown on drawing TDS-0. Use the substance "k" supplied with the TDS unit between the sensor body and the telltale standpipe and also to coat the heater when installing the unit. For float switch systems locate the float switch at the height shown on drawing RFS-0. The float switch should be adjusted for a minimum liquid level differential. The hand expansion valve is to be adjusted for a slight overfeed of refrigerant to avoid overshooting the correct liquid level.

FORCED RECIRCULATION AND BRINE ICE MAKERS

REFER TO PIPING AND WIRING DIAGRAM 10PW-FC.

Forced recirculation (pumped liquid) and brine system ice makers do not require accumulators and the liquid level is determined by the height of the outlet (suction) pipe. On forced recirculation ice makers the suction line should be pitched downwards to drain from the ice maker suction nozzle to maintain the proper liquid level for optimum performance. If it is necessary to run the suction line upwards from a forced recirculation ice maker then it should be p-trapped to maintain the liquid level in the ice maker at the height of the suction line nozzle in the evaporator. The production capacity of the ice maker can be severely reduced by improper piping of the suction line.

On forced recirculation ice makers, the liquid line nozzle is near the bottom of the evaporator and the refrigerant flow is controlled by a Refrigeration Specialties AFR-3 automatic flow regulator which should be installed in accordance with the bulletin included with the regulator. Adjust the flow regulator for a 15% overfeed. This can be done by multiplying the refrigeration load in tons of refrigeration by 1.15 and adjusting the regulator indicator scale to this setting.
ALL ICE MAKERS

Manual shutoff valves, solenoid valve, strainer and other system components should be installed as shown on the piping diagram drawing.

For optimum ice maker performance the ice maker requires, and should be adjusted for, relatively constant conditions. If the ice maker is connected to a central refrigeration system and the suction pressure fluctuates more than 5 psig (0.35 kg/sq cm), a back pressure regulator should be installed and adjusted to the highest fluctuating pressure. The ice maker adjustment procedure is explained in the Initial Startup Procedure section of this manual.

The standard ASME coded evaporator vessels for the Models 10, 20, 40, 60 & 90 are coded for 150 psig (10.5 kg/sq cm) and are provided with a relief valve. The pressure in the ice makers must be maintained below this level or the relief valve will open. The normal way to hold the pressure down is to leave the refrigeration system operable when the ice maker is off. Refrigeration compressors are normally equipped with a low pressure cutout switch with high and low set points. The low set point should be set as low as possible without going into a vacuum or 5 psig below the lowest normal suction pressure if the system is designed to run in a vacuum. The high set point should be set as high as possible to minimize short cycling of the compressor but low enough to restart the compressor within a reasonable period when the ice maker is restarted. If the refrigeration system is going to be turned off while the ice maker is in a warm ambient temperature, the ice maker should be pumped out first.

OIL RETURN

Oil from the compressor contaminates almost every refrigeration system. It is most important to control the oil in a low temperature, high efficiency refrigeration system. An extra large oil separator to minimize the amount of oil entering the ice maker should be used on every ice maker installation. However, since no oil separator traps all the oil from the compressor, other systems are provided to keep the oil from building up in the ice maker. These methods differ for halocarbon refrigerant and ammonia systems.

HALOCARBON REFRIGERANT SYSTEMS

The purpose of the halocarbon refrigerant oil return system shown on the piping diagram is to provide (1) return of the oil contaminated refrigerant from the ice maker to the compressor crankcase via the suction line; (2) provision for a suction line heat exchanger of a type and size which will ensure evaporation of all the refrigerant which contains the oil. All halocarbon refrigerants are handled in the same manner.

The patented internal construction of the NORTH STAR evaporator produces a high velocity recirculation of refrigerant so that the oil and refrigerant are homogeneous and uniformly distributed throughout the evaporator. Therefore the oil return can be tapped from any part of the evaporator. A 1/2" I.P.S. connection is located at the bottom of the evaporator to bleed liquid refrigerant and oil into the suction line.

A manual flow control hand expansion valve (HEV) should be installed in the oil return line as shown and adjusted to return the oil lost from the compressor back to the compressor. Opening the valve so that the suction line heat exchanger is frosted halfway through will usually be adequate to get the oil back. The oil level in the compressor should be checked regularly and the valve adjusted accordingly. A solenoid valve is to be located in this line to prevent liquid accumulation in the suction line when the ice maker and compressor are not operating. The sight glass allows
observation of the flow through the line. The strainer prevents dirt and slag from clogging the hand expansion valve or reaching the compressor. This strainer may have to be cleaned several times during the first weeks of operation as any slag, scale or debris in the system will be carried to this point.

Since the head of the liquid in the evaporator is the force that causes the liquid to flow through the oil return line, it is important that this line be connected to the suction line below the liquid level in the machine as shown on the piping diagram (i.e. the suction line must come down to the oil return line). If operational testing shows the flow is not adequate to return enough oil to the compressor, it can be increased by partially closing the suction line stop valve to create a 1 PSIG (0.07 kg/sq cm) greater pressure in the evaporator. This will help force oil and refrigerant through the oil return line.

The suction line heat exchanger prevents the liquid from the oil return line from flooding back to the compressor. It should be a low temperature baffled type such as the Henry LSX or Dunham-Bush SX and RX types with a nominal rating of at least three times the nominal ice making capacity of the machine. Since heat in the refrigerant liquid going into the heat exchanger is necessary to evaporate any liquid in the suction line before it goes to the compressor, supplying subcooled liquid to the heat exchanger is not recommended. The liquid will be subcooled by the heat exchanger before it enters the ice maker.

### HEAT EXCHANGERS RECOMMENDED FOR HALOCARBON REFRIGERANT SYSTEMS

<table>
<thead>
<tr>
<th>ICE MAKER MODEL</th>
<th>HEAT EXCHANGER MODEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>M5</td>
<td>Henry LSX-045 or Dunham-Bush SX8</td>
</tr>
<tr>
<td>M10</td>
<td>Henry LSX-090 or Dunham-Bush SX15</td>
</tr>
<tr>
<td>M20</td>
<td>Henry LSX-135 or Dunham-Bush RX35</td>
</tr>
<tr>
<td>M40</td>
<td>Henry LSX-220 or Dunham-Bush RX65</td>
</tr>
<tr>
<td>M60</td>
<td>Henry LSX-340 or Dunham-Bush RX100</td>
</tr>
<tr>
<td>M90</td>
<td>Henry LSX-450 or Dunham-Bush RX100</td>
</tr>
</tbody>
</table>

### AMMONIA SYSTEMS

Oil is not miscible with ammonia as it is with halocarbon refrigerant. The ammonia evaporates and is returned to the condensing unit, but the oil remains in the evaporator. This oil will coat the walls of the evaporator, insulating them, and the ice production will decline by as much as 50%. Therefore a system must be provided to deoil the evaporator at regular intervals. The frequency of the deoiling operation will depend upon how much oil is in the liquid ammonia. This is usually a function of the age and wear of the compressor.

The system detailed on the piping diagram uses hot gas to warm the evaporator. Cold oil is like cold molasses and will not drain without being thoroughly heated. The pressure from the hot gas helps force the oil out of the oil drain at the base of the machine to an oil pot where it can be removed.

Since there must be a source of hot gas, ammonia is not recommended as the refrigerant in a system where there is only one evaporator (ice maker). The compressor must have another load to produce hot gas while the ice maker is being deoiled. If it is not possible to supply hot gas to the ice maker, warm water can be circulated over the freezing surface to warm the evaporator for deoiling, but this is a much lengthier process.

The deoiling procedures are described in detail in the Deoiling section of this manual.
ELECTRICAL SYSTEM

REFER TO PIPING AND WIRING DIAGRAM 10PW-0. ITEMS REMOTE FROM CONTROL PANEL NOT MARKED WITH AN ASTERISK (*) CAN BE OBTAINED FROM REFRIGERATION OR ELECTRICAL EQUIPMENT SUPPLIERS.

NOTICE:
Installation and service of electrical components must be performed by a licensed electrician. All electrical wiring must be in accordance with all applicable local, regional and national codes.

Ice maker control panels are required and available from the factory as a standard option. All NORTH STAR control panels manufactured after 1989 are UL listed. The ice maker control panel should be supplied with the correct power and control voltage through circuit breakers or fuses as required by local electrical codes. If a control panel is to be used that has not been manufactured by NORTH STAR, then it must be designed and built according to the wiring diagrams on drawing 10PW-0.

There are different versions of the piping and wiring diagram for the different types of ice maker refrigerant level controls. Use drawing 10PW-0 (LMC) with Sporlan Levelmaster machines, drawing 10PW-0 (TDS) with Thermal Differential Sensor, drawing 10PW-0 (RFS) with float switch machines and drawing 10PW-FC with forced recirculation machines.

Some type of high level control (HLC) should be installed in the ice storage bin to turn off the ice maker when the bin is full to prevent ice from filling the ice maker and damaging the internal components. Rotating paddle types such as those manufactured by Bin-o-matic or Bindicator work well as do some photoelectric switches and capacitive sensors.

Connect the access cover safety switch (ACSS) as shown. This will stop the ice maker immediately if the cover is removed while the machine is running. Connect the JOG pushbutton (PB-IM) as shown. For maintenance purposes the JOG pushbutton can be used to turn the rotor while the access cover is removed.

Connect the emergency stop switch (ESS) as shown to provide for an instantaneous stop capability from the inspection hatch. Connect the load limit switch (LL) as shown to provide overload protection for the drive components. If the load limit switch should trip, find the source of the overload and correct it. The switch contacts can then be reset by pushing a button on the switch.

Connect the pressure switch (PS) as shown to prevent the water pump from running and the oil return line solenoid valve from opening unless the evaporating pressure in the ice maker is pulled down to within 5 psig (0.35 kg/sq cm) of the normal operating pressure. This ensures that the refrigeration system is working properly before ice production can begin. The compressor can be stopped manually or by a low pressure switch contact. Normally there is no electrical interlock between the ice maker and the compressor control circuits.

The normal way to hold the evaporator pressure below the 150 psig relief valve setting when the ice maker is off is to leave the refrigeration system operable. If the refrigeration system is going to be turned off while the ice maker is within a warm ambient temperature, the refrigerant should be pumped out of the ice maker first.
On halocarbon refrigerant ice makers, the oil bleed line solenoid valve (SVB) should be connected through a normally open interlock contact (IL-C) on the compressor starter. This prevents liquid accumulation in the suction line when the compressor is not operating.

The liquid line solenoid valve (SVL), the Levelmaster heater (LM) or Thermal Differential Sensor (TDS), the water pump (P), and the rotor drive motor (M) should be connected as shown. The correct rotation of the rotor when viewed from the inspection hatch is counterclockwise. The correct rotation of the water pump when viewed from the top is clockwise.

The pump selector switch (PSS) allows the operator to prevent the pump from running until the ice maker is at least half full of refrigerant during initial startup. (If the pump is started before the ice maker is half full of refrigerant, the removal tools will cut grooves in the slushy ice formed on the warm drum and the rotor will probably stall when the slush is frozen into hard ice.) The pump selector switch also can be used to put the ice maker in a standby mode with the ice production stopped while leaving the refrigerant controls energized and the rotor turning.

Whenever ice production is stopped by the high level control (HLC) or the STOP pushbutton on halocarbon refrigerant ice makers, the ice maker will continue to make ice for a minute to provide a partial pumpdown of the liquid level. This decreases the possibility of liquid flooding over when restarting a warm ice maker. Timer (1TR) will then turn off the pump and timer (2TR) will allow the rotor to turn for another minute to clean the freezing surface. On ammonia ice makers the ice production will stop immediately when the high level control (HLC) or the STOP pushbutton is actuated. Timer (TR) will allow the rotor to turn for one minute to clean the freezing surface.

**DRIVE SYSTEM**

REFER TO INSTALLATION DRAWINGS IN BACK OF THIS MANUAL.

Bolt the drive motor on the motor mounting plate as shown on the drawings. Remove the variable pitch drive sheave and install the belt guard backing plate as shown. Install the drive sheave on the motor shaft, the driven sheave on the worm gear reducer shaft and the drive belt. Align the sheaves and tension the belt before reassembling the belt guard.

The worm gear reducer is normally lubricated at the factory, but the fill level plug should be removed and the oil level checked prior to operation. If necessary, add a rust inhibiting AGMA No. 8 compound worm gear oil suitable for an ambient temperature of 50° F. to 125° F. (10° C. to 52° C.). Do not use gear oil that is corrosive to bronze gears. Refer to the lubrication suppliers list in the manufacturer's bulletin in the back of this manual.

Remove the oil level and the fill plugs from the top center gear housing and fill this reducer with SAE 80W/90 (ISO 100 or 150) truck duty all purpose gear oil until it flows out of the oil level plug opening. This is a dry well type reducer. **Do not overfill this reducer.** Overfilling will cause oil to flow over the bearing retainer ring dam inside the reducer and drain down through the top bearing onto the top of the rotor shaft inside the ice maker. If this happens it may take several months for all of the excess oil to drain out through the top bearing and decrease bearing life.
WATER SYSTEM

REFER TO INSTALLATION DRAWINGS IN BACK OF THIS MANUAL.

MINIMUM WATER TEMPERATURE IS 40° TO 45° F. (5° TO 7° C.)

The colder the water supplied to the ice maker is, the more ice the ice maker will make. However, if the water supplied to the ice maker is too cold, ice will form in the drip trough at the bottom of the freezing surface and eventually fill it causing the water from the float valve to overflow into the ice bin below the ice maker. The lowest temperature that will work in the ice maker without freeze up problems can vary between different installations somewhat because the temperature of the air inside and under the ice maker will have some effect. Running the water supply line through a circulation heater controlled by a thermostat is the most common method of raising the water temperature to the minimum temperature requirement. Another method is to add hot water through a mixing valve with a thermometer in the line so the mixing valve can be adjusted.

The water tank is to be installed at the back of the ice maker with the salt feeder tank installed as shown on the drawings. The water tank should be supported up off the floor sufficiently for clearance for the drain line which should be piped from the street ell at the bottom of the tank to a suitable water drain outlet. Install the street ell in the bottom of the water tank as shown. An overflow standpipe is provided with a machined end which will slip into the drain outlet street ell in the bottom of the tank. The water tank can be drained by pulling the standpipe out of the drain ell. The tank can be insulated to prevent condensation or a drip pan piped to a drain should be installed under the tank to collect the condensation.

Install the water pump as shown. The customer is responsible for providing and installing the piping from the outlet of the water pump to the flow control valve at the top of the ice maker. Install a strainer in this line as shown. A support bracket is provided with the ice maker to hold this piping at the proper height so that the flow control valve outlet tube will extend down into the hole in the top of the rotor. Attach this bracket with the top gearbox cover bolts so that the flow control valve outlet tube is centered in the top of the rotor and there is no metal to metal contact when the rotor turns. The piping between the pump and the water flow control valve should be insulated to prevent condensation.

Install the float valve and connect the water supply line to the float valve coupling in the side of the water tank. Install a shutoff valve and a strainer in the supply line near the water tank. Connect the float valve outlet to the down leg of a tee fitted onto the 1" inlet to the drip trough at the base of the ice maker with the plastic hose and fittings provided. Install the drain ell and half nipple on the outlet as shown on the drawings. The incoming water flows around the drip trough at the bottom of the freezing surface and then drains through the outlet into the water tank. The incoming water is precooled as it circulates around the drip trough at the bottom of the freezing surface and the heat from the water keeps the drip trough from freezing.

Install the 1/4" salt feeder valve and copper tube as shown on the drawings. A small portion of the water flows by gravity out the other end of the tee through this valve and copper tube into the salt feeder tank inlet tube. The copper tube should extend horizontally and bend down to the salt tank inlet tube. Do not bend the copper tube up and then back down to the salt tank or the resultant head in the tube could prevent the water from flowing to the salt tank. Cut the end of this tube off about 1/2" (13 mm) above the salt tank inlet tube so the rate of flow is visible.
INITIAL STARTUP PROCEDURE

1. On carbon steel ice makers only, jog the rotor around until it is just entering the left side of the inspection hatch opening. Then lock off the rotor drive motor disconnect switch and remove the hatch cover. From inside the ice maker, wash the protective grease coating from the freezing surface with a non-flammable, non-toxic solvent. Then wash the freezing surface with detergent and warm water. Replace the hatch cover and switch the motor drive disconnect switch back to the on position. The Model 10 ice maker will have to be cleaned from below the ice maker since it is too small for a person to get inside it.

2. Check that all refrigerant lines have been installed, cleaned, leak tested, evacuated and insulated as required. Check that the system has been charged with adequate refrigerant. Close the oil drain valve on the machine and open the liquid and suction line stop valves.

3. Check that a water supply line has been connected to the float valve in the water makeup tank and that the float valve outlet has been connected to the water inlet tee with the plastic tube provided. Also check that the pump has been connected to the top of the ice maker with an insulated pipe and strainer. Close the water flow control valve at the top of the ice maker.

Remove the overflow standpipe in the makeup tank and open the water stop valve ahead of the water float valve so water can flush through the drip trough at the bottom of the ice maker and the water tank. Wash the tank clean and replace the overflow standpipe so the tank will fill. Adjust the float valve to close when the water level is about 3/4" (19 mm) below the top of the standpipe. For shipboard ice makers the float valve should be adjusted to close when the water level is about 2" (50 mm) below the top of the standpipe. Fill the salt feeder tank with salt (rock salt preferred) to about 1/2" (13 mm) below the overflow standpipe.

4. Check the operation of the JOG switch (PB-IM) by pushing it and revolving the rotor through one revolution. The rotor should rotate counterclockwise when viewed from the inspection hatch. Turn the pump selector switch (PSS) to the off position. Push the START pushbutton. The rotor should begin turning and the liquid line solenoid should open allowing liquid to begin filling the ice maker. Check the operation of the access cover safety switch (ACSS) by removing the access cover. The rotor should stop immediately. Replace the cover and restart the ice maker. Check the operation of the emergency stop switch (ESS) by pushing it. The rotor should stop immediately. Restart the ice maker and check the operation of the load limit switch (LL) by raising the counterweight at the lower rear corner of the ice maker and pushing the motor drive channel over to trip the limit switch. The rotor should stop immediately. Reset the load limit switch by pushing the reset button on it.

5. At this time the compressor and other high side equipment should be made operational. Restart the ice maker and watch the freezing surface to keep the pump off until the frost line on the freezing surface is above halfway up from the bottom. (If the water pump is turned on before the ice maker is at least half full of refrigerant, the ice maker will make slush instead of ice and the rotor will probably stall.) When the frost line is visible at least half way up the freezing surface, turn the pump selector switch (PSS) to the auto position. The pressure switch (PS) may have to be adjusted to a higher setting at this time to get the pump to run. The pump should rotate clockwise at the top.
6. Open the water flow control valve at the top of the machine so that water fills the first water ring trailing the rotor to about 1/4" (6 mm) above the overflow tube. The water level in the other water rings should be about 1/4" below the overflow tube, but it is not critical and no attempt should be made to adjust this until the ice maker is stopped. The level in all water rings except the first one is adjusted by partially closing the pinch clamps on the hoses connecting the water rings to the drip shield spray tube below.

7. Open the salt feeder control valve all the way until the salt feeder tank is full and then adjust the valve so that it is putting a fast steady drip into the salt tank. Unless the water is very hard, the addition of 100 to 200 parts per million of salt will increase flake size and improve removal. Adjust the valve to the minimum flow necessary to accomplish maximum ice removal.

8. On halocarbon refrigerant machines the oil drain valve should be opened and the hand expansion valve on the oil return line should be adjusted open just enough so that the suction line heat exchanger is frosted about halfway through. This ensures that no liquid is being carried over to the compressor. Check the sight glass often during initial startup to see that oil and refrigerant are flowing. The oil return line strainer may have to be cleaned several times during the first few weeks of operation as any slag, scale or debris in the ice maker and the refrigeration system will be carried to this point.

9. After the ice maker has been making ice to the top of the freezing surface about 30 minutes, the suction pressure should be stabilized and the operation of the pressure switch (PS) can be checked by adjusting it to open its contacts at a setting below the operating pressure. The pump should stop immediately. The pressure switch can then be adjusted to close its contacts at 5 psig (0.35 kg/sq cm) above the normal operating pressure.

10. Rotor Speed Adjustment: For optimum performance the ice maker removal tools should remove 90% to 100% of the ice formed with each pass of the rotor. Collect some ice from beneath the ice maker and check the flake thickness which should be between .060" (1.5 mm) and .080" (2 mm). The ice thickness can be varied by adjusting the variable pitch sheave on the drive motor. Stop the ice maker and lock off the rotor drive motor disconnect switch before making any adjustments. Turning the two halves of the variable pitch drive farther apart will slow the rotor resulting in thicker ice and vice versa. The drive belt tension may have to be readjusted after changing the variable pitch drive sheave. Maximum production is obtained by making thin ice (.060"/1.5 mm) but if the ice is too thin the ice removal tools will only groove the ice and the rotor will eventually stall as the ice builds up on the freezing surface.

11. Drying Time Adjustment: To minimize frost buildup on the removal tools and eliminate moisture problems in the storage bin, the ice should be completely dry when it is removed. After the rotor speed has been adjusted the ice drying time can be adjusted by plugging some water nozzles in the last water ring preceding the rotor with a waterproof putty such as electricians duct seal. Shine a light on the freezing surface directly in front of the removal tools and if the ice is dry it will appear dull and non-reflective. If it is wet and shiny, then stop the ice maker and plug some nozzles. Repeat this process until the ice at the bottom of the freezing surface is dry just before the removal tools remove it. The dry area of the ice will be wider at the top of the freezing surface than at the bottom due to the relative movement of the water downward and the horizontal movement of the water rings.
OPERATING PROCEDURE

The normal procedure to start the ice maker would be as follows:

1. Put the overflow standpipe in the water makeup tank and open the water line stop valve to fill the tank. Add salt to the salt tank if necessary.

2. Press the JOG pushbutton until the rotor makes one revolution to check that it is working okay.

3. Press the START pushbutton and turn the compressor on if it is not already operational. Observe the freezing surface to ensure that the pump does not come on until the freezing surface is frosted at least halfway up from the bottom. (Review #5 of the Initial Startup Procedure section if this does not happen.) Check the ice removal and adjust the salt feeder valve if necessary.

4. On halocarbon refrigerant ice makers check the flow through the oil return line sight glass. No flow visible usually indicates that the strainer in this line needs cleaning.

The ice maker would normally be stopped by the ice bin high level control or the STOP pushbutton. In either case the stop valve in the water supply line to the makeup tank should be closed to prevent water seeping into the ice maker drip trough at the bottom of the freezing surface and freezing in it during the off period. Also it is a good idea to pull the overflow standpipe from the makeup tank and drain it. This drains away any mineral concentrate that has built up in the water tank during operation.

SEAWATER

All NORTH STAR ice makers are capable of making seawater ice. However some modifications are normally required. Seawater ice contains entrapped brine and has a soft rubbery consistency. It tends to cling to the freezing surface as opposed to the hard flakes of freshwater ice which release freely. Special removal tools with a wiper blade feature are required to remove seawater ice and must be installed.

Also the rotor speed becomes much more critical and must be carefully adjusted. If the rotor speed is too slow, the ice will pull loose from the freezing surface and start revolving as a cylinder inside the ice maker. If the rotor speed is too fast, the ice will be too soft for the tools to lift it off the freezing surface. The rotor speed may have to be readjusted periodically since the salinity and temperature of the seawater supply may vary in different locations. The addition of a variable speed control for the rotor speed is very helpful especially for shipboard mounted units.

Under normal conditions all water which enters the ice maker continues to circulate until it is frozen. During the freezing process, fresh water freezes first so it is usually beneficial to install a continuous bleed from the water tank to minimize the salt buildup. Draining the water tank several times a day is also a good method to hold the salinity level down.

The salt feeder tank is not required and can be removed when operating with seawater.

Since seawater ice freezes at a lower temperature than fresh water ice, the best results are obtained at a low evaporator temperature (-10° F., -23° C. maximum).
MAINTENANCE

LUBRICATION

Once a year is sufficient to change the oil in the center reducer and the worm gear reducer. Use SAE 80W/90 (ISO 100 or 150) truck duty all purpose gear oil in the center ring and pinion reducer. Refer to the lubrication suppliers list in the worm gear manufacturer’s bulletin in the back of this manual for the correct oil for the worm gear reducer.

SCALE

Due to impurities in most water supplies, a scale may eventually build up on the freezing surface. One way to reduce the rate of scale buildup is to drain the water makeup tank once or twice a day to prevent minerals from concentrating in the tank. Because water tends to freeze in a pure state, the dissolved minerals concentrate in the unfrozen water which is in a closed system and some eventually deposit on the freezing surface as scale. If there is a high amount of hardness in the water supply, we recommend that a permanent bleed line to a drain be installed in the water line between the water pump and the top of the machine. A control valve can be installed in this line to control the amount of bleed.

A scale buildup on the freezing surface will usually cause poor ice removal and decrease the capacity of the machine by decreasing the rate of heat transfer through the freezing surface. Different minerals in the water form different kinds of scale and some are easier to remove than others. Lime scale is the most common.

To remove scale the refrigerant must be pumped out of the ice maker. One method is to pack coarse (#3) steel wool in front of the removal tools and then run the ice maker with no refrigeration. The water will help wash the scale out of the steel wool. The wool should be turned or replaced every one or two hours of running until the freezing surface is clean.

WARNING:
REMEMBER TO ALWAYS DISCONNECT THE ELECTRICAL POWER BEFORE WORKING INSIDE THE MACHINE.

Another method is to use a commercial ice machine cleaner. This liquid is added to the water in the water makeup tank as directed. The ice maker is run with no refrigeration as instructed until the scale is softened so that it can be removed manually with a disc sander. The drawback to this method is that the acid in this cleaner will attack the galvanized surfaces in the ice maker and accelerate their corrosion with repeated use. This method is not recommended for regular use on ice makers with a carbon steel freezing surface as it can etch the freezing surface if it is too strong and worsen the ice removal.

RUST

Rust will form on carbon steel freezing surfaces whenever the temperature is above 32° F. (0° C.). During times when the ice maker is going to be shut down for long periods of time such as for a seasonal operation, it is recommended that the freezing surface be coated with medium weight oil.

If the ice maker is going to be shut down frequently for short periods of time, it is recommended that the freezing surface be kept below 32° F. (0° C.). This can be done by turning the pump off with the pump selector switch (PSS) and leaving the refrigeration system operating. The low pressure
cutout switch on the compressor can be adjusted to minimize short cycling while still maintaining the evaporator temperature below freezing.

Excessive rust on the freezing surface can be removed using the steel wool method for removing scale as described in the Scale section. However if the surface is deeply pitted, it may have to be returned to the factory for reboring.

DEOILING

HALOCARBON REFRIGERANT SYSTEMS

As described previously, oil return on halocarbon refrigerant systems is a continuous process. It should be monitored daily by checking the oil level at the compressor(s) and observing the flow through the sight glass in the oil return line. The strainer in this line should be cleaned if no flow is observed in the sight glass.

AMMONIA SYSTEMS

Oil accumulation in the ice maker causes a decrease in the ice making capacity of the machine by inhibiting the heat transfer rate through the freezing surface. The ice at the bottom of the freezing surface will look slushy and often random patches of wet ice appear on the freezing surface when deoiling is necessary.

Hot Gas Method: The following procedure is used to deoil the ice maker with hot gas (if the machine is connected as shown on drawing 10PW-0 and 10PW-FC).

1. Close the liquid line stop valve and run the machine until all of the ammonia is pumped out. Stop the refrigeration and the ice maker.

2. Open the oil drain valve at the bottom of the ice maker which is connected to an oil pot or a similar oil trap pressure vessel.

3. Close the suction line stop valve.

4. Open the stop valve in the line connecting the oil trap with the suction line on the compressor side of the suction line stop valve.

5. Open the stop valve in the hot gas line and adjust so that pressure in the ice maker does not exceed 125 pounds (8.75 kg/sq cm).

6. Allow hot gas to blow through the ice maker until the oil drain valve at the bottom of the machine is warm to touch. After the oil drain valve is warm, continue to blow hot gas for at least 30 minutes to allow time for the warmed oil to drain to the bottom and around to the drain of the ice maker evaporator.

7. Close the hot gas line stop valve and follow the procedure described in the section entitled "INITIAL STARTUP PROCEDURE" to restart the ice maker.
Warm Water Method: The following method is used to deoil the machine with warm water if hot gas is not available. The hot gas method is quicker and more effective and should be used if hot gas is available.

1. Close the liquid line stop valve and run the machine until all the ammonia is pumped out. Stop the refrigeration and the ice maker.

2. Close the suction line stop valve.

3. Warm the water in the makeup tank to at least 100° F (38° C), but less than 150° F (66° C) and circulate with the water pump. Add heat to maintain temperature.

4. After the steel in the machine is warm, crack the oil drain valve slowly and drain oil into the oil pot until no more comes out. Close the drain valve.

5. After five minutes, again open the oil drain valve slowly and remove additional oil that has drained down from the walls of the evaporator. Repeat draining every five minutes until all oil is removed. This procedure usually requires a minimum of four hours.

6. Close the oil drain valve and follow the procedure described in the section entitled "INITIAL STARTUP PROCEDURE" to restart the ice maker.
The Sporlan Levelmaster valve (LMC) is one of the types of liquid level controls supplied standard with NORTH STAR ice makers. The insert bulb is installed in the accumulator at the desired liquid level. As the liquid level at the bulb rises, the electrically added heat is carried away by the refrigerant around the bulb and the LMC valve either modulates or shuts off. As the liquid level drops, the increased heat expands the gas in the capillary tube and causes the valve to open.

The LMC shipped with the ice maker was selected on the basis of the operating information supplied to NORTH STAR. This included refrigerant, voltage, suction temperature or pressure, and model of ice maker. Minor adjustments in liquid level can be made with the adjusting stem at the bottom of the valve. After the cap is removed, the capacity of the valve can be decreased by turning the adjusting stem clockwise (in) and vice versa. If the operating conditions are significantly different from the design conditions by which the valve was selected, the valve may malfunction by overfeeding or underfeeding the ice maker.

If the ice maker is not making ice all the way to the top of the removal tools, it is starving for refrigerant. Some of the more common causes are listed below.

1. The 15 watt heater element inside the bulb is either burnt out or it is the wrong voltage. The heater element can be removed from the bulb without opening the seal to the accumulator by removing only the lock ring on the very end of the bulb. After the lock ring is removed, the rubber grommet and heater element can be carefully pulled out as a unit. Stamped on the element is the voltage. Energize the circuit to the heater and check to see if it gets warm.

2. On all halocarbon refrigerant ice makers and Models 60 and 90 ammonia ice makers, the LMC valve has an external equalizing connection. If the piping is not connected between this outlet and the suction line, the valve will not feed properly.

3. The refrigerant line between the valve and the accumulator is too small or has too many restrictions (elbows). This creates excessive pressure drop between the outlet of the valve and the accumulator and reduces the amount of refrigerant reaching the accumulator. The pipe between the expansion valve and the accumulator must be increased to full size of the liquid inlet on the accumulator at the outlet of the expansion valve.

4. The pressure drop across the valve is lower than normal which reduces the capacity of the valve. This is usually the result of operation with a lower head pressure than designed for or a large vertical rise between the receiver and the ice maker. Excessive pressure drop or low pressure in the supply line to the valve can also cause refrigerant flashing in the line which will restrict refrigerant flow to the valve.

5. The strainer or filter drier in the refrigerant line to the LMC valve or the strainer within the valve body is plugged.

6. The refrigerant level in the receiver is so low that the refrigerant line to the ice maker is not full.

7. The liquid line from the receiver is undersized.
THERMAL DIFFERENTIAL SENSOR

The Thermal Differential Sensor (TDS) is one of the types of liquid level controls supplied standard with NORTH STAR ice makers. It is used in conjunction with a customer supplied hand expansion valve and a solenoid valve with a pilot light on the liquid line feeding the ice maker.

A mercury switch is attached to one end of a shaft which has a heat actuated helical coil attached to the other end. When no liquid is present in the telltale at the sensor height, heat from the attached heater will cause the coil to turn the mercury switch clockwise until the switch contacts close. This will energize the solenoid valve to open and feed liquid to the ice maker. When the liquid level comes up the height of the TDS sensor in the standpipe, the liquid will absorb the heat and the coil will turn back until the mercury switch contacts open which will close the liquid line solenoid valve. When the liquid level drops again, the cycle will repeat.

Install the stainless steel telltale tube provided as shown on drawing TDS-0. The connection piping to the telltale should never be trapped and should be insulated. Coat the inside of the Thermal Differential Sensor (TDS) copper housing clamp with substance “k” provided before clamping it to the telltale at the height shown on drawing TDS-0 with the heater receptacle on top. Coat the cartridge heater with substance “k” provided before pushing it into its receptacle in the copper housing.

The hand expansion valve should be adjusted open just enough to slightly overfeed the ice maker to insure that adequate liquid will be supplied to the ice maker at all times. Once the valve is properly adjusted at startup, it will not need readjustment unless conditions at the ice maker change considerably. Do not substitute a globe valve for the hand expansion valve as it does not provide the degree of adjustment necessary for correct operation.

Vibration at the TDS can cause the solenoid valve to chatter when operating. This is caused by the mercury switch vibrating on and off as it nears the on position. This condition can be eliminated by installing an on delay relay which is actuated instead of the solenoid valve. The on delay contacts will then energize the solenoid valve once the mercury switch is irreversibly on. Contact the NORTH STAR engineering department if this condition exists for details about adding this relay.

REFRIGERANT FLOAT SWITCH

The Refrigerant Float Switch (RFS) operates in conjunction with a customer supplied hand expansion valve and a solenoid valve with a pilot light in the same way as the TDS control. The liquid line solenoid valve will close whenever the liquid level in the ice maker is high enough to raise the float ball and open the normally closed contacts. Install the refrigerant float switch so that the liquid level mark on the float chamber is at the height shown on drawing RFS-0 or TDS-0. Adjust the liquid level differential setting in the float switch to the minimum.

AUTOMATIC FLOW REGULATOR (AFR-3)

The automatic flow regulator is provided with ice makers designed for ammonia forced recirculation systems (pumped liquid). The regulator should be adjusted for a 15% overfeed. This can be done by multiplying the refrigeration load in tons of refrigeration by 1.15 and adjusting the regulator indicator scale to the setting.
REPAIRS

WARNING:
REMEMBER TO ALWAYS DISCONNECT THE ELECTRICAL POWER BEFORE WORKING INSIDE THE MACHINE.

BEARINGS

Bearing failure will result in poor or no ice removal. Bearing condition can usually be checked by prying between the solid part of the rotor and the freezing surface with a pry bar. If any movement is detectable, the bearing should be replaced. Normal bearing life on NORTH STAR bearings is about five to seven years. Replacement bearings are available from the NORTH STAR parts department. Since it is quite likely a rotor bearing seat will be damaged if a bearing is allowed to run until it seizes, we recommend replacing the bearings after five years of operation to avoid the expense of repairing or replacing a rotor. Normal bearing life on standard bearings from other suppliers is one to three years.

NOTICE:
NORTH STAR ORIGINAL EQUIPMENT AND REPLACEMENT BEARINGS ARE COMPLETELY PACKED WITH WATER RESISTANT GREASE AND HAVE MINIMAL INTERNAL CLEARANCES TO MINIMIZE RADIAL AND AXIAL PLAY. STANDARD BEARINGS DO NOT MEET THESE SPECIFICATIONS. PERFORMANCE AND BEARING LIFE WILL BE COMPROMISED IF SUBSTITUTIONS ARE MADE.

BOTTOM BEARING

Refer to drawings AC-2 and X000-P3 in the back of this manual.

Bearing replacement procedure: The bottom bearing housing is pulled down off the bottom of the rotor after removing the bolts holding it to the attachment ring. On the Model 10 ice maker remove the three capscrews from the underside which hold the housing in place. The bearing housing fits snugly into a pilot bore in the lower support arm assembly. Over time the bearing housing can rust bond into the pilot bore of the support arm assembly and it may have to be pulled out. The rotor jacking screw as shown on drawing AC-2 can be screwed into the threaded hole in the bottom of the housing and used to jack the housing down out of the pilot bore.

If the bearing housing will not pull free using this method, on Model 10 ice makers there are two 3/8" diameter threaded jacking bolt holes provided for jacking the housing down. On the other ice makers, remove the bolts holding the attachment ring to the lower frame assembly and raise the attachment ring. Place some spacers between the attachment ring and the bearing housing. By tapping on the attachment ring and keeping tension downwards on the housing by tightening up the rotor jacking screw, the housing should pull out of the pilot bore. Remember to be ready to catch the housing when it falls as it is quite heavy. It may be necessary to loosen the rotor jacking screw when the housing is almost out to release a vacuum which can be formed as the housing is pulled down off the bearing.

The bottom bearing can then be removed with a wheel puller after unscrewing the cap screw in the bottom of the rotor and removing the bearing holder plate.

The new bearing can be tapped lightly into place with a block of wood. Before installing the bearing housing coat the top and bottom of the new bearing with a heavy grease to maximize corrosion.
protection. Coat the inside of the bearing housing with grease and also the outside finished surfaces which press into the lower ice maker support arm assembly. Repack the slot in the top of the housing with a food grade grease or a heavy oil. Bolt the attachment ring back in place and the housing can be pulled back into the pilot bore by using some long bolts through the bolt holes in the attachment ring.

**TOP BEARING**

Refer to drawings AC-2, AC-3 & AC-4 for Model 10, AC-2, AC-5 & AC-6 for other ice makers and X000-P4 in the back of this manual.

Bearing replacement procedure: The best method is to remove the top gear housing from the top of the machine and replace the bearing in it before reinstalling the top gear housing back on the machine.

The first step is to remove the water pipe from the pump to the top of the ice maker along with the water flow control valve assembly. Remove the water inlet overflow shield from the top of the rotor by pulling it straight up. Remove the oil drain plug and drain the oil from the top gear housing.

The rotor actually hangs inside the machine supported by the top bearing. The rotor jacking screw (drawing AC-2) is used to prevent the rotor from dropping when the top rotor nut is removed. First, loosen the bolts which hold the bottom plow to the rotor arm. This is to prevent the plow blade from contacting the bottom of the freezing surface when the rotor is jacked up. At the bottom of the ice maker, remove the ½" pipe plug from the center of the bottom bearing housing. Then screw the rotor jacking screw into the threaded plug hole in the bottom bearing housing and tighten the jacking screw until it is up tight against the bottom of the rotor. This will hold the rotor up in the correct position when the rotor nut is removed.

Remove the gear housing cover and the water pipe support bracket. Apply penetrating oil to the rotor nut threads and unscrew the rotor nut with the special top rotor nut wrench shown on drawing AC-3 or AC-5 (left hand threads on all rotors manufactured since February, 1979). The rotor nut can be very tight and it may be necessary to rap on a bar through the rotor nut wrench soundly to break it loose. Pull the ring gear hub key(s) on all ice makers except the Model 10 by screwing a long 3/8" bolt with a sliding weight into the top of it.

Remove the belt guard, belt, drive and driven pulleys. Remove the counterweight shackle and the travel limiting nut from the bottom of the motor drive channel and the hex nut and washer from the end of the pinion shaft. Unbolt the drive motor from the motor drive channel and block or tie it away from the motor drive channel. Using a block of wood and a hammer, tap the worm gear reducer and the motor drive channel which is bolted to it off of the pinion shaft as a unit. Remove the drive support channel by unscrewing the lagbolts securing it to the base, loosen the set screw at the top and slide it off of the pinion shaft housing.

The next step is to pull the ring gear hub which may be corrosion bonded to the rotor shaft. Apply penetrating oil to the joint between the ring gear hub and the rotor shaft. Lay a piece of steel channel or heavy angle across the top of the gear housing. Drill two holes in it spaced apart the same as the two tapped puller bolt holes in the top of the ring gear hub so some high grade bolts can be used to pull up on the ring gear hub. Drill or cut one 1 1/2" diameter hole in it directly over the hole in the top of the rotor. After the bolts are pulling with equal tension, rap soundly on the top of the ring gear at various places with a hammer to help loosen the ring gear hub. Also, the rotor jacking screw can be lowered about 1/4" (6 mm) and a solid round bar can be inserted into the hole in the top of the rotor. The round bar should be long enough to reach the bottom of the hole and
extend above the top. By tamping on the bottom of the rotor hole firmly with this bar or hitting the
top of this bar with a sledge hammer the rotor can sometimes be driven down through the ring gear
hub enough to break the corrosion bond. Heat can also be applied to expand the hub around the
rotor shaft. The ring gear hub can then be pulled off the top of the rotor by using the puller bolts.
Loosen the puller bolts when they run out of travel and place spacers under the channel or angle.
As a last resort, the ring gear can be unbolted from the ring gear hub and the hub can be cold
chiseled off by drilling a line of holes from the outside to the inside of the hub at the keyway.

Use the bearing retainer ring wrench (drawing AC-4 or AC-6) to loosen the bearing retainer ring (left
hand threads). Again it will be necessary to rap on the bar through the retainer ring wrench soundly
to loosen the retainer ring since the threads were sealed with Permatex. The pinion gear may have
to be moved back to get the bearing retainer ring all the way out. This can be done by loosening the
nuts holding the pinion shaft housing to the top gear housing and jacking the pinion shaft housing
flange back by using the jacking bolt holes in the flange.

Next, remove the bolts holding the top gear housing to the top of the ice maker. These are
accessible from inside the ice maker on all models except the Model 10. Then retighten the nuts
holding the pinion shaft housing to the top gear housing if they have been loosened and tap the
pinion shaft housing from side to side horizontally to break the corrosion bond between the gear
housing and the pilot bore in the top of the ice maker. Pull the gear housing out of the pilot bore and
take it off the top of the ice maker. If the gear housing is difficult to pull out of the pilot bore, a small
hydraulic jack can be placed on top of the rotor and a chain can be looped over the top of it and
around the pinion shaft housing on one side and a short pipe nipple screwed into the oil fill plug hole
on the other side. The gear housing can then be jacked up out of the pilot bore.

Before replacing the top gear housing on top of the ice maker, check the bearing seat on the rotor
by either measuring it with a micrometer or partially sliding the new bearing over it. The inner race
of the new bearing should fit snugly over the bearing seat on the rotor. If it is loose, the rotor will
have to be removed and replaced or repaired.

Drive the old bearing out of the gear housing from the bottom with a hammer. Flush the gear
housing out with solvent and wipe clean. Install the new bearing in the gear housing by tapping on
the outer race until it is firmly seated against the bottom. Important: Apply Permatex sealant to the
threads of the bearing retainer ring and screw the retainer ring back into the gear housing.

Lower the rotor with the rotor jacking bolt several turns if this was not done during the ring gear hub
removal procedure. Then install the top gear housing back into its pilot bore by tapping it down
uniformly around its outer perimeter. Bolt the top gear housing back into place.

Now have one person jack the rotor back up from below while another person taps the inner race of
the bearing down until there is a definite ringing sound indicating the inner race of the bearing is
properly seated and resting solidly on the rotor shaft shoulder below it. Not getting the bearing
properly seated during the reassembly process is the single most frequent cause of
problems after replacing the top bearing. Coat the inside of the ring gear hub and keyways with
never seize compound. Reinstall the ring gear with the ring gear hub and the top rotor nut.

Gear backlash: Proper backlash clearance between the ring and pinion gears is necessary for
good performance and longevity. If the top rotor nut and the ring gear hub were reusable then the
backlash should not have changed from what it was before the bearing was replaced. If any of the
components besides the top bearing were replaced then it will be necessary to adjust the backlash
clearance. The backlash clearance as measured by the following method should be between
.0005" and .003" (.013 mm to .076 mm). The underlying principle is that some clearance between
the gears is required or the gears will be carrying the weight of the rotor instead of the top bearing which will result in short gear life. However this clearance must be minimal since excessive clearance will also result in short gear life. Excessive chatter in an ice maker is often the result of excessive gear backlash clearance.

The first step is to lower the rotor by loosening the rotor jacking screw. Tamp down inside the hole in the top of the rotor with a round bar so that the rotor drops down as low as possible.

It will be necessary to prevent the pinion gear from turning when checking the gear backlash. The easiest way to do this is to lock it against the outside end of the pinion shaft housing by using a piece of pipe between the large heavy washers which go on each side of the worm gear reducer and some 3/4" (19 mm) square bar or keystock (minimum size). Cut the pipe slightly shorter than the length through the worm gear reducer. Place one piece of keystock about 6" (150 mm) long on each side of the pinion shaft against the end of the pinion shaft housing and place the inside washer over the pinion shaft against the keystock so the keystock is sandwiched between the end of the pinion shaft housing and the washer. Then put the pipe and then the outside washer over the pinion shaft and tighten the nut on the end of the pinion shaft so that pressure is transferred from the nut to the end of the pinion shaft housing thereby locking the pinion shaft from turning.

Screw a bolt into one of the puller bolt holes on the top of the ring gear hub and then clamp a dial indicator to the top of the gear housing so that the stem of the indicator is resting against one side of the head of the bolt. Have someone pull one way on the rotor arm near the freezing surface until it will go no farther. Set the dial indicator at zero while the rotor is being held one way and then pull the rotor as far as it will go in the opposite direction. The dial reading is the backlash clearance.

If there is no reading, then there is no backlash clearance and shimming is required under the ring gear hub to raise the ring gear. These shims are available from the NORTH STAR parts department. Screw the rotor jacking screw in until it just starts to lift the rotor. Unlock the pinion gear and start turning the rotor. Screw the rotor jacking screw in until the rotor turns freely. Every one quarter turn of the jacking screw equals about .005" (.13 mm) shim. Remove the rotor nut and the ring gear hub and add the shim(s) under the ring gear hub. Replace the ring gear hub, the rotor nut, lock the pinion gear from turning again, unscrew the rotor jacking screw, tamp the rotor down and check the backlash again. Repeat as necessary until correct backlash clearance is obtained.

If the backlash clearance is excessive, then the ring gear will have to be lowered by machining material from the bottom of the ring gear hub. If a new ring gear hub was installed, then the original backlash clearance reading will always be excessive. Jack the rotor back up until the jacking screw gets tight and remove the rotor nut and ring gear hub. Machine .002" (.05 mm) off the bottom of the ring gear hub for each .001" (.025 mm) that the reading was high. Replace the ring gear hub, the rotor nut, unscrew the rotor jacking screw, tamp the rotor down and check the backlash again. Repeat adjustment procedure if necessary.

After the backlash clearance is correct, unlock the pinion shaft and repack the slot in the top of the rotor with a food grade grease. Install all the components which were removed and remember to remove the rotor jacking screw, retighten the bottom plow and check for clearance on the blade.

Remove the oil level and the fill plugs from the top center gear housing and fill this reducer with S.A.E. 80W or 90W truck duty gear oil until it flows out of the oil level plug opening. This is a dry well type reducer. Do not overfill this reducer or oil will flow over the bearing retainer ring dam inside the reducer and drain down through the top bearing onto the top of the rotor shaft inside the ice maker. If this happens it may take several months for all of the excess oil to drain out through the bearing and decrease bearing life.
ROTOR

The rotor would normally never need to be removed unless the top bearing seat is damaged. If this happens the rotor can be repaired by having the bearing seat built up and reground to the correct diameter or the rotor can be replaced. The rotor can be removed by removing all of the components which are attached to it and the top gear reducer assembly. Then it can either be lifted out through the inspection hatch or lowered out through the bottom of the ice maker.

ICE REMOVAL TOOLS

Refer to drawing X000-P3 in the back of this manual.

Normal life of ice removal tools is eight to ten years. The blade against the freezing surface must have a maximum width of .030" (.80 mm) and the leading edge must be sharp and not jagged. Ice removal tools can be damaged if the clearance from the freezing surface is too small and the tools contact the freezing surface. The recommended clearance for all Model 10 ice makers is .010" (.25 mm). For all other carbon steel ice makers the recommended clearance is .015" (.40 mm). For all other stainless steel ice makers the recommended clearance is .020" (.50 mm).

Each removal tool block is 11.25" (286 mm) long so there are two blocks in a Model 10 or 20, four blocks in a Model 40 or 60 and six blocks in a Model 90. To remove the removal tools, the ice maker freezing surface must be above freezing. First remove the top plow. Then loosen the four 1/4" locking bolts holding the locking bar wedge against the top removal tool. Tap the locking bolts with a hammer and the locking bar will release from the removal tool and the tool can be slid out of the top of the rotor groove. This process can be repeated for the rest of the tools.

To install new removal tools, first insert a removal tool into the top of the rotor groove and slide it down to the bottom. It may be necessary to reach into the rotor groove and push the jacking screw spacer plugs back in order to get the tool to slide past them. Locate the bottom tool so that the bottom blade is about 3/4" (19 mm) from the bottom of the freezing surface. Tighten the 3/8" jacking bolts finger tight to hold the tool in place against the freezing surface. Then tighten the 1/4" locking bolts to pull the locking bar in against the removal tool and wedge it in place. To adjust the removal tool clearance loosen the jacking bolts about a quarter turn and retighten the locking bolts. Check the clearance of the leading edge of each blade with a feeler gage. Repeat this process until the clearance is within .002" (.05 mm) of the clearance specified above. Install the rest of the removal tools using this same method. Space the separate removal tool blocks so the distance between the blades at the separation is the same as the rest of the blades.

Replace the top plow after all the removal tools are installed and adjust the clearance for the top plow blade to the same as the removal tool clearance.

FLOAT VALVE

A leaking float valve will waste water. Float valve leaks can be caused by debris clogging the valve seat or by a worn out valve. Debris can be cleared from the float valve by turning off the water supply and removing the cotter key and disassembling the valve. Turning the water back on briefly while the valve is apart should clear any debris. Replacement valves are available from the NORTH STAR parts department.
MAINTENANCE SCHEDULE

WARNING:
REMEMBER TO ALWAYS DISCONNECT THE ELECTRICAL POWER BEFORE WORKING INSIDE THE MACHINE.

DAILY
1. Inspect water rings for plugged nozzles. Clean water rings and nozzles as required.
2. Drain the water from the makeup tank and refill with fresh water. If the ice maker is running, pull the overflow standpipe and allow the water level to drain down to, but not below the top of the water pump impeller housing. Drain for two minutes and refill.
3. Check the oil return line sight glass to ensure strainer is not obstructed on halocarbon systems.

MONTHLY
1. Check for oil accumulation in evaporator on ammonia systems. Deoil if required.
2. Check for scale or rust on evaporator freezing surface. Clean if required.

ANNUALLY
1. Inspect drive belt. Replace if required.
2. Check for leaky float valve. Replace if required.
3. Change oil in top gear reducer and worm gear reducer.
4. If ice removal has worsened, check condition and clearance of removal tools. Adjust or replace as required.

FIVE YEARS
1. Replace rotor bearings with North Star replacement bearings.
TROUBLESHOOTING

In order for the ice maker to perform well it must first make good ice on the freezing surface and then remove at least 95% of the ice from the freezing surface with each pass of the rotor. Low capacity can be the result of problems with either or both of these functions. If the ice maker seems to be running okay, but is not making the expected capacity, then the first things to check are the methods used for determining the capacity, the ice thickness, the incoming water temperature and the evaporator temperature.

The only accurate method of measuring the production capacity of the ice maker is to install a water meter in the water supply line just before it connects to the makeup tank. Since there is no wasted water in a NORTH STAR ice maker, all water measured by the meter is changed to ice. Capacity test readings should be taken over a period of time such as every four hours over a period of 24 hours.

Maximum production is obtained by making thin ice but if the ice is too thin the ice removal tools will only groove the ice and the rotor will eventually stall as the ice builds up on the freezing surface. The ice thickness should be between .060" (1.5 mm) which is about the thickness of an American penny and .080" (2 mm) which is about the thickness of an American nickel. The thickness should be measured with plastic dial calipers for capacity test purposes since the difference between .060" ice and .080" ice can affect capacity by as much as 15%.

The water temperature should be checked with a thermometer in the supply line near the ice maker, not in the ice maker makeup tank since this water is precooled by the ice maker.

The evaporator temperature or pressure reading must be taken at the ice maker, not at the compressor since the compressor reading does not reflect the pressure drop in the suction line.

<table>
<thead>
<tr>
<th>SYMPTOM</th>
<th>POSSIBLE CAUSE</th>
<th>PROBABLE SOLUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ice maker will not start.</td>
<td>Access cover not in place.</td>
<td>Close access cover to trip safety switch.</td>
</tr>
<tr>
<td></td>
<td>Emergency stop pushed.</td>
<td>Pull emergency stop pushbutton out.</td>
</tr>
<tr>
<td></td>
<td>Drive motor overload tripped.</td>
<td>Reset overload (OL-IM) in control panel.</td>
</tr>
<tr>
<td></td>
<td>Pump motor overload tripped.</td>
<td>Reset overload (OL-P) in control panel.</td>
</tr>
<tr>
<td></td>
<td>Power off.</td>
<td>Check main switch, fuse and wiring.</td>
</tr>
<tr>
<td></td>
<td>High level control tripped.</td>
<td>Start after ice level in storage bin is lower.</td>
</tr>
<tr>
<td></td>
<td>Load limit switch tripped.</td>
<td>Reset load limit switch.</td>
</tr>
<tr>
<td>Pump will not start.</td>
<td>Pump selector switch is off.</td>
<td>Turn switch to AUTO position.</td>
</tr>
<tr>
<td></td>
<td>Pressure switch is open.</td>
<td>Review Initial Startup Procedure.</td>
</tr>
<tr>
<td></td>
<td>Pump motor overload tripped.</td>
<td>Check suction pressure.</td>
</tr>
<tr>
<td></td>
<td>Pump failure.</td>
<td>Check pressure switch setting.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Check compressor operation.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reset overload (OL-P) in control panel.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Replace pump.</td>
</tr>
</tbody>
</table>
Thin ice.

- Oil accumulation in evaporator. Ammonia - Decoil ice maker. Halocarbon refrigerant - Remove oil return line restriction.
  - Check sight glass.
  - Clean plugged strainer.
  - Adjust HEV in oil return line.
  - Review Deoiling section.
- Scale on freezing surface. Descale freezing surface. Review Scale section.
- Insufficient water. Open water flow control valve more. Clean water line strainer.
  - Check float valve adjustment.
  - Replace defective pump.
  - Review Initial Startup Procedure section.
- Moisture in refrigerant. Remove moisture from refrigerant.
- Low refrigerant charge. See Low refrigerant charge.
- Insufficient liquid line feed. Clean liquid line strainer.
  - Clean LMC strainer.
  - Open LMC valve.
  - Connect LMC equalizer line.
  - Replace LMC heater element.
  - Increase head pressure.
  - Remove moisture from refrigerant.
  - Replace undersized line between LMC and ice maker.
  - Replace undersized liquid line to LMC.
  - Review Sporlan Levelmaster Valve section.
  - With TDS or RFS, open HEV in liquid line.
  - Check TDS placement on telltale.
  - Replace defective TDS or RFS.
  - Review Thermal Differential Sensor section.
  - Review Refrigerant Float Switch section.
- Poor ice removal. Ice too thin. See Thin ice.
- Ice too thick. Adjust rotor speed faster. Review Initial Startup Procedure section.
- Salt required. Fill salt feeder tank.
  - Open salt feeder valve more.
  - Review Initial Startup Procedure section.
- Scale on freezing surface. Descale freezing surface. Review Scale section.
<table>
<thead>
<tr>
<th>Issue</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Worn rotor bearings</td>
<td>Replace rotor bearings. Review Bearings section.</td>
</tr>
<tr>
<td>Rotor motor overload</td>
<td>See Poor ice removal.</td>
</tr>
<tr>
<td>Poor ice removal</td>
<td>Adjust removal tools. Review Ice Removal Tools section.</td>
</tr>
<tr>
<td>Removal tools too close</td>
<td>See Drip trough full of ice.</td>
</tr>
<tr>
<td>Drip trough full of ice</td>
<td>Add oil to gear reducers. Review Lubrication section.</td>
</tr>
<tr>
<td>Gear reducers need oil</td>
<td>Delay pump on during initial startup. Review Initial Startup Procedure section.</td>
</tr>
<tr>
<td>(At startup)</td>
<td>Heat supply water to 45° F. (min.). Review Water System section.</td>
</tr>
<tr>
<td>Water pump on too soon</td>
<td>Adjust HEV on oil return line. Review Deoiling section.</td>
</tr>
<tr>
<td>Drip trough full of ice</td>
<td>Install adequate heat exchanger. Review Oil Return section.</td>
</tr>
<tr>
<td>Water too cold</td>
<td>Supply warm liquid to heat exchanger.</td>
</tr>
<tr>
<td>Flooding to compressor</td>
<td>Adjust LMC. Review Sporlan Levelmaster Valve section.</td>
</tr>
<tr>
<td>Inadequate heat exchanger</td>
<td>Check LMC size with factory. Review Sporlan Levelmaster Valve section.</td>
</tr>
<tr>
<td>Cold liquid to heat exchanger</td>
<td>Adjust HEV on liquid line. Review Thermal Differential Sensor section.</td>
</tr>
<tr>
<td>LMC needs adjustment</td>
<td>Review Refrigerant Float Switch section.</td>
</tr>
<tr>
<td>Oversized LMC</td>
<td>Clear debris from float valve. Review Float Valve section.</td>
</tr>
<tr>
<td>HEV needs adjustment</td>
<td>Replace float valve. Review Float Valve section.</td>
</tr>
<tr>
<td>Leaky float valve</td>
<td></td>
</tr>
<tr>
<td>Debris in float valve</td>
<td></td>
</tr>
<tr>
<td>Worn float valve seat</td>
<td></td>
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</table>