



ONTARIO RECREATION
FACILITIES ASSOCIATION INC.

SUGGESTED GUIDELINES FOR REFRIGERATION PLANT MAINTENANCE

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Suggested Guidelines for Refrigeration Plant Maintenance

2004

Refrigeration Plant Maintenance Program

Introduction	2
Terminology	2
Procedures for Developing Your Program	3
Refrigeration Plant Maintenance Program Policy	6
Ice Plant Start-up Procedure Checklist	7
Maintenance Program Procedures	8
Daily Maintenance	8
Weekly Maintenance	10
Monthly Maintenance	10
Bi-Annual Maintenance	11
Annual Maintenance	12
Five Year Maintenance	13
Troubleshooting Guide	14
Compressor fails to start	14
Compressor “short-cycles”	15
Suction pressure too high	16
Suction pressure too low	16
Discharge pressure too low	17
Discharge pressure too high	17
System short of capacity	18
Compressor or system noisy	18
Compressor runs continuously	19
Plant Maintenance Inspection Report	20
Job Function Checklist	21
System Condition and Recommendation Form	26
Refrigeration Maintenance and Repair Record	29

INTRODUCTION

The purpose of this document is to assist Facility Managers, Supervisors and/or Operators develop a general maintenance program for a registered unattended refrigeration plant.

Any registered refrigeration plant is required by legislation to operate under the Technical Standards and Safety Act – Operating Engineers Regulation, Boilers and Pressure Vessels Regulation, CSA-51-97 Boiler, Pressure Vessel and Pressure Piping Code and the CSA-B52-99 Mechanical Refrigeration Code.

The Operating Engineers regulation requires that owners/operators for any registered unattended refrigeration plant develop and implement a maintenance program. To ensure the safety of the public and staff, it is required that owners/users of these refrigeration plants clearly understand and comply with the requirements as prescribed by the Operating Engineers Regulation 219/01 and the CSA B52-99 Mechanical Refrigeration Code.

It is therefore the responsibility of the owner/operator to develop the maintenance program to at least include the manufacturer maintenance and service recommendations and to ensure such recommendations are performed. Some of these recommendations may apply to one type of refrigeration system and not another type. For example, one troubleshooting recommendation might apply to a DX unit cooler type of system while others might apply to a flooded type of chiller.

The maintenance shall be performed by one of:

- Certified Operating Engineer or Refrigeration Operator
- Person acceptably trained in the maintenance specifics of the equipment
- Contracted person or company that is acceptably trained, experience and equipped to perform the maintenance.

Through a process of log entries, contract wording, work reports and equipment inspection, the Operating Engineer will be able to verify satisfactory attendance to the required maintenance.

For further information, contact the O.R.F.A. office at 416-426-7062 or the Technical Standards Authority 416-325-2000 Toll-Free (outside Toronto): 1-877-682-8772.

NOTE: INTERPRETATION (as defined by O.R. 219/01)

“**unattended**”, in relation to a guarded plant or guarded installation, means that the plant or installation may be operated,
(a) without the appointment of a chief operating engineer or chief operator, and
(b) without an operating engineer or operator on shift duty providing supervision;

“**attendance**”, in relation to shift coverage, means the physical presence of a person for the purpose of mandatory shift coverage by an operating engineer or operator for the operation of the plant as set out in this Regulation and "attended" has a corresponding meaning;

“**operator**” means a holder of a subsisting certificate of qualification as an operator;

Suggested Guidelines for Refrigeration Plant Maintenance

“**owner**” means the person to whom or which the plant is registered but does not mean the operating engineer or operators who operate, control or maintain the plant;

“**refrigeration plant**” means an installation comprised of one or more refrigeration compressors, prime movers, equipment, pressure vessels and any associated piping;

Please ensure that you complete the following steps and procedures for your refrigeration plant maintenance program.

- ◆ Complete the O.R.F.A. (S.A.F.E.R.) Refrigeration Safety Inspection Checklist for your refrigeration plant. Make sure your document is complete with accurate information. If you do not have the information, please have your refrigeration mechanic assist you.
- ◆ Make sure you list in your logbook or maintenance document the names of the individuals who are permitted to enter your refrigeration room. (Recommend keeping logbook in your vestibule).
- ◆ Be sure to post your TSSA Plant Registration Certificate and a copy of your insurance certificate document in your vestibule.
- ◆ Ensure you have all staff qualifications, certificates and record of training posted in your refrigeration room vestibule.
- ◆ Ensure that all emergency telephone procedures are posted in your vestibule and in your staff office close to the telephone.
- ◆ Ensure a copy of your written emergency procedures and emergency evacuation plan is kept in your vestibule and in your staff office.
- ◆ Ensure that all doors leading into and out of your refrigeration room(s), pieces of equipment and all refrigeration piping are clearly labeled and properly colour coded. All doors should remain locked and signage shall be posted to restrict entry to authorized personnel only.
- ◆ Place a wall file folder at the location of all motors so that you can keep accurate records when equipment is serviced and/or maintained. When any piece of equipment is serviced or worked on by facility staff, electrician or refrigeration mechanic, the refrigeration maintenance and repair record (log sheet) must be filled out and completed by the individual completing the work and a copy placed into the wall file folder. It is recommended that a copy of the work completed be kept in another location for safe keeping as well. (Such as Managers or Supervisors office).

Suggested Guidelines for Refrigeration Plant Maintenance

- ◆ Keep refrigeration room and vestibule organized and clean at all time.
- ◆ Ensure all personal protective equipment is labeled and in place. E.g. Hearing protection, eye protection, face shield, work gloves, neoprene gloves, SCBA (self contained breathing apparatus), ammonia air mask, emergency eye wash/shower station, ammonia detection, neoprene apron, rope, etc.
- ◆ Ensure all staff have been provided with the proper training and that they have a clear understanding of your written refrigeration operations, maintenance procedures, emergency procedures, the Occupational Health & Safety Act and its regulations.
- ◆ Do you meet all code and regulation requirements under the Technical Standards and Safety Act, Operating Engineers regulations, Boiler and Pressure vessels regulations, and the CSA-B52-99 Mechanical Refrigeration Code and Regulations.
- ◆ Ensure that you have a hardbound, page numbered logbook. If you have an electronic log, does it conform to the new regulations and requirements?
- ◆ All refrigeration plant logs are to be available for three (3) years.
- ◆ It is strongly recommended that you keep a copy of the Technical Standards and Safety Act, Operating Engineers regulations, Boiler and Pressure Vessels Regulations and the CSA-B52-99 Mechanical Refrigeration Code on hand at your location.
- ◆ 1) The owner has three options on how to carry out the maintenance program which are:
 - (a) by a qualified licensed refrigeration mechanic,
 - (b) by a certified Operating Engineer or Refrigeration Operator
 - (c) trained and competent individual(s) (the responsibility and onus is on owner to ensure and prove that this individual(s) have competency)
- 2) Once the owner has decided which option they wish to implement, the written maintenance program must clearly define who will be responsible for what repairs and maintenance items. I.e. The municipality or owner must clearly define in writing as to what daily, weekly, bi-annual and annual duties; repairs and maintenance will be performed by their refrigeration “B” operators and or competent facility operators:

And clearly define in writing what duties; repairs and maintenance activities will be performed by their qualified refrigeration mechanic/ mechanical company.

Suggested Guidelines for Refrigeration Plant Maintenance

It is essential that any maintenance activity be performed at least to the maintenance and service recommendations of the manufacturer. Further, all work performed must be done by an accepted process.

- ◆ The owner is responsible that all maintenance carried out on the refrigeration plant is logged in the Log Book or in the case of the refrigeration contractor; all work orders are kept in the logbook.
- ◆ Ensure that you have audible and visual alarms in place and in working order, that are activated by the safety-guarded controls? Do these alarms reach the appropriate personnel on and off premises 24/7?
- ◆ Fail-safe devices must be tested and serviced. Tag according to code
- ◆ Ensure that your gas detection unit is installed in the refrigeration room and properly connected to the ventilation system and tested a minimum of once per year. (It is recommended that it be tested twice per year). Tag according to code
- ◆ Ensure that all your external plant shut down devices are properly installed, labeled and tested at least once per year. Tag according to code
- ◆ Ensure that your ventilation exhaust system meets code, is properly installed and tested on a regular basis.
- ◆ Ensure that you have an approved written procedures manual for your operations.
- ◆ When replacing pressure and temperature gauge markings it is advisable to purchase gauges which image in both imperial and metric readings. It is important that the person responsible for the plant operation can read the gauges to ensure safe operation.
- ◆ It is necessary to replace or service and reseal all safety/relief valves at least once every (5) five years.

Suggested Guidelines for Refrigeration Plant Maintenance

Refrigeration Plant Maintenance Program

Policy

To develop a quality preventive maintenance program based on manufacturer recommendations, to promote operator safety, to increase operating efficiency, to reduce energy consumption, to extend life expectancy of refrigeration plant and equipment, to provide public and ice user safety, to reduce liability, and to provide a means of accumulating equipment history.

Preamble

The qualified facility operator(s) and/or qualified service refrigeration mechanic will carry out the following daily, weekly, monthly and yearly (annually) inspections and preventive maintenance program duties.

The preventive maintenance program is developed according to manufacturer maintenance and service recommendations and is intended to:

- Get more dependable service from the refrigeration equipment.
- Increase operating efficiency and a reduction in energy consumption.
- Improve facility operator's awareness, knowledge and training on the refrigeration system and equipment.
- Reduce risk and liability to our owners and staff.
- Elimination or reduction of major breakdowns and repairs.
- Reduction of overall maintenance costs.
- Provide increased safety to facility staff; ice participants, spectators and general public.
- Efficient scheduling of maintenance operations.
- Reduce spare parts inventory required.
- Better control of labour and material costs.
- Extend life expectancy of refrigeration plant and equipment.
- Better means of identifying causes of breakdowns.
- Allows a process to accumulate the history records for each piece of equipment.
- Provide due diligence.

Suggested Guidelines for Refrigeration Plant Maintenance

Ice Plant Start-up Procedure Checklist

1	Read previous logbook entries before starting plant.	
2	Record compressor hours in log book	
3	Record brine expansion tank level in log book	
4	Confirm chemical treatment levels in the cooling water and brine	
5	Record rink brine thermostat settings in log book	
6	Confirm receiver refrigerant level	
7	Make sure all electrical switches and disconnects are in “off” (open) position	
8	Test refrigeration machinery room exhaust fan before starting plant	
9	Ensure relief valves have not been tampered with	
10	Ensure no personnel are working on any equipment before it is started	
11	Close main switch on main panel	
12	Close one valve on brine pump not being started	
13	Start brine pump in “hand” position	
14	Allow pump to run ½ hour, check brine system, header, and tubes for leaks	
15	Record brine pressure, temperature, and level	
16	Open water valve to condenser water circulation tank	
17	When tank has filled to overflow pipe level, start pump in “hand” position	
18	Check water sprays on condenser	
19	Record pump pressure in log book	
20	Shut off condenser pump, place switch in “auto” position	
21	Start condenser fans in “hand” position – check that both operate	
22	Shut off condenser fans, place switches in “auto” position	
23	Check compressors oil level	
24	Check compressors water valves are all open	
25	Check compressors electrical switches are in “off” (open) position	
26	Check compressors electrical disconnects are in “off” (open) position	
27	Turn over compressors by hand using drive belts. Be careful not to pinch hands- FOLLOW PROPER LOCK-OUT PROCEDURES	
28	Ensure the valves to all pressure gauges and controls are open.	
29	Check that discharge valves are open from compressor to condenser	
30	Check that inlet and outlet valves at expansion valve(s) are open	
31	Check that main suction valve and all oil return line valves are closed	
32	MAKE SURE THAT COMPRESSOR DISCHARGE VALVES AND LINE VALVES TO CONDENSER ARE OPEN	
33	Confirm all valves are in their correct open or closed position before starting	
34	Open suction valve on first compressor to be started	
35	Close disconnect switch for that compressor	
36	Open main suction valve ¼ - ½ turn	
37	Place compressor electrical switch in “auto” position	

38	(Compressor may be on time delay start for up to 3 minutes). When compressor starts, maintain suction pressure at 25 p.s.i.g. (Open main suction valve slightly to increase; close slightly to decrease suction pressure)	
39	Check compressor cooling water drain for flow at condenser tank	
40	Record all plant readings (pressure, temperature, levels etc.) every ½ hour for the first 4 hours, and every hour afterward until close-up at night	
41	When first compressor has stabilized at normal operating temperatures, second compressor can be started up	
42	When second compressor has stabilized at normal operating temperatures, third compressor can be started up	
43	Continue operating main suction valve to maintain 25 p.s.i.g suction pressure; when suction valve is wide open, record compressor hours in log book.	
44	If start up after an extended shut down period, confirm operation of guarded controls.	

PROCEDURES:

DAILY MAINTENANCE:

1. Inspect ice conditions and record findings.
2. Inspect each compressor and record findings in log book
 - (a) Discharge Pressure
 - (b) Discharge temperature
 - (c) Suction Pressure
 - (d) Suction Temperature
 - (e) Oil Pressure
 - (f) Oil Level
 - (g) Glycol Temperature
 - (h) Elapsed or Run Time hours
 - (i) Belts
 - (j) Hoses
 - (k) Electrical Couplings and Connections
 - (l) Guards and Covers
 - (m) Oil added
 - (n) Rotate daily oil filter strainer if applicable.
3. Inspect all pumps and motors and record findings in log book
 - (a) Brine Pump Pressure
 - (b) Brine Temperature IN
 - (c) Brine Temperature Out
 - (d) Expansion Tank Level – Tank X

Suggested Guidelines for Refrigeration Plant Maintenance

- (e) Expansion Tank Level – Tank Y
 - (f) Water Pump Pressure
 - (g) Water Pump Temperature
 - (h) Under Floor Glycol Temperature (where applicable)
4. Inspect and record temperatures in log book
- (a) Refrigeration Room Temperature
 - (b) Outside Air Temperature
 - (c) Ice Surface Temperature (where applicable)
 - (d) Ice Slab Temperature (where applicable)
 - (e) Under Floor Heating Temperature (where applicable)
5. Inspect Condensers and record findings in logbook.
- (a) Motor
 - (b) Fan
 - (c) Belts (visual)
 - (d) Pump
 - (e) Inspect receiver refrigeration level.
6. Inspect Chiller/High Pressure Receiver
- (a) Drain oil following proper oil draining procedures
 - (b) Compare logged consumption with the amount drained out.
They should be equal)
 - (c) Record in log book
7. Test and inspect exhaust fan to ensure it is operating and record findings in log book.
8. Ensure security of access doors.
9. It is recommended to check for pipe vibration

WEEKLY:

1. Inspect and test both brine and water chemical treatment for condenser cooling water then record in logbook.
2. Inspect the Condenser Unit
 - (a) Condenser piping
 - (b) Condenser belts
 - (c) Condenser squirrel cages
 - (d) Condenser eliminators (check over spray)
 - (e) Condenser bearings (any noises)
 - (f) Condenser for ice and snow accumulation
 - (g) spray nozzles and troubles
3. Inspect cleanliness of refrigeration room and ensure no flammable liquids are stored.
4. Inspect all piping in refrigeration room
5. Check lighting in refrigeration room
6. Inspect, test and record Air Quality findings in log book
 - (a) Carbon Monoxide (ppm)
 - (b) Nitrogen Dioxide (ppm)
 - (c) Ammonia (ppm)
7. Inspect sump pump

MONTHLY:

Performed by Refrigeration Mechanic or qualified and competent personnel:

1. Inspect all compressors (**Note:** Ensure all electrical and valve lock outs in place)
 - (a) sound of bearings
 - (b) any over spray
 - (c) belts
 - (d) electrical connection
 - (e) couplings for stretch
 - (f) rotate crankshaft by hand on each compressor during shut down period.
2. Inspect all pumps (**Note:** Ensure all electrical and valve lock outs in place)
 - (a) sound of bearings

Suggested Guidelines for Refrigeration Plant Maintenance

- (b) any over spray
 - (c) belts
 - (d) electrical connection
 - (e) couplings for stretch
 - (f) rotate brine/glycol pump by hand during shut down period
3. Inspect all motors
- (a) sound of bearings
 - (b) belts (where applicable)
 - (c) electrical connection
 - (d) couplings for wear
4. Inspect Water Tank – inspect and clean strainer
5. Inspect Brine/Glycol Tanks
6. Inspect Ammonia Detector
7. Inspect and test audible system devices – auto dialer (where applicable)
8. Inspect visual alarm lights

BI-ANNUALLY:

1. Inspect and test all safety devices:
- (a) evaporator high level cut out
 - (b) oil failure
 - (c) low pressure cut out
 - (d) high pressure cut out
 - (e) high oil temperature cut out
 - (f) high discharge temperature cut out
 - (g) high level switch on receiver
 - (h) energy cut out switch
 - (i) fire box cut out switch
 - (j) vestibule cut out switch
 - (k) temperature controls
2. Complete compressor oil changes complete with inspection of unit

3. Complete condenser maintenance
 - (a) Electrical lock out
 - (b) belts
 - (c) clean and grease bearings
 - (d) inspect pump
 - (e) inspect spray nozzles
4. Inspect and test exhaust fan
5. Grease all motors
6. Inspect and remove drain plugs on motors and pump bearing hosing
7. Inspect and test all personal protective equipment and record findings in logbook, i.e. SCBA, CGM, Face Shields, etc.

ANNUALLY:

1. Complete maintenance to compressor(s)
 - (a) year 1 – top end inspection
 - (b) year 2 – bottom end inspection
2. Complete detailed inspection of all equipment.
3. An inspection of all electrical control terminals and connections by a qualified electrician.
4. Test ammonia
 - (a) is system adequately charged?
5. Test brine
 - (a) are levels correct?
 - (b) are any leaks noticed?
 - (c) is there air in the system?
 - (d) is brine mixture correct or is mixture too weak?
6. Test glycol
 - (a) are levels correct?
 - (b) are any leaks noticed?
 - (c) is there air in the system?
 - (d) is glycol mixture correct or is mixture too weak?

7. Inspect Headers

- (a) Inspect all connections and clamps
- (b) Inspect all piping and U connections
- (c) inspect for leaks
- (d) treat header pipes
- (e) flush and clean header trench

8. Ensure fire safety equipment is inspected and updated as required.

9. Confirm with the local fire department that their site safety plan and plant information record is on hand and current.

Every 5 Years

1. At some point between 1-5 years it is advisable to have the pressure gauges calibrated.

2. It is necessary to replace or service and reseal all safety/relief valves at least once every (5) five years.

TROUBLESHOOTING GUIDE

When trouble develops in a refrigeration system, the cause is not always easy to pinpoint since the system contains many components and controls. To aid the operator or maintenance man in analyzing the trouble, some manufacturers provide a troubleshooting guide for their equipment. In the absence of a manufacturer's troubleshooting guide, the following can be used in its place. This general guide applies to systems with reciprocating compressors. However, many of the items also apply to systems with centrifugal compressors.

TRUBLE: Compressor fails to start

SYMPTOMS	POSSIBLE CAUSE	CORRECTIVE ACTION
1. No power	Fuses or circuit breaker open	Check circuit for shorts or grounds. Replace fuses or close circuit breaker after fault is corrected.
2. Thermal overloads of motor	No power on motor terminal	Check motor circuit and motor for grounds or starter open shorts. Correct fault. If overloads tripped due to compressor overloading, find reason. Reset thermal overloads.
3. Low voltage	Circuit tester glows but at reduced brilliance	Check with voltmeter. Call power company.
4. Defective starter	Test for burned-out holding coil or broken contacts	Repair or replace
5. Burned-out motor	Full voltage at motor terminals but motor does not run	Repair or replace
6. Open control circuit	No power on terminals of starter holding coil	Locate open operating or safety control and determine cause. Correct and reset control.
7. Broken or sheared coupling	Motor runs, compressor does not	Repair or replace. Check alignment
8. Seized compressor	Motor hums but does not start. Starter will trip on overload	Repair compressor
9. Motor hums but does not start. Starter will trip on overload.	Single phase condition	Find cause such as blown fuse and take corrective action

TROUBLE: Compressor “short-cycles”

SYMPTOMS	POSSIBLE CAUSE	CORRECTIVE ACTION
1. Intermittent contact in electrical circuit	Compressor operates normally but starts and stops frequently	Repair or replace faulty control
2. Low pressure controller differential set too close	Compressor operates normally but starts and stops frequently	Reset differential
3. Leaky liquid line solenoid valve	Valve may hiss when closed. Also temperature change in refrigerant line through valve.	Repair or replace
4. Dirty or iced evaporator	Reduced air flow due to: a) Dirty air filters b) Broken fan belt c) Improperly adjust fan belt tension	Clean or defrost evaporator. Check filters and fan drive.
5. Insufficient condensing	Excessively high discharge pressure. Compressor cuts off on high pressure cut-out	Check operation of condenser fan, water supply.
6. Overcharge of refrigerant	High discharge pressure	Remove excess refrigerant
7. Non-condensable gases	High discharge pressure	Purge system
8. Lack of refrigerant	Normal operation but frequent starting and stopping on low pressure cut-out	Check for leaks, repair and recharge
9. Water valve inoperative or restrictive	High discharge pressure	Clean or repair water valve.
10. Restricted liquid line strainer or solenoid stop valve	Suction pressure too low, frosting at strainer	Clean strainer or valve
11. Faulty motor	Motor starts and stops rapidly	Repair or replace motor

TROUBLE: Suction pressure too high

SYMPTOMS	POSSIBLE CAUSE	CORRECTIVE ACTION
1. Excessive evaporator load.	Compressor runs continuously	Reduce load. Check for excessive fresh air or infiltration, poor insulation.
2. Expansion valve overfeeding.	Suction line abnormally cold. Liquid flooding to compressor.	Regulate superheat. Check remote bulb attachment to suction line.
3. Expansion valve stuck open.	Suction line abnormally cold. Liquid flooding to compressor.	Repair or replace valve.
4. Expansion valve too large.	Abnormally cold suction line. Liquid flooding to compressor.	Check valve rating, replace if necessary.
5. Broken suction valves in compressor.	Noisy compressor, reduced capacity.	Repair or replace valves.

TROUBLE: Suction pressure too low

SYMPTOMS	POSSIBLE CAUSE	CORRECTIVE ACTION
1. Lack of refrigerant.	Bubbles in sight glass.	Check for leaks then charge system.
2. Evaporator dirty or iced up.	Compressor short-cycles.	Clean or defrost.
3. Clogged liquid line filter-drier.	Temperature change in liquid line before and after filter-drier.	Replace cartridge.
4. Expansion valve sensing element has lost charge.	No flow of refrigerant through valve.	Replace sensing element.
5. Obstructed expansion valve.	Loss of capacity	Clean valve.
6. Contacts on controller stuck in closed position.	Conditioned space too cold.	Repair or replace control.
7. Compressor capacity control range set too low.	Compressor short-cycles.	Reset control range.

TROUBLE: Discharge pressure too low

SYMPTOMS	POSSIBLE CAUSE	CORRECTIVE ACTION
1. Too much condenser water.	Water temperature at outlet to low.	Adjust water-regulating valve.
2. Lack of refrigerant.	Bubble in sight glass.	Check for leaks. Add refrigerant.
3. Broken or leaky compressor discharge valves.	Suction pressure rises faster than 35 kPa (5 lbs) per minute after compressor shuts down.	Repair or replace valves.
4. Leaky relief bypass valve.	Low discharge pressure and high suction pressure.	Inspect valve, replace if necessary.

TROUBLE: Discharge pressure too high

SYMPTOMS	POSSIBLE CAUSE	CORRECTIVE ACTION
1. Insufficient supply to condenser or water too warm.	Water temperature at outlet too high	Increase water supply, adjust water regulating valve, and check spray nozzles.
2. Fouled tubes in shell-an-tube condenser.	Water temperature at outlet too low.	Clean tubes.
3. Air passages through air-cooled condenser dirty.	Temperature difference between air in and out too large, low air volume.	Clean condenser.
4. Improper operation of evaporative condenser.	Low air or spray water volume. Scaled coil surface.	Correct air or water flow. Clean coil surface.
5. Non-condensables in system.	Very hot condenser.	Purge system.
6. Overcharge of refrigerant.	Very hot condenser.	Remove excess.

TROUBLE: System short of capacity

SYMPTOMS	POSSIBLE CAUSE	CORRECTIVE ACTION
1. Flash gas in liquid line.	Expansion valve hisses.	Add refrigerant.
2. Clogged strainer or stop valve.	Temperature difference in liquid line before and after strainer or valve.	Clean or replace.
3. Ice or dirt on evaporator.	Reduced airflow.	Defrost coil or clean.
4. Expansion valve stuck or obstructed.	Short-cycling or continuous operation.	Repair or replace valve.
5. Excess pressure drop in evaporator.	Superheat too high.	Rest thermostatic expansion valve.
6. Improper superheat adjustment.	Short-cycling or continuous operation.	Adjust thermostatic expansion valve.
7. Expansion valve improperly sized.	Short-cycling or continuous operation.	Replace with correct valve.

TROUBLE: Compressor or system noisy

SYMPTOMS	POSSIBLE CAUSE	CORRECTIVE ACTION
1. Coupling loose or misaligned.	Coupling bolts loose, vibration.	Tighten coupling; check alignment.
2. Lack of oil.	Compressor cuts out on oil failure control.	Add oil.
3. Dry or scored seal.	Squeaky seal during operation.	Check oil level; replace seal.
4. Internal parts loose or broken.	Compressor knocks.	Overhaul compressor.
5. Liquid floods back to compressor.	Compressor knocks, abnormal cold suction line.	Check rating and adjustment of expansion valve. Replace valve if defective.
6. Compressor or motor loose on base.	Compressor or motor jumps on base.	Tighten hold-down bolts.
7. Improper piping support.	Piping vibrates.	Relocate, add, or readjust hangers and supports.
8. Water regulating valve is dirty, water pressure too high.	Water valve chatters or hammers.	Clean valve; reduce supply pressure.

TROUBLE: Compressor runs continuously

SYMPTOMS	POSSIBLE CAUSE	CORRECTIVE ACTION
1. Excessive load.	High temperature of substance to be cooled.	Check for excessive warm air infiltration, or for inadequate insulation of space to be cooled.
2. Thermostat set too low or defective.	Low temperature of substance to be cooled.	Reset or repair thermostat.
3. Welded contacts or stuck electrical control in motor starting circuit.	Low temperature of substance to be cooled.	Repair or replace faulty control.
3. Lack of refrigerant.	Bubbles in sigh glass.	Repair leak and charge system.
4. Overcharge of refrigerant.	High discharge pressure.	Remove excess.
5. Leaky valves in compressor.	Compressor noisy or operating at abnormally low discharge pressure or abnormally high suction pressure.	Overhaul compressor.
6. Solenoid valve stuck open.	Low temperature of substance to be cooled.	Repair valve.

PLANT MAINTENANCE INSPECTION REPORT

PERSONNEL PRESENT DURING INSPECTION:

Facility staff	_____
Signature	_____
Refrigeration Company	_____
Signature	_____
Refrigeration Mechanic	_____
Signature	_____
Inspection Date	_____

JOB FUNCTION		MID SEASON	SHUT DOWN	START UP
1.	Compressors Top Side Inspection			
	Remove heads and inspect.		X	X
	Remove crankcase covers and inspect.		X	X
	Inspect suction valves and seats.		X	X
	Inspect discharge valves and seats.		X	X
	Replace suction and discharge springs.		X	X
	Inspect rings and cylinder walls for wear.		X	X
	Inspect wrist pin bearing for wear.		X	X
	Inspect connecting rod bearing for wear.		X	X
	Inspect shaft seal for oil leakage.		X	X
	Remove and inspect oil cooler.		X	X
	Lubricate compressor motors.			
	Remove diamond covers and inspect.		X	X
	Replace required gaskets and seals.		X	X
2.	Compressor Oil Change.			
	Remove and dispose of spent oil.		X	
	Remove side cover.		X	
	Wash out crankcase.		X	
	Remove and wash Cuno oil filter.		X	
	Wash oil filter casing.		X	
	Remove and clean oil suction strainer.		X	
	Clean and inspect sight glass.		X	
	Replace oil to manufacturers specs.		X	
	Replace required gaskets.		X	
	Start compressor and adjust oil pressure.		X	
	Inspect and test oil pressure gauge.		X	

JOB FUNCTION		MID SEASON	START UP	SHUT DOWN
3.	Compressor # 1			
	Record oil pump pressure.			
	Inspect unloading mechanism.			
	Lubricate and test low-pressure switch.			
	Lubricate and test high-pressure switch.			
	Lubricate and test oil failure switch.			
	Lubricate and test water failure switch.			
	Inspect belts and drive.			
	Inspect compressor-cooling system.			

4.	Compressor # 2			
	Record oil pump pressure.			
	Inspect unloading mechanism.			
	Lubricate and test low-pressure switch.			
	Lubricate and test high-pressure switch.			
	Lubricate and test oil failure switch.			
	Lubricate and test water failure switch.			
	Inspect belts and drive.			
	Inspect compressor-cooling system.			

5.	Evaporative Condenser			
	Remove eliminators and inspect.	X	X	
	Remove access covers and inspect.	X	X	
	Inspect water distribution system.			
	Inspect belts and drive.		X	
	Inspect and lubricate shaft bearings.		X	
	Inspect and clean fans and housings.		X	
	Inspect and lubricate motors.		X	
	Purge condenser of non-condensable.	X	X	
	Record water pressure.			
	Inspect and observe pump operation.			
	Inspect sump water supply and float valve.			
	Rescale cooling system and inspect coil.	X	X	
	Drain and clean tank if required.	X	X	
	Inspect and clean spray nozzles.	X	X	X

	JOB FUNCTION	MID SEASON	START UP	SHUT DOWN
6.	Brine System			
	Inspect chiller for brine leaks.			
	Inspect chiller for insulation deterioration.			
	Check ammonia levels and sight glasses.			
	Check chiller for corrosion.			
	Inspect and operate high-level float switch.		X	
	Inspect all valves to ensure good condition.			
	Inspect Brine pump coupling.			
	Inspect seal bearing housing.			
	Inspect motor.			
	Lubricate pump and motor.		X	
	Inspect, clean, and lubricate brine stat		X	
	Take brine sample and provide test results.	X	X	
	Test specific gravity of brine solution.	X	X	
	Provide report on brine chemical analysis.	X	X	
	Inspect brine level in expansion tank.			

7.	Electrical panel and controls			
	Inspect and test overload switches.		X	
	Verify fuse sizing and function.		X	
	Inspect and secure terminal screws.		X	
	Test timers and cycled operation.		X	
	Inspect and test firebox electrical switch.		X	
	Inspect and test emergency stop switch.		X	
	Inspect and test exhaust fan.		X	

8.	Motor Amperages and Voltages			
	(30) Horsepower Motor			
	L1 Amperage		X	
	L2 Amperage		X	
	L3 Amperage		X	
	L1-L2 Voltage		X	
	L1-L3 Voltage		X	
	L2-L3 Voltage		X	
	(60) Horsepower Motor			
	L1 Amperage		X	

Suggested Guidelines for Refrigeration Plant Maintenance

	L2 Amperage		X	
	L3 Amperage		X	
	L1-L2 Voltage		X	
	L1-L3 Voltage		X	
	L2-L3 Voltage		X	
	Brine Pump Motor			
	L1 Amperage		X	
	L2 Amperage		X	
	L3 Amperage		X	
	L1-L2 Voltage		X	
	L1-L3 Voltage		X	
	L2-L3 Voltage		X	
	Condenser Fan Motor			
	L1 Amperage		X	
	L2 Amperage		X	
	L3 Amperage		X	
	L1-L2 Voltage		X	
	L1-L3 Voltage		X	
	L2-L3 Voltage		X	
	Condenser Pump Motor			
	L1 Amperage		X	
	L2 Amperage		X	
	L3 Amperage		X	
	L1-L2 Voltage		X	
	L1-L3 Voltage		X	
	L2-L3 Voltage		X	

JOB FUNCTION		MID SEASON	SHUT DOWN	START UP
8.	Motor Amperages and Voltages			
	L1 Amperage		X	
	L2 Amperage		X	
	L3 Amperage		X	
	L1-L2 Voltage		X	
	L1-L3 Voltage		X	
	L2-L3 Voltage		X	
	Main 200 Amp Panel			
	L1 Amperage		X	
	L2 Amperage		X	
	L3 Amperage		X	
	L1-L2 Voltage		X	
	L1-L3 Voltage		X	
	L2-L3 Voltage		X	

9.	Shut Down Inspection Procedure			
	Isolate charge.	X		X
	Shut compressors down.	X		X
	Shut condenser down.	X		X
	Shut brine pump down.	X		X
	Tag all isolated valves with proper markers.	X		X
	Isolate and lockout electrical panels and supply.	X		X

10.	Additional Inspections			
	Inspect and report on any oil leaks.			
	Inspect and report on any pipe vibration.			
	Inspect safety guards and equipment.			
	Inspect fire line and fire valve.			
	Inspect relief valves and relief line to outside.			
	Inspect firebox.			
	Inspect and operate indicator lights.			
	Inspect for hazards and cleanliness.			
	Calibrate suction and discharge gauges.	X	X	

Comment on system condition and recommendations for Capital Improvements:

Compressor # 1

Compressor # 2

Condenser

Chiller/Heat Plate

Brine/Glycol System

Electrical

Headers

Other

GENERAL COMMENTS

Refrigeration Maintenance and Repair Record

DATE	WORK DESCRIPTION	REFRIGERATION MECHANIC	FACILITY OPERATOR	EQUIPMENT WORKED ON

Suggested Guidelines for Refrigeration Plant Maintenance