SOP-6.1

Operation of Vogt Ice Makers

Objective	This procedure is established to describe the Technical Operating Specifications (TOS) and to set forth Standard Operating Procedures (SOP) for the operation of the Vogt icemakers. All operator and technicians working with this Vogt Icemaker should be very familiar with the Vogt Service manual that covers the VOGT P-34 A-XLOF STAINLESS STEEL equipment. This document can be found in the Plant Engineers Office
Purpose	The purpose of the TOS is to provide a description of the ice maker, define its function, operating conditions and limits, consequences of deviations from operating limits, describe its controls, instrumentation and safety systems and set its operating alignment(s). The purpose of the SOP is to establish the proper steps for startup, operation, and shut-down of the icemakers.
Concerns	Careful attention should be provided to liquid ammonia level in the Icemaker recirculator (PRR-1) vessel and water temperature. Among the incidents we are trying to prevent are: • Damage to compressors due to diverting liquid ammonia to the compressors • Low water temperature (below 45°F) resulting in freezing and equipment damage • Low suction pressure that will cause excessive low temperatures which requires additional defrosts time could result in damaged equipment (expanded or ruptured tubes) and possible loss of ammonia to atmosphere.
Department	**Engineering**
Operator Responsibility	**Plant Engineer - Mike Cannon** **Plant Manager - Steve Waters**
Equipment/Location	Vogt Icemakers IM-1 through IM-10, (Model P34 A-XLOF), Icemaker room.
Related documents	Inspection and Maintenance Records – **in the Plant Engineer's office.** System Log Book – **in the Plant Engineer's office.** Manufacturer's Installation and Operations documents – **in the Plant Engineers office.** Block Diagrams – **in the PSM/RMP Program document –Plant Engineers office.** P&IDs - **in the PSM/RMP Program document – Plant Engineers office.** Ammonia MSDS – **in Right to Know notebook located in the hall at battery charging station.** **Copies of all documents – Plant Managers office.**
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Technical Operating Specification (TOS)

Function	During normal operation the ammonia is fed to the icemakers through an icemaker recirculator (PRR-1), in which the liquid ammonia is pre-chilled to approx. 12°F. The flow rate of ammonia is controlled by continuous pressure from ammonia pumps that pump the ammonia from the icemaker recirculator through a liquid solenoid valve (on or off) through a hand expansion valve (regulates flow), into the icemaker vessel. Vogt icemaker water pumps recirculate water through the icemaker (evaporator tubes) upon which the ice forms. As the icemaker rejects heat from the water the ammonia absorbs the heat, causing it to boil off. It turns into a gas vapor at which time the gas is pulled back to the icemaker recirculator PRR-1 by various compressors (Typically C3-C5). The compressors compress the gas vapor; it continues to the condensers (Typically (EC1-EC4), in which the heat is rejected to the atmosphere through the water and airflow of the evaporative condenser units. As the hot gas is cooled, it condenses back to a liquid; it flows through control valves back to the icemaker recirculator vessel and is continuously recirculated. The ice making cycle is regulated by a PLC, (Programmable Logic Controller) which controls the sequence, events and time cycles. When the ice making cycle is complete, the vessel is pressurized to generate heat to defrost the unit. To accomplish the defrost cycle, the water pump stops, the liquid solenoid valve (V-1-13) closes, the suction stop CK-2 valve (V-03) closes, and the hot gas valve solenoid inlet regulator valve (V-1-18) opens. At this time pressure builds to approximately 70 psig. The hot gas stops flowing, heat is generated, defrosting starts, the ice cutter unit starts, and the auger system starts, the ice falls freely from the tubes during the timed defrost mode. The defrost solenoid/regulator opens for approximately 15 seconds and allows pressure to drop in the vessel to below 50 psig before the CK-2 suction valve opens and next freeze cycle begins. The ice is augured to the blast freezer for drying and to the rakes where it is stored. This typical cycle is repeated as required by production requirements The vessel has a safety defrost /solenoid regulator (V-1-06) that is set to approximately 80 psig to assure that the vessel is never over pressurized. The vessel is also protected with a dual pressure relief valve (V-1-15), to prevent over pressurization.

Description	Capacity/Size	Operating Limits	Deviations/Consequences
Vogt Ice Makers (Model P34 A-XLOF) Ammonia refrigerant Stainless Steel Liquid Over Feed System 1 1/4“ tube size 1 1/8” Actual **Ice** size	96.4 tons/24 hrs. (1768 pounds per cycle) With setting of: 3.0 min. defrost 10.2 min. freeze time Makeup Water temp of 55°F Blow down water 40 gal/cycle	Suction pressure: 20 to 30 psig	High suction pressure and high water temperature results in inefficient ice production. High suction can be a result of compressor capacity problems, condenser pressure or water chillers effectiveness.
			Low suction pressure results in freezing up (or plugging) of icemakers.
Water chiller		Water temperature: 55°F – 65°F	Higher water temperatures results in loss of capacity.
			Lower water temperatures and low suction pressure could result in an increased rate of freezing and freeze up the unit.

Ice maker recirculator		Operating level at 30% to 35%	High ammonia levels could result in compressor damage due to the carryover of liquid ammonia to the compressors. Low ammonia levels could result in loss of capacity.
Description	**Item Number**	**Function**	**Position/Set point**
Controls and Instrumentation			
Suction Pressure Gauge	¼ inch Hansen (HGV1) Panel	Pressure indicator for suction	12-20 psig
Hot Gas Pressure Gauge	¼ inch Hansen (H7771) Panel	Pressure indicator for Hot Gas	Discharge pressure.
Icemaker cycle setting PLC (Programmable Logic Controller)	Allen Bradley System	Controls the freeze and defrost cycle time.	Freeze cycle time 10.2 min. Defrost time 3.0 min.
Liquid Line Solenoid	V-1-12 1 ½" Hansen (HS4A)	Turn ammonia liquid on or off	ON or OFF
(2 each) Hand Isolation valves for Liquid Solenoid valve with strainer.	V-1-12 & V-1-16 (1 ½ Hansen) (AS150C) & (GS150C)	Isolate Liquid Solenoid for removal or maintenance	Hand angle stop vales (Open or Closed)
Liquid Line Strainer	1 ½" Hansen (ST200) V-1-15	Protects against foreign debris	Filtration
Liquid Line Hand Expansion Valve	1 ½" Hansen (RS150C) V-1-15	Regulates rate of liquid ammonia flow	Various restriction control
Liquid Line Check Valve	1 ½" Hansen (HCK4-7) V-1-14	To prevent liquid backup.	Pressure driven check valve
Defrost or by-pass solenoid/regulator	V-1-06 RS (A4AB-ST) V-1-06	Opens at end of defrost cycle to drop pressure and prevents over pressurization of icemaker vessel.	Solenoid open for approximately 15 seconds at the end of defrost cycle and bleed regulator is set to approximately 80 psig
(2 each) Hand Isolation valves for defrost by-pass regulator.	V-1-17 & V-1-20 (2 ½" angle) Isolation valves.	Isolate Defrost Regulator for removal or maintenance.	Hand angle stop vales (Open or Closed)
Water temperatures will be displayed on Panelview.	Thermocouple wire device (In and Out of water chiller)	Temperature indication of the in coming (make-up) water.	55-65°F
Inlet Hot Gas Regulator Solenoid	V-1-18 Hansen 2 ½". (4AOS)	Supplies hot gas to icemaker vessel for defrost	70 psig
Hot Gas Line Strainer	1-1/2 inch Hansen (ST200) V-1-18	Protects against foreign debris	Filtration
Hot Gas Check Valve	2 inch Hubbell (R2004) V-1-23	Prevents liquid backup in hot gas line.	Pressure operated check valve

Automated Suction Stop Valve W/gas operated check valve W/ pilot for gas actuation.	V-1-3 5 inch RS (CK-2) stop check valve.	Closes suction line to allow pressure to build in vessel to build heat for defrost.	Gas powered operation valve with pilot solenoid operation. (Open or Closed position)
Solenoid operated pilot valve controls gas that operates CK-2 check valve	V-1-10 ½" (RS Pilot valve)	Solenoid opens and closes small pilot valve that provides gas pressure to operate CK-2	(Opened or Closed)
Oil Trap Drain Valve	V-1-26 (½" Hansen AT051C)	Hand valve on oil drain trap. Allows trapped oil to be removed from vessel.	See SOP 7 (Oil Drain Procedure)
(2 each) Hand Isolation valves for CK-2 Suction Stop Valve	V01 & V02 (5" angle) RS Hand Isolation Valve	Isolate CK-2 Stop Suction for removal or maintenance.	Hand angle stop valve. (Open or Closed)

Safety & Safety Systems			
Description	**Item Number**	**Function**	**Position/Set point**
High-pressure dual valve pressure safety relief.	V-1-21 ½ Hansen (H5601) 3-way	To prevent over pressurization of icemaker vessel	Factory Set @ 275 psig
In the event of an ammonia leak that reaches 200 ppm in the air, the automated system controller will turn on all exhaust fans, and if 500 ppm of ammonia is detected, it will turn off all motors except the exhaust fans.			
Before any vessel or component entry is made see SOP 10 on use of Jet pump.			
Before any operation of or any maintenance procedure is performed, personnel should have reviewed the Vogt Service Manual for the equipment. This Manual is kept in the Plant Engineers Office.	Before opening of system. See SOP 11 on Safety issues covering protective cloths and tools to have on hand when dealing with ammonia.		

The Vogt Icemaker system is equipped with a freeze up switch, that in the event of a freeze up, leaves the suction valve open, turns off the water pump and closes the liquid line valve. The unit remains idle for the duration of it's freeze cycle. This allows the liquid level to decrease and provide needed space to receive an adequate volume of hot gas needed for a clean defrost to occur on the next normal defrost cycle. This should clear the unit. The unit will then return to the normal control cycle.			

Vogt Icemaker Valve Table

UNIT	Val #	Size	Type cont	Description	Function	Manuf.	Model
V-(1-10)	1	5"	BW	ANGLE VALVE FOR CK-2 GAS STOP VLV.	ISOLATION VALVE	R/S	-
V-(1-10)	2	5"	BW	GLOBE VALVE FOR CK-2 GAS STOP VLV.	ISOLATION VALVE	R/S	-
V-(1-10)	3	5"	FLG	GAS POWERED SUCTION STOP VALVE	STOP FLOW VALVE	R/S	CK2
V-(1-10)	4	1/2"	FPT	ANGLE VALVE	CHARGING VALVE	HANSEN	AT051H
V-(1-10)	5	1/4"	FPT	LIQUID LINE STRAINER DRAIN VALVE	DRAIN VALVE	HANSEN	HGV1
V-(1-10)	6	2"	FLG	DEFROST BY-PASS PRES. REG. W/STR.	DEFROST PRESSURE	R/S	A4AB-ST
V-(1-10)	7	1/4"	FPT	PRESSURE GAUGE, 30"-0-160#	MEASURE PRESSURE	R/S	Q6
V-(1-10)	8	1/4"	MPT	GAUGE VALVE	ISOLATION VALVE	R/S	V12
V-(1-10)	9	1/2"	SW	ANGLE VALVE	ISOLATION VALVE	R/S	-
V-(1-10)	10	1/2"	FLG	PILOT SOLENOID VAL. W/STR. FOR CK-2	START/STOP FLOW	R/S	S8F-ST
V-(1-10)	11	1/2"	SW	HAND EXPANSION VALVE	METERING CONTROL	R/S	-
V-(1-10)	12	1 1/2"	SW	GLOBE VALVE	ISOLATION VALVE	-	-
V-(1-10)	13	1-1/2"	FLG	LIQUID LINE SOLENOID VALVE W/STR.	START/STOP FLOW	-	-
V-(1-10)	14	1 1/2"	FLG	LIQUID LINE CHECK VALVE	DIRECTION CONTROL	-	-
V-(1-10)	15	1 1/2"	SW	LIQUID LINE HAND EXPANSION VALVE	METERING CONTROL	-	-
V-(1-10)	16	1 1/2"	SW	ANGLE VALVE	ISOLATION VALVE	-	-
V-(1-10)	17	2 1/2"	BW	GLOBE VALVE	ISOLATION VALVE	-	-
V-(1-10)	18	2 1/2"	FLG	PRESSURE REGULATOR W/STR., 2.5"	MODULATION VALVE	HANSEN	HA4AS-ST
V-(1-10)	19	3/8"	FPT	ANGLE VALVE	PURGE	HANSEN	H7773
V-(1-10)	20	2"	BW	GLOBE VALVE	ISOLATION VALVE	-	-
V-(1-10)	21	3/4"	FPT	DUAL RELIEF VAL. ASSM, SET 275 PSIG	OVER PRES. RELIEF	HANSEN	H5601-275#
V-(1-10)	22	1/4"	FPT	ANGLE VALVE	ISOLATION VALVE	HANSEN	HGV1
V-(1-10)	23	2"	FLG	CHECK VALVE	DIRECTION CONTROL	HUBBELL	R2204
V-(1-10)	24	1/4"	FPT	ANGLE VALVE	ISOLATION VALVE	HANSEN	H7771
V-(1-10)	25	3/8"	FPT	ANGLE VALVE	ISOLATION VALVE	HANSEN	H7773
V-(1-10)	26	1/2"	FPT	ANGLE VALVE	DRAIN VALVE	HANSEN	AT051H

Standard Operating Procedure (SOP)

Task Flow

Manual start-up procedures
|
Monitor normal operations
|
Manual shut-down procedures
|
Emergency shut-down procedures
|
Operation During Power Failure

Task	Step	Comment
Manual start-up procedures (following maintenance or emergency operations)	1. Visually check the unit for lockout/ tag out devices.	
	2. Gradually open (to full open position) the manual isolation valves in the icemaker suction line and check for leaks.	The suction valve or defrost valve must be opened to allow gas pressure from the suction side to back up into the piping so leaks can be detected prior to opening in the liquid feed line. If any leaks are detected, close the valve and fix the leaks before proceeding.
	3. Gradually open (to full open position) the manual isolation valve in the icemaker hot gas line and check for leaks.	
	4. Gradually open (to full open position) the manual isolation valve in the liquid line.	
	5. Turn the selector switch for desired icemaker to the **Auto** position.	
	6. Visually verify that all control valves are in the **Auto** position.	
	7. Monitor the level in the icemaker as it fills with liquid ammonia.	The level in the icemaker should increase to 100 % capacity, as any excess liquid would over feed into the icemaker recirculator.
	8. Observe icemaker through several complete cycles (freeze and defrost) to ensure that it is functioning correctly and there are no problems or leaks	

STANDARD OPERATING PROCEDURES – OPERATION OF VOGT ICE MAKERS

Task	Step	Comment
System monitoring during normal operations.	1. Read the logbook prior to the start of each shift to determine the operational status of the refrigeration system, assess any maintenance/repair work that is underway, and record your shift activity.	This information is kept in the Engineer's office with records kept for 10+ years (excellent source of information for apprentice operators)
The Vogt Icemaker log sheet should be filled out once per shift. The sheets will be collected by the Plant Engineer, reviewed, signed and filed daily. The logbook will remain on file in the Plant Engineers Office. Check lubrication schedule daily for any listed equipment due for lubrication.	2. Visually inspect the icemakers through a complete cycle, inspect the ice and size of the opening in the ice as it fall into the augers. The opening size should not exceed 3/16"; large hole (Shell Ice) will break up and create additional snow. Make adjustments to the freeze cycle as required.	Inspections are critical in the on-going operations for safety and performance of the plant. Note unusual noises, oil stains, vibration, etc
	3. Visually inspect to determine that water level in reservoir is adequate. Verify that water valves are functioning properly. Verify that pump is adequately supplying the top reservoir and that all water diffusers are in place. Verify there are no water leaks on icemaker.	At any time ice becomes contaminated for any reason, contact the Plant Engineer or Plant Manager.
	4. During defrost verify that hot gas regulator is not exceeding 70psig and that the time it requires to reach that point matches the performance time of other ice-makers	**Never** put your hand in to any auger for any reason. See Lock/Out tag out section for safety details concerning augers
	5. Verify that defrost regulator does not bleed gas during defrost cycle. At the end of the defrost cycle it opens for approximately 15 seconds and allow vessel pressure to drop below approximately 50 psig before the CK-2 stop valve opens to start the next freeze cycle.	The regulator protects against over pressurization and is not required to function during defrost cycles The regulator should be set to 80 psig.
	6. Follow lubrication schedule in the Vogt service manual and record all maintenance and repair work on icemaker and refrigeration system in the logbook.	Hourly, visually inspect the auger system, though the blast freezer, verify blast temp and ice condition as the ice leaves and enters the rake. Verify the rake is functioning properly,

STANDARD OPERATING PROCEDURES – OPERATION OF VOGT ICE MAKERS

Task	Step	Comment
Manual shutdown procedures for evacuating entire unit & opening vessel.		The Vogt icemaker is equipped with isolation valves for each of the control valves. Using the isolation valves, personnel can disassemble, remove and perform preventative maintenance on the control valves. Evacuation of the entire vessel would be rare.
	1. Close and tag the manual isolation valve V-1-12 in the liquid supply line. If the icemaker can function properly, allow the unit to continue running as usual (this allows heat from incoming water to help boil the ammonia out quicker). If equipment cannot function properly continue to step 2. If equipment is allowed to continue in normal ice production with the liquid supply closed, the liquid level will be reduced each cycle. Monitor each cycle. The frost line should continue to go down the vessel as the liquid is boiled out of the unit. As the unit is depleted of liquid and the unit will no longer produce ice, go to step 3.	
	2. Otherwise, if equipment cannot continue to make ice and vessel must be pumped out then close liquid line isolation valve V-1-12 and hot gas inlet isolation valve V-1-17. Leave the CK-2 check valve V-1-03 closed. Connect a hose that has been verified to be with in date that is appropriate for ammonia work to the service valve on the lower hot gas manifold and connect the other end to the wet suction line of the PRR2. With the CK-2 check valve closed, pressure should build very slowly and help move the liquid out through the ½ " service valve into the accumulator PRR2. When the liquid has been removed then continue with section 3.	
	3. If a Jet pump is available see SOP 10 for proper use, and connect a hose that is verified to be with in date and is the appropriate type for ammonia service from the 1/2 in. hand valve located on the vent port near the top of the unit (V-1-19). Allow any excess ammonia vapor to be vented out until there is no pressure reading on the suction gauge. Close the vent port valve, remove the hose, and slowly re-open the valve to the atmosphere to verify there is no vapor in the vessel.	

Task	Step	Comment
.	4. Follow the lockout/tag out procedure described in lockout / tag out manual to lockout the appropriate disconnect.	After maintenance procedures are complete, to re-starting the unit, follow Manual start-up procedures (following maintenance & emergency operations) on page 7.
.	5. At this time, work can begin on vessel repair or maintenance procedures.	

Emergency shutdown procedures and emergency operations	1. In the event of a major ammonia release (e.g., pipe rupture) or fires, severe enough that equipment should be shut down, then use one of the (**Break glass E-Stops)**, located just outside of the North, East and South engine room exit doors. This is a pull handle type E-Stop emergency shut down switch. This will close all inlet valves, turn off all motors and start all exhaust fans. 2. In the event of an ammonia leak that reaches 200 ppm in the air, the automated system controller will turn on all exhaust fans, and if 500 ppm of ammonia is detected, it will turn off all motors except the exhaust fans.	Notify the Plant Engineer or Plant Manager.
	3. In the event of an ammonia leak from a single icemaker or piping to or from an icemaker. • Stop the flow of ammonia liquid to the individual piece of equipment by closing the valve in the liquid supply line (or stopping the appropriate pump); • Turn on the exhaust fans in the area; • Leave the valves in the suction lines open to lower the pressure on the equipment.	Consult PSM/RMP Equipment Summaries and SOPs for additional procedures to follow for these units.
	4. Start the engine room ventilation fans for all leaks in or around the engine room. The switches to manually start the ventilation fans are located just outside each of the outside doors into the engine room and in the Panelview.	There are visual and audible alarms for the ammonia detectors in multiple locations throughout the facility.

	5. For compressor, evaporator, condenser, recirculator and other plant equipment problems, or emergencies concerning other equipment, see the associated SOP that covers the operation of that equipment.	Read and be familiar with all equipment document, service manual and safety bulletins associated with all equipment in the plant operation. Be prepared prior to operating the equipment. Be knowledgeable about procedures before you need them. Do your part to develop a safe, clean and efficient operation.
	6. To re-start follow **Manual start-up procedures (following maintenance & emergency operations)** found on page 7 of this SOP.	

Task	Step	Comment
Operations during a power failure	1. If information is obtained that power will be off for a long period close the main liquid ammonia feed valve (King valve) which is located outside the engine room at the controlled pressure receiver.	
	2. Place each compressor start selection switch in the "OFF" position.	
	3. Monitor the system pressures until power returns.	When power is restored, the evaporative condenser fans and cooling water pumps should start automatically as appropriate pressure set points are reached.
	4. To restart the plant use the procedure on page 7 of this SOP; for **Manual start-up procedures (following maintenance or emergency operations)**.	

STANDARD OPERATING PROCEDURES – OPERATION OF VOGT ICE MAKERS