

# KEEP REFRIGERATED AFTER OPENING

by BILL VAAS

## Annual Refrigeration System Maintenance

**A**t this time of the year, all of our arenas are well into the operating season. For the most part, the refrigeration system should have been operating relatively trouble-free since startup. This doesn't happen by accident. In order to minimize equipment problems and potential shut-downs, every arena must have a refrigeration equipment maintenance program, regardless of the length of the operating season.

This program should consider:

- 1) maintenance required during the annual shut-down period; 2) checks and maintenance during the initial startup; 3) ongoing preventative maintenance throughout the operating season; and 4) proper shut-down of the system at the end of the season in preparation for inspection and repairs. Today's arena refrigeration plants contain sophisticated equipment provided by different suppliers; therefore, in developing and implementing a maintenance program, careful thought must be given to what checks and maintenance will be done "in house" by properly trained arena staff and what work must be performed by

external qualified contractors. It cannot be stated strongly enough that any maintenance work done on refrigeration equipment must be performed by properly qualified personnel following the manufacturer's recommendations. In general terms, the following summarizes considerations for the implementation of an annual refrigeration maintenance program for an arena.

### Annual Shut-Down

Preparations for the annual shut-down of the refrigeration system should be well planned and in place prior to the last ice rental of the season. In many cases, arenas have entered into a service

agreement with a licensed refrigeration contractor to have this work done. The proper annual shut-down of the system will include procedures for closing valves, disconnecting electrical circuits, the shut-down and maintenance of equipment related to primary and secondary refrigerant circuits and required compressor maintenance, plus checks on the condenser and related equipment.

A number of valves in the refrigeration plant will be closed during the shut-down period. Any valves that must be closed should be clearly tagged in accordance with established lock and tag procedures, with a notice to this effect being attached to the main panel disconnect switch. Control switches for all compressors, brine/glycol pumps and condenser fans and pumps should be turned off and tagged. The main electrical disconnect switch for the entire system should then be switched off and clearly tagged as well. As an additional precaution, fuses may be removed from the panel.

In systems with multiple compressors, each compressor will have the suction and discharge service valves closed during the annual shut-down in order to isolate each one for servicing. If



*Refrigeration skid with reciprocating compressors.*

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so equipped, the valve on the oil return line should also be closed. In addition, any primary refrigerant left in the crankcase must be purged, using proper safety procedures for that particular refrigerant, before the compressor can be opened. When considering compressor maintenance during the shut-down period, reference must be made to the manufacturer's recommendations. Usually, on a reciprocating compressor (screws may be different) the number of hours a compressor runs during any given season will determine the extent of necessary maintenance. When the compressor is opened for an internal inspection, all parts should be thoroughly checked and replaced where necessary and any additional wear investigated. Regardless of the need for replacement of internal compressor parts, the crankcase oil should be changed more frequently, ensuring that the interior of the crankcase is well flushed out prior to recharging with clean oil. A sample of the used oil from each compressor should be analyzed annually to help determine the wear on

internal parts. Upon completion of any repair work, the compressor(s) should be closed up and filled to the correct level with oil that is compatible with the primary refrigerant.

With respect to the secondary refrigerant equipment, the brine/glycol stop valves should remain open during the shut-down period to prevent hydraulic pressure damage due to expansion as the brine/glycol warms up. The rink floor piping, headers and brine/glycol lines should not be isolated from the brine/glycol expansion tank for the same reason. If using brine as the secondary refrigerant, the pump should be rotated at least once a month during shut-down to break up any calcium deposits that may damage pump seals. Bearings and valve stems should be greased. As well, bypass filters on the brine/glycol system should be cleaned or the filter replaced. Header pipes should be inspected for corrosion and loose hose clamps. The level of brine/glycol in the expansion tank should be checked and recorded. Once a year, a sample of brine/glycol should be taken and sent to

a reputable lab for analysis. The lab should identify the strength and pH of the solution and, in addition, recommend any adjustments to the mixture and/or its treatment.

Condenser inspection must not be forgotten during the shut-down period. On an evaporative condenser, coils should be checked for scale build-up, the condenser water tank drained and thoroughly flushed, and the spray nozzle system inspected for plugged or damaged nozzles and any problem nozzles replaced. In addition, all bearings and other moving parts require proper lubrication as stipulated by the manufacturer, including the condenser shaft. V belts should be inspected and replaced if necessary. Any filter used on the water circulating system should be cleaned or replaced, and all water valve stems should be greased. Water-cooled condensers must have the heads removed and the tubes cleaned, while air-cooled condensers should be power-washed and fins should be checked. With this work completed, the refrigeration system will be ready for start-up.

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## Start-up Checks and Maintenance

A properly qualified person must start the refrigeration plant. In many arenas today, a refrigeration contractor does this. Prior to turning on any equipment, a number of procedures must be re-visited. All valves that were previously closed and tagged must be re-opened, including the water supply lines to the compressors and condenser. The proper level of primary refrigerant in the chiller must be confirmed. The correct oil level in each compressor's crankcase must be verified before it is started and then re-checked once the compressor is running. V belts on the compressors and condenser fan motors should be examined for tightness and alignment. Any fuses removed from electrical panels as part of the shut-down process must be re-installed, and all necessary electrical switches turned back on. Also, remember to check the battery inside any computerized controls and replace it if necessary.

Prior to turning on the brine/glycol pump, the seal and coupling should be checked and the shaft examined for tightness and alignment. Once the pump is switched on, the brine/glycol level should be re-checked at the expansion tank and seals on the pump monitored for leaks. When the condenser pump is operated, the water nozzles must be checked again and the pump seal monitored for leaks. When all compressors and pumps are switched on and running, operating pressures and temperatures will begin to change. These must be observed regularly to confirm proper operating conditions. Carefully listen for any unusual noises that will indicate a problem, and follow up as necessary.



*Condensers require regular maintenance before, throughout, and after the skating season.*

## Checks and Maintenance After Start-up

Once the refrigeration plant has been successfully started, every operator is responsible on his/her shift for ensuring that the plant remains in good operating condition. This requires a number of checks that must be done daily on a per-shift basis, including: proper oil level in the compressors, liquid leaks in the system, adequate brine/glycol levels, proper refrigerant level at the chiller, plus monitoring all operating pressures and temperatures. Also, the condenser water tank must be examined for proper level and the buildup of any dirt or scale. As a result of the procedures listed above, some periodic maintenance may be required throughout the operating season. This may include such things as re-adjusting V belt tension, adding or draining oil (depending on primary refrigerant used), replacing worn couplings on pumps, adding brine/glycol and dealing with any electrical problems such as blown fuses, broken switches or faulty operating controls. It should be noted again that a properly trained and

qualified person should perform any maintenance done on the refrigeration plant. One of the operator's most important tasks after start-up is that of maintaining an accurate logbook that records all operating conditions in the refrigeration plant plus any work done on the equipment. In many jurisdictions this is law. Please check all codes or standards that are applicable to your own arena so that you, as a supervisor or operator, clearly understand the responsibilities with respect to the logbook.

The successful operation of a refrigeration system in today's arenas relies on a maintenance program that includes adequate funding for ongoing equipment maintenance or replacement, plus a partnership between owners, properly trained staff, equipment suppliers and contractors who are committed to keeping the system well maintained. This type of refrigeration system maintenance program will go a long way to contributing to a cost-effective, trouble-free season, which should be the goal of every arena. ★