What the **Watchman Watches**

A Quick Guide to Refrigeration System Vital Signs

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It is often said that rounds men and rounds women (a.k.a., "rounds persons") should constantly be on the lookout for any indication of system upsets. But exactly what should they look for?

For most people the first answer that comes to mind is, "thermometers and pressure gauges." Another possible answer is, "they should be using their eyes, ears, and noses."

An effective rounds program must use all of these in conjunction with training and reasoning skills to provide meaningful results.

Let's look at these in detail.

EYES

The rounds people should be constantly on the lookout for anything that looks out of place or appears different than normal. This should include both visual indicators in the systems as well and an awareness of operational and personnel behavior.

For example: While performing rounds, Jim noticed a toolbox near an ammonia screw compressor that was running. When he looked closer he noticed the coupling guard had not been reinstalled at completion of the work. By taking notice of the toolbox and giving special attention Jim was able to prevent a potentially serious accident.

Visual Thermometer Checks

Thermometers allow us to check temperatures within our refrigeration system. In many instances, we check pressures in lieu of temperatures because the pressure/temperature relationship for ammonia at saturated conditions allows us to directly infer temperature at known pressure. However, in areas of the systems where components are not operating near saturated conditions (or if conditions are suspect), the checking of temperatures is required.

Some areas where temperatures should be routinely checked are compressor suction lines, brine or glycol, condenser cooling water, and compressor discharge temperatures.

Jennifer performs the rounds upon her arrival every morning; however, she had developed the bad habit of setting her driving gloves on the reciprocating compressor to dry them while she did rounds. Imagine her surprise when she re-entered the engine room to find her gloves on fire! The fire was quickly extinguished and a major incident was averted. What do "flaming gloves" have to do with thermometers? The compressor head should not have been that hot. Two opportunities were missed. The first was that if the compressor discharge temperature had been checked, it would have indicated an unusually high temperature requiring a repair or a shutdown. Second, if the head cooling water return temperature had been monitored, the issue would have been found much earlier and a costly compressor repair could have been avoided.

Visual Pressure Gauges

As noted above, pressure gauges can allow us to determine both temperature and pressure within our system during saturated conditions. But the question arises—out of the dozens of gauges throughout the refrigeration system, how do we

determine what gauges to check during daily rounds? Do we check them all? Probably not.

Critical gauges in all refrigeration systems are: compressor discharge and suction pressure level (high stage, low stage, low-low stage, etc.). Other critical gauges may include gauges associated with critical processes.

Also, a pressure gauge should be installed and checked on a regular basis anywhere a pressure fluctuation may cause either a safety issue or an impact on production.

Lisa was conducting the refrigeration system rounds one evening in a poultry facility. A water chiller was chilling red water for an open-face bird chiller. The water returned to the chiller at about 40°F. Water exited the chiller at 34°F. As Lisa was checking the gauges, she noticed the pressure within the chiller was 31 PSIG which indicates an ammonia temperature of 18°F—a temperature too low for safe operation. Lisa de-energized the liquid solenoid and repaired the suction regulator. (It had stuck in the open position.)

Lisa's actions prevented a severe freeze-up that would likely have resulted in crushing the chiller tubes, causing tens of thousands of dollars in equipment damage, and lost production.

Visual Sight Glasses

While today's modern electronic level sensors and remote monitoring are convenient and excellent tools they should not be trusted without regular rounds verification.

Level sensors are mechanical and electrical and as such they are subject to calibration error and at some point they will fail.

Bull's eyes and tubular sight glasses, on the other hand, are reliable—they don't lie!

A good rounds person will use both. The level indicators are used to record an accurate level. The bull's eye is used to ensure that the electronic level probe is reasonably accurate.

Why do we need to know what the level is anyway?

Low levels may indicate make-up problems. It is better to find the issue before high temperatures (lack of cooling) becomes an issue.

High levels may lead to slugging or indicate an overfeed situation.

Lewis was performing rounds at 3:00 p.m., the last duty of his shift. He walked past the receiver which was the last stop on his rounds. He noticed the receiver level had dropped five bulls' eyes since his morning shift. Lewis knew this was cause for alarm. In the five years he had been doing rounds he had never seen such a drastic drop. A quick radio call to the refrigeration supervisor solved the mystery of the missing ammonia. The recirculator level had been increased in preparation for some upcoming work.

Sudden shifts in levels can indicate issues, so Lewis did the right thing. Any severe fluctuation should be reported immediately.

Visual Frost Patterns

Frost patterns or lack of frost can be an indicator of the system status.

When a component normally has frost but is not frosted during rounds, it is cause for concern. For instance, the outlet of a thermal expansion valve which is suddenly defrosted may be a sign of a failed solenoid valve. It can also be something as simple as an indication that the unit is in defrost.

Another example is frost patterns on the outlet of the liquid expansion valve during the hot gas defrost cycle. This is an indication of a liquid supply solenoid valve that has failed to open. The hazard of this situation is the cold liquid contacting the hot vapor. This releases a tremendous amount of energy.

Excessive frost on the face of an evaporator is an indication of a failed defrost cycle.

An usual frost pattern may also be an indication of a system problem. An oil pot which is frosted at the top is an indication of oil accumulating in the oil pot. Frost on the bottom (only) of an oil pot may be an indication of contaminants in the system.

What about frost shaped like a donut? If there is an ammonia leak with significant pressure it can actually create a frost pattern that looks like a donut. The hole in the middle identifies the location of the leak.

Blue ice can also be an indication of an ammonia leak into the ice. Other leaking materials into water or ice can generate different colors. It is vital that we check for any unusual coloration and investigate the cause of the discoloration.

EARS

Hearing protection should always be worn in hazardous areas. Hearing protection does not prevent the rounds people from using their ears. Unusual sounds or the absence of normal sounds can be an indication of system issues. Most times a rounds person who enters the engine room to perform rounds and finds the engine room completely silent knows there are serious issues at hand. Another example is the case of Mary, a third-shift rounds person. Mary had just exited the machinery room and entered the production area. A "hissing" sound attracted her attention. She investigated the sound and found a control pneumatic control valve leaking air. Her early detection of the air leak prevented a costly production delay.

NOSE

The way a system "smells" can tell the trained rounds person a lot about the operation of the refrigeration system. The "hot" smell of melting insulation, the pungent odor of burnt oil, even the "chemical" smell of leaking water treatment chemicals are clear signs of system problems. Larry was beginning his rounds in the engine room when he smelled an unusual odor.

What the Watchman Watches continued on page 31

What the Watchman Watches continued from page 13

When he investigated, he found a calcium chloride brine leak from the brine chiller. Had he ignored the odor and accepted it as normal, the results could have included severe corrosion of several pipe nipples and an isolation valve. Larry's investigation prevented a potentially costly pipe replacement or disruption of service.

Another example is the failure to investigate a faint odor of ammonia during condenser inspections. The result was the loss of thousands of pounds of ammonia through a relatively small leak because the leak was masked by the cooling water flowing over the coils and subsequently allowed to continue for weeks after first being detected.

The Hidden Keys to Success

Transfer Counts

Facilities which use automatic transfer systems should monitor transfer counts on a regular basis. There is an ideal number of transfers for every system. In some systems, three to four transfers are normal. A single wing recirculator may have several hundred transfers a day. The important thing for the rounds person is the ability to recognize a variance from normal.

An increase in transfers is a sign of an overfeed condition somewhere in the system. A decrease in transfers may be an indicator of a lack of normal liquid feed.

The rounds person should be aware of the current refrigeration load and weather conditions. These may have a bearing on transfers.

Mechanical failures of the transfer system may also result in a change in transfer counts.

Remember the variance from the norm is the important distinction.

Purge Counts

If the facility is equipped with an automatic purger, the purge times and counts can be a strong indicator of problems in the system. An increase in purges is an indication of air being drawn into the system. A lowering of purge counts can also give us a clue to the operation of the system.

As we've discussed with other rounds issues, we are looking for a variance from normal. However, we must not get complacent. Normal may not be correct. Just because it "always looks that way" doesn't mean it should. We will discuss this in greater detail in the future.

Miscellaneous

Each system component has specific items to be checked on a regular basis.

System control panels and ammonia detection panels should be checked to assure there are no active alarms. The rounds person should also check the alarm history since the last round.

Evaporators should be checked for failed motors, missing fan blades, and icing.

Much like evaporators, condenser fan motors should be checked daily.

Sump tank levels should be checked to assure adequate water is available for cooling.

Chillers may require a check for brine concentrations, suction pressure, liquid levels and pump pressures.

Compressors may require checks of suction pressures, discharge pressures, discharge temperatures and oil levels. Each compressor micro panel should be checked to assure it is operated in the correct mode (remote or local). Slide valve position should also be checked to assure that it loads and unloads automatically. Each microprocessor should be checked to assure that there are no active alarms.

Refrigerant pumps should have oil levels checked. It may also be necessary to check pump discharge pressures or differential pressure.

Each vessel will have a specific list of items to check based on its use. A receiver may require a level check where a recirculator may require a level check as well as a pressure check.

A rounds log does not have to be specific to the refrigeration system. A facility which uses air compressors should be regularly checking the oil level within the air compressor. These types of checks should be incorporated in the rounds log. In most cases it is not logical to force employees to perform two simultaneous rounds.

This list is certainly not complete. There are many components so there are many items to check. The manufacturer's information should be consulted. Additionally, industry references, such as IIAR Bulletin 110, should also be used.

Organization

Rounds sheets should be organized to provide a thorough walkthrough. Remember the "eyes, nose and ears." By organizing the sheet to guide the rounds person through the system, the person has opportunities to use eyes, nose and ears.

What does the future of rounds hold? Imagine portable electronic rounds devices, automatic trending and rounds logs on demand (The ability to print a rounds sheet listing the status of equipment and the computerized reading. These are then verified by the rounds person).

Rounds are a vital part of the safety and reliability plan for any facility. They should be given the importance they deserve. The ability of the rounds people to react to changes seen while performing the rounds will ultimately result in a safer and efficient compressor room.