Mechanical cooling unit maintenance (PRELIMINARY / DRAFT)

As electronics technicians we likely do not have training to fully understand and maintain refrigeration systems. However there are basic checks that can be performed and we should know what to look for to spot troubles early. Many preventive maintenance items such as belts, filters, motor alignments, and coil cleaning can easily be performed. By law, we are not permitted to actively work on the refrigeration system. Basic troubleshooting is ok before a refrigeration mechanic is called in. Hands, ears, and eyes are valuable tools. Don't make any adjustments or release refrigerant.

Mechanical cooling systems are designed to operate as a closed system. Keep all building doors closed while a mechanical cooling unit is operating. If other rooms in the site use mechanical ventilation (not cooling) keep doors closed to those rooms as well. Otherwise it will be very difficult for the system to maintain proper temperature.

Place a small card on front of the unit to record maintenance. Belt condition, motor and bearing greasing, air filter changes, condenser coil cleaning, etc. Include date maintenance performed and next maintenance due.

Supply air louver adjustments

The first and most obvious thing to check when entering a building is the supply air louvers. The room is used for mixing cool air from the mechanical cooling unit. The cool air must be blown high to the ceiling, towards the far end of the room. As it settles it will mix with warm air providing proper cooling and reducing any hot spots. Do not direct the air towards the floor.

Air filters

Inspect the filters each trip to ensure they are relatively clean. They should be replaced annually or more frequently as required. In some areas with high pollen or dust the filters may need changing 3 or 4 times per year. Ensure the site has enough spare filters for a full change.

Belt tension ******** Picture required **********

For a system that operates 24/7 the belts should be loose. This will minimize pressure on motor and blower bearings and maximize belt life. Minor belt slippage or chirp on startup is acceptable provided there is no slippage while running. The belts can have several inches of slack when moved up or down when tension is checked. Belts should last about 3-4 years between changes. No tools should be required for changing belts. It will be easy to roll belts off the pulleys by hand. Belts will not fall off during operation if alignment is correct. An easy check is to listen to the belts. Any squeaks could indicate high tension against the pulleys or poor alignment. A properly tensioned and aligned belt will produce very little noise. Belt dressing and other sprays are not required.

Store belts away from ozone-producing unguarded fluorescent lights, mercury vapor lights, and high voltage electrical equipment. It should be in a cool, dry, dust-free, and clean area, away from radiators and direct sunlight. Temperatures below 85F/30C and relative humidity below 70% are recommended.

Pulley alignment ******* Picture required **********

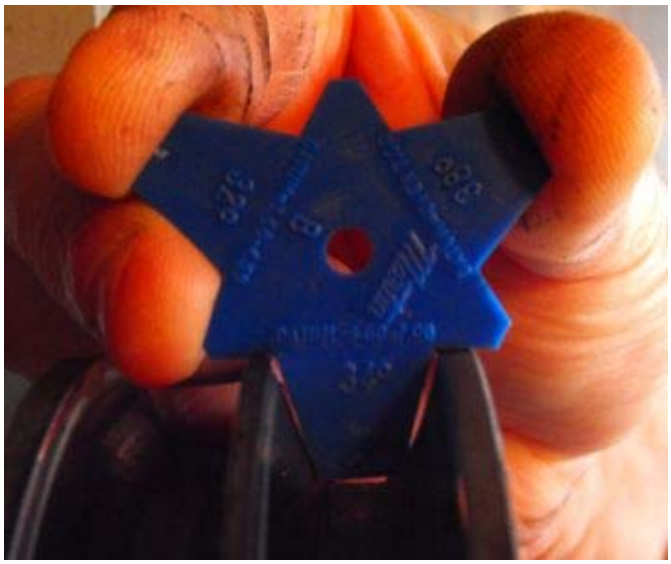
Motor and blower shafts must be parallel. Pulleys must be on the same plane. As a quick check, stand back from the unit and look at the motor pulley. As you move sideways the front and rear edges of the pulley will come together so you are looking flat along the outer edge. This edge must coincide with the two edges of the blower pulley. It is typically easier to adjust the motor than attempt to move the blower. Adjust the frame to change the motor angle. Move the pulley horizontally on the motor or blower shaft to get both in the same plane. A long carpenters level is helpful to get this correct. Place it along the outer edge of the larger pulley and rotate slowly. The level will touch the smaller pulley evenly and equally on both edges if alignment is correct.

Next place the level on the motor pulley and rotate to compare alignment against the blower pulley. Make adjustments as required. Motor alignment should be required only when the unit is new and following motor or bearing replacement. There should be no requirement to make adjustments following a belt change. An obvious indication of improper alignment is black residue on the supply air louvers. The belts will wear excessively and dirt will be deposited on the louvers. The pulleys will also exhibit excessive wear if alignment is incorrect or tension too high. Misaligned sheaves will accelerate wear of the V-belt sidewalls, which will shorten both belt and sheave life. Misalignment can also cause V-belts to roll over in the sheave or throw all the load to one side of the belt, which can stretch or break the tensile cord.
Download this PDF for a Gates white paper for belt alignment.
http://www.gates.com/file_display_common.cfm?thispath=Gates%2Fdocuments_module&file=Proper+Alignment.pdf

Also from Gates.
Parallel misalignment results in accelerated belt/sheave wear and potential belt stability problems with individual V-belts. Uneven belt and cord loading is not as significant a concern as with angular misalignment. However, parallel misalignment is typically more of a concern with V-belts than with synchronous belts. This is because V-belts run in fixed grooves and cannot free float between flanges, as synchronous belts can, to a limited degree.

V-belt sheaves – pulley inspection

Belt life will be reduced if the sheaves are worn. Inspect belts for any unusual wear. Excess or unusual wear may indicate problems with the drive design or past maintenance procedures (ie improper alignment or belt tension). Inspect grooves for wear and nicks. Use a sheave gauge to determine if the grooves are worn. Place the proper sheave gauge into the sheave groove and check for wear. If more than 1/32" of wear can be seen between the gauge and groove side wall, the sheaves are worn and should be replaced. A light source such as a flashlight may be used to backlight the gauge. Shiny grooves are often polished because of heavy wear. Inspect the sheave grooves for rust or pitting. If rusted or pitted surfaces are found the sheave should be replaced. Make sure the pulleys are straight and not bent. Any wobble while turning could indicate improper installation or a bent pulley or shaft.
http://www.gatesprograms.com/assets/offers/Belt_PM_Manual.pdf



Thermostat adjustment

Many systems use free cooling at times outside temperature is below 12C. The refrigeration system is shut down and outside air is used to mix with return air to maintain proper room temperature. Ensure the changeover does not occur below 12C as the refrigerant is not designed for cold temperatures. When

switching modes if the thermostats are not set exactly the same there will be a period of high temperature supply air. You will need to monitor supply air temperature while changing modes several times to make minor adjustments.
Dual systems supplying air the same room will often not switch modes at the same time. Choose one as the main and run a 24VAC control cable to the second unit. This will ensure both change modes at the same time. The thermostats will require careful adjustment to ensure both units share the heat load equally.

Condenser coil cleaning

The coils must be clean to allow proper air flow and heat exchange. Dirty coils will cause head pressure to raise and create added stress on the compressors. Inability to maintain proper room or supply temperature could be an indication of a dirty condenser coil. The system may shut down due to high head pressure. Dirty coils is the major cause of compressor failure and the main reason systems do not perform to their full capacity. Cleaning should be done at least every two years or annually if the site has heavy dust or pollen problems.

Wear gloves, rain gear, and eye protection. The cleansing solution is acid based. Spray water through coils to make everything wet. Spray cleaning solution through coil, starting at bottom and working upwards. Begin application from inside cabinet and watch for solution to make its way to front of coil. Once covered from inside, spray outside surface of coil, again starting from bottom and working upwards. Let solution create foam over entire coil. Leave for a few minutes, then rinse fully. Start inside cabinet at the top and work downwards. Then move to outside, start at top and work downwards. Dirt particles will be seen as water flushes through coils. A second or third application may be required on coils that are very dirty. Regular tap pressure is adequate for rinsing. A pressure washer is not required and will bend the cooling fins. Get a metal comb for straightening any bent fins to optimize air flow.

Evaporator coils are usually exposed to less dirt and contaminants but should also be cleaned as required to maintain proper air flow and cooling capabilities.

**** Need picture of cleanser and manual pump sprayer ****

Motor care

Electric motors and pulleys should be treated carefully and not mishandled. While they are large and heavy, they are also precision and delicate equipment. Any mistreatment or abuse will result in damage, improper operation, reduced reliability, and early failure. Treat it as if it was a high power vacuum tube. Never use a hammer to install or remove pulleys! Listen to the motor and blower assembly. Any rattling noises or vibration should be investigated.

Motor cleaning

It is very important that the air passages be kept clean so that the motor can dissipate the heat by circulating cool fresh air. With totally enclosed-fan cooled motors, it is also necessary to keep the cooling fins free of dirt and debris, because these motors depend entirely on heat transfer through the fins to dissipate heat. To assure proper cooling make certain nothing prevents sufficient amounts of fresh air from reaching the motors. Make sure the motor is not recirculating hot exhaust air because its vents are placed too close to a wall or another motor.

Motor and bearing greasing

Clean grease nipple prior to attaching grease gun to prevent dirt from entering bearing.
Motor should be running while greasing. 24-36 month intervals. (check with manufacturer recommendations)
Blower must be turned by hand while grease applied. Two small squirts every six months.
Use a stethoscope for listening to bearings and motors.

The process of lubrication is a critical one, requiring special care to achieve the levels of bearing performance that extend bearing life.

In general four key recommendations need to be observed.

1. The grease should be stored in a proper room to avoid penetration of contaminants. Before lubricating a motor, clean the grease nipple. Whenever possible, motors fitted with a grease fitting must be lubricated with the motor running. If not, pump in half of the grease fill recommended in the motor manual, run the motor for a minute, switch it off and then pump in the remaining grease. Motors not designed with a grease fitting must have the bearing carefully removed for lubrication.

2. All grease must be removed and the bearing housing carefully cleaned with the application of kerosene or diesel. When greasing, force the grease to penetrate into bearing races and all other internal orifices.
3. It is quite important to spin the bearing while lubricating it so as to ensure proper grease penetration, hence avoiding noisy operation. The heating temperature when mounting the bearings cannot exceed 90C, as this will affect the grease adversely resulting in a reduction of bearing life.
4. In cases where the bearing has been removed then heated and refitted to a shaft, it is important to avoid incorrect alignment by checking to determine the internal bearing cap is making a correct fit with the shaft.

If these recommendations are observed as part of a planned maintenance schedule, reliable motor operation will be ensured and also extended bearing life. As a result, maintenance costs will be reduced and unexpected - and costly - production failures will be avoided.

Types of grease

Grease incompatibility – Greases are made with different base compounds such as lithium or poly-urea. Not all greases are compatible with each other; therefore it is important to use the same grease or compatible substitute throughout the life of the bearing. Too much or the incorrect type grease can cause premature motor failure. Make sure it's mineral grease and not synthetic. Engineered air will recommend their preferred type of grease to be used.

Never install grease-tubes to motors or bearings. Assume a 30 inch long, 3/8" diameter tube is in place. Two squirts of grease are applied every six months. The grease in the tube has moved about 2" maximum per year. This means that it will take 15 years for the grease to reach the bearings, upon which time the grease has hardened. It is useless and will destroy the bearing. If tubes are in place remove them. Use a flexible extension on the grease gun to connect to the bearing.

Visual checks

There should be no ice on the thermal expansion valves. Call in a refrigeration technician if adjustments are needed. The tubing should feel cold.

While operating, sight glasses should be full and the liquid should be clear. Minor bubbling is ok. There will be bubbles as the compressor cycles on and off. This is normal. Heavy bubbling could indicate loss of refrigerant or inadequate charge. The sight glasses may bubble if the doors to the unit are opened. This is to be expected. Compare the color indicator dot at the center. If it indicates moisture call in a refrigeration technician. The system may need to be emptied, a new dryer installed, and refrigerant added. Find and repair the leak in the system. In most systems it is more economical to install new refrigerant than recycle original and have to replace the dryer a second time.

There should be no black residue inside the site glass. This side suffered compressor failure. The entire system had to be cleaned and refilled.

Refrigerant charging

A licensed refrigeration technician must perform this work.

From EngAir Maintenance Manual, page 20. http://www.engineeredair.com/manuals/L62S38714.pdf
"Raise the head pressure to a saturated discharge pressure that corresponds to 130F (54C). Charge refrigerant into the system slowly until the system sight glass is clear. The system must be at design air flow and load."

This manual is different from the one supplied with the units. It should be downloaded and made available at each site, along with a copy of the manual specific for the EngAir system installed.

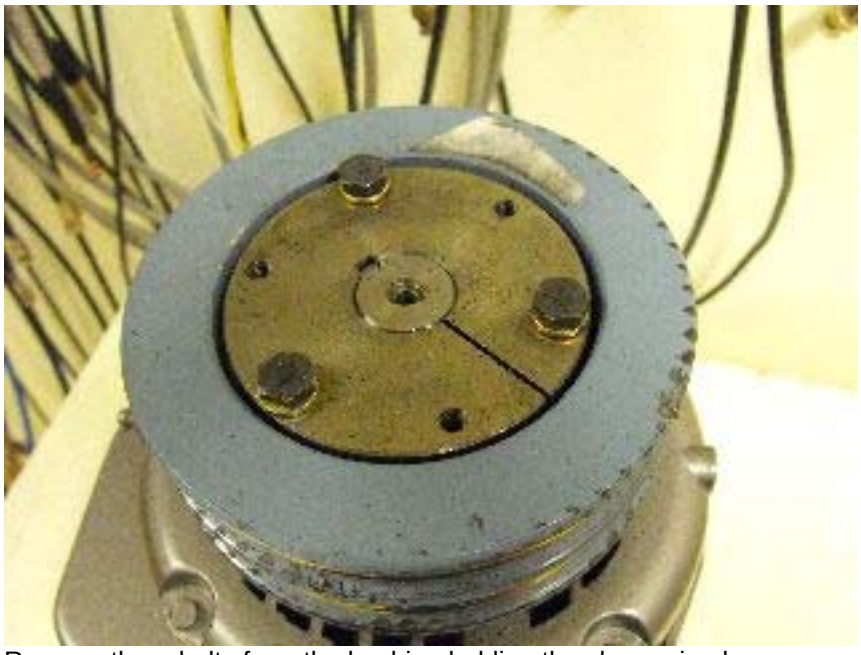
Each refrigerant circuit is sealed. It will need to be topped up only if there is a leak. Never merely add refrigerant and walk away. Insist that the leak be found and fixed. I've found the front panel test ports often have slow leaks. The refrigerant has oil added to lubricate the compressor. The oil will travel throughout the system. Look for oil residue to help find leaks. The refrigeration technicians will sometimes use Snoop, commonly used to find transmission line air leaks to look for bubbles.

There seems to be confusion amongst refrigeration technicians about exactly how to top up or recharge the EngAir systems as they seem to use a non-standard procedure. The numbers stamped on front of the units have been described as a nominal charge, not necessarily the proper amount required. Some techs will fill precisely to this amount and nothing more. It is difficult to get a straight answer from anyone for the correct technique. Once you find a reputable refrigeration technician that you can trust leave it to his judgement as to the best way to fill the system.

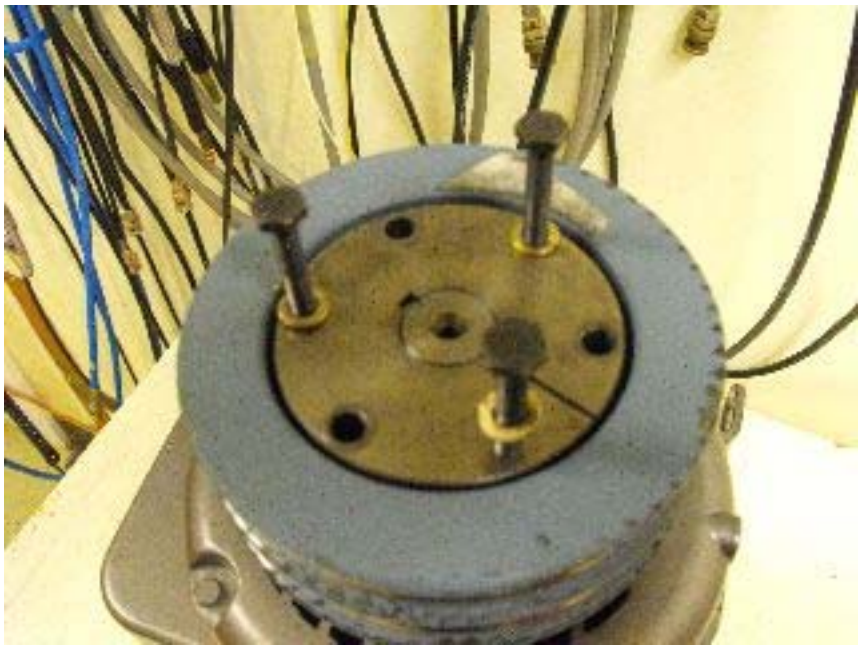
Unfortunately the technique described in the maintenance manual seems to create ongoing problems. Frequently the compressors will shut down due to high head pressure. As a result, the front panel tag figure has been used to refill each stage to the stated amount of refrigerant. There may be heavy sight glass bubbling, but the HLPC switch does not trip.

Pulley Replacement

Original motor. Bearings damaged and making loud growling noises while motor is running. Take note of the pulley position on the shaft such that it can be installed in the same position on the new motor.



Remove three bolts from the bushing holding the sheave in place.



Relocate the bolts to the threaded holes in the bushing.

Tighten bolts evenly and the sheave will drop away from the bushing.

Use Allen key to loosen bolt holding the key. The bushing will slide off the shaft.

These are the removed parts ready to be installed.

Place the sheave onto the motor. Install the bushing and key. The shaft position should be similar to the old motor. Tighten the bolt against the key with an Allen wrench.

Install bolts through large holes in bushing into threaded holes in sheave. Tighten by hand until the sheave slides onto the bushing.

Tighten bolts, alternating between bolts to ensure sheave slides evenly onto bushing.

Completed pulley installation, motor ready for installation. Be sure to check pulley alignment and belt tension when the motor is placed in service.

Further information

This document was requested after someone used a hammer to install a replacement pulley onto a motor shaft. It resulted in smashed bearings on a new Baldor motor and a cracked pulley bushing. This required another trip to the site to perform the repair properly and added expense to repair the motor. There have also been other ongoing issues that seem to be related to the systems operating at high pressure due to dirty condenser coils. Properly maintained these systems will last a long time. Neglected and they will cost a lot of money in repairs.

These are my personal notes and thoughts from the past several years. My research and writing takes place after work hours, on my own time, and purely out of personal interest. I've done my best but can not guarantee 100% accuracy throughout. Do your homework and double check before using the information in any critical application. I appreciate constructive suggestions and ideas for improvement. Please let me know if you have found the information useful or if you find errors or typos.

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I'd like someone to assist with proof reading and translation to French. Please email if you are interested in helping out.

Latest changes and updates will be available on my personal web page.
http://members.rennlist.org/warren/HVAC_PM.pdf

Other items I've been working on.

Antenna splitter cable replacement, power divider calculations, etc.
http://members.rennlist.org/warren/SplitterCableDesign.pdf

Relative humidity measurement and remote monitoring, dehydrator theory.
http://members.rennlist.org/warren/RelativeHumidityAndDehydrators.pdf

Construct a simple and inexpensive dew point monitor for monitoring dehydrator performance.
http://members.rennlist.org/warren/DewPointMonitor.pdf

Broadcast and RF related grounding ideas.
http://members.rennlist.org/warren/grounding.pdf

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