COLMAC COIL
Manufacturing Inc.

Technical Bulletin

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MECHANICAL INTEGRITY INSPECTIONS OF AIR COOLERS

Owners should perform periodic mechanical integrity inspections on air coolers to ensure the continued reliability of the unit and to minimize the risk of an accidental ammonia release. This article lists some of the more common issues to look for when performing mechanical integrity inspections of a typical air cooler.

1) Excessive Ice or Material Buildup

Inspect all air coolers for material buildup on the fins and drain pans. Dust and/or packaging material fibers are common sources for this build up. Inspect the air coolers operating in areas below freezing for excessive ice buildup on the fins and drain pans. Excessive ice and material buildup could interfere with air flow and reduce the coil capacity. Excessive ice buildup between the bottom of the coil tubes and the drain pan could cause mechanical damage to the coil tubes and drain pan. Remember that hot gas defrosted air coolers commonly have an array of heating tubes attached to the drain pan. Any damage to these tubes or to the tubes in the coil core could result in an ammonia leak. Follow the manufacturer's guidelines for defrosting air coolers, which might include adjusting the number of defrosts and their duration. Adjustment of the defrost regulator pressure setting may also be needed to ensure complete defrosting. If adjustments to the defrost scheme do not prevent excessive ice buildup, contact the air cooler manufacturer, a contractor, or a consultant for further analysis.

Figure 1: Ice accumulation in drain pan of hot gas defrosted air cooler

2) Corrosion of Tubes, Fins or Connections

Figure 2: Corroded air cooler tubes

Inspect the surface of the tubes, fins, and piping connections for signs of pitting or uneven discoloration. Also inspect any insulated pipes where the vapor barrier might be compromised. Excessive pitting could result in an ammonia leak if the pit continues through the wall thickness of the tube or pipe. Corrosion of the fin surfaces results in reduced refrigeration capacity, so it is important to also check these surfaces. Visually inspect all areas of the coil with a flashlight. For hard to reach areas, use a flexible, lighted bore scope. If possible, measure the depth of large pits with a micrometer depth gauge. Generally, any pit deep enough to measure is cause for concern and remedial action to stop the corrosion and repair the materials should be taken. Consider taking digital pictures of any beginning corrosion for future comparison. Corrosion of tubes and fins can be prevented by only using cleaning chemicals that are suitable for the materials of construction. Many cleaning chemical suppliers and/or your air cooler manufacturer will have recommendations regarding this. In some corrosive environments, a water rinse system can be utilized to keep contaminants from building up on tube and fin surfaces.

3) Exceeding Maximum Allowable Working Pressure (MAWP)

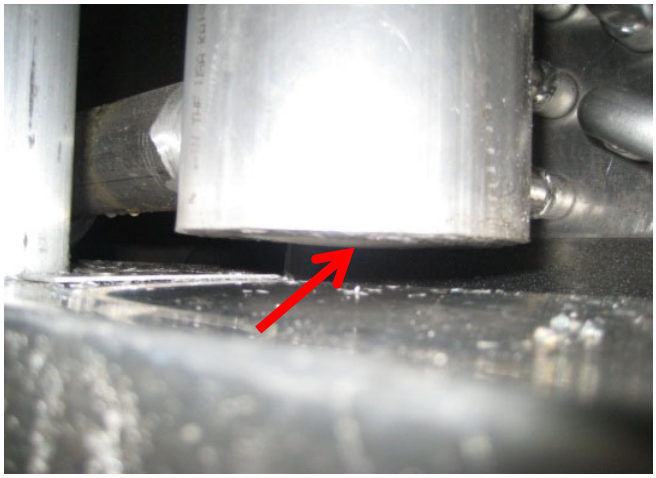

Figure 3: Bulged end cap on air cooler header

Inspect the ends of the evaporator header pipes for signs of bulging. The largest diameter end cap is typically the first location that any signs of over-pressurization will be evident. Tubes or pipes that look misshapen are also signs of over-pressurization. Trapped liquid in an air cooler could expand and cause the internal pressure to exceed the MAWP. This could result in ruptured components and ammonia leaks. Hydraulic shocking, or vapor propelled liquid, is another internal force that could exceed the air cooler's MAWP and cause ammonia leaks. Prevention measures include using good piping practices per the IIAR Piping Handbook, keeping hot gas lines clear of liquid, and always allowing the defrost pressure to equalize before opening the suction stop valve.

4) Fan Vibration and Integrity

The fan assemblies on air coolers should be inspected annually, or per the manufacturer's recommendation for your specific air coolers. With the fans running, look and listen for any vibrating components. Typically, vibration in larger sheet metal panels will be the most noticeable. Keeping a safe distance from the fan, and with all guards in place, watch the fan in operation, looking for any vibration as it rotates. Listen for any sudden changes in noise levels or tones. For variable frequency controlled fans, check for vibration over the entire range of speeds. For multi-fan units, shutdown individual fans to localize the source of vibration. With the fan motors off and safely locked out, check the torque on the bolts securing the fan assembly to the motor shaft. Also check the torque on the bolts holding the fan motor to its mount. Check with your air cooler manufacturer for proper bolt torque values. If left unchecked, loose fasteners in either the fan hub or the motor mount could result in a catastrophic failure such as mechanical damage to the air cooler tubes which could result in an ammonia leak.

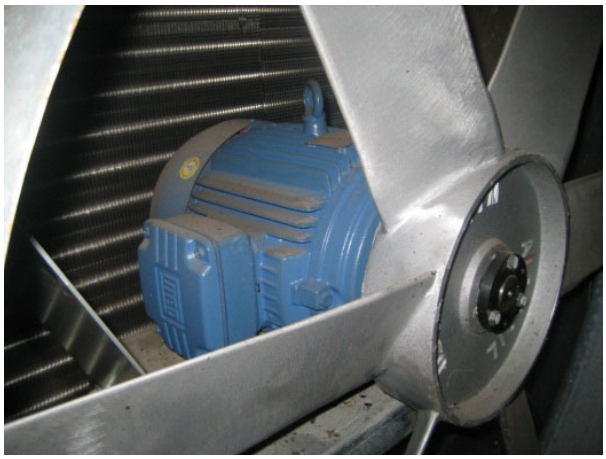

Figure 4: Typical air cooler axial fan assembly

5) Refrigerant Distribution Tube Condition

Some air coolers are equipped with refrigerant distributor devices that meter equal amounts of liquid and vapor refrigerant to each coil circuit. The distributors are commonly connected to each coil circuit by means of long, small diameter feed tubes, usually about ¼" in diameter. It is important to periodically check these feed tubes for signs of rubbing. This will typically show up as a flattened area on one or more distributor tubes. If not repaired, the rubbing could eventually wear through the tube wall, causing an ammonia leak. Visually inspect each tube paying close attention to those that are touching or close to touching. Contact the air cooler manufacturer or a refrigeration contractor to reorient the tubes, install wear sleeves, or replace the tubing.

Figure 5: Typical distributor tube assembly

6) Integrity of Housing, Unit Supports, and Piping Supports

The condition of the air cooler's housing and supports should be inspected annually. Visually inspect the unit housing and the hangers for cracks, missing or loose fasteners, and any signs of corrosion. Deteriorated supports could result in the unit falling from the mounting location, which could result in an ammonia leak. Also inspect piping supports near the air coolers. Typically, air coolers are not designed to support piping, control valves, or hand valves. Improperly supported piping could overstress the coil connections, resulting in a leak. Any unit and piping supports that show any signs of damage should be repaired or replaced immediately.

Figure 6: Ceiling suspended air cooler

7) Protection Against Traffic Hazards

Air coolers that are operating in areas of high fork truck traffic should have their protective barriers inspected annually. Visually check each barrier for evidence of damage due to fork trucks. Damaged barriers should be repaired or replaced. Traffic impacting an air cooler could cause mechanical damage and ammonia leaks. Prevention measures include adding additional protection, training lift operators to not hit the protective barriers or units, and adding warning / caution signs.

Figure 7: Floor mounted barriers

8) Electrical Integrity

Electrical components mounted to air coolers should be inspected annually. Look for loose connectors or signs of overheating, such as black marks, melting of wire insulation, or cracks in wire insulation. Visually inspect the electrical connectors and use an infrared camera to look for overheating components. Any electrical issues, if left uncorrected, could result in a fire. Contact a company electrician or an electrical contractor to either repair or replace defective equipment.

Figure 8: Infrared photo showing overheating wire

9) Missing Fan Guards

The presence of and condition of fan guards should be inspected annually. In the absence of proper guarding, people could be injured or product could come into contact with moving fan blades. Visually inspect each air cooler to make sure that each fan is guarded and what condition each guard is in. Contact the equipment manufacturer to obtain replacement fan guards.

Figure 9: Air cooler with missing fan guards

10) Suitable for Operating Conditions

Air coolers should be inspected annually to determine that the unit is still being operated within the intended conditions. One way to verify this is to check the unit serial plate for the minimum and maximum design operating temperatures and pressures. Operating air coolers below the minimum design temperature could result in material failures and rupture due to embrittlement at low temperatures. This is especially true for air coolers constructed from some carbon steels and hot dip galvanized. Air coolers with aluminum or stainless steel tubes typically can operate safely at very low temperatures. Air coolers operating above design temperature could lead to over-pressurization and rupture, which could be possible during higher temperature cleaning processes. Contact the equipment manufacturer to verify design values and only operate equipment within recommended design parameters, or replace equipment operating outside of design.

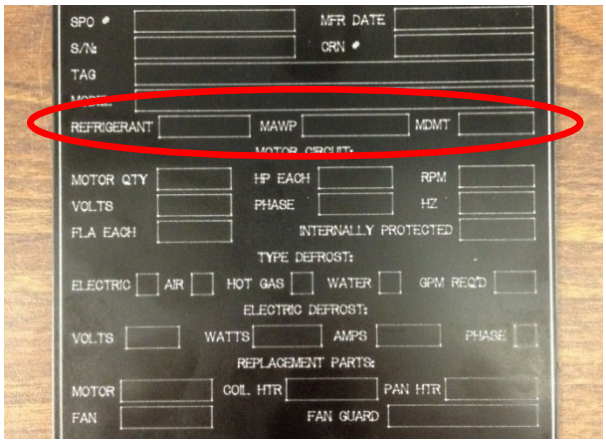

Figure 10: Typical serial plate for an air cooler

Owners can be assured of continued reliability and the minimum risk of an accidental ammonia leak by performing these mechanical integrity inspections on air coolers in their facilities. More information can be found in the following reference materials:

- Manufacturer's IOM's
- IIAR Bulletin No. 109
- Standard IIAR-2
- ASME B31.5
- ASHRAE Standard 15
- ASHRAE Refrigeration Handbook

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