Maintenance Guidelines for Chillers

Chillers play an essential role in maintaining business operations, whether they support production processes, storage of perishable goods, equipment cooling systems, or general comfort cooling. A breakdown of this equipment may result in unnecessary downtime, business interruption, product spoilage, or reduced productivity due to discomfort. The best practice to help ensure that equipment is reliable and reduce the risk of equipment breakdowns is to establish a preventive and predictive maintenance program.

It is important to familiarize yourself with the type of equipment and how it is used at your location. Important system characteristics to note include equipment type and manufacturer, system rating, refrigerant type, total system charge, physical layout, etc.

Types of Chiller Systems

All chillers follow the same basic principles to remove heat from a liquid. The liquid is usually water and is often referred to as chilled water. The most common type of chiller systems includes the following:

Air-cooled chillers: Heat is removed from the chill water to the atmosphere using a forced air-cooled condenser.

Water-cooled chillers: Heat is removed from the chill water by a cooling tower or other water source.

Absorption chiller: Absorption chillers operate on a different thermodynamic principle than air- and water-cooled chillers, which rely on compression. Instead, they use a heat supply such as steam, hot water, or another heat source and use water mixed with lithium bromide as the refrigerant.

Preventive Maintenance Guidelines

The following guidelines can be useful for developing a comprehensive maintenance program specific to your operation.

Preventative maintenance, inspections, and testing should be scheduled in accordance with the manufacturer's recommendations for the specific equipment and should only be completed by qualified technicians following manufacturer recommended procedures and all applicable safety precautions.

Maintenance activities should be well-documented to maintain a machine history record. Thorough documentation can provide data to help establishing trends, identifying abnormal conditions and track work performed by vendors. System parameters should be monitored continuously during normal operations. Keep a daily log to help establish normal operating conditions and identify abnormal trends.

The following recommended preventative maintenance practices should be included in your program:

Motors and compressors:

- Inspect for physical damage, signs of wear, intact seals and gaskets, indication of leaking fluids, dust/debris build-up, and tightness of bolted connections.
- Ensure moving parts are properly lubricated.
- Check for abnormal noise, temperature, vibration, etc.

Condensers and evaporators:

- Check unit for damaged or plugged coil fins that could limit the amount of air exchange needed for unit efficiency and proper operation.
- Check the fan blades and shafting for damage and excessive wear. Verify fans are balanced and centered in their housing.
- Listen for audible indications of abnormal operations, such as grinding, high pitch noises, or excessive vibrations.
- Check for corrosion, damage, excessive buildup of debris, etc.

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Refrigerant and lubrication oil testing:

- Perform superheat and subcooling pressure testing to determine if the system requires charging.
- Conduct compressor oil analysis in accordance with manufacturer guidelines. Tests include acid content, viscosity, and wear metal content.
- Test refrigerant for contamination and any indication of oil absorption.
- Test system integrity prior to initial startup and periodically to help identify refrigerant leaks that may occur over the life of the equipment.

Water treatment program:

Treatment programs are designed to minimize oxygen corrosion, scale buildup, and reduce formation of precipitates throughout the system. A proper water treatment program may reduce the risk of equipment failure and decreasing thermal efficiency. A water treatment program should also be established for the cooling tower water if applicable.

Electrical testing:

- Take amp draw readings annually. Measurements of the power consumption may identify an issue when readings are outside of expected nameplate data.
- Calibrate and test safety devices in accordance with manufacturer recommendations or at least annually. This includes pressure/flow switches, leak detection, sensors, high vibration trips, etc
- Test local and remote alarms at least annually, including high and low temperature, low oil pressure, and low section pressure, to ensure they will function as designed to alert the appropriate personnel for needed intervention.

Predictive Maintenance Guidelines

- **Insulation testing:** Motor and electrical insulation is subject to degradation over time. Insulation testing will reveal degrading conditions and assist in establishing life expectancy of equipment. Refer to the manufacturer's documentation for insulation life expectancy and recommended testing frequency.
- **Eddy Current testing:** On larger condensers, the tubes are subject to various stresses which can result in the formation of bulges, cracks, and leaks. Eddy current testing may help identify these kinds of issues. Eddy current testing should be performed every five years or in accordance with the manufacturer's recommendations.
- **Vibrational analysis:** Annual vibration monitoring of rotational equipment can reveal degrading conditions before a breakdown occurs.
- **Liquid testing program for absorption chillers**: Absorption chillers are designed to operate with chemical additives and inhibitors. Over time, chemicals can become depleted, which can cause performance problems and result in corrosion and potential equipment failure. Testing should be performed at least annually and should check for the following properties:
  - Lithium bromide level
  - Inhibitor level
  - Suspended solids
  - Alkalinity level
  - Ammonia level

Contingency Planning

In the event of chiller equipment failure, it is important to have a written contingency plan established to minimize the interruption to business operations. Factors such as component lead time, access, rental equipment options, installation of rental equipment, excess/spare refrigerant, and contractor availability can affect outage times. Business interruption may be reduced, and applicable expenses forecasted, by having a formal contingency plan in place. Contingency plans should be reviewed and updated annually to keep key components of the plan accurate and up to date.

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