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Inspection guidelines for Yankee hood systems

Scope

This Technical Information Paper provides general guidelines for Yankee hood inspection, maintenance, and process tuning in order to help ensure safe, reliable, and economical operations.

Safety precautions

The inspection and repair of Yankee hoods is inherently dangerous work. Hazards include fire, explosion, asphyxiation, heat exhaustion, burns, falls, and cuts. Internal inspections require confined space entry and the provision for confined space rescue and air monitoring.

Hood systems vary widely in design and risk exposure. It is important that a detailed risk assessment is completed prior to internal inspections, or repair work, on Yankee hood systems. A qualified safety person, and/or a qualified maintenance engineer, should complete the risk assessment well in advance of the inspection or repairs. Once the risk assessment is complete, the proper permits, personnel, personal protective equipment (PPE), and procedures can be put in place based on the mill's unique safety policies.

Limitations

While Yankee hoods are generic in their function, the designs can be quite different. The materials of construction, type or style of installed equipment and theory of operation will vary from machine to machine. Due to this difference in designs, universal inspection criteria are not practical. The following guidelines for safe, reliable, and economical operations must be considered along with the mill's experience, the age of the equipment, and the knowledge of hood's design. Hood inspection criteria will evolve over time as the mill gains the experience of previous inspections. Each hood system will have a unique inspection frequency based on this myriad of variables.

Inspection points

In alphabetical order, the inspection points are:

Air balance

Yankee hood systems need to be properly balanced relative to supply and exhaust volumes. If supply volume is excessive, hot air will be forced from the sides of the hoods or follow the sheet to the dry end hood exit. This creates both a fire hazard and a risk of personnel injury. The hood system balance should never be positive, where hot air can escape to the machine room. Generally, it is recommended to operate Yankee hoods at 1 - 5% negative pressure.

The objective is to not spill any high temperature air into the machine room and to also not create so much negative pressure that the relatively cool machine room air inhibits drying at the sheet edges.

The OEM is the best source of information for proper hood air balancing. Almost every OEM has a service group who will help optimize your Yankee hood system and the payback period is normally quite short. Very few hood systems are properly balance, and systems will drift over the years, so an air system balance should be planned every two years.

Bearings

There are several bearing designs and lubrication methods found in Yankee hood systems. These include babbitt plain bearings and rolling element bearings. Lubrication options include grease, static oil and recirculating oil. Proper lubrication selection depends on various design considerations. Routine inspections include vibration monitoring, lubrication analysis, temperature monitoring and visual inspections and are all important elements of safe, reliable operation. Either installed data collection or manual sampling can be used and provide different levels of monitoring and recurring or non-recurring data collection costs. The key for all hood bearing systems is that a carefully designed and executed predictive maintenance program is used to prevent unplanned down time. This becomes especially important for Yankee hood applications due to their hot, dusty service.

Burners

An adequate preventive burner system maintenance program and periodic inspections of the gas burners and controls are necessary to assure continued safe operation of the Yankee hood. The exact schedule for inspection of the equipment should be carefully developed and rigidly adhered to.

General practice is to prepare a checklist to be followed when making maintenance checks. Such a checklist will cover at least the following items.

- Gas safety shut off valve (s)
- Flame failure control response
- Burner gas control system
- Time delay timers
- Electric ignition system
- Pilot burner assembly
- Motor starter interlocks
- Supervisory pressure switches
- Damper limit switches
- Supervisory temperature switches

Never should any safety device be wired out (by-passed) or eliminated from the system.

Keep sight glasses clean to allow for visual inspection of the burner flame. Flame adjustment and all operating safeties are a vital part of an efficient and safe gas burner performance. The flame should be a billowing type, blue with yellowish orange tips. A lazy loafing type flame, colored yellow, red, or orange, is fuel rich and very unsafe. A qualified burner technician should immediately adjust the flame properly to avoid a possible explosion.

The burner supplier or qualified burner technician should verify the burner for proper air/ fuel ratio setting at normal heat output, ensure all mechanical linkages are in good working order, inspect nozzle condition and test emissions levels to ensure efficient combustion.

The primary emissions from natural gas-fired burners include nitrogen oxides (NOx), carbon monoxide (CO), and carbon dioxide (CO2). As the oxygen concentration, peak flame temperature, and the time of exposure at peak temperature increase, NOx emission levels increase.

Carbon monoxide is the result of incomplete or improper combustion typically caused by:

- improper mixing of the combustion air with the fuel being burned; and / or
- the lack of complete burning because of an inadequate supply of combustion air to the fuel-burning equipment or cooling of the flame in the burner chamber. The configuration of the burner chamber and flame protection sleeve will affect emissions.

Combustion air flow should remain constant at normal burner output to assure proper fuel/air mix. Combustion air flow will be altered if:

- Inlet air filters become dirty
- Temperature and pressure in the burner chamber change
- Air mixers or screens are added to the burner chamber
- Pre-heat economizer is added. This increases resistance at the combustion blower and increases the temperature and specific volume of the combustion air. A significant reduction in mass flow delivered to the burner will result.

Any reduction in combustion air flow should be corrected or the fuel / air ratio reset. An increase in the combustion blower performance may be required to meet the burner demand.

Clearance

Uniform hood clearance is important to controlling energy cost and moisture profile. Clearances should be verified at eight points, top and lead in edges of the wet end hood, front and back; top and lead out edges of the dry end hood, front and back. Measurements should be taken both in cold and hot conditions in order to fully understand the expansion characteristic of the hood. The objective is to run the hood clearances evenly at 14 −25 mm, at all eight points while at operating temperature (20 mm average).

The Yankee hood size, weight, mass, operating temperature as well as the locations of the structural support stops, wheels and tracks determine how the hood will thermally expand. Shimming the wheel tracks and adjusting the cold hood closer to the Yankee dryer should only be done after analyzing the expansion characteristics at maximum operating temperature.

Corrosion and fatigue

Wet environments and cyclical temperatures associated with hood systems results in an extreme service environment for ducts, fans and hoods. Wet end hoods can be prone to corrosion due to water spray from the press and the proximity of the hood. Cracking or distortion at the nozzles of hood toes can create undesirable air flow dynamics. This can have an adverse effect on the CD moisture profile. All welds and corners of rectangular ducting, flanges, flex ducts and hoods have a higher potential as fatigue points and therefore should be inspected for cracking on a regular basis and promptly repaired. The OEM's design approach for accommodating expansion and contraction should be considered when making welded repairs and patches. It's worth noting, the potential for fatigue cracking is reduced by manufacturers selecting round cross section ducting when practical. Signs of hot, moist air leaking through cladding should be noted and investigated. Keeping equipment in good condition, with minimal leakage will preserve the integrity of insulation and cladding. Stainless corrosion is often in the form of Stress Corrosion Cracking. This occurs with the wrong mix of elevated temperatures, chlorides, stresses coupled with austenitic stainless steel. This SCC damage can typically reveal itself suddenly, so careful inspection looking for small cracks or what appears to be brittle material is important. Cladding needs to be completely seal welded in areas that see frequent water from overspray or wash-up. This will prevent wide spread corrosion damage of ducting walls that frequently occurs with long term exposure to wet insulation.

Dampers (ducts)

The duct dampers are vital elements for control of recycled air and exhaust air. The proper function of these dampers ensures a safe system purge and reliable energy management. It is important to inspect the dampers from the inside and to step the damper through its control range and observe the mechanical response. Both manual and automatic dampers should be verified for proper and repeatable function. The process involves entering the duct work per the mill lock-out protocol and with radio contact to the control room, step each damper through its control range and verify smooth damper motion and linear response of the damper positioning.

Damper (hood)

Most wet end hoods and some dry end hoods have CD profiling dampers. These dampers, and the actuators which control them, can be prone to malfunction. Dampers can stick, shafts can twist and linkages can fail. Internal inspection and observation, as each damper is stepped through its control range, is important. The process should be repeated twice for each damper to ensure the predictable function of the system.

Exhaust moisture

Controlling exhaust moisture is the fundamental variable for the energy efficient operation of a Yankee hood system. Depending on hood system design and placement of dampers, the approach to measuring and adjusting for exhaust moisture will vary. It should be noted that the optimum exhaust moisture, when related to energy consumption, can change with both paper grade and season. Optimum exhaust moisture should therefore be checked for both the lightest and heaviest weight grades and also during the coldest and hottest seasons of the year in your region. This data will then provide the basis for efficient hood operations.

The OEM is the best source of information for optimum hood exhaust moisture settings. Almost every OEM has a service group who can help optimize your Yankee hood system and the payback period is normally quite short. Very few hood systems are properly optimized and systems will drift over the years, so exhaust optimization should be planned every two years.

Fans

Fan function is one of the most important aspects of Yankee hood safety, reliability, and economy. Fans should be visually inspected and monitored for vibration. If possible a permanent vibration monitoring system should be installed. This system should monitor vibration both axially and radially. Regardless of the type of monitoring done, the vibration data collected should be maintained in a database and periodically reviewed to determine if adverse trends are developing that could lead to premature failure.

An internal inspection of the fan should be completed when warranted, i.e. an increase in vibration. This inspection should include a visual check for excess debris build-up, loose fasteners or balance weights, broken welds and bent components. Static pressure should be measured and compared to the fan curve and amps measured and compared to full load amps both cold and hot conditions. Belts and sheaves should be visually inspected for wear and proper belt alignment and tension should be routinely verified. Insulation around the fan housings should be inspected and missing insulation replaced in order to maintain efficiency.

Fasteners

External fasteners, especially in the wet end hood, can loosen; wire ties can corrode and break, and create the possibility of fasteners falling into the felt run. Inspection of these should not be overlooked. Each year several felts and pressure rolls are lost due to fasteners from the hood system falling into the felt run.

Flex joints

Flexible joints that allow the hoods to be retracted without disconnecting from the main ductwork are prone to wear, fatigue and eventual slow failure. There are various designs that typically fall into two categories: metal or fabric. The best method to determine the flex joint condition is using infrared analysis. Areas of high temperature indicate a possible air leak through a crack or hole in the flex joint. Further inspection of the cold flex joint both inside and outside typically reveals the problem area.

While some minor cracks or holes can be repaired, it is typically better to plan on replacing the flex joint. Spare flex joints or repair kits should be kept onsite in case of serious damage that would prevent the Yankee hood system from operating.