Maintenance and Troubleshooting of Positive Displacement Blowers

IAOM Wheat State
12/5/2013

Presented by Ben Kice
System Sales and Design
Kice Industries, Inc.
Introduction

• The positive displacement blower is often the heart of many types of pneumatic conveying and process systems.

• Often, such an important piece of equipment is forgotten until it fails.

• Once the blower has failed, the maintenance personnel must scramble to get the system back online.

• Some simple procedures can often prevent damage to the blower and make your life at work much better!
Positive Displacement Blowers
Air Power Unit
(Pressure Conveying System)
Air Power Unit
(Vacuum Conveying System)
Interior of a Kice PD Blower
Overview of Topics

- Lubrication
- Starved inlet
- Over-pressure
- Over-temperature
- Installation errors
Starting and Running A PD Blower While Low on Oil...

...will result in almost immediate failure of the gears. Once the gears begin to fail, the following can occur:

- Rotor lobes will clash

- End clearances will change, thrusting the driven rotor into the free end plate

- Bearings will also fail, causing the rotor lobes to clash even further

If caught early, the blower is rebuildable
This poor blower was a victim of never having been filled with oil…

Strangely enough, it took 20 minutes for the blower to fail.
...even though there were tags affixed to the blower stating that the blower had been shipped dry.
Improperly Maintained Lubricant

**Dirty oil:** Bearings and gears will wear out prematurely. Oil should be changed every 500-1000 hours of operation; more frequently if operating in a demanding application or in a dirty environment.

- If you think 500 hours is a short time, some automobile manufacturers recommend oil changes every 3000 miles. At an average of 30 MPH, that is equal to only **100 hours** of operation.

- Blowers operating with external lubrication systems with large quantities of oil and filtration can operate 3-6 months without oil changes.
Improperly Maintained Lubricant

**Failed Lubricant:** Oil will be black and beginning to turn into tar.
- Bearings and gears will show evidence of further damage, such as damaged rolling elements and damaged teeth.
- Generally caused from thermal breakdown of the lubricant.
- Demanding applications (13-18 PSIG) may require oil changes as frequently as 100-250 hours.
- Oil sampling programs are very valuable for the purpose of optimizing oil life and minimizing waste.
Condition of oil in blower: black and thick; beginning to become tar
Gear damage from running without oil
Improperly Maintained Lubricant

**Inadequate Lubrication:** Bearings and/or gears will be discolored due to heat buildup. Normally caused from:

- Operation of a blower at too slow of a speed. Since a blower is splash lubricated, minimum speeds are necessary to provide proper lubrication of teeth.

- Use of too low a viscosity for lubricant. Follow guidelines in the operation and maintenance manual for the blower. Kice typically recommends an ISO-100 synthetic oil when the ambient temperature is 90° F, or less. Above 90° F, ISO-150 synthetic oil is recommended.
Starved Inlet

Starved inlet is a condition where the airflow entering the blower is so restricted that there is insufficient air supply to provide adequate cooling of the blower.
Starved Inlet

Visual signs of starved inlet may include:

- “Browning” of paint on the blower
- A uniform, yellowish “straw” color of the rotors, end plates and housing, indicating an internal temperature of 430-480°F. The deeper the yellowish color, the higher the temperature.
- In some cases there may be purple or blue colors in places, indicating temperatures as high as 640°F
Starved Inlet

If allowed to continue, visual signs of starved inlet may include:

- Bubbling or charring of paint on the blower
  - *most indicated near the discharge side of the blower*
- Wear on the non-gear end plate of the blower
- Evidence of contact between rotors themselves
- Evidence of contact between rotors and inlet port.
- Seizure of blower, resulting in catastrophic failure
**Housing:** Gold in color, turning purple near the discharge port.

**End plates:** Gold in color, turning purple near the discharge port; evidence of driven rotor being pushed into the end plate.
Rotors: Uniform gold in color, evidence of some contact with each other and the housing
Starved Inlet

Starved inlet can be prevented by:

- Monitoring an inlet filter restriction indicator
- Visually inspecting the inlet filter regularly
  - Do not completely rely on instrumentation
- Changing the inlet filter when necessary
  - when differential pressure across inlet filter reaches approximately 10” of water column
- Installation of a vacuum switch and/or a vacuum relief valve on the inlet side of the blower
- Installation of a temperature switch in the blower discharge stream as close to the blower as possible
Over-pressure

Positive displacement blowers are “work horses”. They do not give up. They will stuff air into a pipe, or self-destruct in trying.

Damage resulting from over-pressure is apparent when the discharge of the blower has been restricted.

The type of damage sustained from over-pressure:

- Contact between rotors and inlet port of housing
- Contact between rotors and non-gear end plate
- Severe cases may include inter-lobe contact and even contact between the rotors and the gear end plate
Note evidence of contact with rotors and housing
Rotor interlobe contact; also note damage on housing
This view shows free end contact
Over-pressure can be prevented by:

- Installation of a pressure relief valve on the discharge of each blower
  - Prior to any other control valves or airlocks
- If spring type, perform regular checks on relief valve settings to assure proper setting and operation
  - Some include pressure relief valves in their equipment calibration schedules
- Installation of discharge pressure switch at the blower discharge
Over-temperature

Damage resulting from over-temperature is not always as apparent as starved inlet or over-pressure. There may be symptoms of both in an over-temperature situation.

Over-temperature can be caused by:

- Inlet air temperatures that are elevated above ambient
- Recirculation of airflow from the blower discharge to the blower inlet
- Throttling of blower discharge in an attempt to reduce airflow
Blower Design:
830 cfm @ 10 PSIG

Variables to Consider:
Air Volume
Pressure
Speed
Break HP
Temperature Rise
Over-temperature can be prevented by:

- Installation of a discharge pressure switch at the blower discharge
- Installation of a heat exchanger prior to the blower inlet in a recirculation loop
- Always operate the blower with valves wide open. Never use valves for the purpose of choking down the blower discharge.
Installation Errors

When installing or replacing a blower, installation errors can wreak havoc with your production schedule. The most common errors are discussed today, but also, refer to Tuthill’s Field Troubleshooting Manual for additional guidance.

**Soft foot condition:** Where uneven loads are exerted on the blower when mounting.

- *Often occurs when reinstalling a repaired or replacement blower.*
- *Preventable by checking between each foot and the mounting surface with a feeler gauge and installing shim stock under feet before tightening mounting bolts.*
**Installation Errors**

**Improper installation of valves:** Check valves, pressure relief and vacuum relief valves are unidirectional. It is vital to make sure that these valves are installed properly.

- Be completely familiar with the specific valve and pay close attention to the direction the valve must be oriented.
  - *If you don’t know, just ask.*
Installation Errors

Excessive overhung load: This usually results in broken drive shafts, damaged drive shaft bearings, or fretting of the drive shaft.

- Tighten belts only to point necessary to transmit the motor nameplate power.
  - Often, belts are tightened by sight. This almost always will exceed design of the drive.
  - Make certain that you are familiar with the amount of deflection required.

<table>
<thead>
<tr>
<th>TENSION</th>
<th>New Belt</th>
<th>Used Belt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Static Tension (Per rib/strand):</td>
<td>128 to 137 lbf</td>
<td>110 to 119 lbf</td>
</tr>
<tr>
<td>Static Belt Pull:</td>
<td>254 to 273 lbf</td>
<td>218 to 236 lbf</td>
</tr>
<tr>
<td>Rib/Strand Deflection Distance:</td>
<td>0.34 in</td>
<td>0.34 in</td>
</tr>
<tr>
<td>Rib/Strand Deflection Force:</td>
<td>8.8 to 9.4 lbf</td>
<td>7.7 to 8.2 lbf</td>
</tr>
<tr>
<td>Sonic Tension Meter:</td>
<td>569 to 610 N</td>
<td>488 to 528 N</td>
</tr>
<tr>
<td>Belt Frequency:</td>
<td>58 to 60 Hz</td>
<td>53 to 56 Hz</td>
</tr>
</tbody>
</table>

505C/507C Model STM Settings: Weight: 140.38g/m, Width: 1mm/#R, Span: 552mm
Powerband Multiplier: 1.0043 to 1.0046, 1.0037 to 1.0040
Improper location of pressure or temperature sensors: Provides false reporting of what is actually over-pressure or over-temperature.

- Locate pressure, vacuum, and temperature instrumentation within 6 inches of the blower inlet and discharge
  - *Provides most accurate readings and best protection*
- Do not rely on infrared “skin temperature” thermometers. These devices will not give an accurate representation of the temperature inside the blower. These should only be used to determine trends and to stave off possible future problems.
Summary

Blower life can be optimized with:

• Regular oil changes with lubricant appropriate for the application
• Clean inlet air (or as clean as possible)
• Protection against over-pressure
• Protection against over-heating
WWW.KICE.COM - NEW LOOK; NEW INFORMATION
Thank you for the opportunity to speak to you today

Should you have any questions Please visit our website at www.kice.com or contact us at sales@kice.com