CONDITION MONITORING

Hannon Electric provides comprehensive mechanical and electrical field testing for condition monitoring, troubleshooting and failure analysis including; vibration analysis, motor testing and thermography.
BENEFITS OF CONDITION MONITORING

- Sustained Expertise
- Fast Start-up
- Low manpower commitment
- No capital costs
- Lower ongoing program costs
- Shared commitment to success
HANNON’S APPROACH

Hannon Electric’s approach to the customer:

- Commitment to training.
- Commitment to having the best analytical tools.
- Commitment to educating the customer.
- Commitment to communicating results and status to the customer.
- Commitment to saving the customer money in maintenance, repair and downtime costs.
VIBRATION ANALYSIS

Hannon Electric has made the investment in DLI equipment and training to provide best in-class services. The DLI system provides for more thorough analysis and trending of rotating equipment through the use of automated diagnostics and analysis tools that quickly and accurately confirm problems.
VIBRATION ANALYSIS

The most widely used CM technology. Trending and analysis of vibration signatures are used to rate equipment condition and allow for corrective actions prior to breakdown. Primary diagnosis’ include; misalignment, imbalance, and bearing problems.
COMMON PROBLEMS IDENTIFIED

- Imbalance
- Misalignment
- Ball Bearings
- Looseness
- Bent shaft

- Journal Bearings
- Gear Problems
- Impeller Blade Problems
- Motor Problems
- + 650 more
Hannon Electric has made the investment in PDMA equipment and training to provide best in-class services. The PDMA system is the world leader in Motor Condition Monitoring allowing 6 Fault Zones to be evaluated and trended. The tester provides field test capabilities for DC Motors, AC Induction, Synchronous, and Wound Rotor Motors, Drives, Generators and smaller transformers.
Motor circuit evaluation, current signature and power analysis are used by Hannon Electric in the field for condition monitoring and problem diagnostics to allow corrective action to be taken in a planned manner prior to breakdown.
VIBRATION ANALYSIS
HOW ARE VIBRATION DIAGNOSTICS PERFORMED?

Incoming Spectra

What machine is this & what are its vibration sources?

How does this spectra compare to that of a healthy machine?

What, if anything, is wrong with this machine and how bad is it?

Machinery Fault Report

How does the program work?

Maintenance Planning
MAINTENANCE PLANNING

- Schedule immediate repairs (Extreme Faults)
  - Avoid catastrophic failure or secondary damage
- Schedule normal repairs (Serious Faults)
  - Planned outage or maintenance period
- Review parts availability (Moderate Faults)
  - Stock long-lead-time parts for critical equipment
  - Order parts in advance for planned shut downs
- Retest following maintenance or replacement
  - Reset baseline & reference information
  - Verify maintenance was performed correctly
COLOR 1 - ASH HOUSE 2
Report generated on: 9/7/2007 09:48 AM
Acquired: 9/6/2007 11:43 PM  1xM = 1669 RPM  1xF = 621 RPM
Averages: 0

Figure of Merit = 21.
WARNING: SIGNIFICANT MAX LEVEL MAY INDICATE A
PROBLEM

Maximum level: 0.76 (0.0%) in/s at 1.02x on 2V

RECOMMENDATIONS:

DESIRABLE: CHECK DRIVE SHEAVE FOR RUNOUT AND
ECCENTRICITY

DIAGNOSTICS:

MODERATE DRIVE SHEAVE PROBLEM
  0.76 (607%) in/s at 1.00xM on 2V in low
  range
  0.40 (320%) in/s at 1.00xM on 2A in low
  range
  0.20 (162%) in/s at 1.00xM on 2H in low
  range

POSITION LEGEND:
  POSITION 2 IS: MOTOR, BEARING 2
  POSITION 3 IS: FAN, BEARING 3
  POSITION 4 IS: FAN, BEARING 4

The report automatically provides the supporting diagnostics for confirmation.
The faults are automatically trended for severity with the legend showing the problems identified. This assists in prioritizing repairs and corrective actions based upon the problem identified, the severity and the trend of machine.
EXPERT VIEW (FAULT TRENDING)
Hannon Motor testing:
- Identifies problems with motors, power quality and the power circuit.
- Trends condition and severity of motor condition.
- Pin Points root causes of motor failure.
BENEFITS OF PROACTIVE PLANNING

Proactive planning allows for reconditioning motors to:

- Take action before motor failure.
- Provide justification and prioritization for motor reconditioning.
- Provide information to reduce planned work on healthy motors.
- Provide measurement of effectiveness of reconditioning work.
BENEFITS OF PROACTIVE PLANNING

Allows for proactive action on Motor Circuit and Power issues:

- Provide information on power circuit issues (fuse and high resistance connections) to reduce motor deteriorating condition and failures.
- Provides power quality information on conditions detrimental to motor life.
- Provides insight into VFD power issues affecting motor and drive life.
BENEFITS OF FIELD ANALYSIS

Troubleshooting and failure analysis to:
- Verify motor or other component failure
- Identify the failure mode of a motor.
- Identify root cause of motor failure.
- Verify proper repairs are made before start-up to reduce risk of reoccurring failure.
SUMMARY OF MOTOR FAILURES

- Rotor: 10%
- Other: 12%
- Stator: 37%
- Bearing: 41%
Hannon utilizes PdMA’s fault zone analysis approach in evaluating motor condition.

**Fault Zones**
- Power Quality
- Power Circuit
- Insulation
- Stator
- Rotor
- Air Gap
# Fault Zone Analysis

**Fault Zone Analysis for: PF-868**

<table>
<thead>
<tr>
<th>Fault Zone</th>
<th>Test Type</th>
<th>Date</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Circuit</td>
<td>Voltage Imbalance Ph-Ph (%)</td>
<td>06/21/01</td>
<td>Good</td>
</tr>
<tr>
<td></td>
<td>Resistive Imbalance (%)</td>
<td>06/21/01</td>
<td>Good</td>
</tr>
<tr>
<td>Power Quality</td>
<td>Voltage THD Ph-Ph (%)</td>
<td>06/21/01</td>
<td>Good</td>
</tr>
<tr>
<td></td>
<td>Current THD (%)</td>
<td>06/21/01</td>
<td>Good</td>
</tr>
<tr>
<td></td>
<td>HVF (%)</td>
<td>06/21/01</td>
<td>Good</td>
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<tr>
<td>Insulation</td>
<td>Stator</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>RTG (Meg)</td>
<td>06/21/01</td>
<td></td>
</tr>
<tr>
<td></td>
<td>OVR (MCE)</td>
<td>06/21/01</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PI</td>
<td>06/21/01</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CTG (pF)</td>
<td>06/21/01</td>
<td>Caution</td>
</tr>
<tr>
<td></td>
<td>Zero Sequence (%)</td>
<td>06/21/01</td>
<td></td>
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<tr>
<td>Rotor</td>
<td>RTG (Meg)</td>
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<tr>
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<td>PI</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CTG (pF)</td>
<td>N/A</td>
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</tr>
<tr>
<td>Stator</td>
<td>Imp. Imbalance (%)</td>
<td>06/21/01</td>
<td>Caution</td>
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<tr>
<td></td>
<td>Inductive Imbalance (%)</td>
<td>06/21/01</td>
<td>Caution</td>
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<tr>
<td>Rotor</td>
<td>Fp Amplitude (Delta dB)</td>
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<td>Good</td>
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<tr>
<td></td>
<td>Inductive Imbalance (%)</td>
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<td>Resistive Imbalance (%)</td>
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<tr>
<td></td>
<td>Inductance Ph-Ph (mH)</td>
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<tr>
<td></td>
<td>Resistance Ph-Ph (Ohm)</td>
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<td>Air Gap</td>
<td>Eccentricity</td>
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<td>Alarm</td>
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<td>Peak One (Delta dB)</td>
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<td>Peak Two (Delta dB)</td>
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<td>Peak Three (Delta dB)</td>
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<td>Peak Four (Delta dB)</td>
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<td></td>
<td>RIG (Eccentricity)</td>
<td>True</td>
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</tr>
</tbody>
</table>

*Double Click* on any Fault Zone or Test Type for a complete definition.
OFF-LINE DETAILED REPORT

One example of how customizable the Detailed Report is:

[Image of detailed report screen]

[Graphs and charts showing test results]
POWER CIRCUIT ISSUES
ROTOR ISSUES
ON-LINE TESTS PERFORMED

- In-Rush/Start-Up
- Low and High Resolution Current Capture
- Eccentricity Capture
- Advanced Spectral Analysis (Demodulation)
- Power Analysis
HOW TO GET STARTED?

Hannon Electric’s Start-up:

- Hannon Field representatives are available for review of machinery identified for analysis.