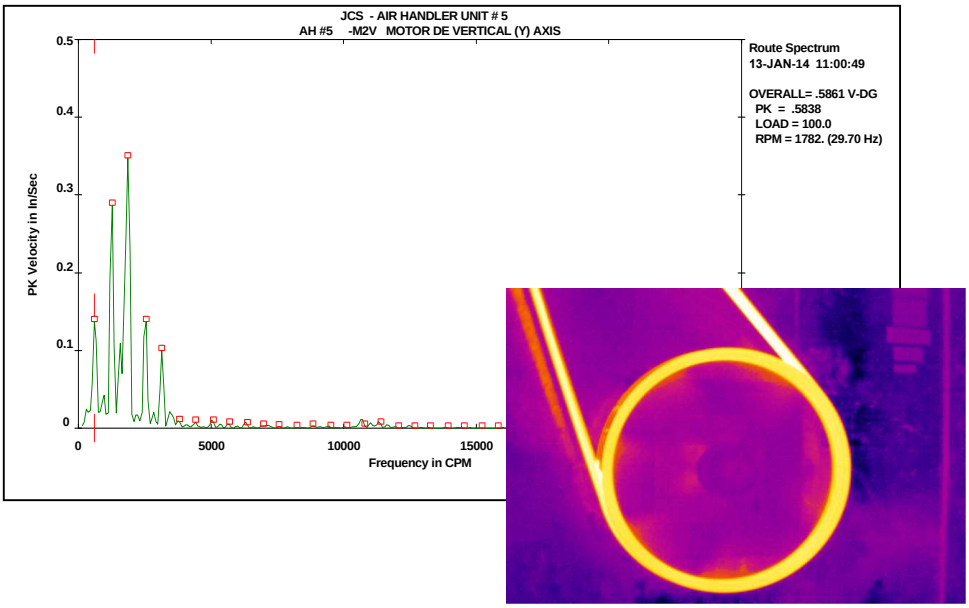
VIBRATION ANALYSIS REPORT

AB CONTROL SYSTEMS

AIR HANDLER UNITS #1 AND #2

DATA COLLECTED: 1/13/14



CMS Condition Monitoring Services Inc.

January 13, 2014

Attn: Service Operations
AB Control Systems

RE: Vibration Analysis on Air Handlers

Please find the following observations and recommendations in regards to the vibration data collected on Monday, March 11.

Overall vibration levels appear to be within acceptable levels. However, Air Handler #1 appears to have a misaligned fan to motor sheave or some minor looseness on the motor support. Air Handler #2 appears to be operating normally at this time with no indications of mechanical defects.

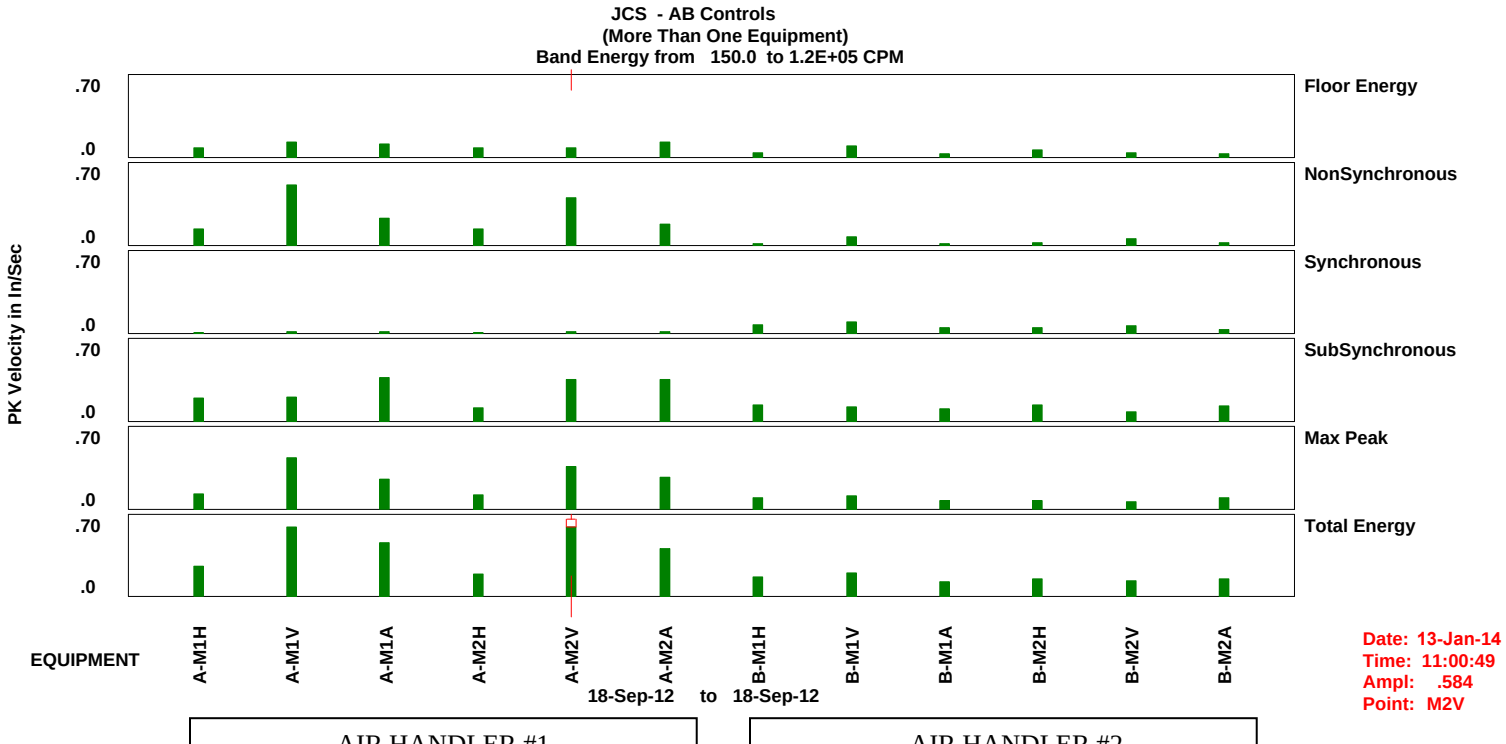
Data was collected on the motor and both drive and non-drive end fan data points and is referred to as *x* (horizontal) *y* (vertical), and *z (*axial) on most measurement points. Data was also collected on the frame to determine the effect of any dampening systems and the amount of vibration, if any, that was being transferred to the structure.

Because the motor and fans shafts are running at different speeds, it is best to present the data analyzed by grouping the motors and fans, and then those data points can be compared between both units.

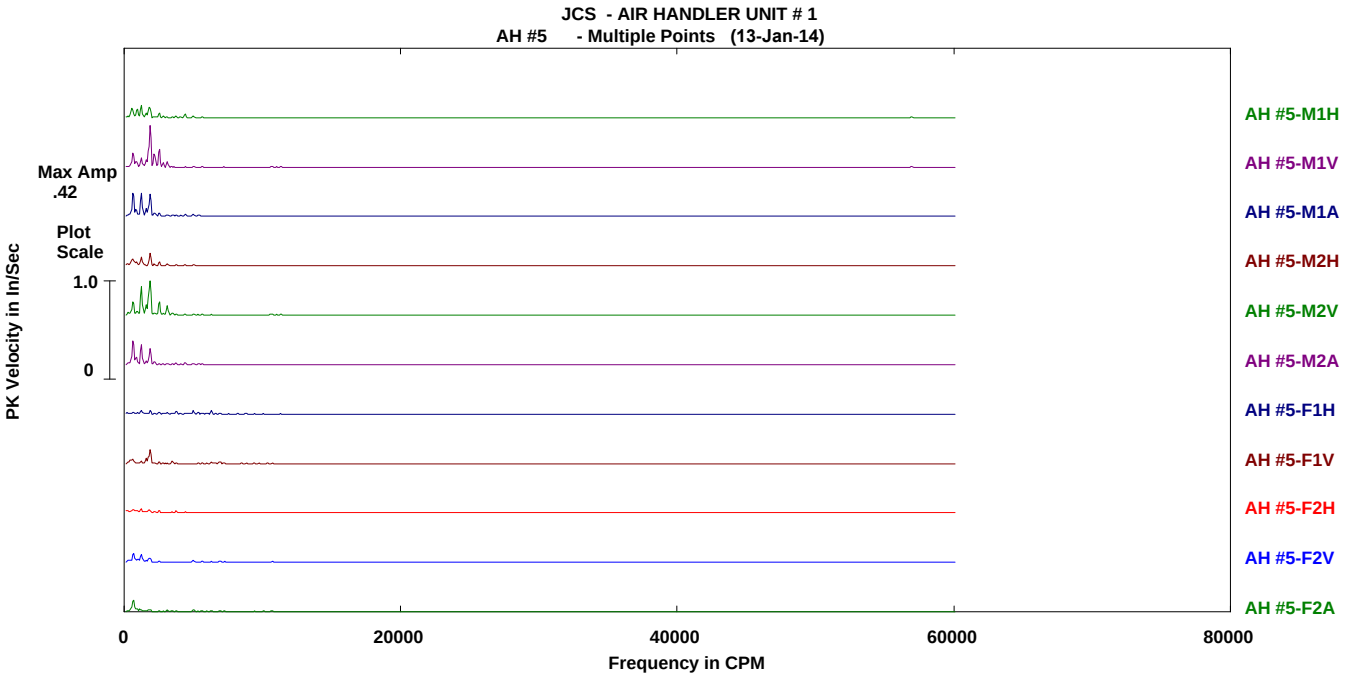
Typically vibration will be referred to as "inches per second peak velocity" *ips*, although the raw acceleration data was reviewed and if needed referred to in this report as "*g*" forces.

Detail observations:

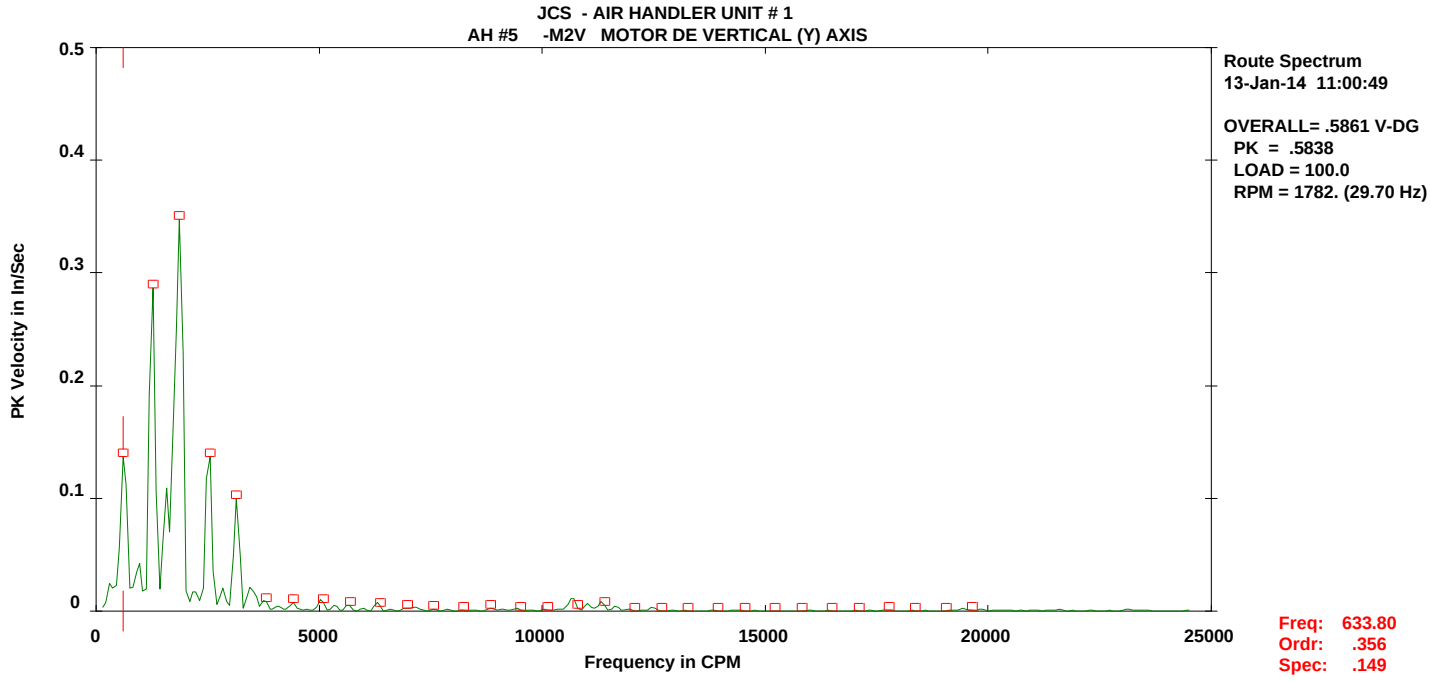
In looking at the motor data, air handler unit #1 shows some elevated vibration on the motor in the vertical and axial planes that is excited by fan shaft speed and harmonics. In the graph below the vibration energy is shown as an overall value and then is also separated into separate bands such as peak energy, synchronous and so on. It can be observed that the vertical data points on unit A (which is unit #1) shows overall energy that exceeds .58 inches per second velocity. This is shown to be in the non-synchronous band because its source is from the fan shaft speed and not from motor speed.



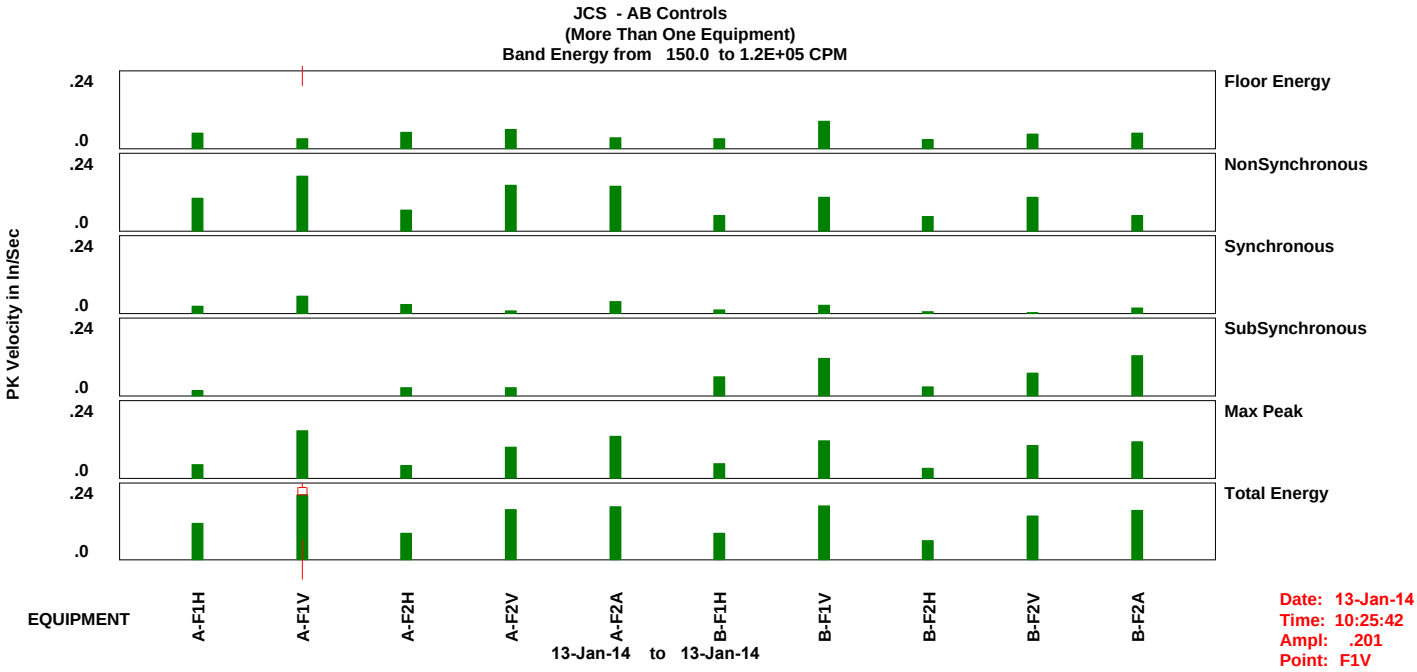
In the following graph the vibration data on unit five is shown on motor and fan data points which shows that there is little energy on the fan shaft and virtually all energy is on the motor points.



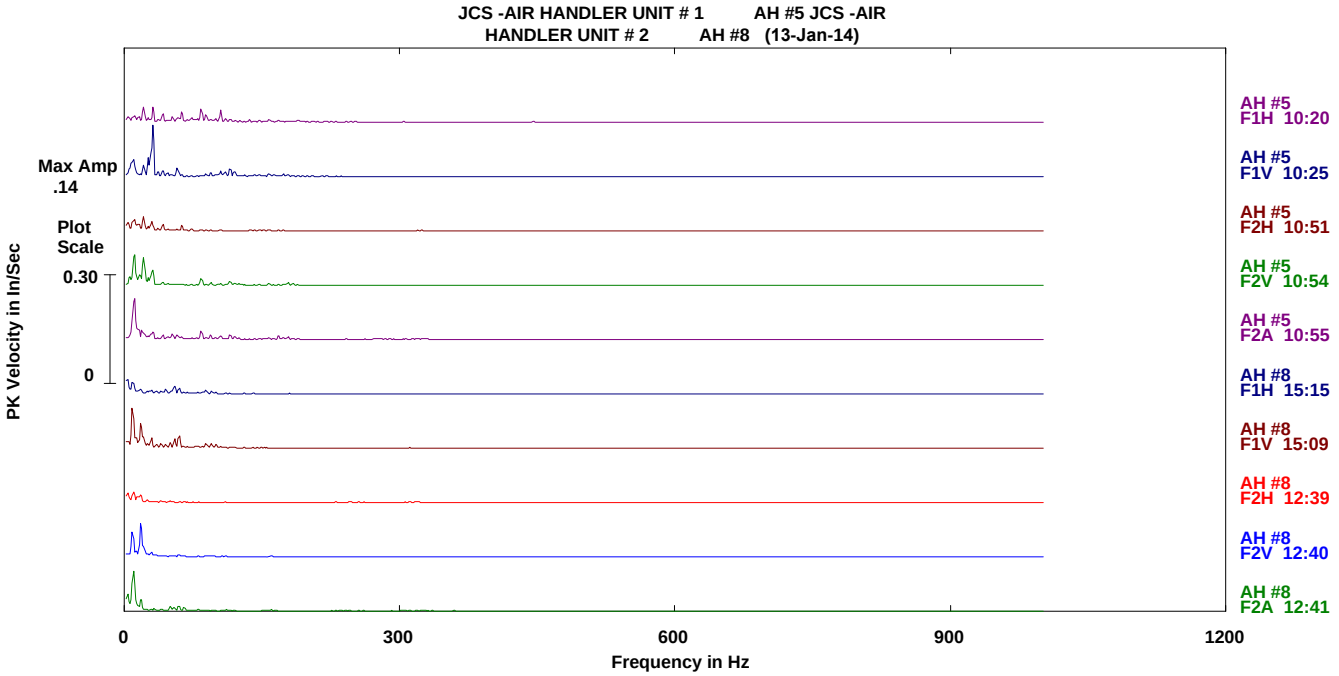
The FFT spectrum below shows the motor drive end vertical data point detail with peaks marked at 633 counts per minute (CPM) and harmonics. **Due to the presence of axial vibration coupled with vertical energy, a misalignment of the fan to motor sheave is likely**. As a secondary concern, a loose motor base may be present but less likely as there would be little reason for the radial energy generated by looseness to excite the motor axially.



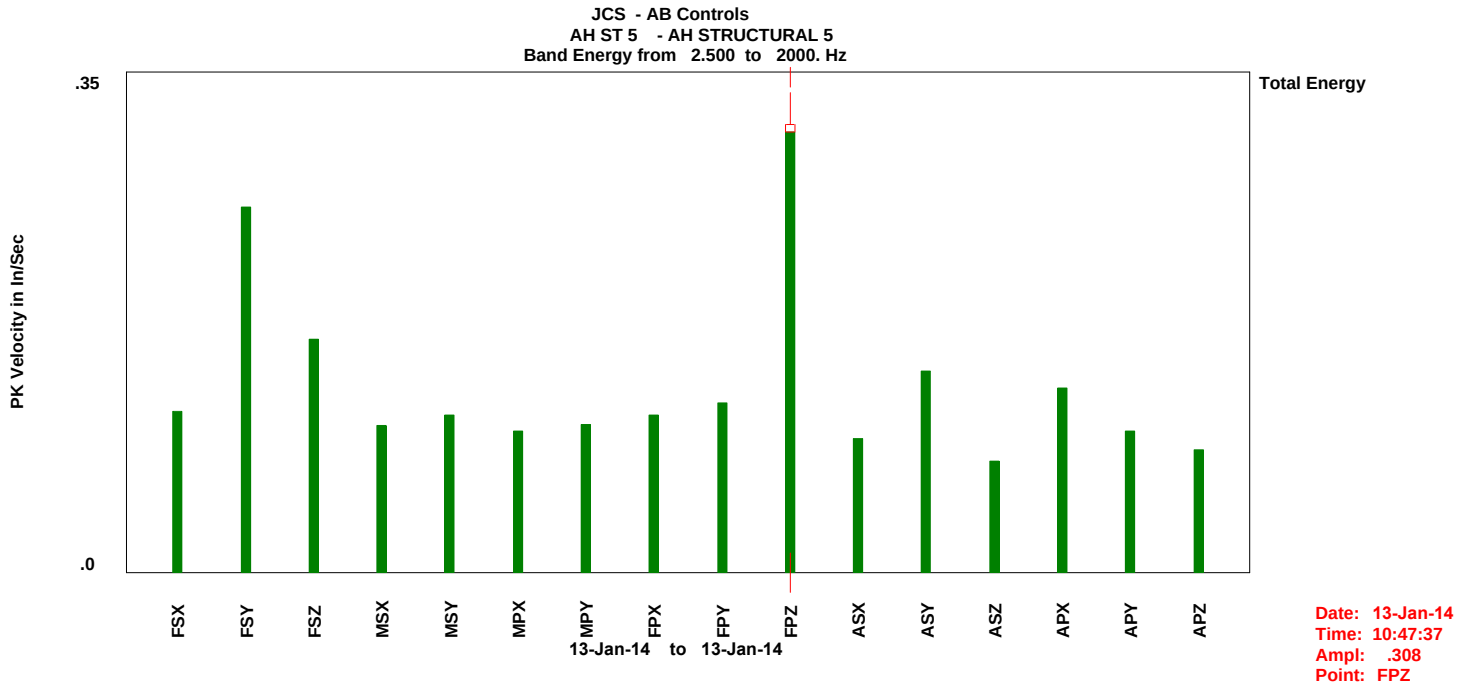
With regards to the fan energy on both units there is no indication of any excessive vibration. The energy graph below of both fans shows relatively even vibration with maximum levels less than .21 *ips*.

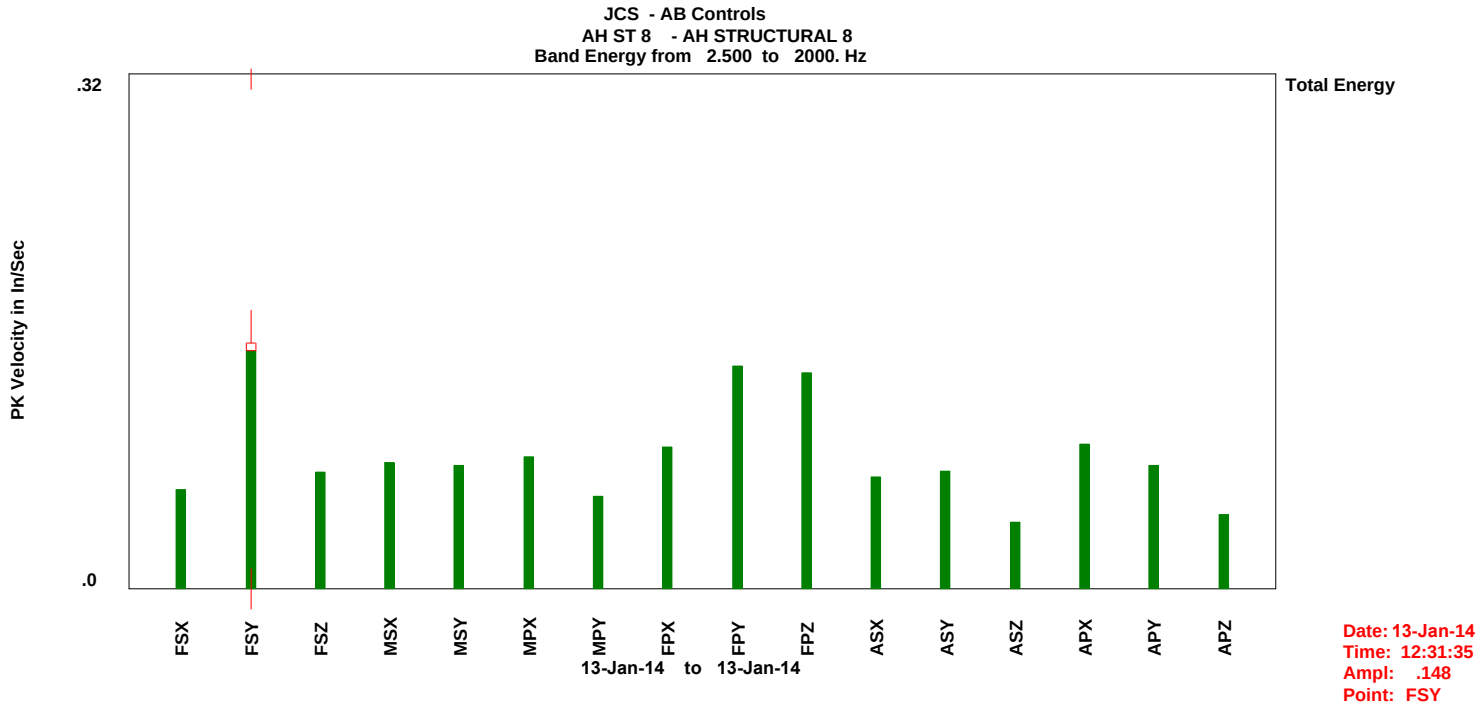


As a second illustration the FFT graph of all fan data on both units is shown below in velocity.



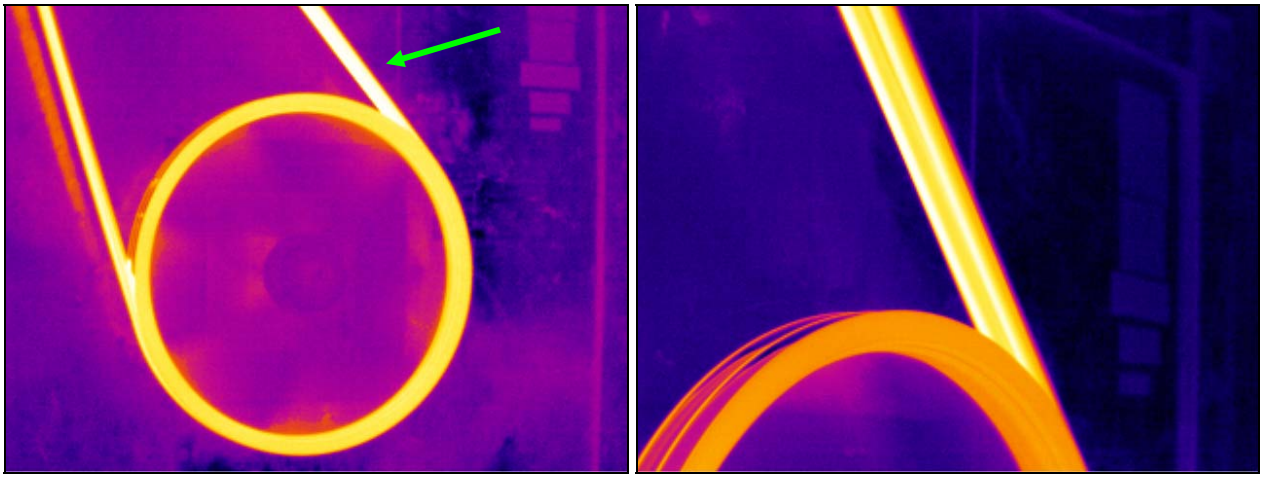
With respect to the structure the following graphs show an energy profile. Unit #1 is illustrated in the top graph and shows some elevated energy on a few readings which is at 1855 CPM, or 3x fan shaft speed. The bottom graph of Unit #2 indicates an even energy profile.





Infrared Inspection

While onsite the CMS technician inspected this unit with a Fluke Ti32 Thermal Imaging Camera. The infrared images below support the vibration findings that unit #1 has some misalignment or potential excessive wear on the fan sheave.



Unit #2 was also inspected with the thermal imaging camera but temperature patterns appear normal. A comparative image on unit #2 was not available due to the position of the unit.

Summary and Conclusions

As mentioned in opening comments, there is an indication that unit 1 has either a misaligned fan to motor sheave or to a lesser extent some minor looseness on the motor support that is excited by the fan shaft speed and is transferring to the structure. Infrared data suggests that if misalignment is not present, excessive wear may exist on the fan sheave. Vibration levels are slightly to moderately elevated and should not be considered critical in nature. Since the fan energy is the predominant forcing frequency on these units, it stands to reason looseness or misalignment would manifest itself at fan speed and harmonics.

Recommendations:

Inspect unit #1 and verify alignment is within tolerances. Inspect motor base for loose or cracked support bolting.

I trust this report meets with your expectation with regards to content and scope. If I can be of additional assistance please do not hesitate to contact me for additional information of clarification of the above.

Regards,

Kirk Cormany
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