



Sample Predictive Maintenance Report

Vibration Assessment Analysis

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August 17, 2006

ABC Company
123 Street
Anywhere, USA

Dear Sir:

Subject: Baseline vibration testing of both Gypsum Bleed Pumps and both Mist Eliminator Pumps.

Part 1: Gypsum Bleed Pumps

Abstract

ISI was contacted to perform baseline vibration testing on the Gypsum Bleed Pumps (AB-P4031A/B) under full load conditions on August 15th and 16th. It should be noted that both pumps were using water as process fluid vice slurry, as would be during normal operation. While no condemning problems were recorded on either machine, the "A" unit has a very early stage defect on both of the motor bearings while the "B" unit has an early-to-mid stage race defect on the pump non-drive end (NDE) bearing.

Data and Analysis

I Gypsum Bleed Pump "A" (AB-P4031A)

A Motor Condition

- 1) Baseline vibration data collected on the motor test points indicates a very early stage outer race defect on both of the motor bearings. The levels of impacting are so low that the defect is probably not yet visible to the naked eye (FIGURE 1). One possible cause may be false brinnelling, a condition caused by ambient vibration on a stationary ball bearing which leaves impressions of the rolling elements on the outer raceway. False brinnelling typically occurs, for example, when a motor is shipped on a tractor trailer or stored in a warehouse without adequate vibration isolation or without the shaft being rotated by hand.
- 2) Belt condition and pulley alignment appears to be satisfactory.

B Pump Condition

- 1) No significant bearing defects, imbalance, cavitation, or other hydraulic problems were noted. There was an anomaly with the discharge pipe expansion joint that was causing a loud noise and elevated broadband vibration which transmitted back to the pump bearing housing. This may be due to air trapped in the system causing pressure pulsations combined with the fact that the process fluid used for the test was water vice slurry.

Regardless, no immediate corrective actions are required until data can actually be collected with slurry being pumped. Discharge pressure was 16 psig +/- 1 psig.

II Gypsum Bleed Pump "B" (AB-P4031B)

A Motor Condition

- 1) No significant vibration problems were observed on any of the motor test points. No corrective actions are required.
- 2) Belt condition and pulley alignment appears to be satisfactory.

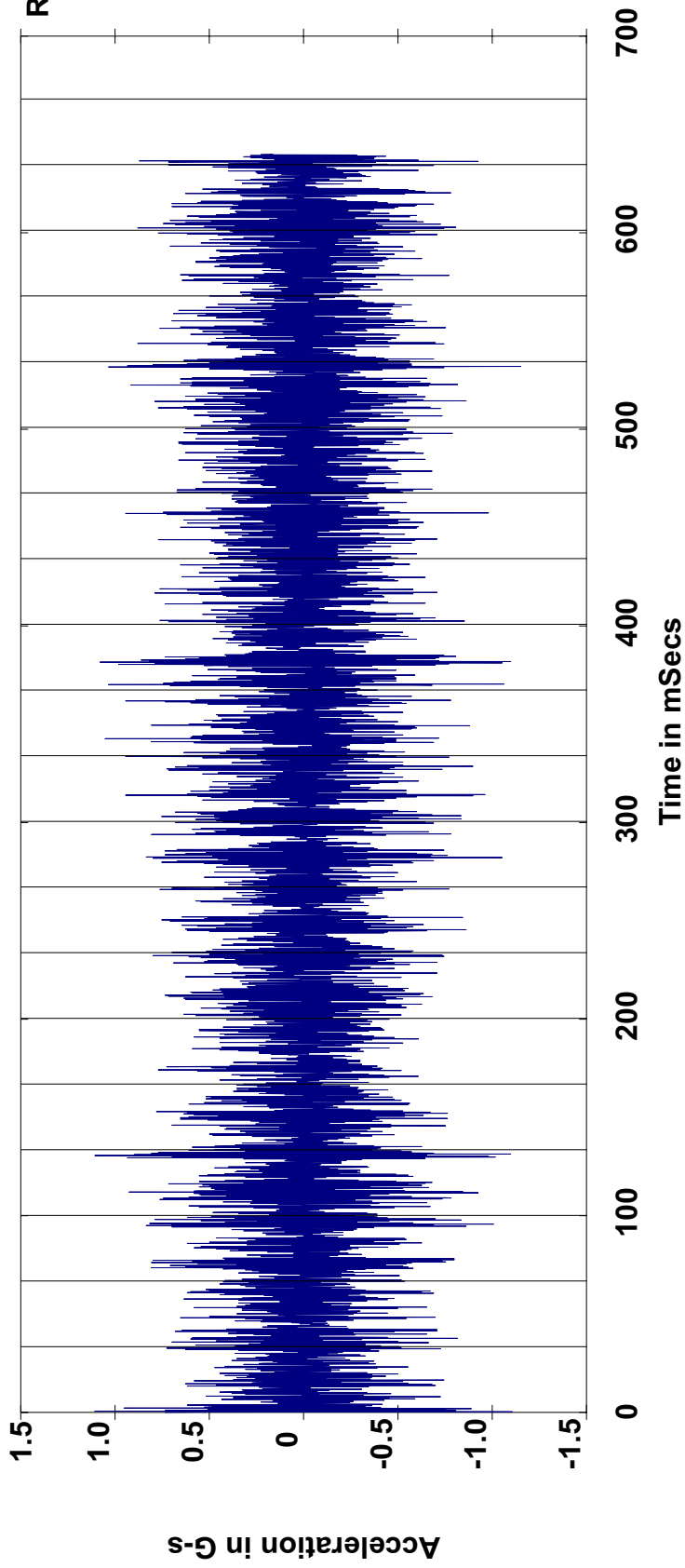
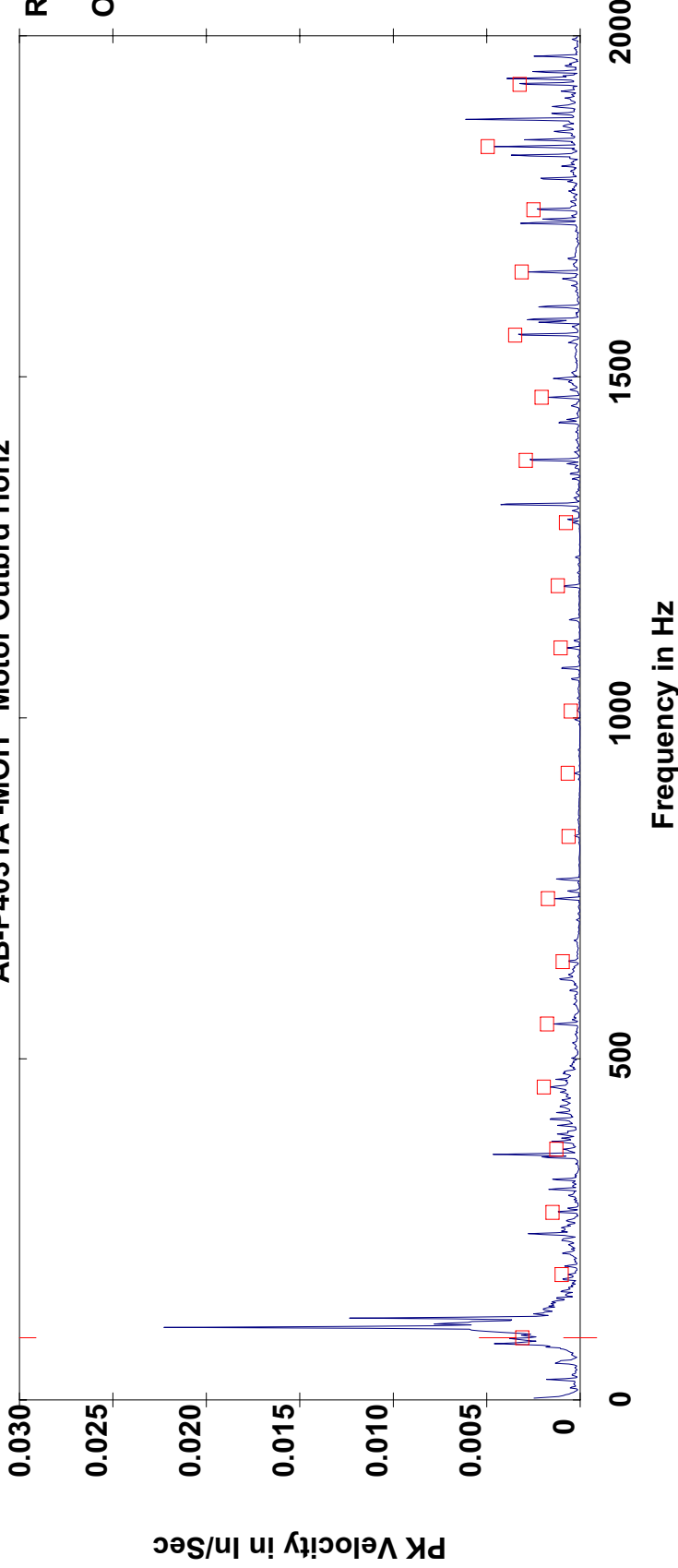
B Pump Condition

- 1) Noted a moderate amount of metallic impacting occurring on the pump bearing housing, particularly on the NDE bearing (FIGURE 2). Levels appear to be about 4 times higher than those recorded on the "A" pump. The pump was run for an hour and bearing temperature did not exceed 128° F, which is well within specification (temperatures greater than 180° F would have been considered problematic and indicative of a lubrication issue). A stethoscope was used to listen to both pump bearings and an unmistakable, though muffled, mechanical clicking sound could be detected from the NDE bearing. The actual confirmation of this suspected bearing defect as well as the severity requires knowledge of the bearing manufacturer name and model number. Discharge pressure was 16 psig +/- 1 psig.

Recommendations

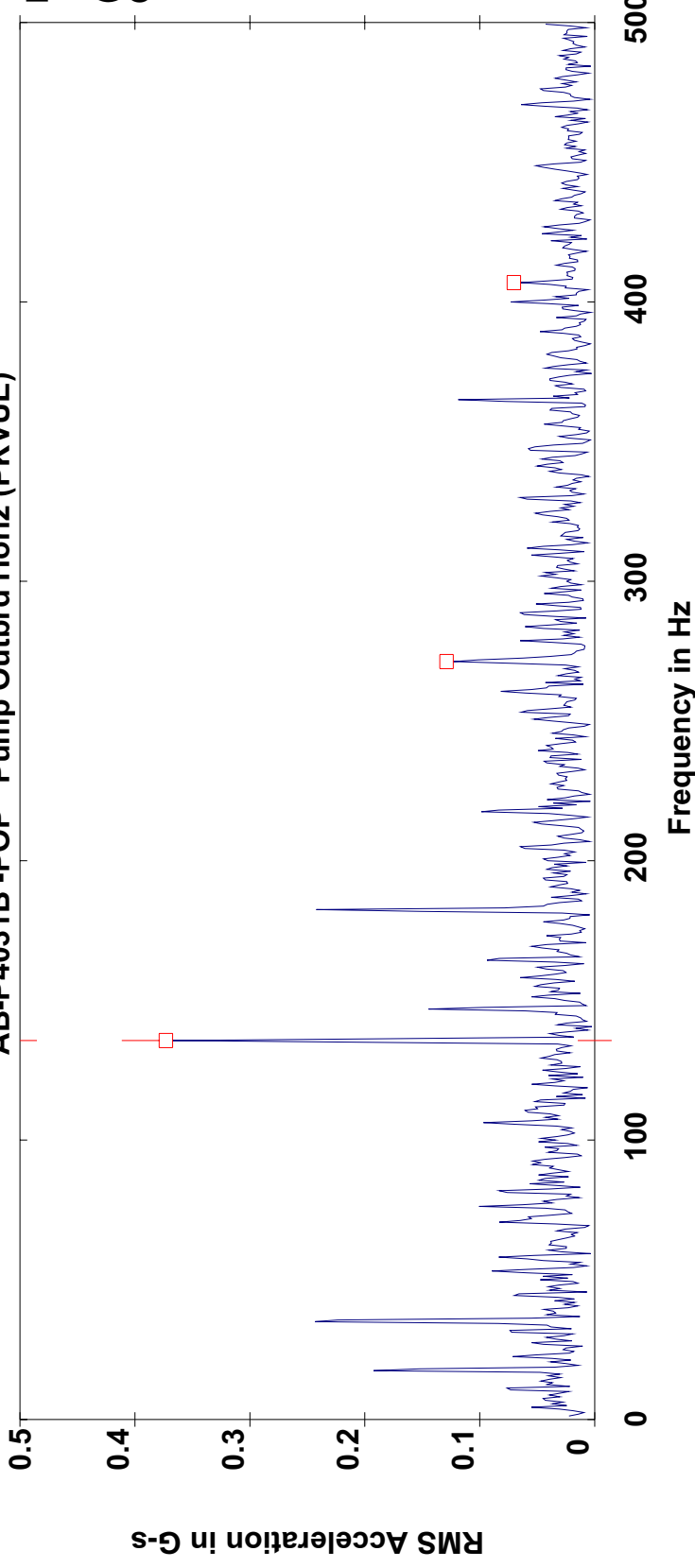
- Gypsum Bleed Pump "A": Continue monitoring the bearing defects on the motor with vibration spectrum trending. No immediate corrective action is required.
- Gypsum Bleed Pump "B": Provide ISI with the pump bearing manufacturer and model number to verify the defect on the NDE bearing. Perform additional vibration trending to determine if the fault is worsening. Also, check bearing preload and endplay to ensure the bearing is not slightly bound or cocked.

CRSS - Gypsum Bleed Pump "A"
AB-P4031A -MOH Motor Outbrd Horiz

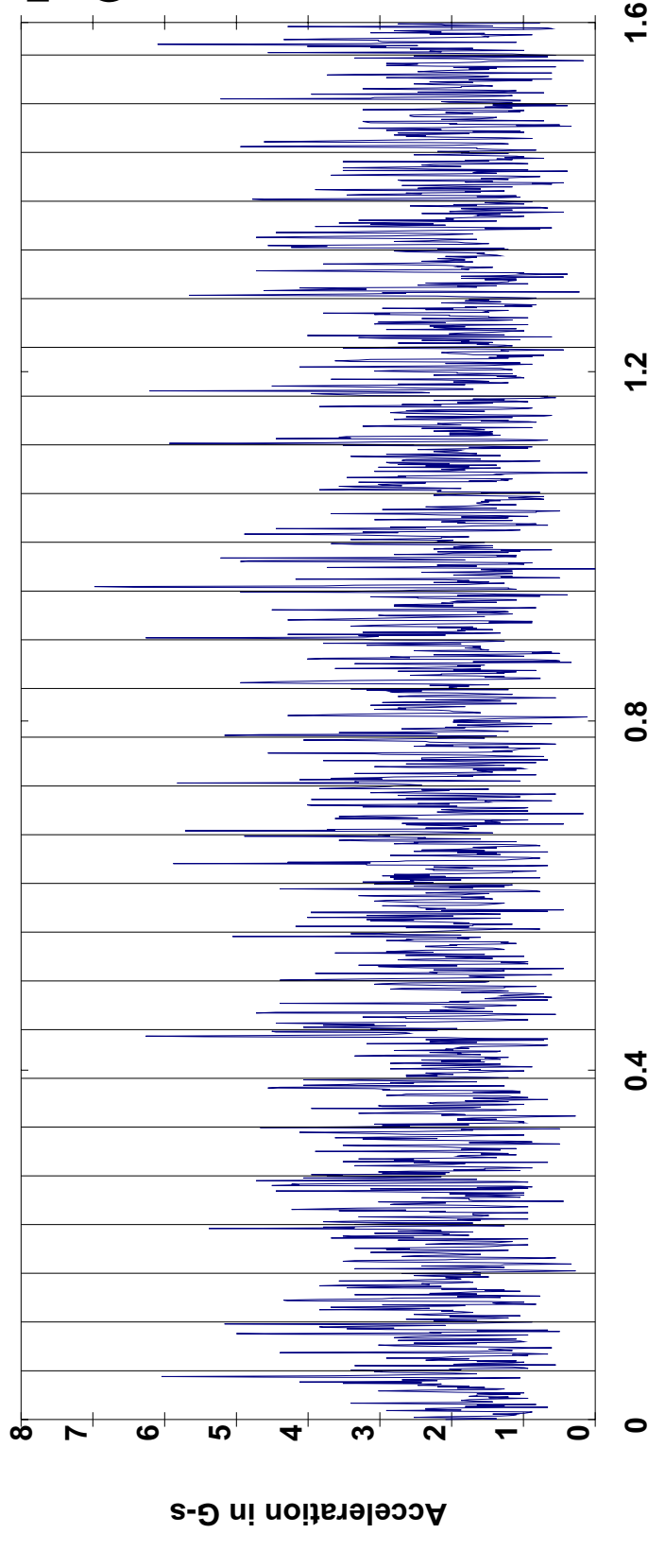


Label: FIGURE 1

CRSS - Gypsum Bleed Pump "B"
AB-P4031B -POP Pump Outbrd Horiz (PKVUE)



Route Spectrum
16-Aug-06 10:56:37
(PkVue-HP 1000 Hz)
OVERALL= 1.17 A-AN
RMS = .9621
LOAD = 100.0
RPM = 1075. (17.92 Hz)



Route Waveform
16-Aug-06 10:56:37
(PkVue-HP 1000 Hz)
RMS = 2.33
PK(+) = 6.98
CRESTF= 3.00
DCoff = 0.0

Freq: 135.67
Ordr: 7.572
Spec: .367

Label: FIGURE 2

Part 2: Mist Eliminator Pumps

Abstract

ISI was contacted to perform baseline vibration testing on the Mist Eliminator Pumps (MW-P4001A/B) under full load conditions on August 15th and 16th. Both units have similar problems with excessive vibration on the motor due to softfoot amplified by natural frequency problems with the baseplate support. The pumps themselves appeared fine.

Data and Analysis

III Mist Eliminator Pump “A” (MW-4001A)

A Motor Condition

- 1) Baseline vibration testing indicated excessive amplitudes of a vibration occurring at 120 Hz on several motor test points (FIGURE 3). While the motor was running, one of the motor foot hold down bolts was slightly loosened and a significant decrease was observed in overall vibration level. This is indicative of a softfoot condition due to either a defect with the motor feet or the baseplate being warped or twisted slightly. When the hold down bolt is tightened, it smashes the motor foot flat on the base and contorts the stator frame, resulting in an uneven air gap between the rotor and stator. This uneven air gap causes a vibration to occur at twice line frequency, or 120 Hz. The highest reading observed was 0.47 inches/second (IPS) on the motor DE bearing, axial plane. Efforts to check the alignment of the unit and shim the softfoot were unsuccessful, sometimes resulting in even higher levels. The alignment itself was ruled out as a problem when the motor was run uncoupled and no change was observed in the motor vibration. Furthermore, a “bump” test was performed on the motor to determine where the system natural frequencies were. It was discovered the natural frequency of the motor was within 10% of 120 Hz in all 3 test planes (FIGURE 4). This means that if a forcing function (such as softfoot) causes a vibration to appear within 10 – 15% of the observed natural frequency, this vibration can become significantly amplified in the manner of a tuning fork being struck. A bump test was also performed on the motor with the inboard left hold down bolt loose. Not only did vibration levels decrease by half, but the natural frequency shifted left and away from the softfoot vibration at 120 Hz (FIGURE 5). That is to say, the amplification factor was removed by changing the stiffness of the system. Long term operation in this condition without corrective action may result in excessive motor operating temperatures and premature failure of the motor bearings.

B Pump Condition

- 1) No significant bearing defects, imbalance, cavitation, or other hydraulic problems were noted. Discharge pressure was 88 psig.

IV Mist Eliminator Pump “B” (MW-4001B)

A Motor Condition

- 1) The baseline vibration condition and analysis of this unit is nearly identical to the “A” pump, except for the high vibration being located only in the horizontal plane instead of the vertical and axial as well (as with the “A” motor). The highest reading recorded was 0.41 IPS on the motor NDE bearing, horizontal plane.

B Pump Condition

- 1) No significant bearing defects, imbalance, cavitation, or other hydraulic problems were noted. Discharge pressure was 88 psig.

Recommendations

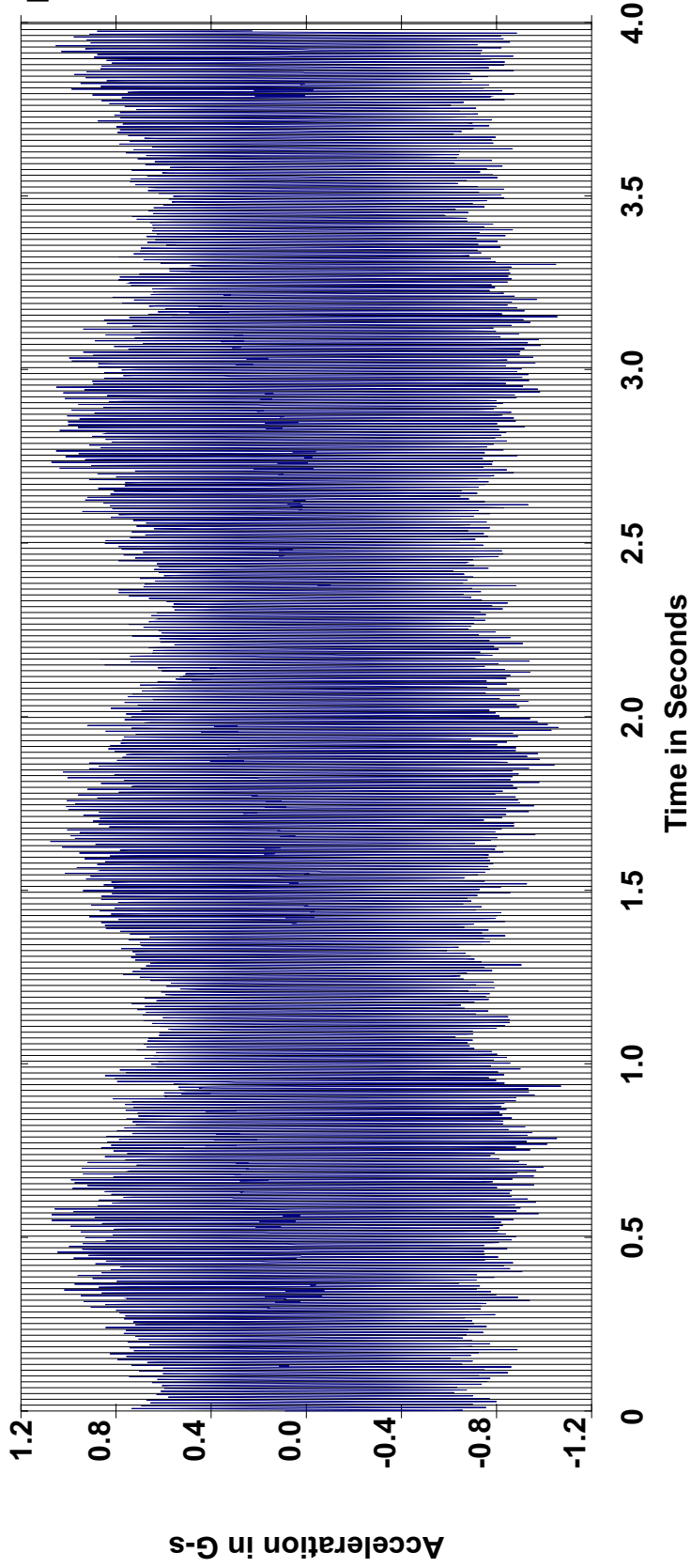
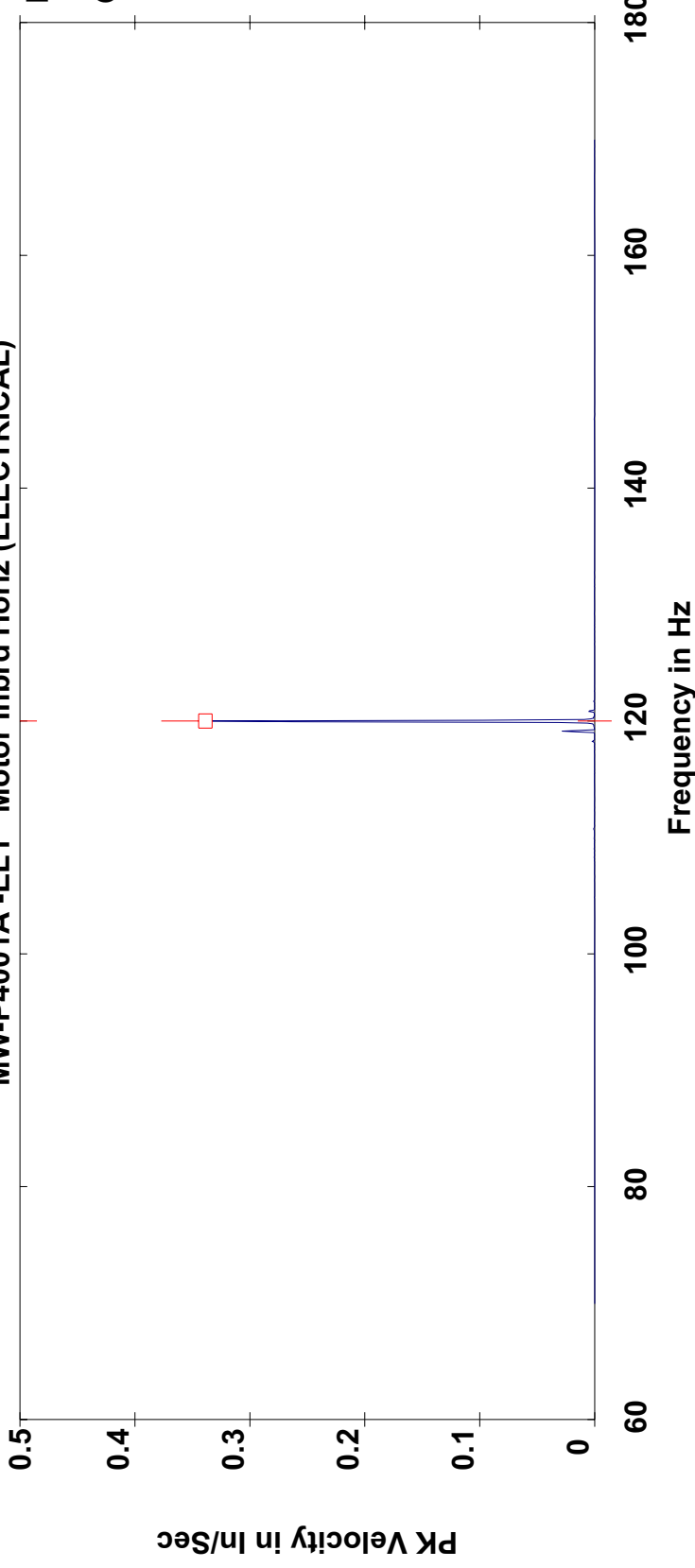
- Recommend using a machinist’s level to ensure the baseplate is flat in width and length, particularly where the motor feet sit. Flatness should be within 0.002 inches/foot. Machine the surface as necessary to achieve this standard.
- Fill the baseplate in with non-shrinking grout and allow to cure before making any further adjustments. Contact the pump vendor for further assistance on this, or consult a foundation specialist. Additional modifications to the foundation may be necessary to have the desired effect on the natural frequency and ultimately the overall vibration level.
- Verify the motor feet sit flat on the baseplate and use a dial indicator mounted to the baseplate and contacting the motor shaft to determine if softfoot exists. Repair as necessary.
- Perform vibration acceptance testing on the motors both uncoupled and coupled to determine the effectiveness of the repair.

Please feel free to call if there are any questions regarding this analysis and thank you for letting ISI service your facility.

Respectfully,

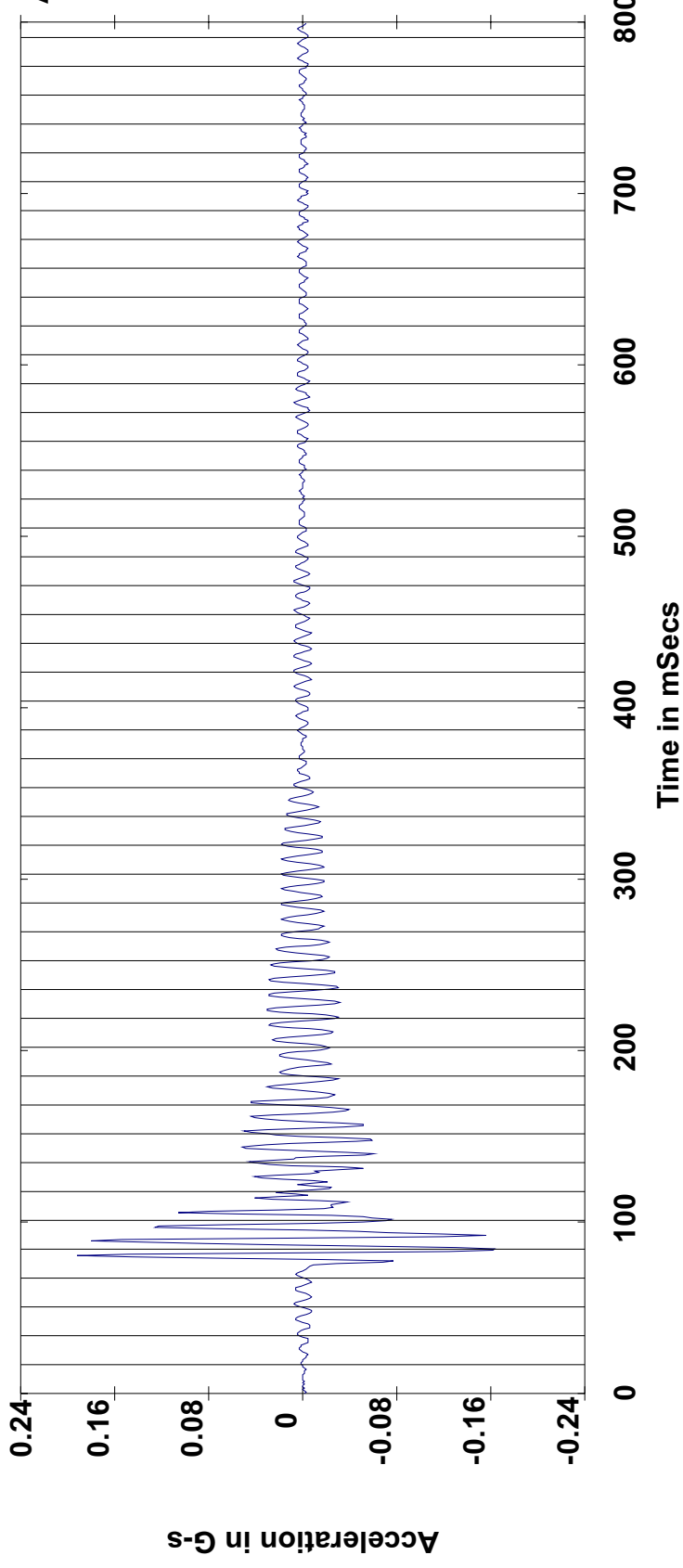
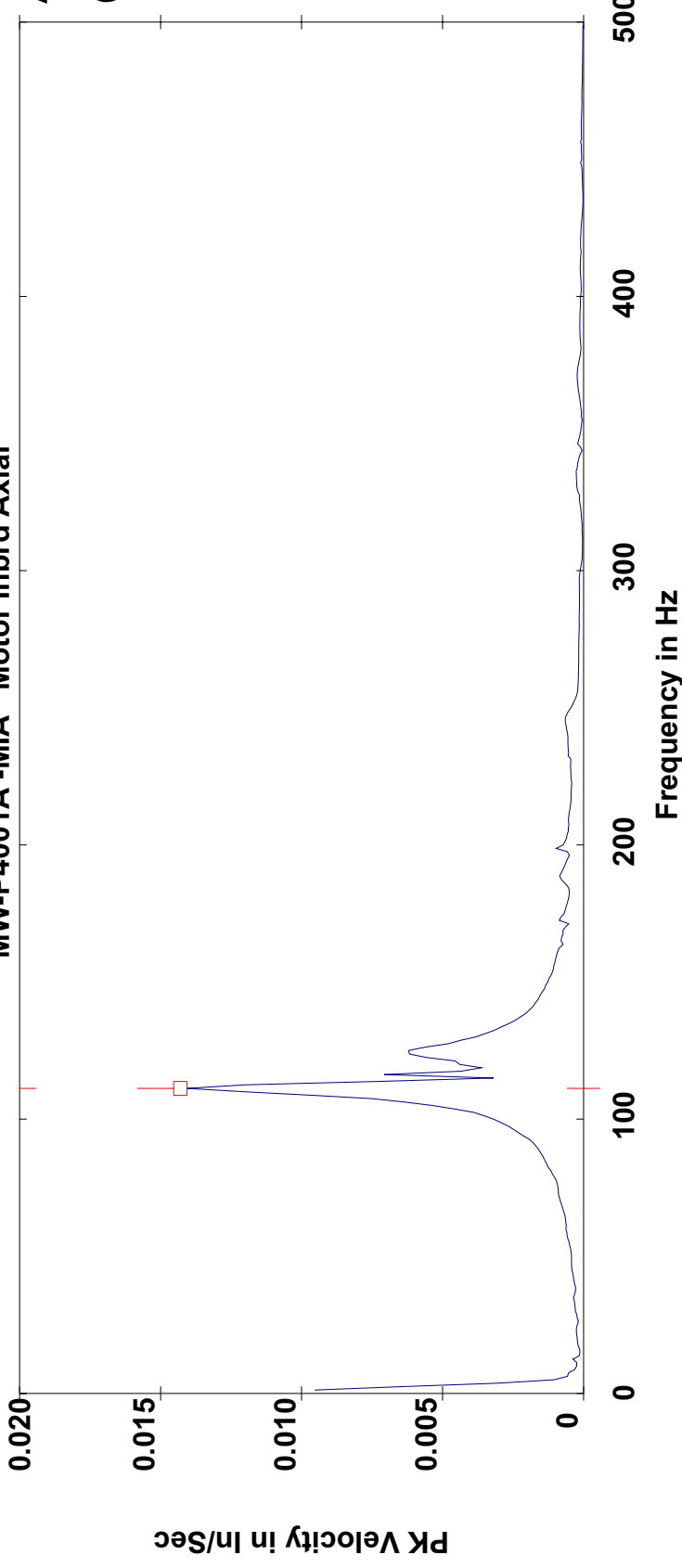
Frank T. Vereb
Predictive Maintenance Engineer
Instrumentation Services, Inc.

CRSS - Mist Eliminator Pump "A"
MW-P4001A -EL1 Motor Inbrd Horiz (ELECTRICAL)



Label: FIGURE 3

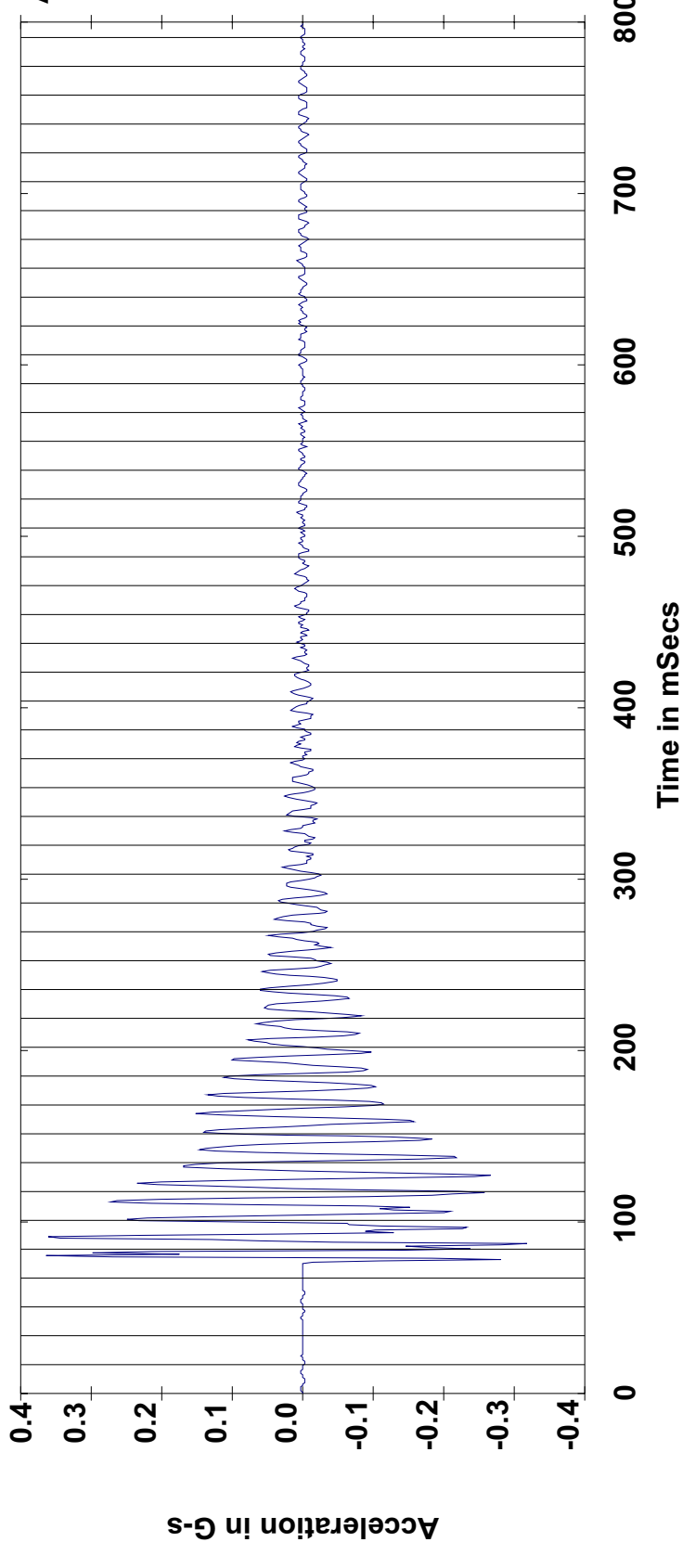
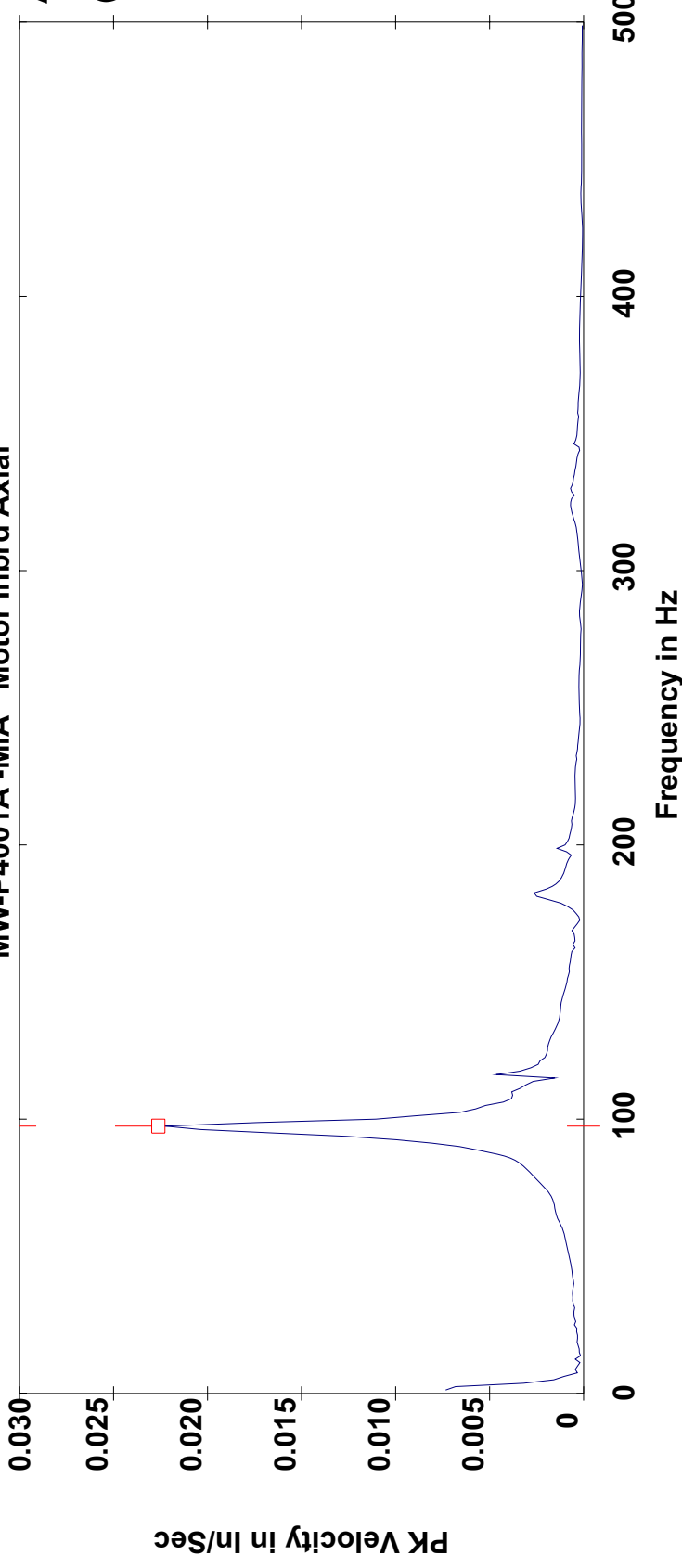
CRSS - Mist Eliminator Pump "A"
MW-P4001A -MIA Motor Inbrd Axial



Freq: 111.83
Ordr: 1.882
Spec: .02058

Label: FIGURE 4: Before loosening bolt

CRSS - Mist Eliminator Pump "A"
MW-P4001A -MIA Motor Inbrd Axial



Freq: 96.91
Ordr: 1.631
Spec: .03368

Label: FIGURE 5: After loosening bolt.