

VIBRATION ACCEPTANCE REPORT

SAMPLE CUSTOMER

PUMPING PLANT 1

DATA COLLECTED: 12/15/18

SAMPLE CUSTOMER VIBRATION REPORT

PUMPING PLANT 1

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Certified Field Pump Acceptance Test

January 6, 2019

Prepared for:
Sample Customer

Mr. Smith,

Please find on the following pages the analysis and graphical data of the initial baseline data collected on the pit pumps.

Pump(s) Tested:

Pump 1

Pump 2

Summary of findings:

All pumps are running well within acceptable limits at all flow points with respect to overall vibration values. The only item of note is the potential of a motor bearing defect on Pump 2. The pattern and frequency is consistent with a defective bearing in early stages, but it is essential to obtain the bearing number in order to positively identify.

There are responses as a result of the bump testing that align themselves with some of the fundamental forcing frequencies. The fundamental energy in these pumps are 1x shaft speed or vane pass at 2x shaft speed. Since these are variable speed units the potential band of energy is quite wide and overlaps between full speed shaft frequency and minimum speed vane pass. From a technical standpoint, these units should not have a resonant response within 15% of known fundamental forcing frequencies. However, from a realistic standpoint when looking at the overall vibration levels of these units when running within the resonant response bands, they are still well within acceptable levels. This leads me to question the value in expending resources to resolve as the resulting benefit would be minimal from a vibration amplitude standpoint. Data also indicates the units appear to be free of any bearing related defects or excessive clearances or looseness.

Findings and recommendations:

No recommendations at this time for remedial action. To address the potential bearing and rotor issues noted, operate the pumps normally and monitor every 30-60 days for changes against baseline. Obtain bearing information in the form of conventional common bearing numbers.

Scope

The scope of this report is twofold:

1. To review and establish initial baseline data from which to base future condition monitoring recommendations.
2. To identify excessive vibration that would adversely affect equipment reliability and provide recommendations for remediation.

To accomplish the above, the procedure was to record live data utilizing the Adash 4-Channel Analyzer at a 64KHz sample rate while the units were started and ran at minimum flow, mid-flow, and full speed with points taken at motor top and bottom X and Y axes. An additional data point was taken in the axial plane. A bump test in the X, Y, and A axes was also performed to identify resonant frequencies that are contributing to excessive vibration noted during the test. It is also useful to document these frequencies for future reference should there come a time that they would contribute to excessive vibration not found during this test.

Allowable Standards

Hydraulic Institute Standard 11.6 – 2012 was reviewed and used as the primary basis for allowable vibration levels. Although this publication refers to BHP as the basis of determining acceptable vibration levels, for simplicity sake nameplate HP is utilized as the variation in knowing the actual BHP is minimal.

The below alarm set points are suggested as a starting point and seem reasonable to me with regards to overall vibration levels. Velocity limits referenced as acceptable as per table in HI 11.6, excellent standards are 50% of acceptable. I do not have in my library a good standard to reference for acceleration. Acceleration data is relevant to consider to determine higher frequency energy that would be related to excessive cavitation, motor issues related to the stator and rotor, and bearing defects in early to moderate stages. The acceleration alarms are a result of comparative analysis of similar pumps and experience.

Bump test bands are set at 85% and 115% of shaft speed and vane pass which is at 2x shaft speed for Marina 1 pumps. Pumps were tested at minimum 615 rpm and maximum full speed of 1180 RPM, these bands are highlighted on the accompanying bump test graphs so the response peaks can be determined to be within or outside of expected forcing frequencies.

Pumps 1 & 2

Velocity RMS Overall Limits:

The screenshot shows a software interface for configuring Velocity RMS Overall Limits. It features a tabbed menu with 'Properties', 'Route', 'Abs. Alert Limits', and 'Data'. The 'Abs. Alert Limits' tab is active. A checkbox labeled 'Use limits' is checked. Below this, a 'Unit' dropdown menu is set to 'in/s'. Four alert levels are defined with their respective limits: 'EXCELLENT' (0.11), 'ACCEPTABLE' (0.22), 'Alert' (0.33), and 'UNSATISFACTORY'. Each limit value is preceded by a plus sign (+) and followed by a downward arrow (v).

Acceleration RMS Overall Limits:

The screenshot shows a software interface for configuring Acceleration RMS Overall Limits. It features a tabbed menu with 'Properties', 'Route', 'Abs. Alert Limits', and 'Data'. The 'Abs. Alert Limits' tab is active. A checkbox labeled 'Use limits' is checked. Below this, a 'Unit' dropdown menu is set to 'g'. Four alert levels are defined with their respective limits: 'EXCELLENT' (1), 'ACCEPTABLE' (3), 'Alert' (5), and 'UNSATISFACTORY'. Each limit value is preceded by a plus sign (+) and followed by a downward arrow (v).

Content of the report:

This report provides the following information:

- Analyst summary
- Conclusions and recommendations
- Applied standard references
- Tabular information with regards to the various test speeds
- Combined trend data on X, Y axes in velocity and acceleration
- Axial trend data in velocity and acceleration
- Results of bump test data and with response frequencies noted and allowable bands illustrated
- Supplemental Attachments
 - Analyst ANSI Level III Vibration Certification
 - Pump Specific Information

Feel free to contact me with any questions regarding the content of this report.

Kirk Cormany

President/ Certified ANSI Level III Vibration Analyst

Office: 805-619-7701

Cell: 805-478-0797

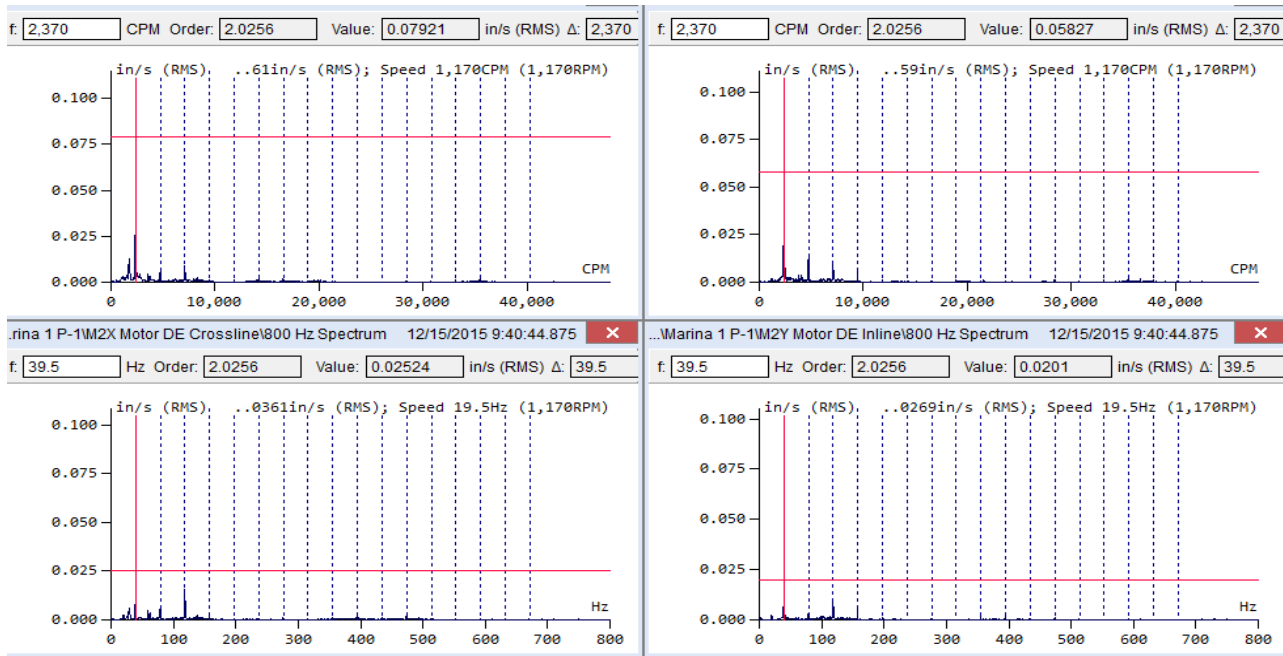
Condition Monitoring Services, Inc.

kcormany@conditionmonitoringservices.com

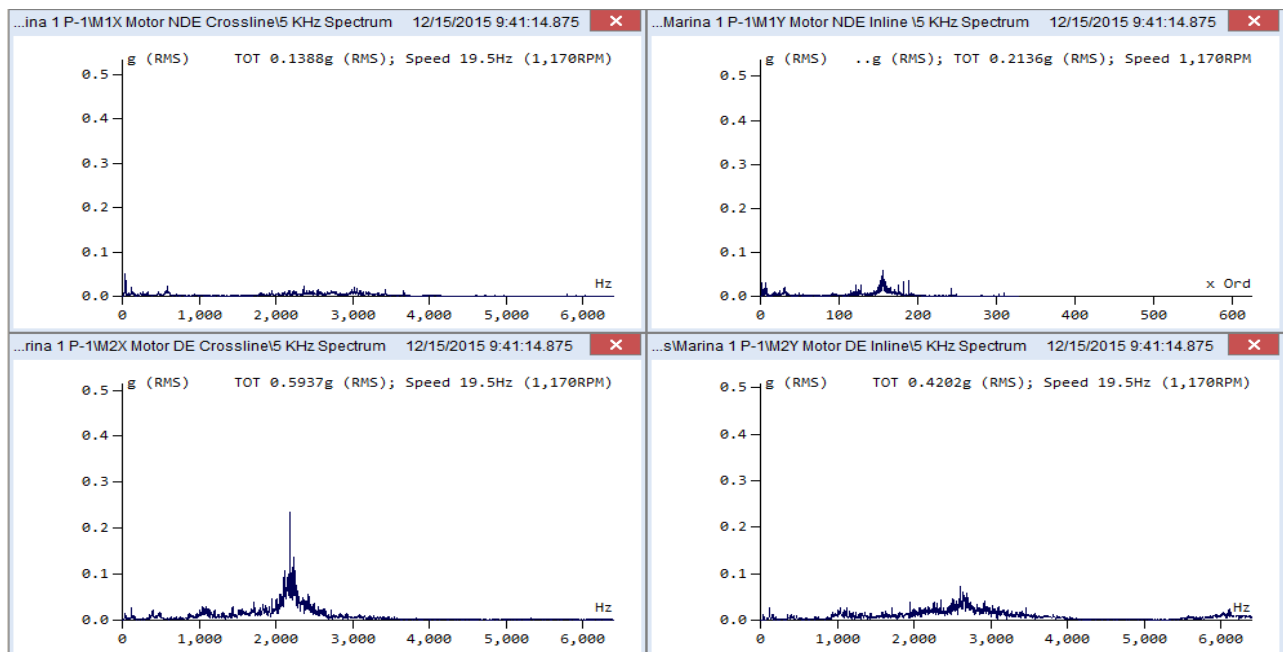
Pump 1

The unit was run at 615, 725 then at full speed 1170 RPM. This unit is running well within acceptable limits. In the top set of spectral graphs, the motor top and bottom bearing data is shown in Velocity scaled at .10 ips/rms. The cursor and harmonics are spaced at 2x shaft speed which is vane pass and for the most part dominates the energy spectrum as expected. The lower set of spectrum is in acceleration RMS looking at higher frequency values. These graphs are scaled to .5 g's and indicate very little energy when at full speed.

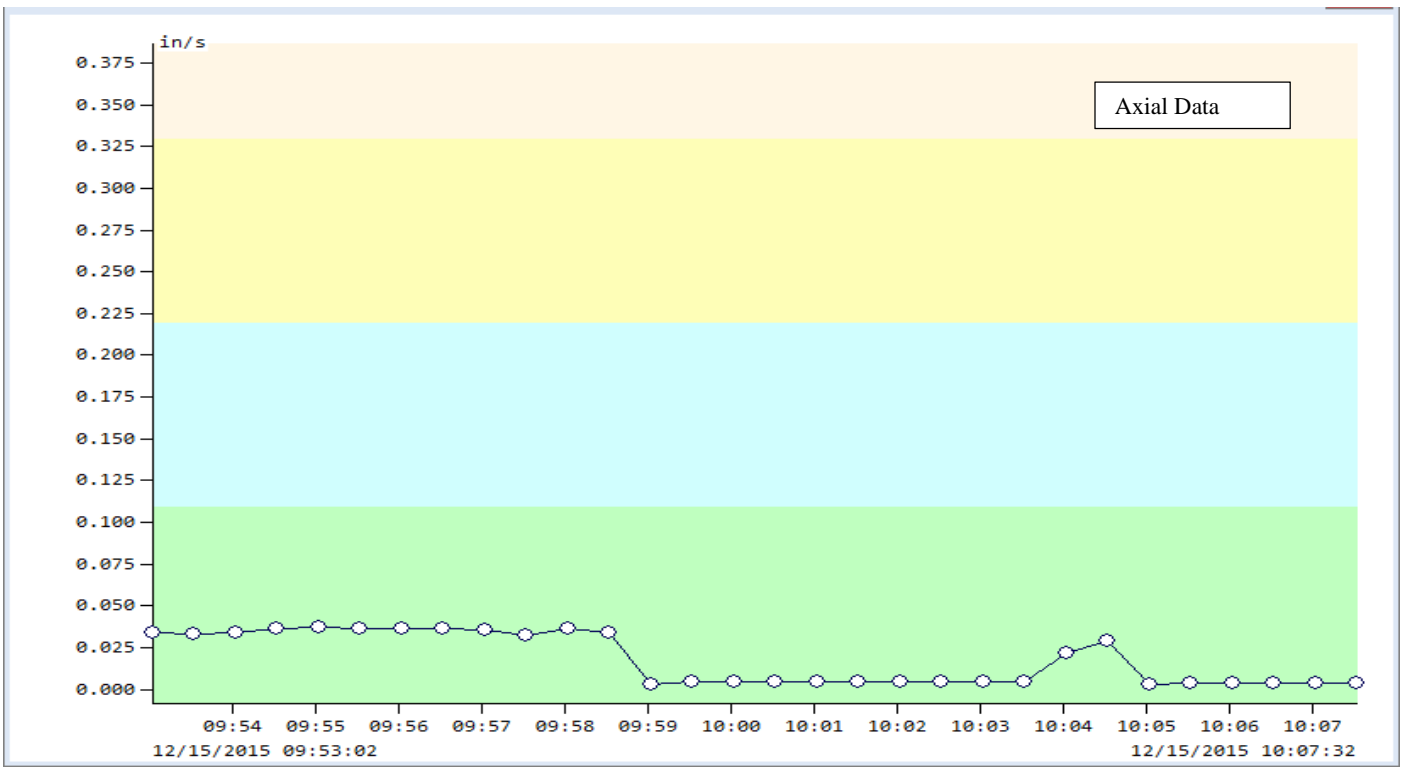
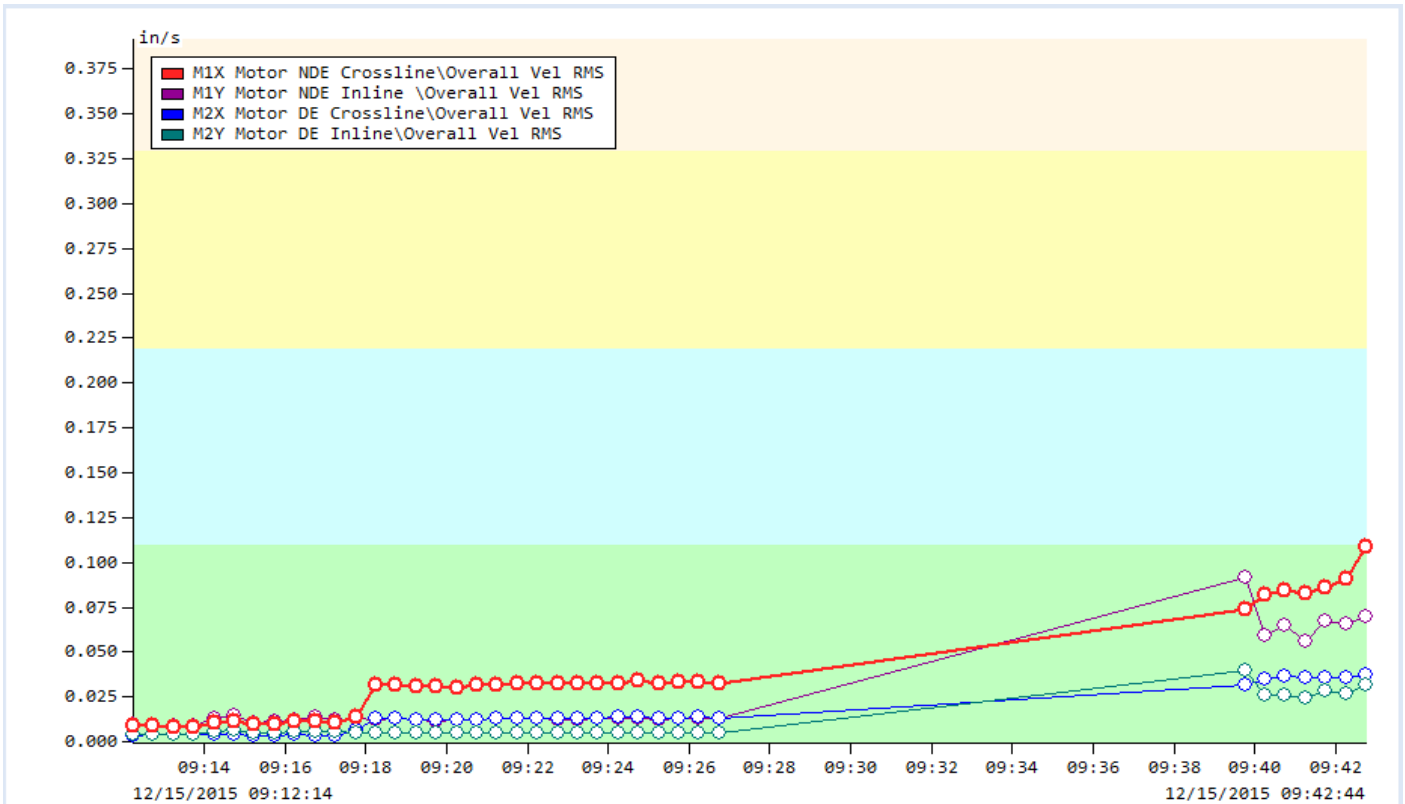
Velocity Spectrums Set To .10 Ips/Rms Scale



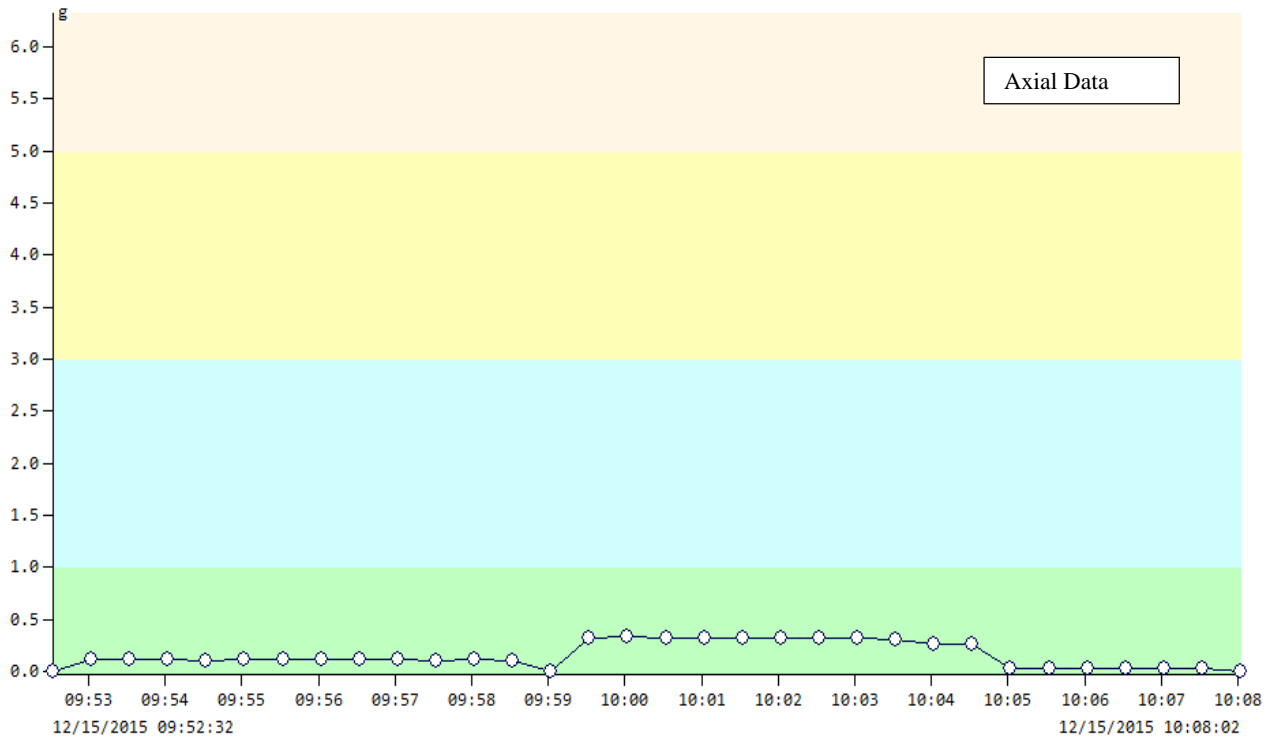
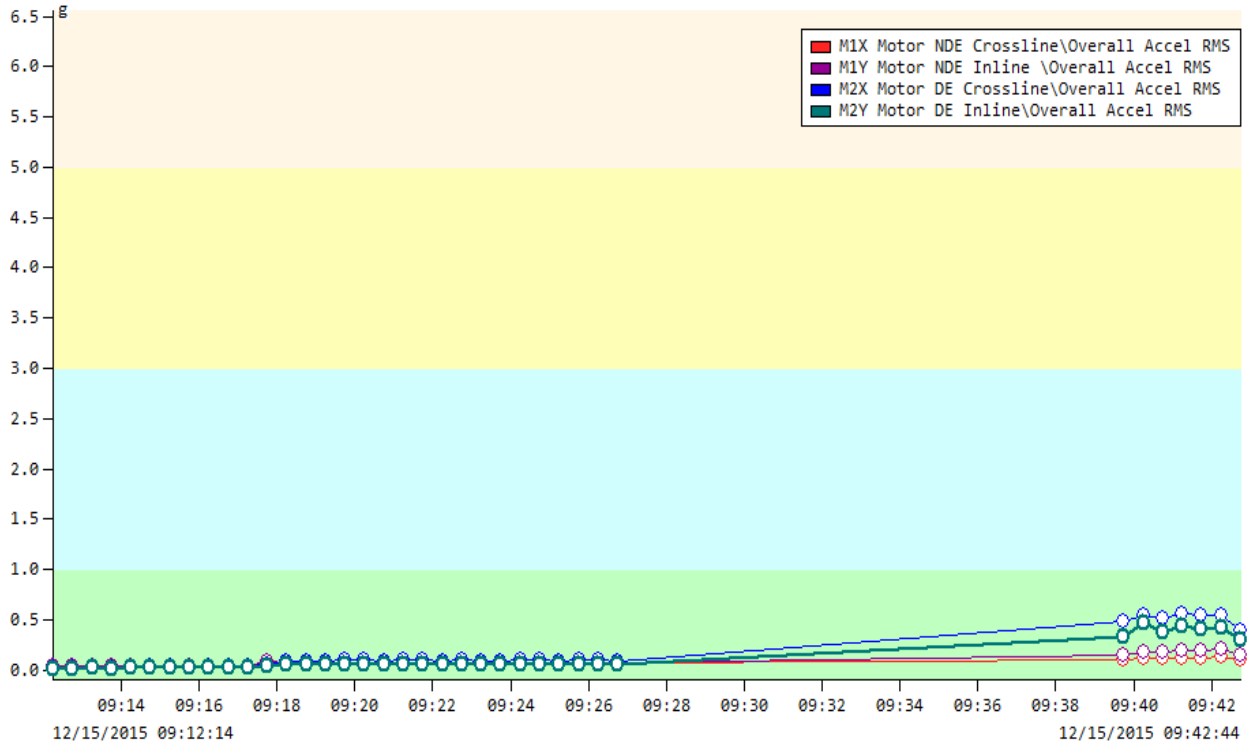
Top and Bottom Bearing Data in Acceleration Set to .5 G Scale



Overall Velocity Trend Values At All Speeds On All Points

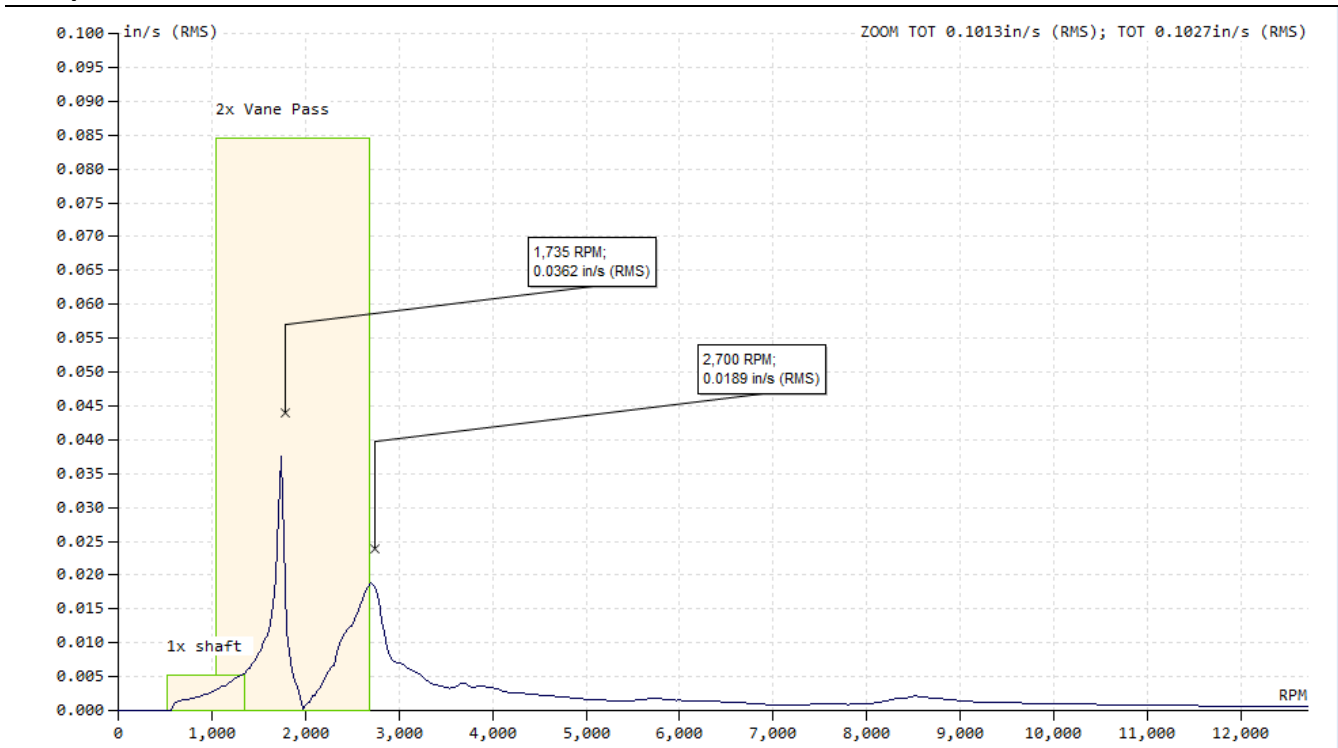


Overall Acceleration RMS Energy Values At All Speeds On All Points

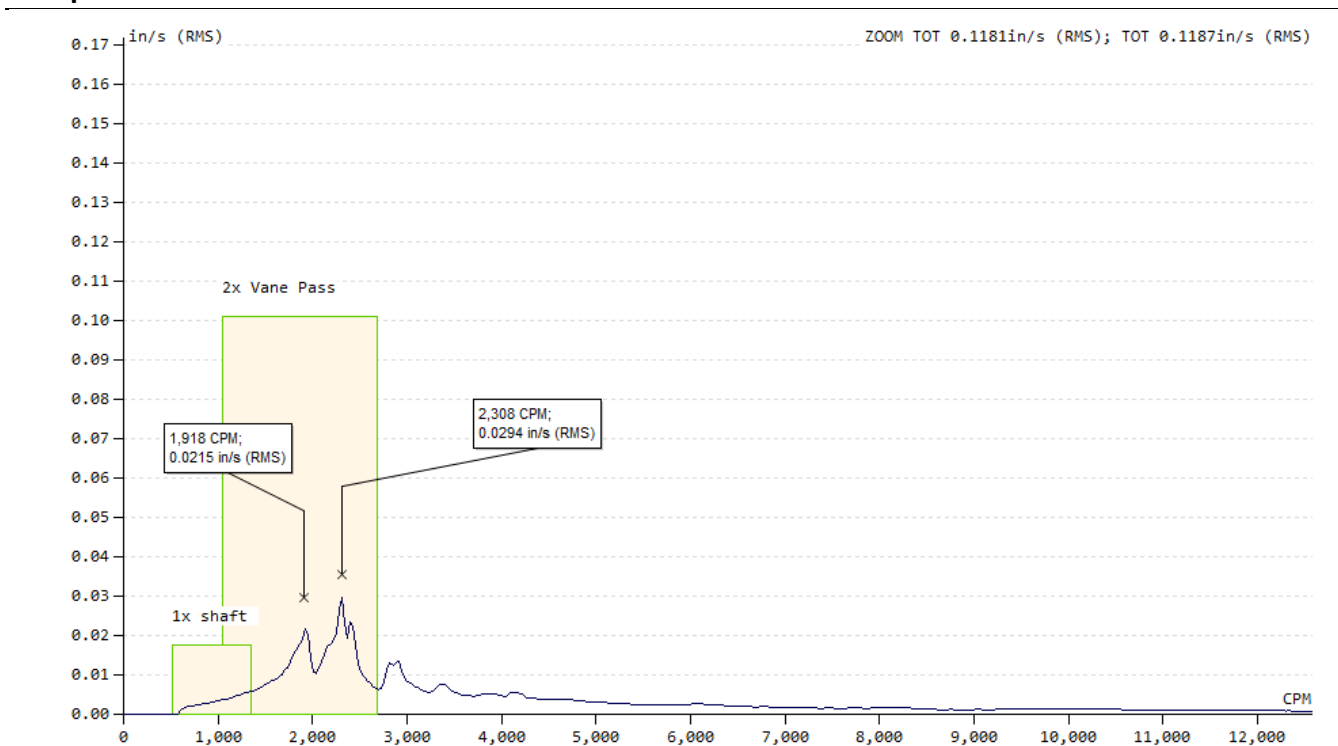


Bump test data returns responses within the expected band of operation, but vibration data returns very little amplitude changes.

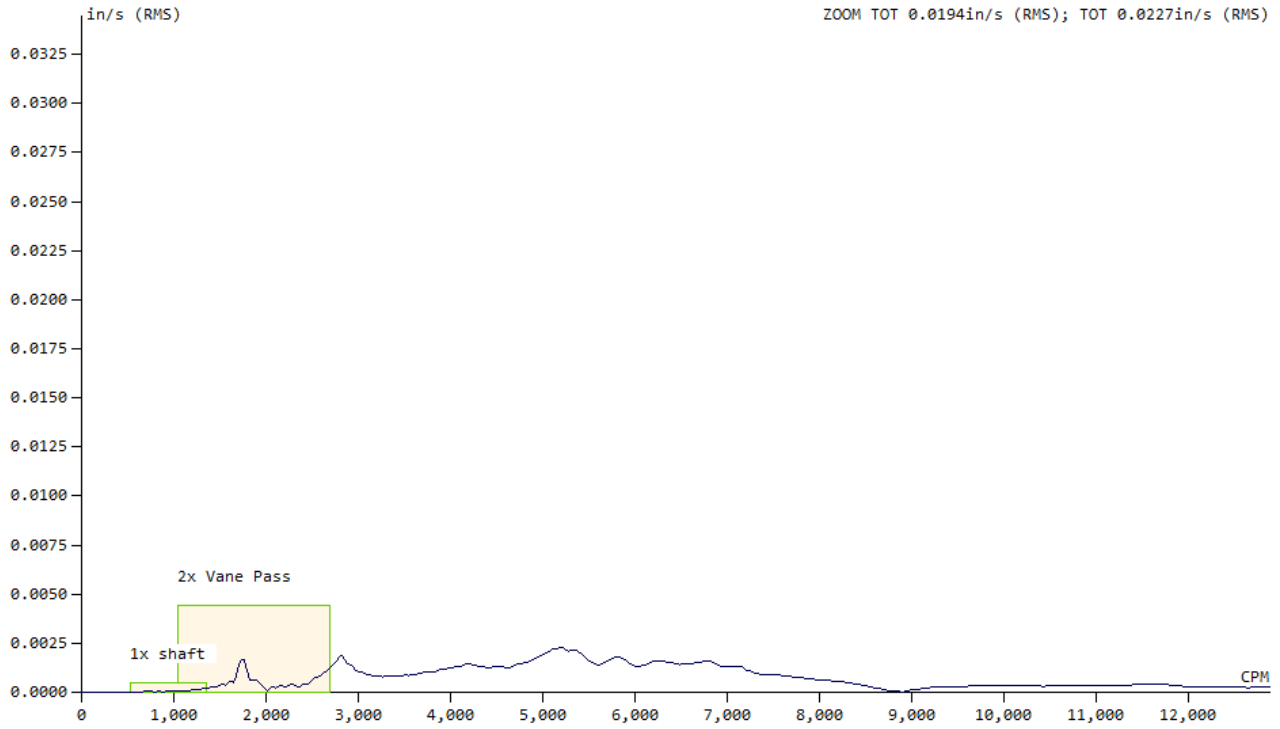
Bump Test Results X Axis



Bump Test Results Y Axis



Bump Test Results, Axial Axis





Applied Limit ips/rms 0.33

PASS
FAIL

PUMP 1											
		M1X Motor NDE Crossline		M1Y Motor NDE Inline		M2X Motor DE Crossline		M2Y Motor DE Inline		M2A Motor Axial	

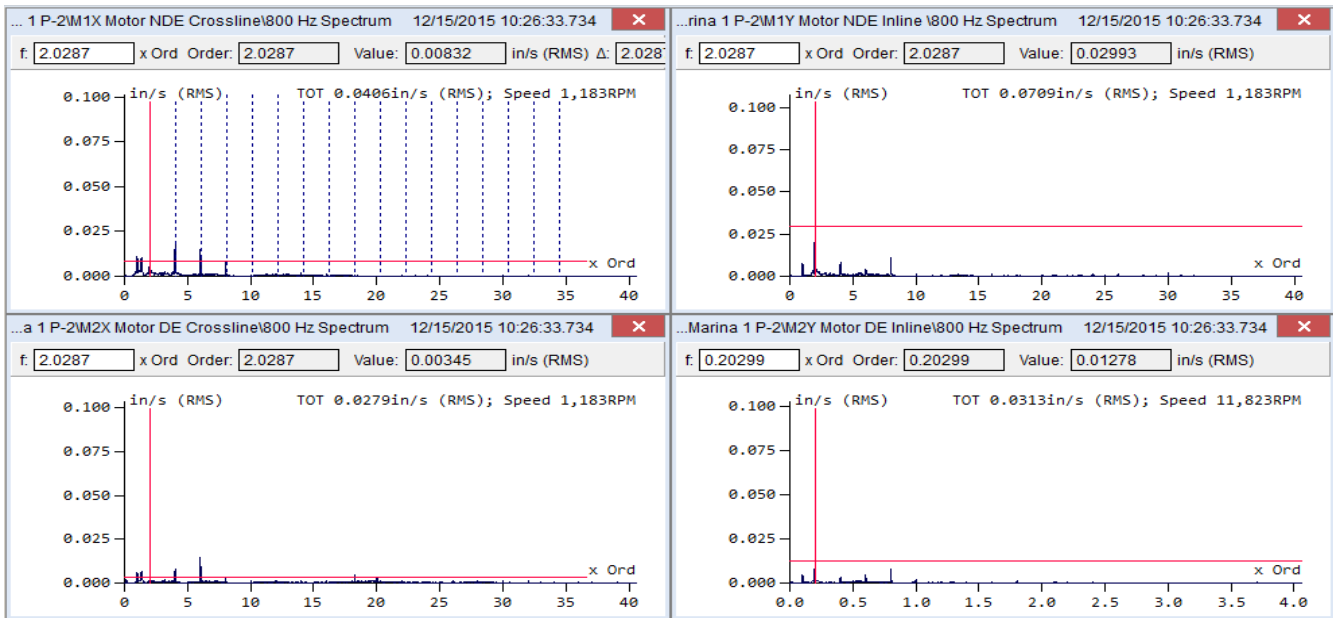
Date	RPM	Value [in/s]	LIMIT %	Value [in/s]	LIMIT %	Value [in/s]	LIMIT %	Value [in/s]	LIMIT %	Value [in/s]	LIMIT %
9:12 AM	615	0.009	3%	0.010	3%	0.004	1%	0.004	1%	0.000	0%
9:13 AM	615	0.009	3%	0.009	3%	0.004	1%	0.004	1%	0.033	10%
9:14 AM	615	0.011	3%	0.013	4%	0.004	1%	0.005	2%	0.036	11%
9:15 AM	615	0.010	3%	0.011	3%	0.004	1%	0.005	2%	0.037	11%
9:16 AM	615	0.011	3%	0.014	4%	0.004	1%	0.006	2%	0.035	11%
9:17 AM	725	0.011	3%	0.012	4%	0.003	1%	0.006	2%	0.032	10%
9:18 AM	725	0.032	10%	0.013	4%	0.013	4%	0.005	2%	0.003	1%
9:19 AM	725	0.031	9%	0.012	4%	0.012	4%	0.005	2%	0.004	1%
9:20 AM	725	0.032	10%	0.012	4%	0.013	4%	0.005	2%	0.005	2%
9:21 AM	725	0.032	10%	0.013	4%	0.013	4%	0.005	2%	0.005	2%
9:22 AM	725	0.033	10%	0.013	4%	0.013	4%	0.005	2%	0.005	2%
9:23 AM	725	0.033	10%	0.012	4%	0.013	4%	0.005	2%	0.004	1%
9:24 AM	725	0.034	10%	0.013	4%	0.014	4%	0.005	2%	0.003	1%
9:25 AM	725	0.032	10%	0.012	4%	0.013	4%	0.005	2%	0.004	1%
9:26 AM	725	0.033	10%	0.013	4%	0.013	4%	0.005	2%	0.004	1%
9:39 AM	1170	0.074	22%	0.092	28%	0.031	9%	0.040	12%	0.004	1%
9:40 AM	1170	0.082	25%	0.059	18%	0.035	11%	0.026	8%	0.000	0%
9:41 AM	1170	0.086	26%	0.067	20%	0.036	11%	0.028	8%		
9:42 AM	1170	0.109	33%	0.070	21%	0.038	12%	0.032	10%		

Pump 2

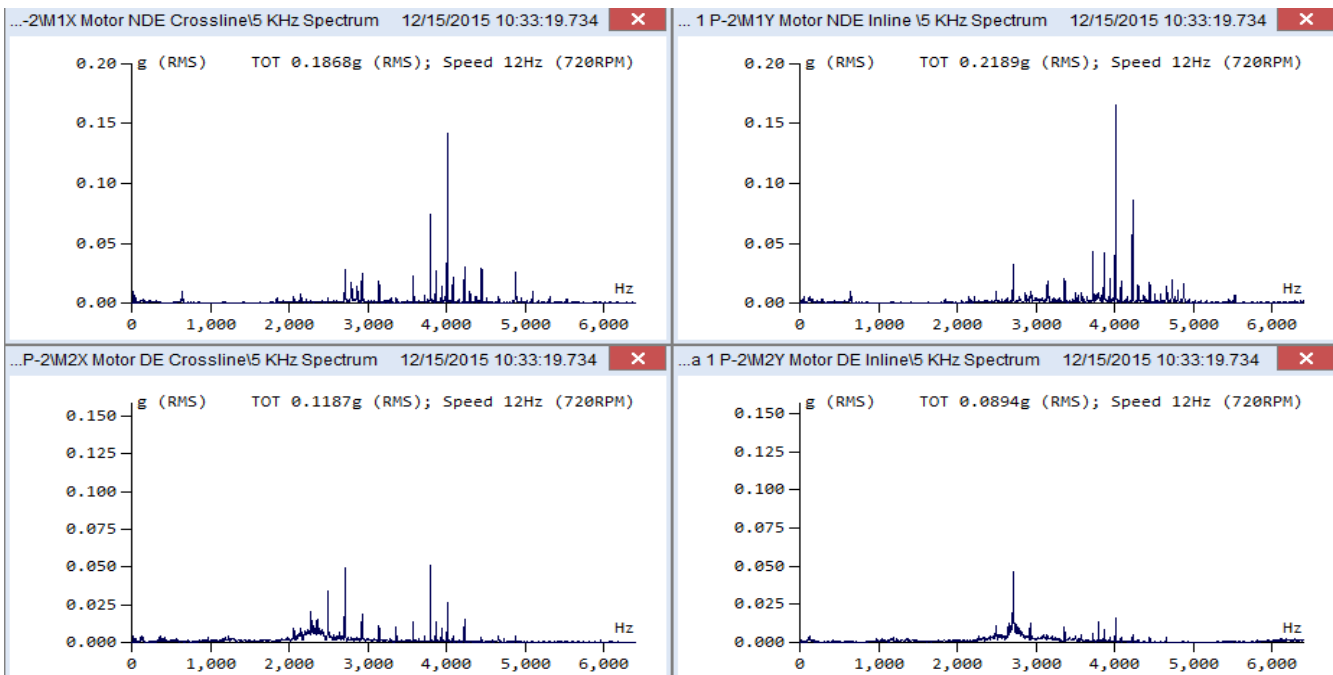
This unit was tested at 1183, 720, and 614 RPM. In the top set of spectrums the velocity value returns a normal pattern limited to pump vane pass and harmonics as expected. In the bottom set of graphs, the acceleration higher frequency data indicates a potential bearing defect is present on the motor. Specific bearing information will be needed in order to make a positive determination.

Recommend providing bearing information and monitoring this unit on a 30 day rotation for stability or upward trending.

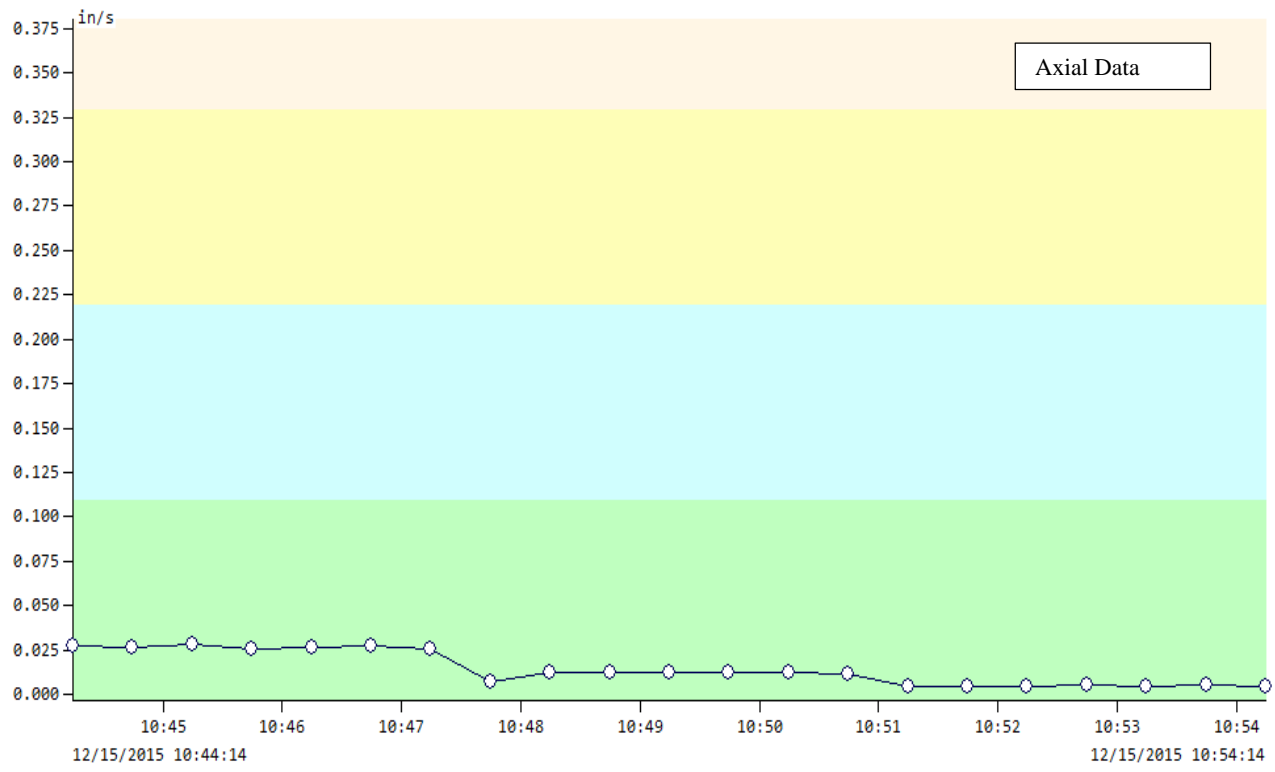
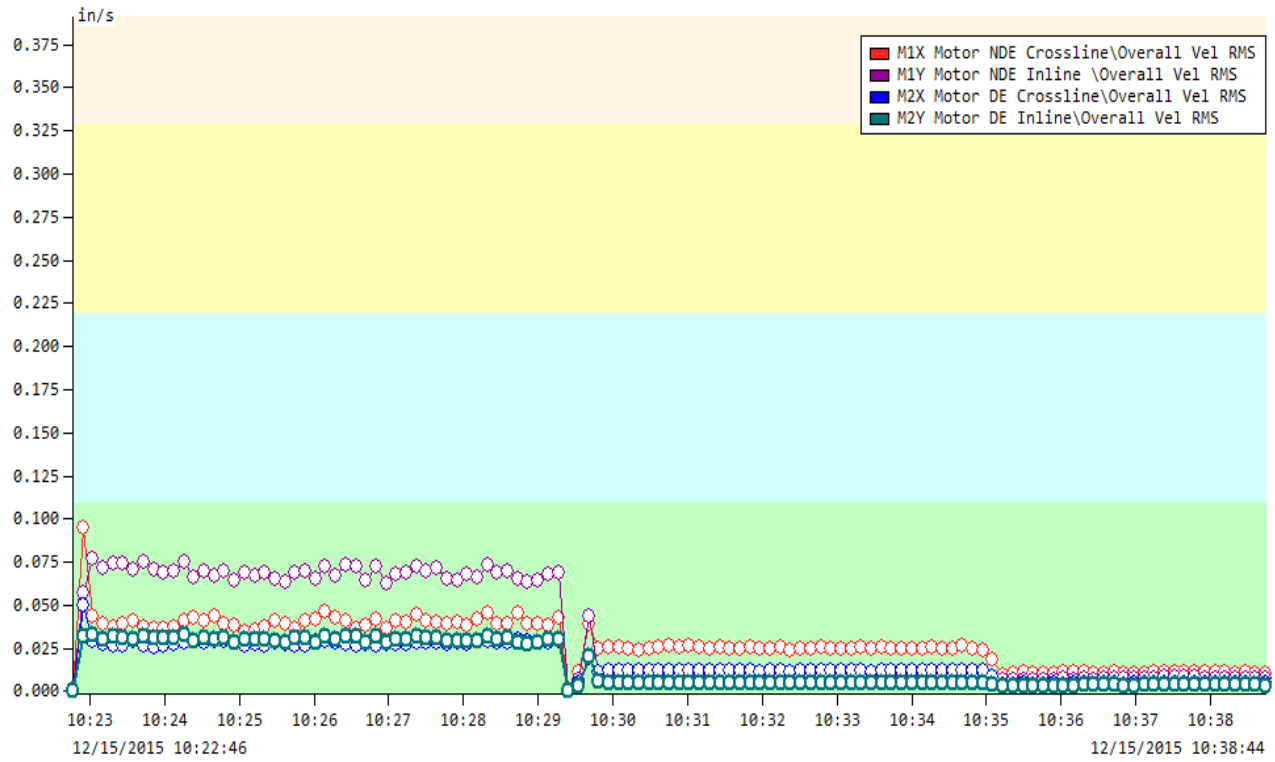
Velocity Spectrums Set To .10 Ips/Rms Scale



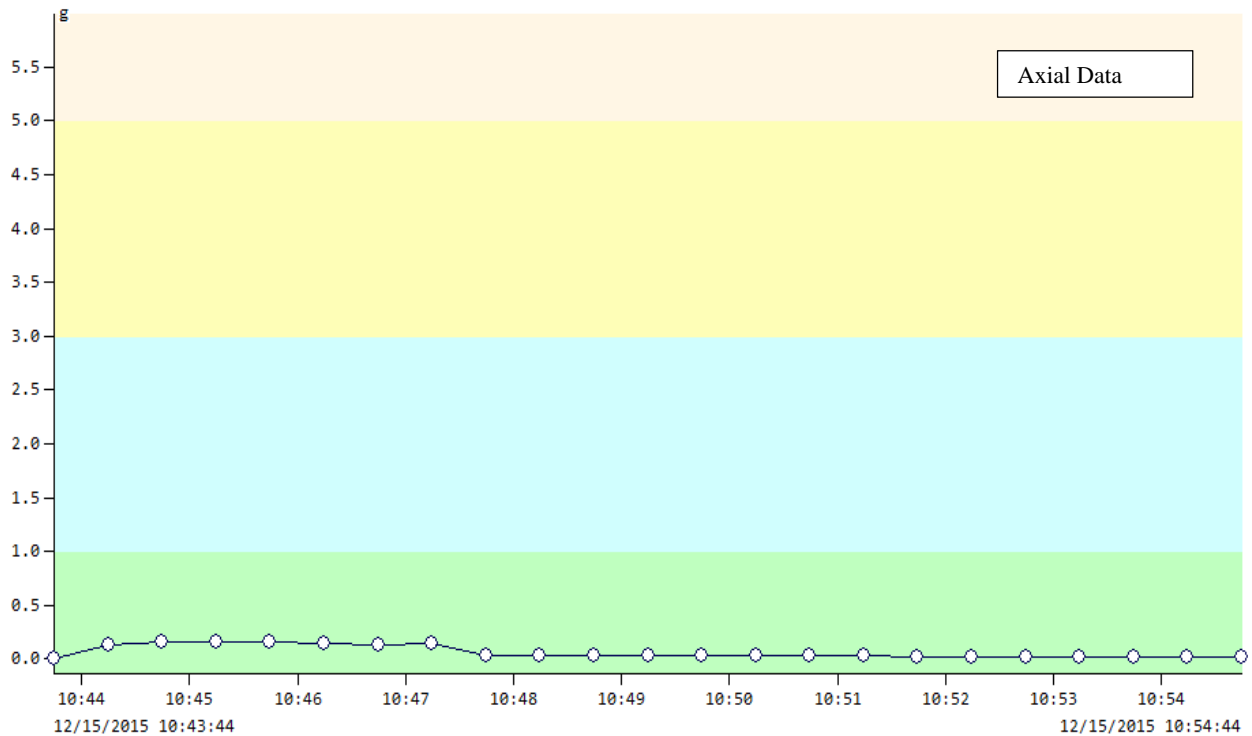
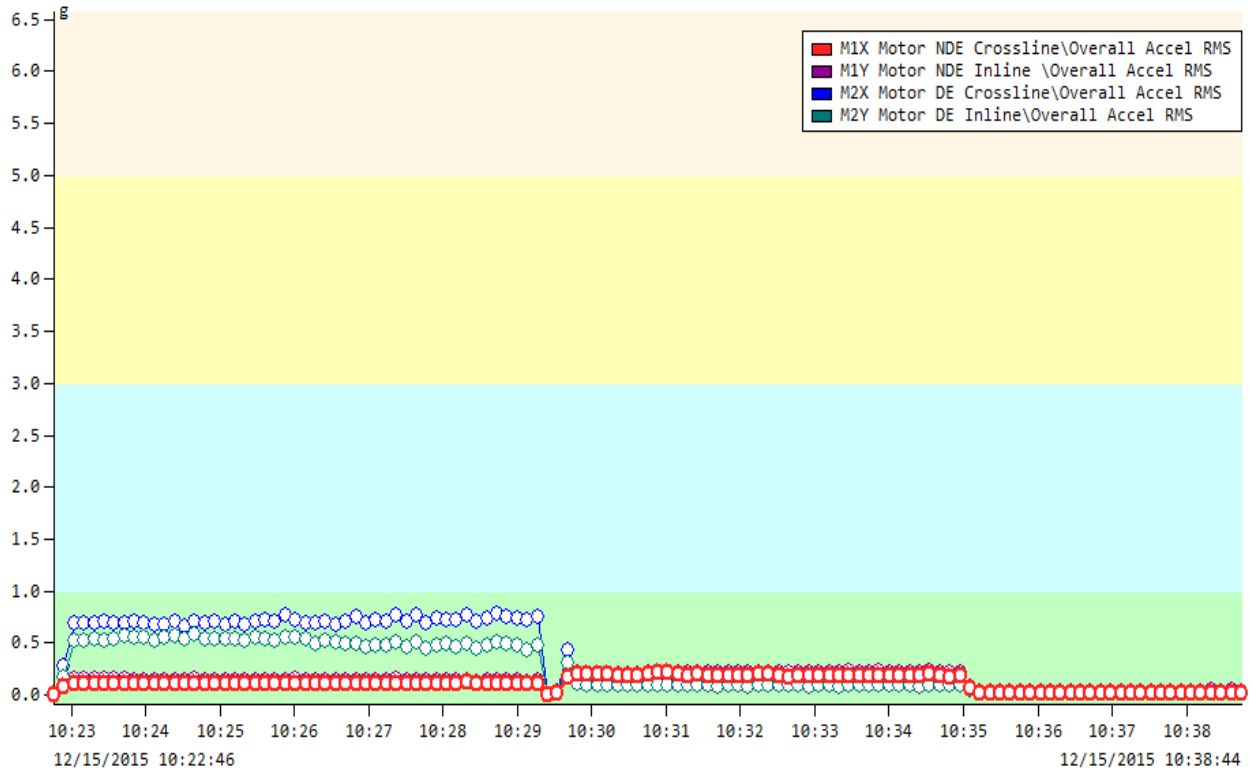
Top and Bottom Bearing Data in Acceleration Set To .5 G Scale



Overall Velocity Trend Values At All Speeds On All Points

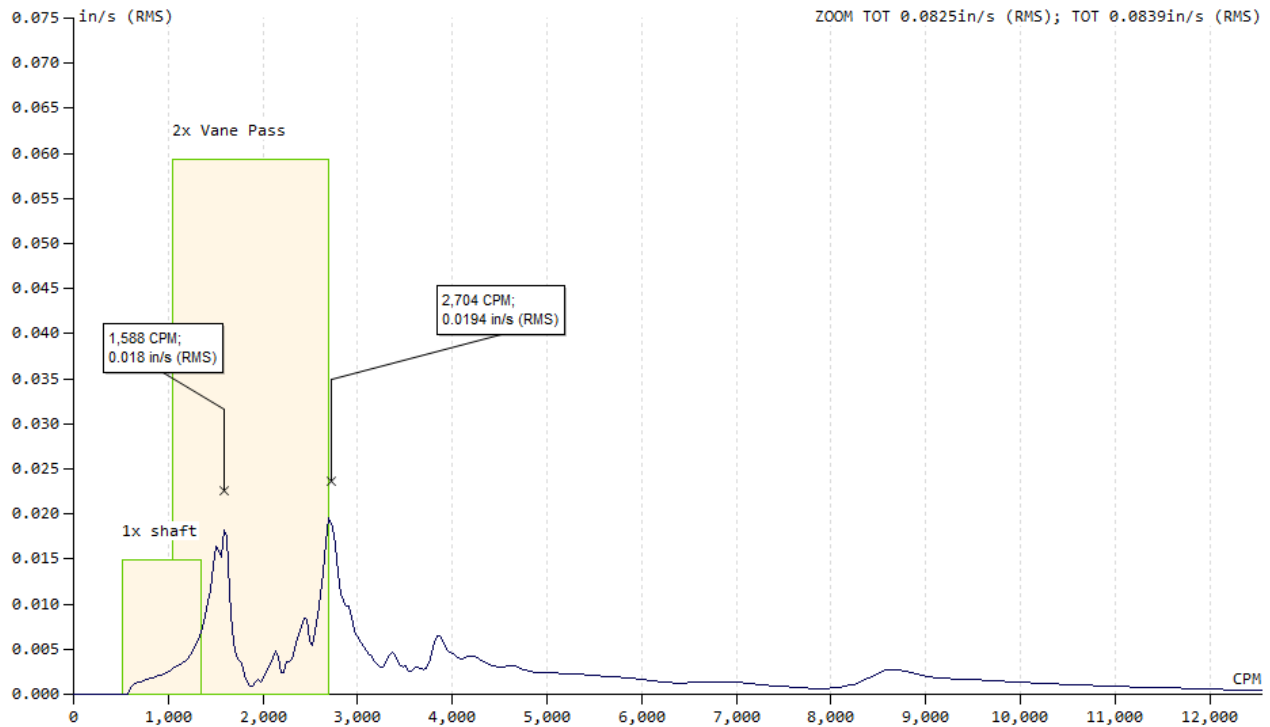


Overall Acceleration RMS Energy Values At All Speeds On All Points

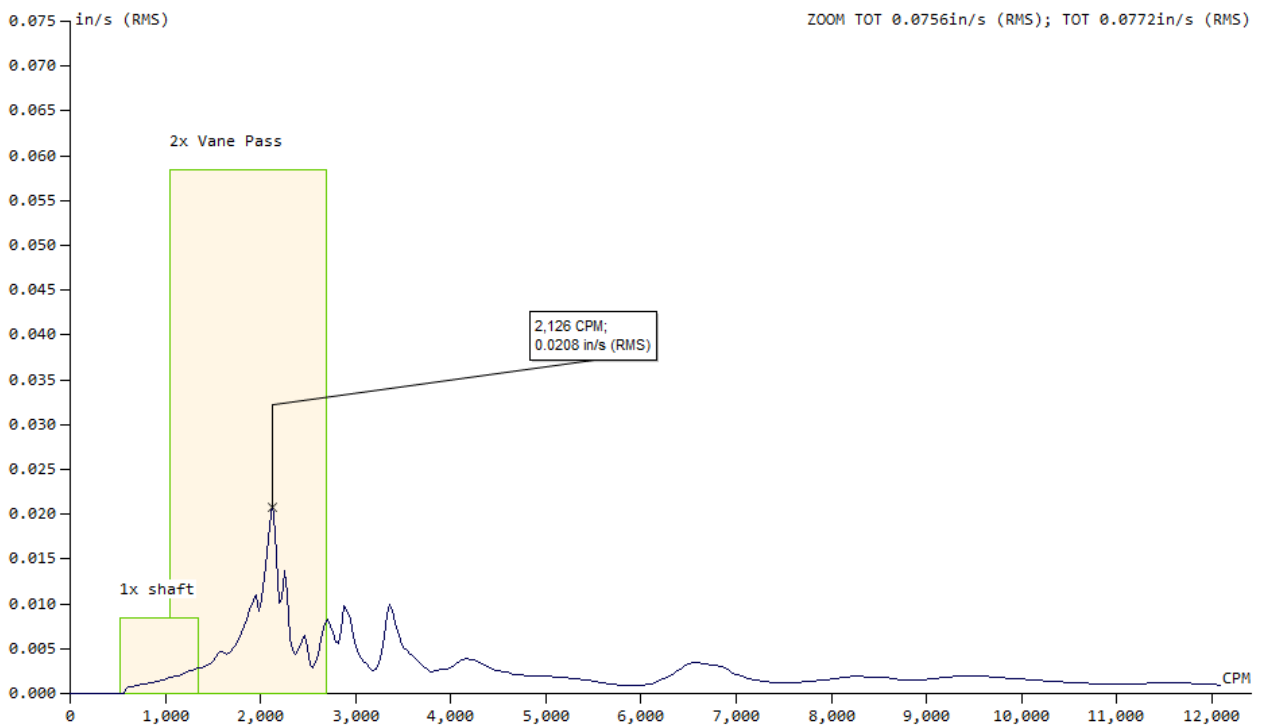


Bump test data returns responses within the expected band of operation, but vibration data returns very little amplitude changes.

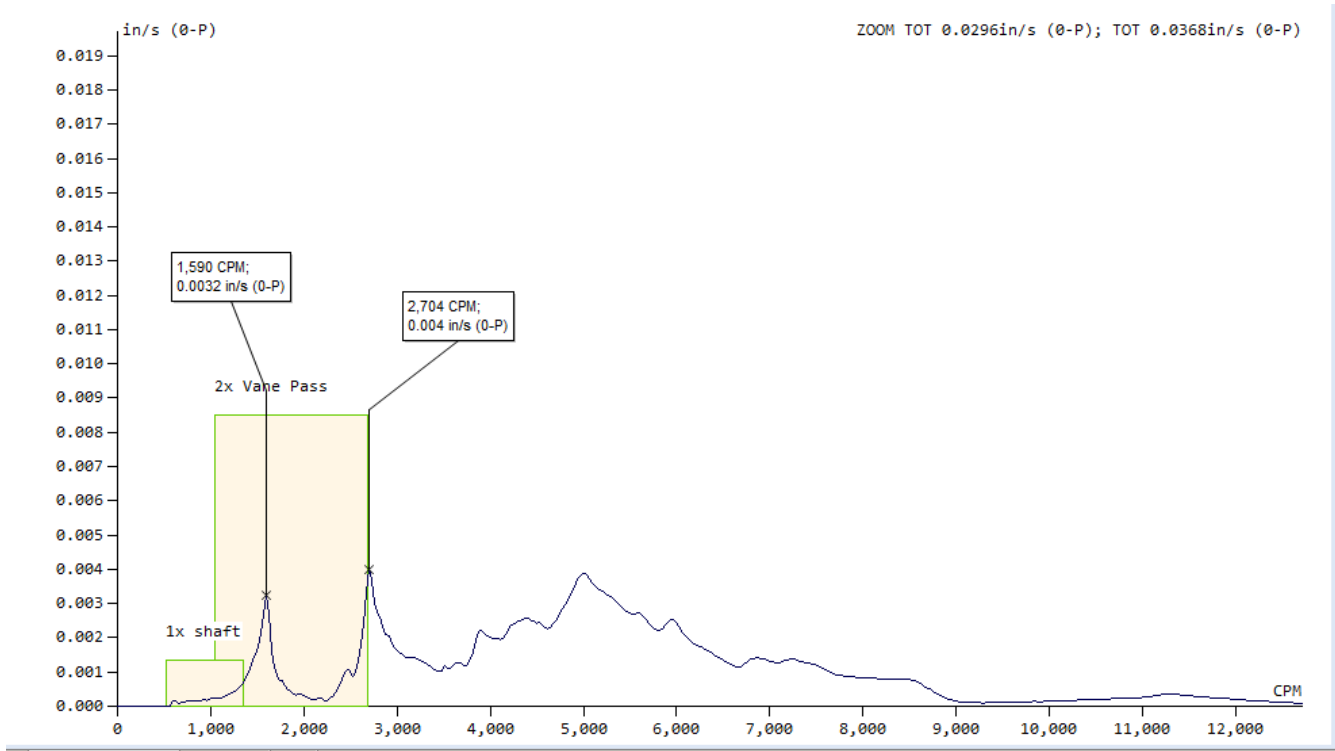
Bump Test Results X Axis



Bump Test Results Y Axis



Bump Test Results, Axial Axis





Applied Limit ips/rms 0.33

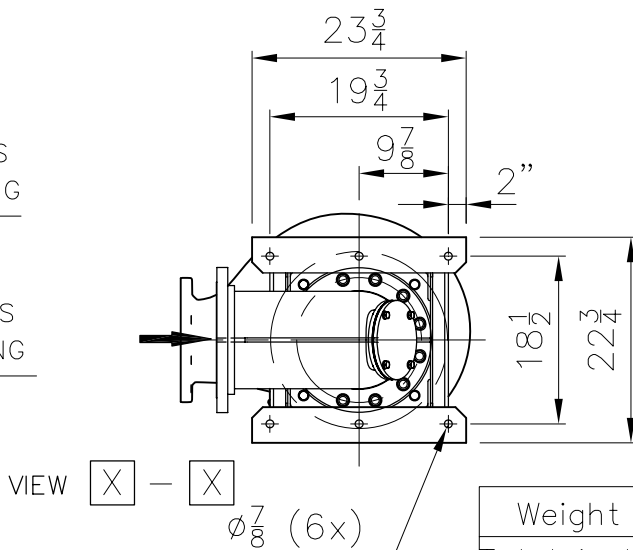
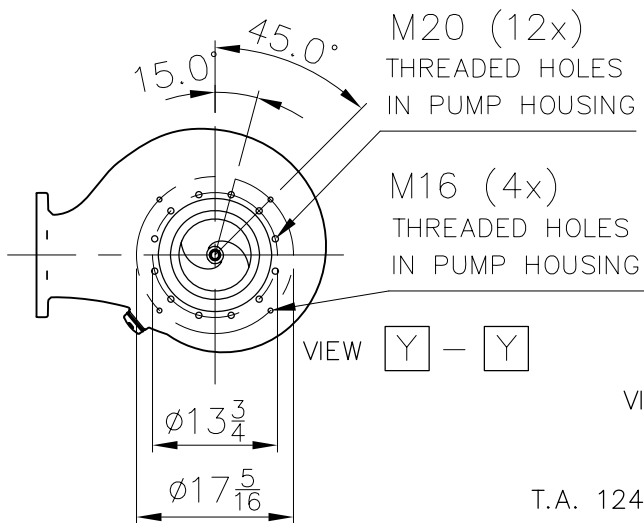
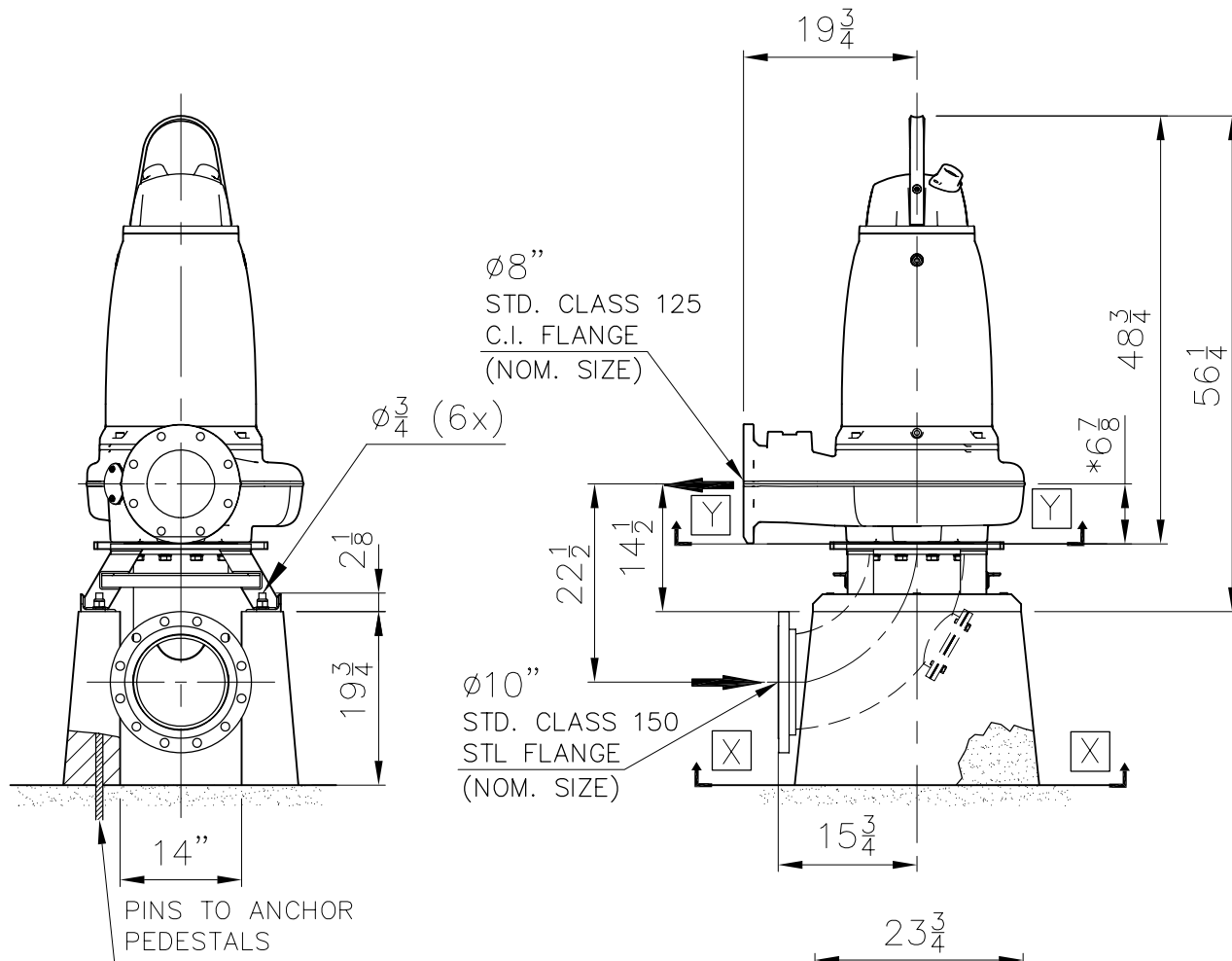
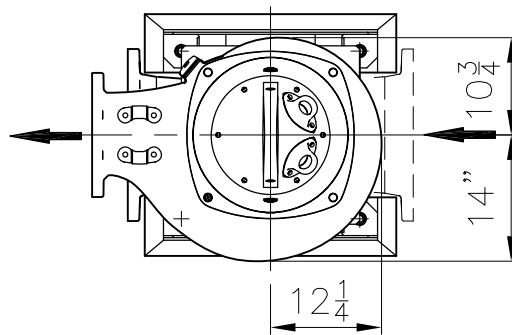
PASS
FAIL

PUMP 2											
		M1X Motor NDE Crossline		M1Y Motor NDE Inline		M2X Motor DE Crossline		M2Y Motor DE Inline		M2A Motor Axial	
Date	RPM	Value [in/s]	LIMIT %	Value [in/s]	LIMIT %	Value [in/s]	LIMIT %	Value [in/s]	LIMIT %	Value [in/s]	LIMIT %
10:22 AM	1183	0.000	0%	0.001	0%	0.000	0%	0.000	0%	0.000	0%
10:23 AM	1183	0.036	11%	0.069	21%	0.027	8%	0.031	9%	0.012	4%
10:24 AM	1183	0.037	11%	0.070	21%	0.027	8%	0.031	9%	0.012	4%
10:25 AM	1183	0.041	12%	0.070	21%	0.027	8%	0.031	9%		
10:26 AM	1183	0.042	13%	0.065	20%	0.029	9%	0.028	8%		
10:27 AM	1183	0.040	12%	0.065	20%	0.029	9%	0.029	9%		
10:28 AM	1183	0.039	12%	0.068	21%	0.028	8%	0.030	9%		
10:29 AM	1183	0.026	8%	0.010	3%	0.012	4%	0.005	2%		
10:30 AM	720	0.025	8%	0.010	3%	0.012	4%	0.005	2%		
10:31 AM	720	0.025	8%	0.010	3%	0.012	4%	0.005	2%		
10:32 AM	720	0.024	7%	0.010	3%	0.012	4%	0.005	2%		
10:33 AM	720	0.025	8%	0.010	3%	0.012	4%	0.005	2%		
10:34 AM	720	0.025	8%	0.010	3%	0.012	4%	0.005	2%		
10:35 AM	614.1	0.011	3%	0.007	2%	0.005	2%	0.003	1%		
10:36 AM	614.1	0.011	3%	0.007	2%	0.004	1%	0.004	1%		
10:37 AM	614.1	0.011	3%	0.008	2%	0.005	2%	0.004	1%		
10:38 AM	614.1	0.011	3%	0.008	2%	0.005	2%	0.004	1%		

NOTE:

PUMP CAN BE ROTATED ABOUT IT'S CENTERLINE TO 4 POSITIONS RELATIVE TO THE INLET ELBOW:
INCREMENTS ARE 90°

* DIMENSION TO INLET ELBOW FLANGE ONLY FOR 6 POLES



Weight (lbs)
Total incl. stand
1345

T.A. 12432

	Denomination	Drawn by	Checked by	Date
	Dimensional drwg NT 3202 MT Ø10" / Ø8"	MRD	GJ	03192009
		Scale	Reg no	
		14-68 24 25	5399	-



TECHNICAL ASSOCIATES OF CHARLOTTE, P.C.
VIBRATION ANALYSIS III

By Presentation of This

CERTIFICATE OF ACHIEVEMENT

Hereby Certifies

KIRK F. CORMANY

has completed the 24 hours of training "Introduction To Special Vibration Diagnostic Techniques And How To Analyze Low, High And Variable Speed Machines" and has successfully passed a closed-book written examination for the Level III Vibration Analysis Method under the ASNT curriculum guidelines stipulated in SNT-TC-1A

TECHNICAL ASSOCIATES OF CHARLOTTE, P.C.
Class Time 24-Hours - Test Time 4-Hours

Test Dates: October 29, 2004

Seminar Authorized By:
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Charlotte, NC 28204
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James E. Berry, P.E.
James E. Berry, P.E., Analytical Group
Certification Examination Author