TDI REFRIGERATION

Vibration Analysis Report

For

Customer Name
Customer Location

April 22, 2013

TDI Refrigeration
13505 Yorba Avenue, Suite Z Chino, CA 91710
(866) 383-2653 office • (909) 614-7343 fax • www.tdirefrigeration.com

RBM Report Introduction

Data was collected recently at your facility and the analysis of this data is presented in the following report.

Each piece of equipment in your facility will fall into one of three categories.

1. No problems detected – equipment operating normally.

2. Data analysis indicates attention is needed or a potential problem exists – minor maintenance may be required, equipment must be watched more closely for any increase in vibration amplitude or an anomaly has been detected. An anomaly does not necessarily indicate a problem but it does indicate something in the spectrum that is not present in a normal spectrum. The color yellow in the bearing area will depict this problem category.

3. Equipment defect has been confirmed – repair work must be performed at some point in the near future. The color red in the bearing area will depict this problem category.

The contents of this report will highlight the equipment that poses potential problems and equipment that require repair work.

Keywords:

Certainty: This indicates how well the data indicating equipment defect follows accepted analysis rules. This is based on a numerical value from 1-5, where 5 is 100% certain.

Urgency: This is a rating that combines the Certainty and Operational Significance into a weighted value. The following is the description of each weighted value:

1. Normal - Equipment has no known defects – Operate equipment normally
2. Attention – Equipment requires attention to avoid future damage.
3. Significant - Data analysis indicates a low priority problem exists – additional data may be required, equipment must be watched more closely for any increase in vibration amplitude.
4. Serious - Equipment defect has been confirmed - repair work must be performed at some point in the near future.
5. Emergency – Equipment defect has been confirmed – the machine should be shut down and repair work must be performed as soon as possible. Continued operation will result in a safety risk and/or serious damage to equipment.

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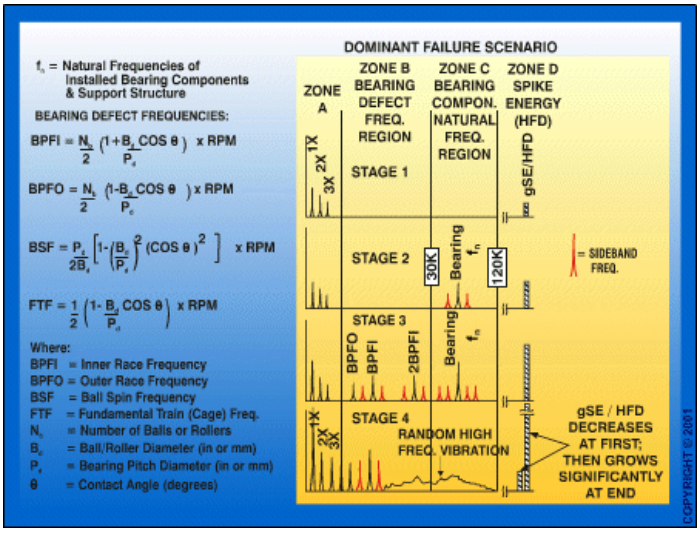
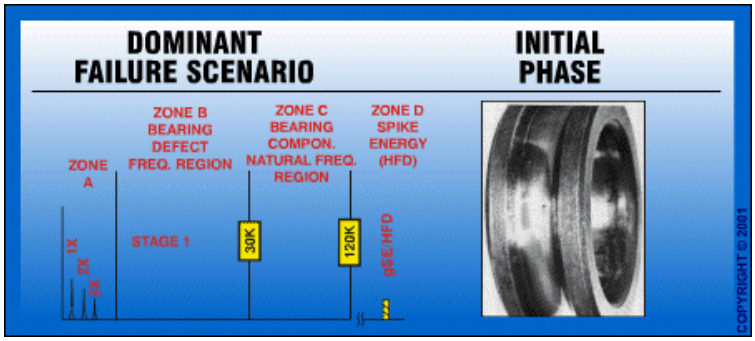
The Four Stages of Bearing Failure

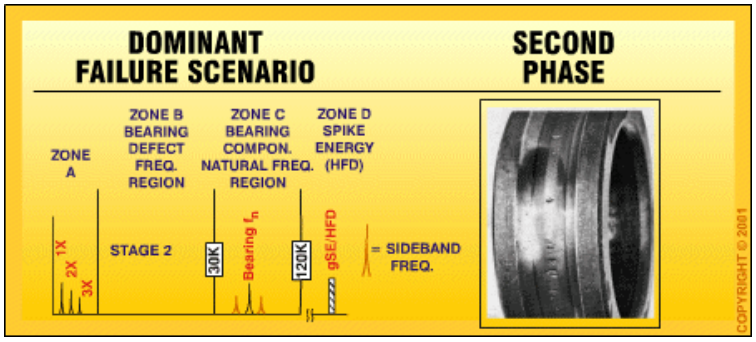


Stage 1



STAGE 1: Earliest indications of bearing problems appear in ultrasonic frequencies ranging from about 250,000 - 350,000 Hz; later, as wear increases, usually drops to approximately 20,000 - 60,000 Hz (1,200,000 - 3,600,000 CPM). These are frequencies evaluated by Spike Energy (gSE), HFD(g) and Shock Pulse (dB). For example, spike energy may first appear at about .25 gSE in Stage 1 (actual value depending on measurement

Stage 2



STAGE 2: Slight bearing defects begin to "ring" bearing component natural frequencies (f_n) which predominantly occur in 30K - 120K CPM range. Such natural frequencies may also be resonances of bearing support structures. Sideband frequencies appear above and below natural frequency peak at end of Stage 2. Overall spike energy grows (for example, from .25 to .50 gSE).

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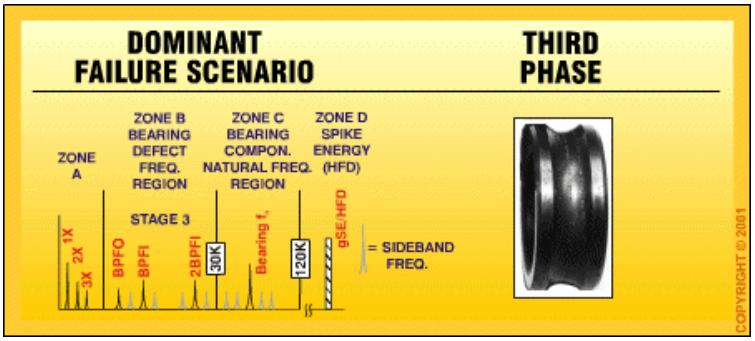
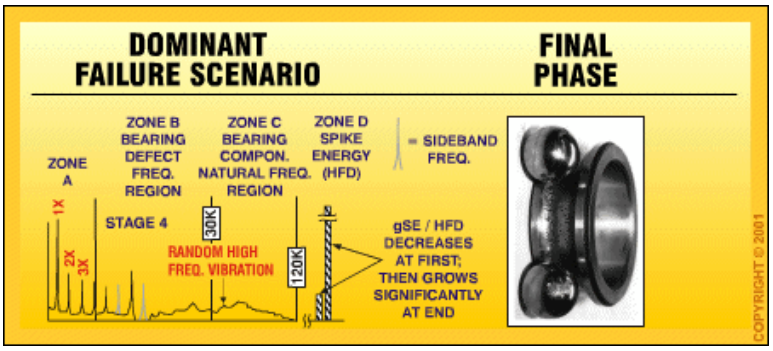
Stage 3



STAGE 3: Bearing defect frequencies and harmonics appear. When wear progresses, more defect frequency harmonics appear and number of sidebands grows, both around these and bearing component natural frequencies. Overall spike energy continues to increase (for example, from .5 to over 1 gSE). Wear is now usually visible and may extend throughout periphery of bearing, particularly when many well-formed sidebands accompany bearing defect frequency harmonics. High frequency

Stage 4



STAGE 4: Towards the end, amplitude of 1X RPM is even effected. It grows, and normally causes growth of many running speed harmonics. Discrete bearing defect and component natural frequencies actually begin to "disappear" and are replaced by random, broadband high frequency "noise floor". In addition, amplitudes of both high frequency noise floor and spike energy may in fact decrease; but just prior to failure, spike energy and HFD will usually grow to excessive amplitudes.

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Spectral Analysis Scan Report

Customer Name, City, CA. April 22, 2013

York SAB163HF	**S/N 130775**	**C2**	**Potential Problem (See Report)**
York SABHF	**S/N 128798**	**C3**	**No Problem Detected**
York SABHM	**S/N 132363**	**C4**	**Potential Problem (See Report)**
York SABHM	**S/N 13238**	**C5**	**No Problem Detected**

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Vibration Survey Problem Detail

Area: **Customer Name, City, CA**

Equipment: **C2, York SAB163HF, S/N 130775**

Title: Bearing Fault, Rotary Screw Compressor, C4

Fault: Thrust BPFI Fault

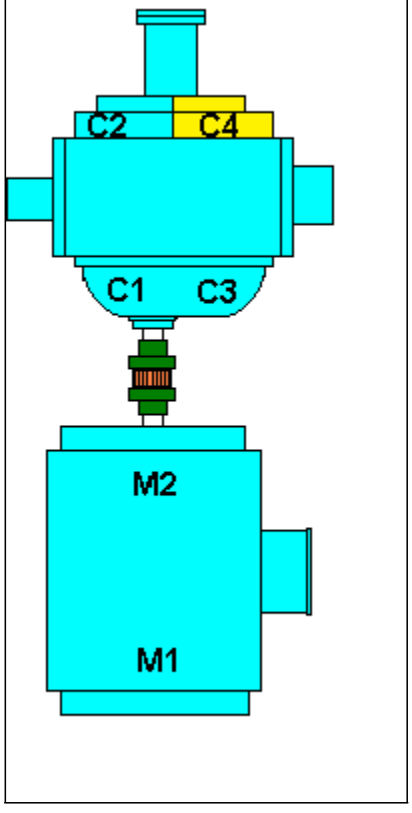
Explanation: The fundamental defect frequency, BPFI "Ball Pass Frequency Inner Race" and its harmonics are appearing in the spectrum with rotating speed sidebands. Moderate impacting at the BPFI frequency can be seen in the time waveform. The thrust bearings are in beginning stage 3 of the 4-part bearing failure scenario.

Recommendation: Continue to operate and start to closely monitor the bearings by increasing vibration survey frequencies to establish trending. Monitor for any increase in vibration amplitude and noise. Conduct another survey in 3-4 months.

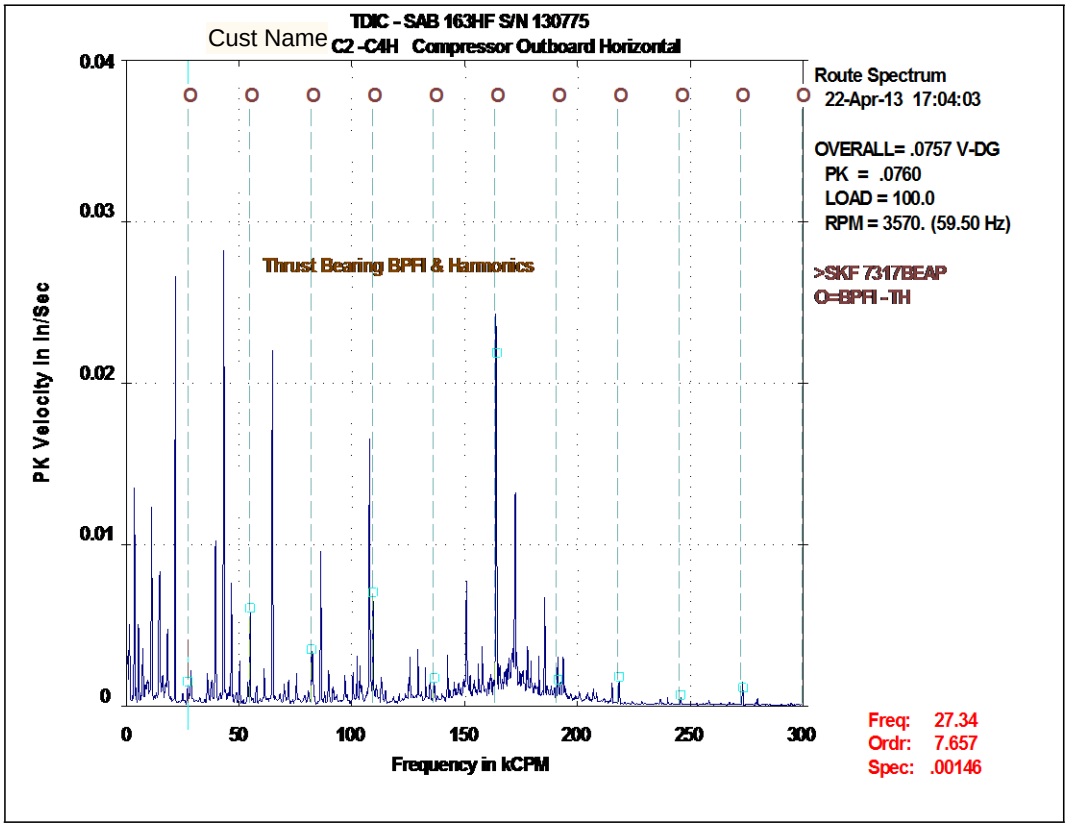
Urgency:
Significant

Survey: 22-Apr-13
Certainty: 4
Analyst: James Gable

Vibration Survey Points



Compressor Problem Spectrum



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Vibration Survey Problem Detail

Area: **Customer Name, City, CA**

Equipment: **C3, York SAB163HF, S/N 128798**

Title: No Fault, AC Induction Motor, Rotary Screw Compressor

Fault: No Faults

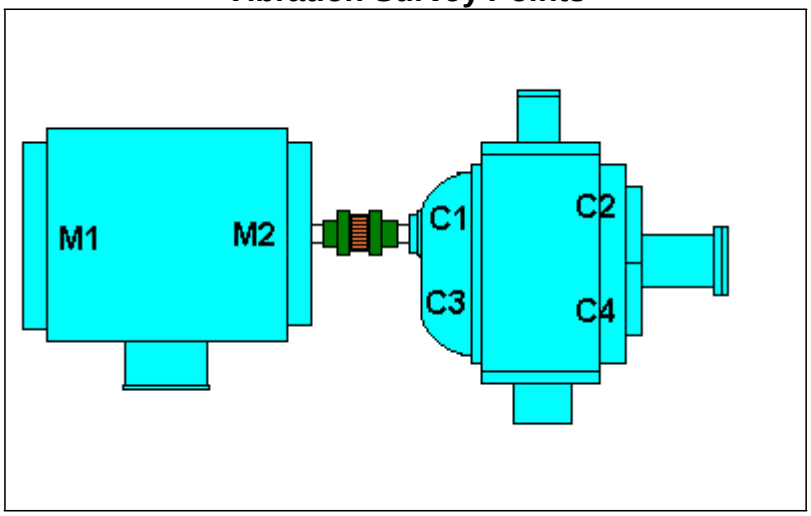
Explanation: No faults were detected during this survey period.

Recommendation: Continue to operate as normal and conduct another survey in 6 months.

Urgency:
Normal

Survey: 22-Apr-13
Certainty: 4
Analyst: James Gable

Vibration Survey Points



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Vibration Survey Problem Detail

Area: **Customer Name, City, CA**

Equipment: **C4, York SAB163HM, S/N 132363**

Title: Bearing Fault, AC Induction Motor, M1, M2

Fault: BSF/Cage Fault

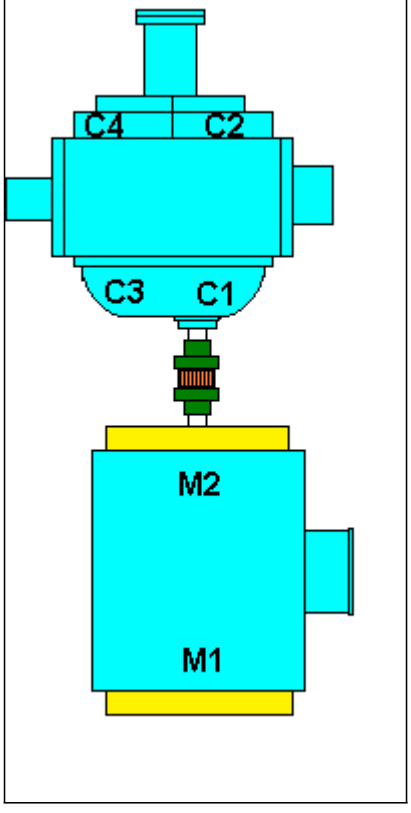
Urgency:
Significant

Survey: 22-Apr-13
Certainty: 4
Analyst: James Gable

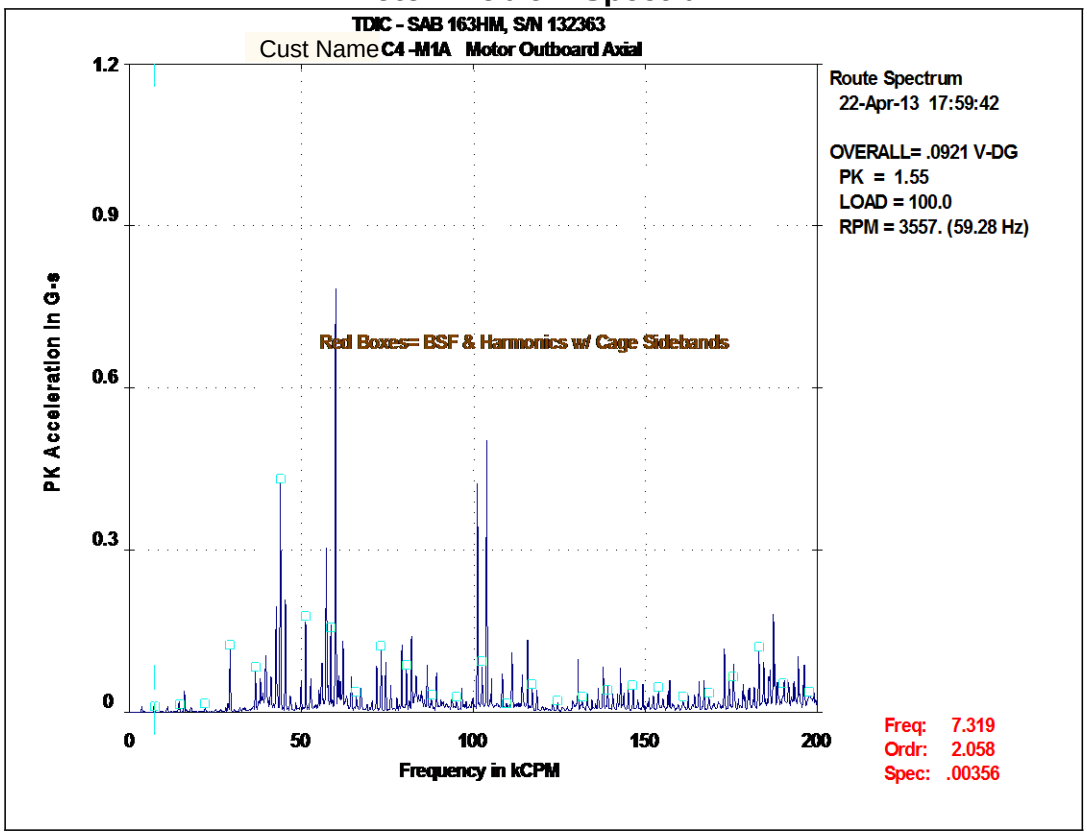
Explanation: The fundamental defect frequency BSF "Ball Spin Frequency" and its harmonics are appearing in the spectrum with cage sidebands. This indicates asperities are forming on the balls of the bearing. Impacting is light at this time in the time wave form. The bearings are in stage 2 of the 4-part bearing failure scenario.

Recommendation: Continue to operate. Ensure the bearings are lubricated as per the motor manufactures lubrication frequency and grease type. Closely monitor for any increase in vibration amplitude and/or noise. Conduct another survey in 6 months.

Vibration Survey Points



Motor Problem Spectrum



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Vibration Survey Problem Detail

Area: **Customer Name, City, CA**

Equipment: **C5, York SAB163HM, S/N 13238**

Title: No Fault, AC Induction Motor, Rotary Screw Compressor

Fault: No Faults

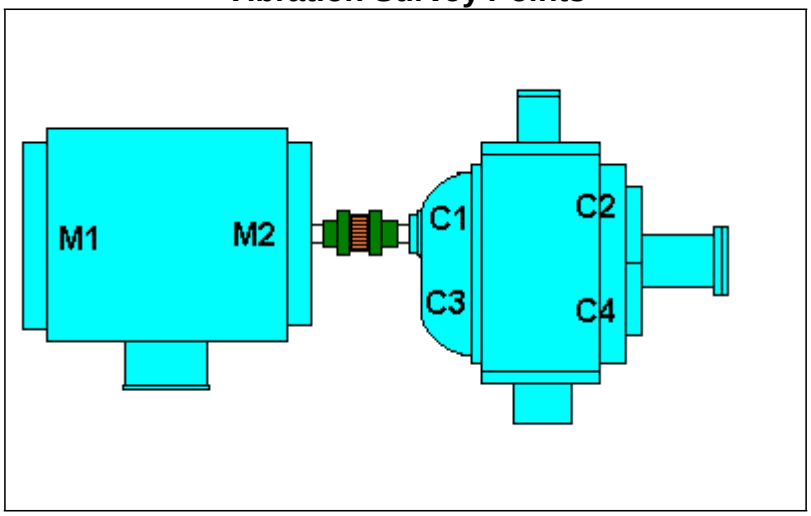
Explanation: No faults were detected during this survey period.

Recommendation: Continue to operate as normal and conduct another survey in 6 months.

Urgency:
Normal

Survey: 22-Apr-13
Certainty: 4
Analyst: James Gable

Vibration Survey Points



Abbreviated Last Measurement Summary

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Database: west\FES Pacific.rbm
Area: TDI Contractor Route
No. 1: CustCity
Report Date: 08-May-13 16:13

MEASUREMENT POINT	OVERALL LEVEL	HFD / VHFD
C2 - SAB 163HF S/N 130775	(22-Apr-13)	
HRS	23826. STANDARD	
	OVERALL LEVEL	HFD
M1H	.074 In/Sec	.420 G-s
M1V	.069 In/Sec	.453 G-s
M1A	.108 In/Sec	.939 G-s
M2H	.062 In/Sec	.588 G-s
M2L	.050 In/Sec	
M2V	.090 In/Sec	.447 G-s
M2A	.170 In/Sec	.707 G-s
C1H	.138 In/Sec	.286 G-s
C1V	.154 In/Sec	.762 G-s
C1A	.220 In/Sec	.514 G-s
C2H	.081 In/Sec	.933 G-s
C2V	.081 In/Sec	.351 G-s
C2A	.192 In/Sec	.577 G-s
C3H	.082 In/Sec	.516 G-s
C3V	.089 In/Sec	.690 G-s
C3A	.257 In/Sec	.641 G-s
C4H	.076 In/Sec	.547 G-s
C4V	.088 In/Sec	.492 G-s
C4A	.170 In/Sec	.588 G-s
C3 - SAB 163HF S/N 128798	(22-Apr-13)	
HRS	1319.0 STANDARD	
M1H	.052 In/Sec	.203 G-s
M1V	.226 In/Sec	.253 G-s
M1A	.134 In/Sec	.171 G-s
M2H	.118 In/Sec	.250 G-s
M2L	.086 In/Sec	
M2V	.151 In/Sec	.338 G-s
M2A	.145 In/Sec	.478 G-s
C1H	.163 In/Sec	.461 G-s
C1V	.187 In/Sec	.707 G-s
C1A	.238 In/Sec	.511 G-s
C2H	.130 In/Sec	.657 G-s
C2V	.115 In/Sec	.862 G-s
C2A	.159 In/Sec	1.049 G-s
C3H	.136 In/Sec	.671 G-s
C3V	.225 In/Sec	.583 G-s
C3A	.179 In/Sec	1.215 G-s
C4H	.149 In/Sec	.699 G-s
C4V	.127 In/Sec	.425 G-s
C4A	.244 In/Sec	.690 G-s

C4	- SAB 163HM, S/N 132363		(22-Apr-13)	
	HRS	33010.	STANDARD	
	M1H	.068	In/Sec	.264 G-s
	M1V	.060	In/Sec	.331 G-s
	M1A	.092	In/Sec	.436 G-s
	M2H	.076	In/Sec	.129 G-s
	M2L	.060	In/Sec	
	M2V	.048	In/Sec	.264 G-s
	M2A	.054	In/Sec	.235 G-s
	C1H	.053	In/Sec	.185 G-s
	C1V	.066	In/Sec	.264 G-s
	C1A	.033	In/Sec	.293 G-s
	C2H	.025	In/Sec	.119 G-s
	C2V	.042	In/Sec	.145 G-s
	C2A	.029	In/Sec	.177 G-s
	C3H	.056	In/Sec	.313 G-s
	C3V	.060	In/Sec	.231 G-s
	C3A	.050	In/Sec	.129 G-s
	C4H	.027	In/Sec	.162 G-s
	C4V	.033	In/Sec	.240 G-s
	C4A	.037	In/Sec	.144 G-s

C5	- SAB 163HM, S/N 132362		(22-Apr-13)	
	HRS	13238.	STANDARD	
	M1H	.053	In/Sec	.164 G-s
	M1V	.037	In/Sec	.162 G-s
	M1A	.031	In/Sec	.475 G-s
	M2H	.078	In/Sec	.164 G-s
	M2L	.079	In/Sec	
	M2V	.033	In/Sec	.428 G-s
	M2A	.035	In/Sec	.217 G-s
	C1H	.057	In/Sec	.740 G-s
	C1V	.081	In/Sec	.906 G-s
	C1A	.038	In/Sec	.475 G-s
	C2H	.029	In/Sec	.527 G-s
	C2V	.048	In/Sec	2.132 G-s
	C2A	.030	In/Sec	1.066 G-s
	C3H	.048	In/Sec	.334 G-s
	C3V	.076	In/Sec	.718 G-s
	C3A	.047	In/Sec	.431 G-s
	C4H	.028	In/Sec	.334 G-s
	C4V	.029	In/Sec	1.066 G-s
	C4A	.031	In/Sec	.613 G-s

Clarification Of Vibration Units:

Vel	-->	In/Sec	PK
HFD	-->	G-s	PK