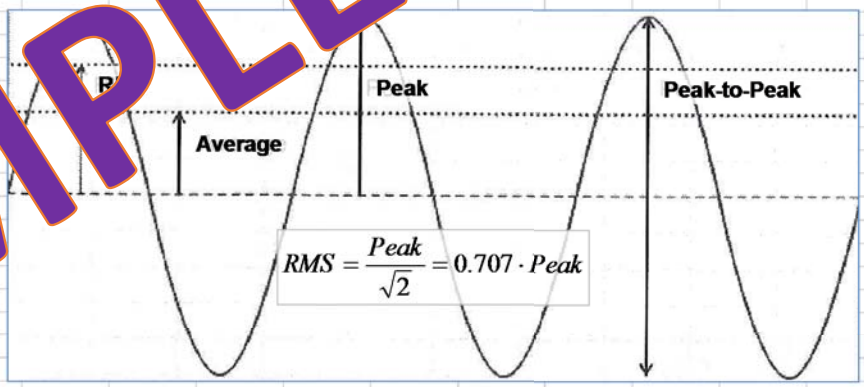
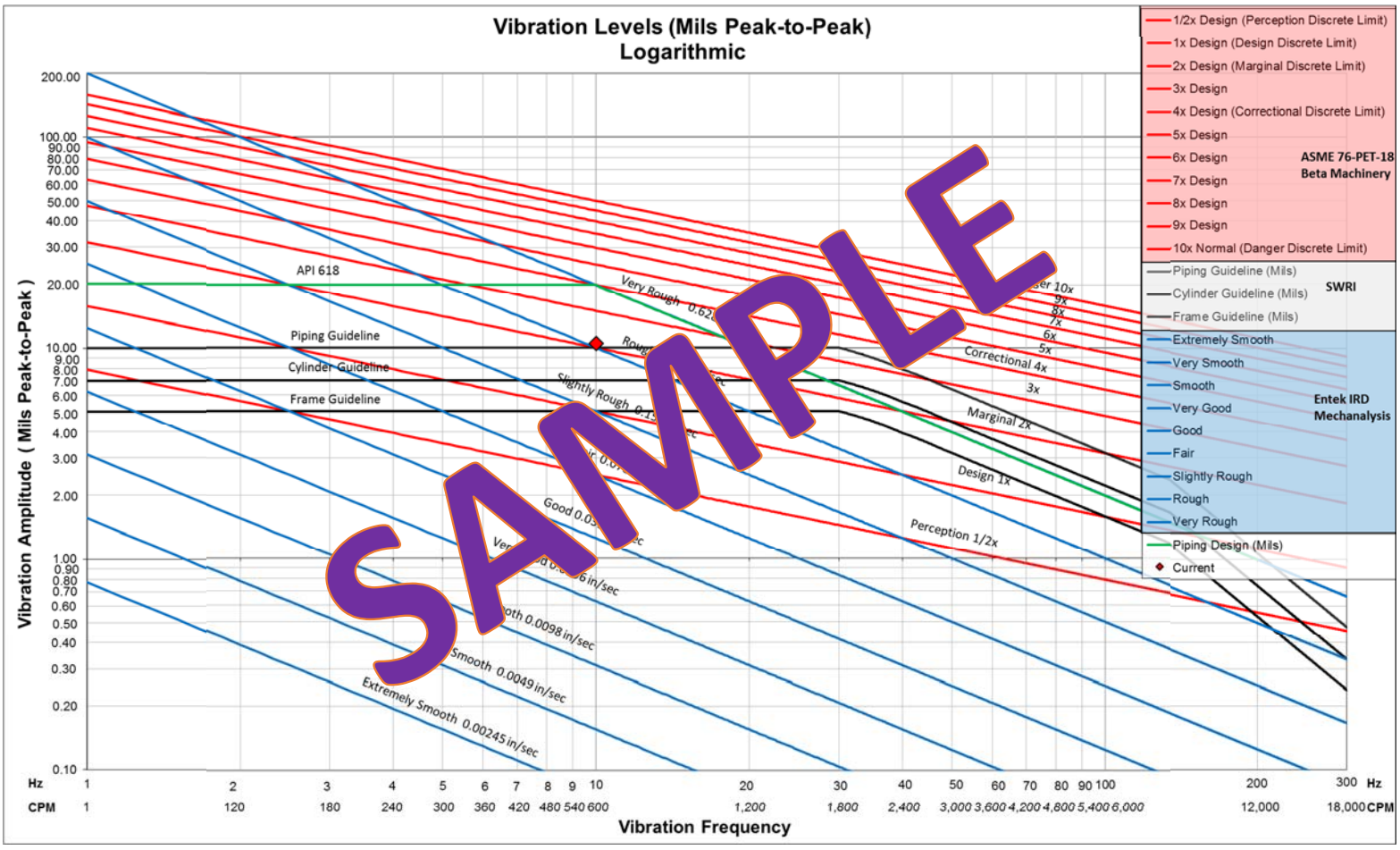
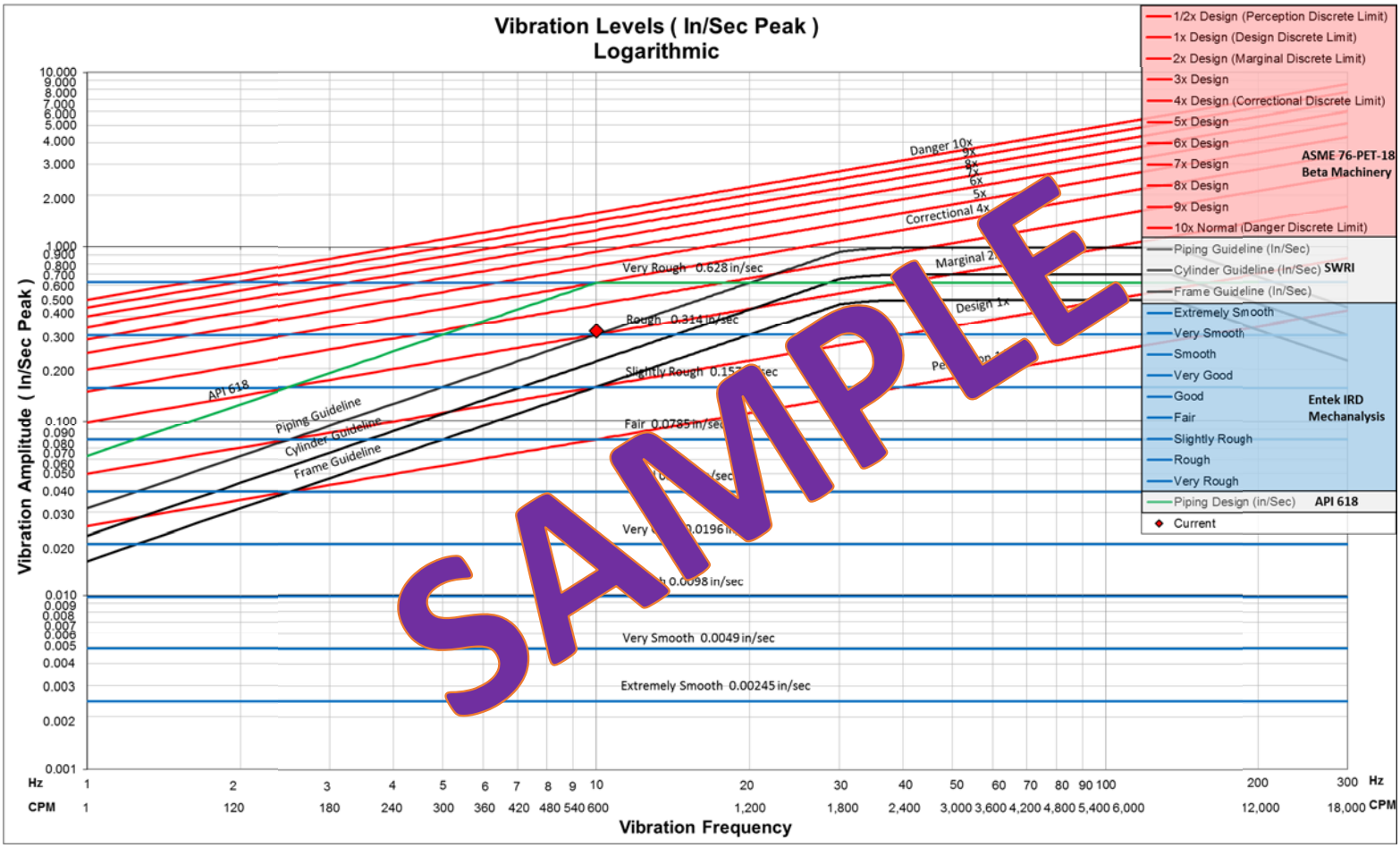
Input Parameters			Password:	697
Select Parameter:	Velocity	Choose **Displacement**, **Velocity**, or **Accleration**		
Measured Amplitude:	0.330	In/Sec Peak		
Measured Frequency:	600	CPM		
which is:	10.000	Hertz		
English				
Displacement	10.504	**Mil Peak - Peak**		
	5.252	Mil Peak		
	3.714	Mil RMS		
Velocity	0.660	In/Sec Peak - Peak		
	0.330	**In/Sec Peak**		
	0.233	In/Sec RMS		
Acceleration	0.107	G's Peak - Peak		
	0.054	**G's Peak**		
	0.038	G's RMS		
Metric				
Displacement	266.807	µm Pe		
	133.404	µm Pe		
		µm RM		
Velocity		mm/Sec		
	8.382	mm/Sec		
		ec S		
Acceleration		m/ Peak		
	0.527	m/ Peak		
	0.3	**c² RMS**		



0 - 600 RPM (CPM)	**use**	**DISPLACEMENT**
600 - 60,000 RPM (CPM)	**use**	**VELOCITY**
60,000 RPM (CPM) and Higher	**use**	**ACCELERATION**




Vibration Levels (In/Sec Peak)
Logarithmic
Vibration Amplitude (In/Sec Peak)
Vibration Frequency
Hz
CPM
1/2x Design (Perception Discrete Limit)
1x Design (Design Discrete Limit)
2x Design (Marginal Discrete Limit)
3x Design
4x Design (Correctional Discrete Limit)
5x Design
6x Design
7x Design
8x Design
9x Design
10x Normal (Danger Discrete Limit)
ASME 76-PET-18
Beta Machinery
Piping Guideline (In/Sec)
Cylinder Guideline (In/Sec)
Frame Guideline (In/Sec)
SWRI
Extremely Smooth
Very Smooth
Smooth
Very Good
Good
Fair
Slightly Rough
Rough
Very Rough
Entek IRD
Mechanalysis
Piping Design (in/Sec)
API 618
Current
Danger 10x
Correctional 4x
Very Rough 0.628 in/sec
Rough 0.314 in/sec
Slightly Rough 0.157 in/sec
Fair 0.0785 in/sec
Very Smooth 0.0049 in/sec
Extremely Smooth 0.00245 in/sec
API 618
Piping Guideline
Cylinder Guideline
Frame Guideline
SAMPLE

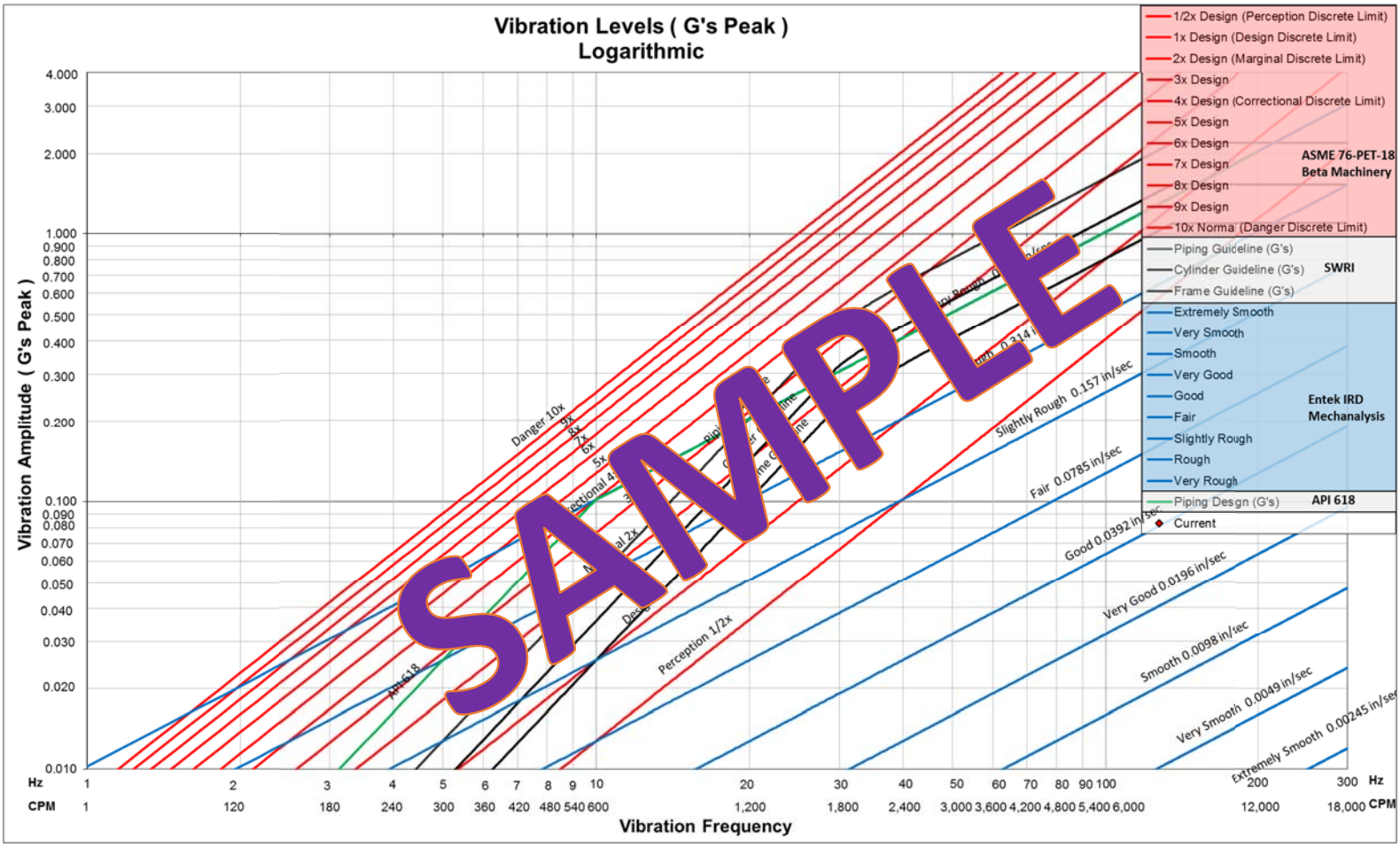

Vibration Levels (G's Peak)
Logarithmic
Vibration Amplitude (G's Peak)
Vibration Frequency
Hz
CPM
1/2x Design (Perception Discrete Limit)
1x Design (Design Discrete Limit)
2x Design (Marginal Discrete Limit)
3x Design
4x Design (Correctional Discrete Limit)
5x Design
6x Design
7x Design
8x Design
9x Design
10x Normal (Danger Discrete Limit)
ASME 76-PET-18
Beta Machinery
Piping Guideline (G's)
Cylinder Guideline (G's)
Frame Guideline (G's)
SWRI
Extremely Smooth
Very Smooth
Smooth
Very Good
Good
Fair
Slightly Rough
Rough
Very Rough
Entek IRD
Mechanalysis
Piping Desgn (G's)
API 618
Current
Danger 10x
Slightly Rough 0.157 in/sec
Fair 0.0785 in/sec
Good 0.0392 in/sec
Very Good 0.0196 in/sec
Smooth 0.0098 in/sec
Very Smooth 0.0049 in/sec
Extremely Smooth 0.00245 in/sec
Perception 1/2x
API 618
SAMPLE

Table II - Technical Associates of Charlotte, P.C. (also Entek IRD's Criteria)

OVERALL VIBRATION ALARMS AND MACHINE CONDITION RATING CHART

PEAK OVERALL VELOCITY, IN/SEC

1. Assuming Machine Speed = 600 to 10,000 RPM.
2. Assuming Measurements by Accelerometer of Velocity Pickup securely mounted as Close as Possible to Bearing Housing.
3. Assuming Machine is Not Mounted on Vibration Isolators (for Isolated Machinery - Set Alar 30% - 50% Higher).
4. Set Motor Alarms the Same as that for the Particular Machine Type unless Otherwise Noted.
5. Consider Setting Alarms on Individual External Gearbox Positions about 25% Higher than that for a particular Machine Type.

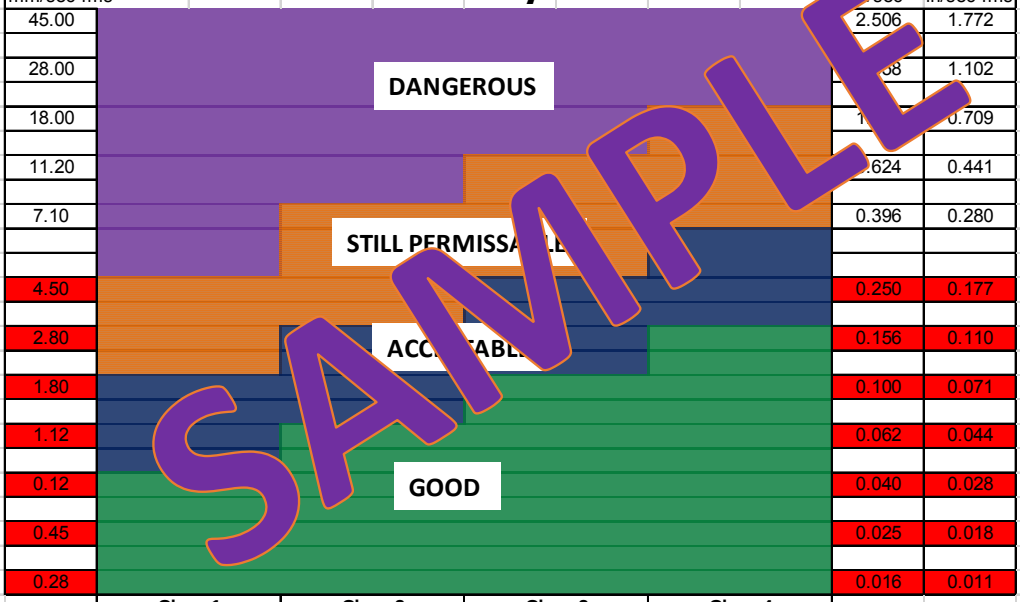
	Velocity (Inches/Sec)		
MACHINE TYPE	**FAIR**	**ALARM 1**	**ALARM 2**
COOLING TOWER DRIVES			
Long, Hollow Drive Shaft	0.375	0.600	0.900
Close Coupled Belt Drive	0.275	0.425	0.650
Close Coupled Direct Drive	0.200	0.300	.450
COMPRESSORS			
Reciprocating	0.325	0.500	
Rotary Screw	0.300	.450	650
Centrifugal With or W/O External Gearbox		00	
Centrifugal - Integral Gear (Axial Measurement)	.200		0.450
Centrifugal - Integral Gear (Radial Measurement)	150	0.2	0.375
BLOWERS (FANS)			
Lobe-Type Rotary		0.450	0.675
Belt-Driven Blowers	0.27	0.425	0.650
General Direct Drive Fans (with Coupling)	250	0.375	0.550
Prmary Air Fans	0.250	0.375	0.550
Vacuum Blowers	0.200	0.300	0.450
Large Forced Draft Fans	0.200	0.300	0.450
Large Induced Draft Fans	0.175	0.275	0.400
Shaft-Mounted Integral Fan	0.175	0.275	0.400
Vane-Axial Fans	0.150	0.250	0.375
MOTOR/GENERATOR SETS			
Belt-Driven	0.275	0.425	0.675
Direct Coupled	0.200	0.300	0.450
CHILLERS			
Reciprocating	0.250	0.400	0.600
Centrifugal (Open-Air) - Motor & Compressor Separate	0.200	0.300	0.450
Centrifugal (Hermetic) - Motor & Impellers Inside	0.150	0.225	0.350
LARGE TURBINE GENERATORS			
3600 RPM Turbine/Generators	0.175	0.275	0.400
1800 RPM Turbine/Generators	0.150	0.225	0.350
CENTRIFUGAL PUMPS			
Vertical Pumps (12' - 20' Height)	0.325	0.500	0.750
Vertical Pumps (8' - 12' Height)	0.275	0.425	0.650
Vertical Pumps (5' - 8' Height)	0.225	0.350	0.525
Vertical Pumps (0' - 5' Height)	0.200	0.300	0.450
General Purpose Horizontal Pump - Direct Coupled	0.200	0.300	0.450
Boiler Feeder Pumps - Horizontal Orientation	0.200	0.300	0.450
Piston Type Hydraulic Pumps - Horizontal Orientation (under load)	0.150	0.250	0.375
MACHINE TOOLS			
Motor	0.100	0.175	0.250
Gearbox Input	0.150	0.225	0.350
Gearbox Output	0.090	0.150	0.225
Spindles:			
a. Roughing Operations	0.065	0.100	0.150
b. Machine Finishing	0.040	0.060	0.090
c. Critical Finishing	0.025	0.040	0.060

Height from Grade to Top Motor Bearing. May be Necessary to Specify Lower Alarm for Lower Motor Bearing & for Upper Pump Bearing (depending on Height)

*NOTE: The "ALARM 1" and "ALARM 2" overall levels given above apply only to in-service machinery which has been operating for some time after initial installation and/or overhaul. They do not apply (and are not meant to serve as) Acceptance Criteria for either new or rebuilt machinery.

ISO 10816 - 1 Vibration Severity Chart

Velocity



CLASS 1 Small machines, especially production electrical motors up to 15 kW (20 HP).

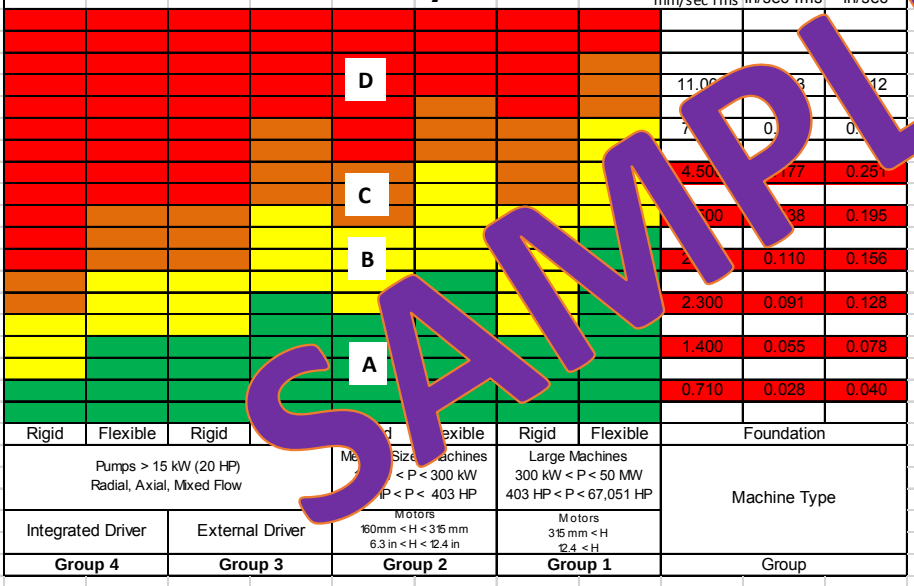
CLASS 2 Medium sized machines, especially electrical motors > 15 kw (20 HP) to 75 kW without special foundations.

CLASS 3 Large machines on heavy foundations.

CLASS 4 Largest machines and turbo machines with special foundations.

ISO 10816 - 3 Vibration Severity Chart

Velocity



10 - 1,000 Hz r > 600 rpm

GROUP 1 Large machines with rated power above 300 kW (403 HP); electrical machines with shaft height H > 315 mm (12.4 in) These machines normally have sleeve bearings. Speeds from 120 rpm to 15,000 rpm.

GROUP 2 Medium-sized machines with a rated power above 15 kW (20 HP) up to and including 300 kW (403 HP); electrical machines with shaft height 160 mm (6.3 in) to 315 mm (12.4 in). These machines normally have rolling element bearings. Speeds above 600 rpm.

GROUP 3 Pumps with a rated power above 15 kW (20 HP). External driver.

GROUP 4 Pumps with a rated power above 15 kW (20 HP). Integrated driver.

EFRC - European Forum for Reciprocating Compressors

Table 4.1 - Definition of Key Zones

Zone	Level	Description	Notes
A	< A/B boundary	Good	Test-be, as-designed, on-installation
B	> A/B - B/C	Acceptable	Acceptable for in-field operation
C	> B/C - C/D	Marginal	Analysis and possible correction. Clarify between OEM and operator that the compressor is suitable for long term safe operation
D	> C/D boundary	Unacceptable	Urgent correction or shutdown

Table 4.2 - Displacement

Part	Metric						English					
	Horizontal Compressors			Vertical Compressors			Horizontal Compressors			Vertical Compressors		
	µm RMS			µm RMS			mil			mil		
	Key Zones			Key Zones			Key Zones			Key Zones		
	A/B	B/C	C/D	A/B	B/C	C/D	A/B	B/C	C/D	A/B	B/C	C/D
Foundation	32	48	72	32	48	72	1.26	1.89	2.[illegible]	1.26	1.89	2.83
Frame (top)	85	127	191	85	127	191	3.35	5.00	7.5[illegible]	[illegible]	5.00	7.52
Cylinder (lateral)	139	207	310	170	255	382	5.47	8.1[illegible]	12.20	[illegible]69	10.04	15.04
Cylinder (rod)	170	255	382	139	207	310	6.69	10.[illegible]	15.04	[illegible]47	8.15	12.20
Dampers	202	302	454	202	302	454	7.95	11.8[illegible]	17.87	[illegible]	11.89	17.87
Piping	202	302	454	202	302	454	[illegible]	[illegible]89	17.87	[illegible]	11.89	17.87

Table 4.3 - Velocity

Part	Metric						English					
	Horizontal Compressors			Vertical Compressor[illegible]			Ho[illegible]tal Compressors			Vertical Compressors		
	mm/sec RMS			mm[illegible] RMS			[illegible]n/sec			in/sec		
	Key Zones			[illegible]			[illegible]ey Zones			Key Zones		
	A/B	B/C	C/D	A/B	[illegible]	[illegible]	[illegible]	B/C	C/D	A/B	B/C	C/D
Foundation	2	3	4.5	[illegible]2	[illegible]	[illegible]	0.11	0.17	0.25	0.11	0.17	0.25
Frame (top)	5.33	8	12	[illegible]	[illegible]	[illegible]	0.30	0.45	0.67	0.30	0.45	0.67
Cylinder (lateral)	8.67	13	19.5	10.[illegible]	16	24	0.48	0.72	1.09	0.59	0.89	1.34
Cylinder (rod)	10.67	16	24	8.67	[illegible]3	19.5	0.59	0.89	1.34	0.48	0.72	1.09
Dampers	12.67	[illegible]	28.5	[illegible]	[illegible]	28.5	0.71	1.06	1.59	0.71	1.06	1.59
Piping	12.67	[illegible]	[illegible]28.5	[illegible]67	19	28.5	0.71	1.06	1.59	0.71	1.06	1.59

Table 4.4 - Acceleration

Part	[illegible]etric						English					
	Horizontal Compr[illegible]			Vertical Compressors			Horizontal Compressors			Vertical Compressors		
	m/sec² RMS			m/sec² RMS			G's			G's		
	Key Zones			Key Zones			Key Zones			Key Zones		
	A/B	B/C	C/D	A/B	B/C	C/D	A/B	B/C	C/D	A/B	B/C	C/D
Foundation	2.51	3.78	5.65	2.51	3.78	5.65	0.36	0.55	0.81	0.36	0.55	0.81
Frame (top)	6.7	10.05	15.08	6.7	10.05	15.08	0.97	1.45	2.17	0.97	1.45	2.17
Cylinder (lateral)	10.89	16.34	24.5	13.4	20.11	30.16	1.57	2.36	3.53	1.93	2.90	4.35
Cylinder (rod)	13.4	20.11	30.16	10.89	16.34	24.5	1.93	2.90	4.35	1.57	2.36	3.53
Dampers	15.92	23.88	35.81	15.92	23.88	35.81	2.30	3.44	5.16	2.30	3.44	5.16
Piping	15.92	23.88	35.81	15.92	23.88	35.81	2.30	3.44	5.16	2.30	3.44	5.16

"Proven Method for Specifying Spectral Alarm Band Levels" James E. Berry, 4th Edition, 2002

ASME Vibration Alarm Limits

$$Design\_Limit = \sqrt{\frac{250}{Hz}}$$

$$Marginal\_Limit = 2\sqrt{\frac{250}{Hz}}$$

$$Correctional\_Limit = 4\sqrt{\frac{250}{Hz}}$$

$$Danger\_Limit = 10\sqrt{\frac{250}{Hz}}$$

Displacement (mils)

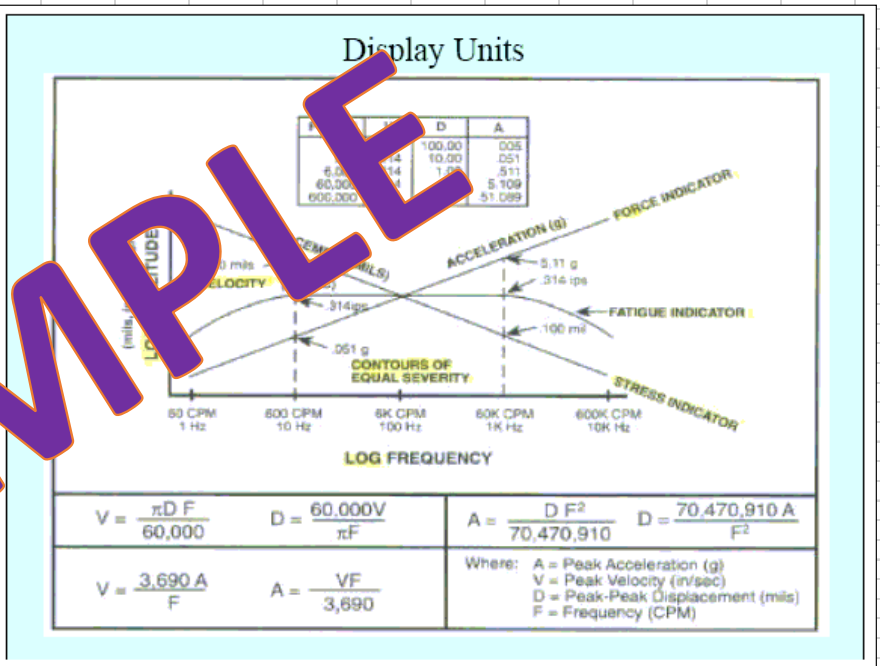
$$D = \frac{60{,}000V}{\pi F} \qquad D = \frac{60 \cdot 32.174 \cdot 12 \cdot 60{,}000A}{2\pi^2 F^2} = \frac{70{,}470{,}910A}{F^2}$$

Velocity (in/sec)

$$V = \frac{\pi DF}{60{,}000} \qquad V = \frac{60 \cdot 32.174 \cdot 12 \cdot A}{2\pi F} \quad \frac{0A}{F}$$

Acceleration (G's)

$$A = \frac{2\pi VF}{60 \cdot 32.174 \cdot 12} = \frac{VF}{3{,}690} \qquad A = \frac{2\pi^2 DF}{60 \cdot 32.174 \cdot 1} \quad \frac{000}{} = \frac{DF^2}{70{,}470{,}910}$$



If the malfunction frequency is less than 600 CPM (RPM) use displacement.

If the malfunction frequency is between 600 and 60,000 CPM use velocity.

If the malfunction freque4ncy is above 69,000 CPM use acceleration.