

# Anhang

$$T = T_s \times N = \frac{N}{F_s} = \frac{N}{2.56 \times F_{max}} = \frac{\text{lines}}{F_{max}}$$

T = Time required to collect the waveform

Ts = Time between each sample

Fs = Sampling rate = Samples per second

N = Number of samples (1024, 2048, 4096, etc.)

$$\text{Resolution} = \frac{F_{max}}{\text{lines}}$$

$$\text{Bandwidth} = \text{Resolution} \times \text{Window factor}$$

Window factor = 1 (no window/uniform/rectangular) or 1.5 (Hanning window)

Separating frequency  $\geq 2 \times \text{Bandwidth} \geq 2 \times \text{Resolution} \times \text{Window Factor}$

Required spectral lines  $\geq 2 \times \text{Window factor} \times F_{max} / \text{Separating frequency}$

Accuracy of frequency (at peak) =  $\pm \frac{1}{2} \times \text{Resolution}$

Prime numbers: 1, 3, 5, 7, 11, 13, 17, 19...

1 in = 25.4 mm

1mm = 0.039 in

### Trial weight calculation:

$$W = \frac{F}{K \times R \times N^2}$$

F = 10% of rotor mass divided by the number of bearings in kg

K = 0.011

N = RPM/1000

R = Radius in cm

### Umrechnung der Maßeinheiten

$D_{pk-pk} = \frac{19098 V_{pk}}{f_{cpm}} \quad V_{pk} = \frac{5217 A_{rms}}{f_{cpm}}$	$D_{pk-pk} = \frac{27009 V_{rms}}{f_{cpm}} \quad V_{rms} = \frac{93712 A_{rms}}{f_{cpm}}$
$D_{pk-pk} = \frac{9.958 \times 10^7 A_{rms}}{f_{cpm}^2} \quad A_{rms} = \frac{f_{cpm} V_{pk}}{5217}$	$D_{pk-pk} = \frac{2.53 \times 10^9 A_{rms}}{f_{cpm}^2} \quad A_{rms} = \frac{f_{cpm} V_{rms}}{93712}$
$V_{pk} = \frac{f_{cpm} D_{pk-pk}}{19098} \quad A_{rms} = \frac{f_{cpm}^2 D_{pk-pk}}{9.958 \times 10^7}$	$V_{rms} = \frac{f_{cpm} D_{pk-pk}}{27009} \quad A_{rms} = \frac{f_{cpm}^2 D_{pk-pk}}{2.53 \times 10^9}$
<p><b>D = Weg:</b> Mils pk-pk  <b>V = Geschwindigkeit:</b> in/s pk  <b>A = Beschleunigung:</b> g rms  <b>F = Frequenz:</b> CPM</p>	<p><b>D = Weg:</b> Mikrometer pk-pk  <b>V = Geschwindigkeit:</b> mm/s rms  <b>A = Beschleunigung:</b> g rms  <b>F = Frequenz:</b> CPM  <b>1 g rms = 9.8 m/sec<sup>2</sup></b></p>

### ISO 10816-3 Schwingstärke

						Velocity 10-1000Hz r > 600rpm 2-1000Hz r > 120rpm	
					11		0.43
					7.1		0.28
					4.5		0.18
					3.5		0.14
					2.8		0.11
					2.3		0.09
					1.4		0.06
					0.71		0.03
					mm/s rms		inch/s rms
rigid	flexible	rigid	flexible	Foundation			
medium sized machines 15kW < P ≤ 300kW		large machines 300kW < P < 50MW		Machine Type			
motors 160mm ≤ H < 315mm		motors 315mm ≤ H					
Group 2		Group 1		Group			

- A New machine condition
- B Unlimited long-term operation allowable
- C Short-term operation allowable
- D Vibration causes damage

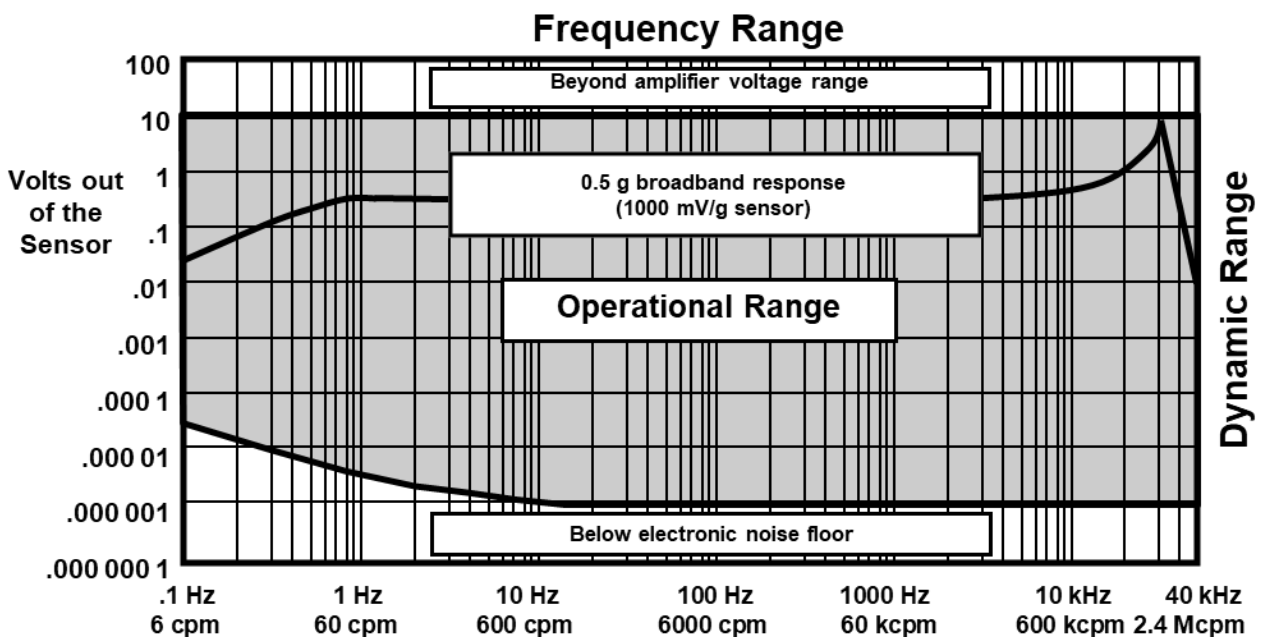
If the lowest natural frequency of the combined machine and support system in the direction of measurement is higher than its main excitation frequency (this is in most cases the rotational frequency) by at least 25 %, then the support system may be considered rigid in that direction. All other support systems may be considered flexible.

### ISO 10816-3 Schwingstärke

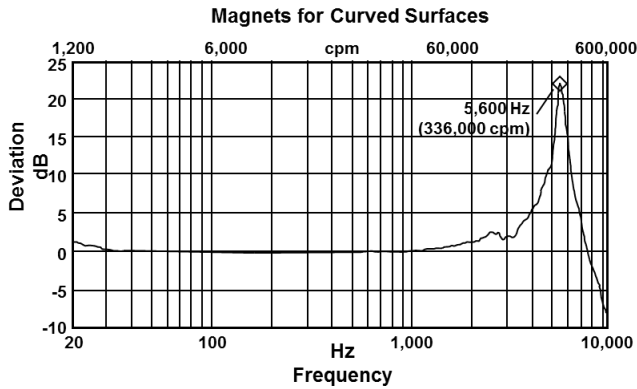
				140	5.51	Displacement $10^{-1000\text{Hz}} r > 600\text{rpm}$ $2^{-1000\text{Hz}} r > 120\text{rpm}$
	<b>D</b>			113	4.45	
		<b>C</b>		90	3.54	
				71	2.80	
		<b>B</b>		57	2.24	
				45	1.77	
				37	1.46	
				29	1.14	
		<b>A</b>		22	0.87	
				18	0.71	
				11	0.43	
				$\mu\text{m rms}$	$\text{mil rms}$	
rigid	flexible	rigid	flexible	Foundation		
medium sized machines $15\text{kW} < P \leq 300\text{kW}$		large machines $300\text{kW} < P < 50\text{MW}$		Machine Type		
motors $160\text{mm} \leq H < 315\text{mm}$		motors $315\text{mm} \leq H$				
Group 2		Group 1		Group		

- A New machine condition
- B Unlimited long-term operation allowable
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- D Vibration causes damage

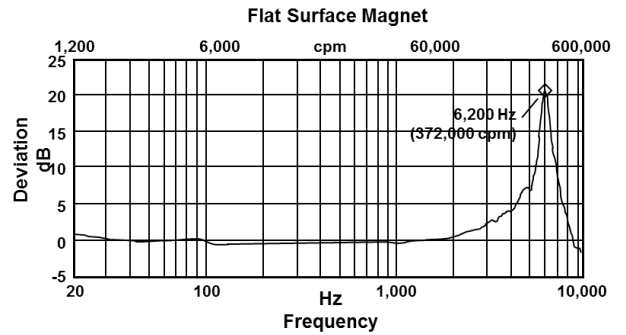
### Aufnehmerbetriebsbereich



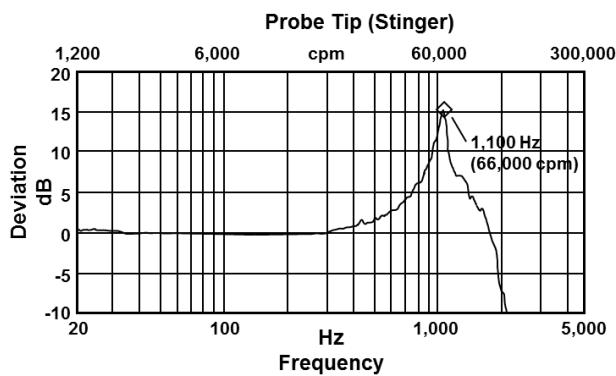
### Aufnehmerfrequenzgang - Magnete auf gewölbter Oberfläche



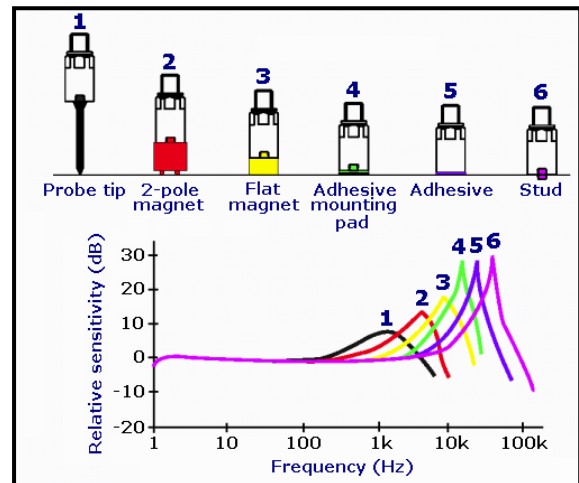
### Aufnehmerfrequenzgang - Magnete auf flacher Oberfläche



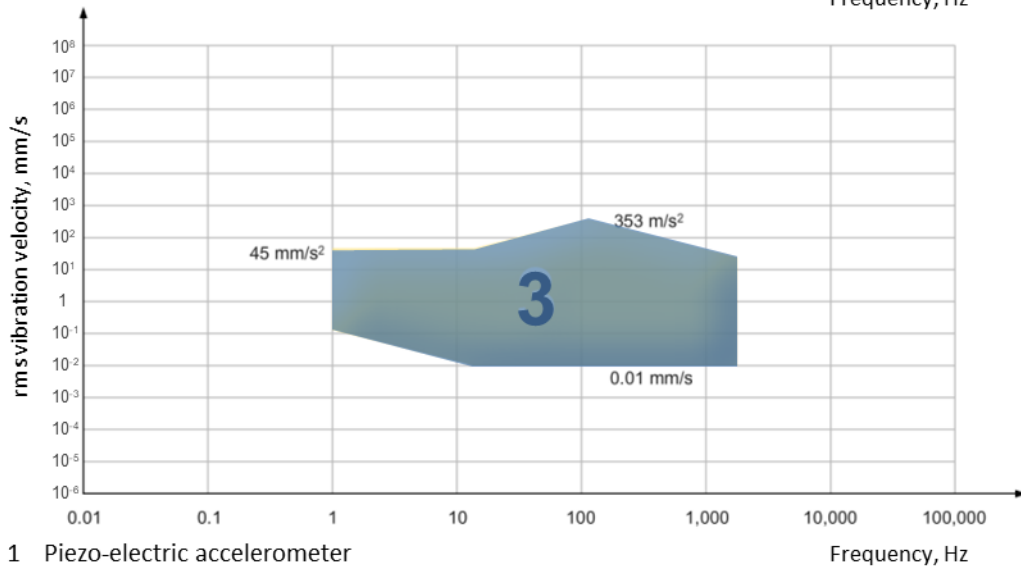
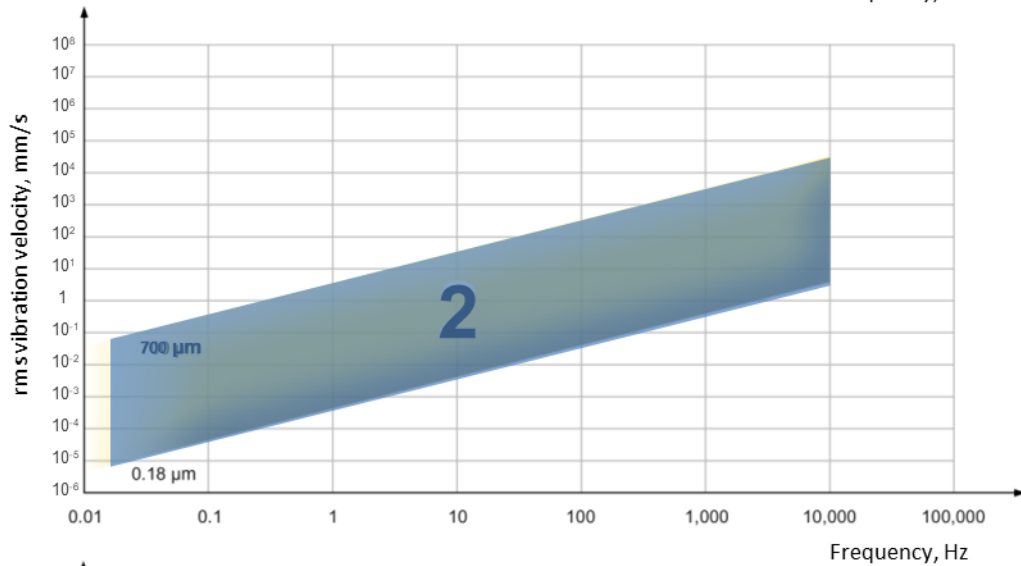
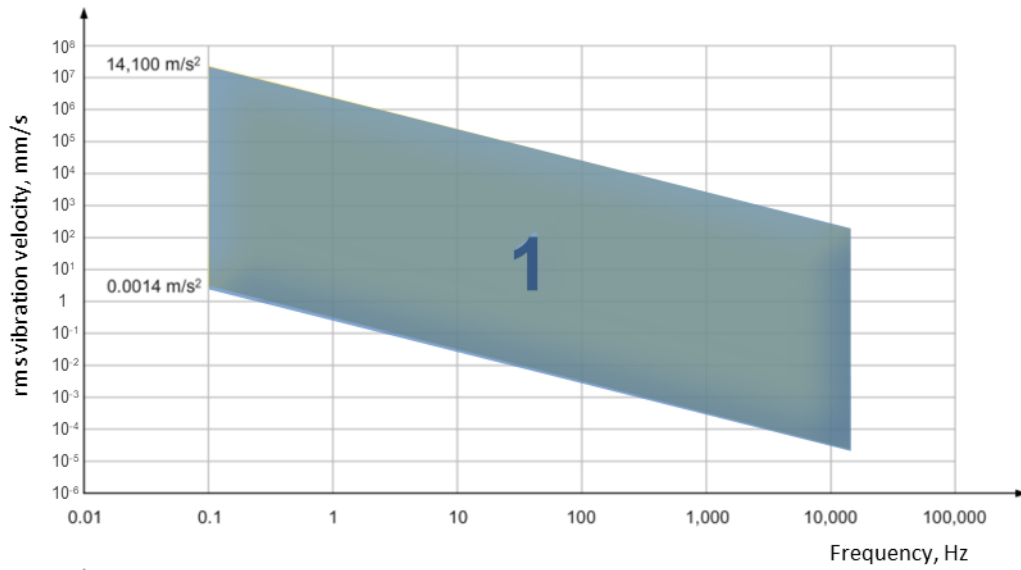
### Aufnehmerfrequenzgang - Tastspitzen oder Handsonden



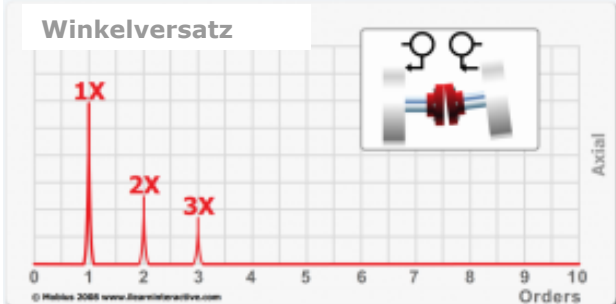
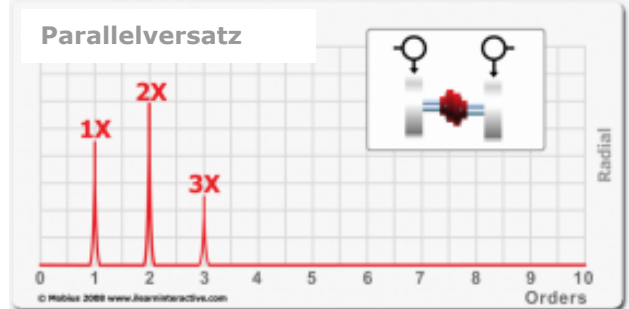
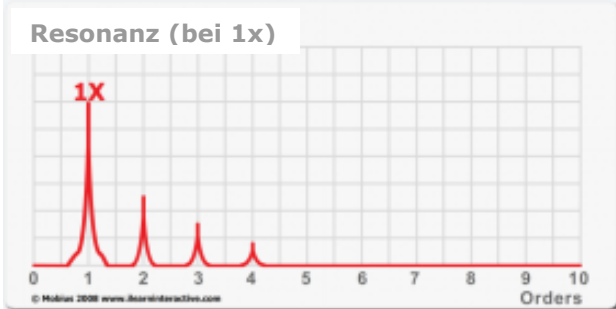
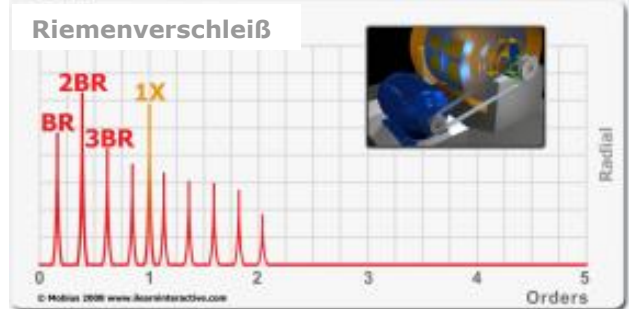
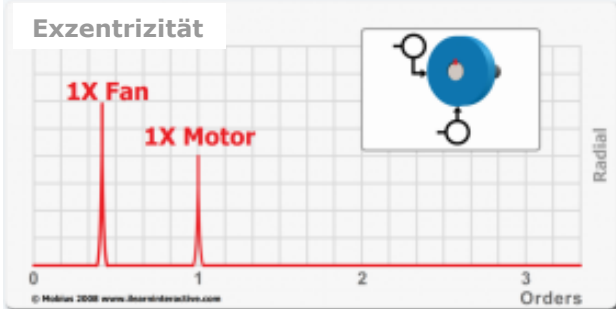
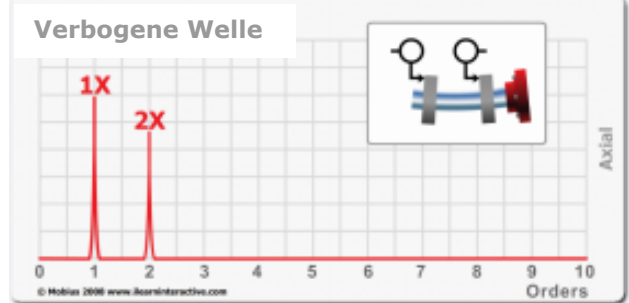
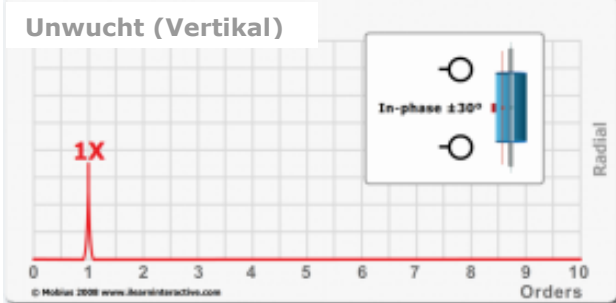
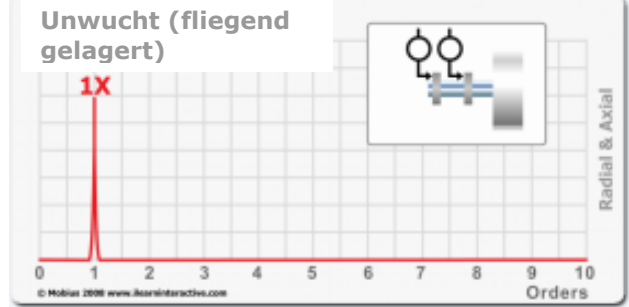
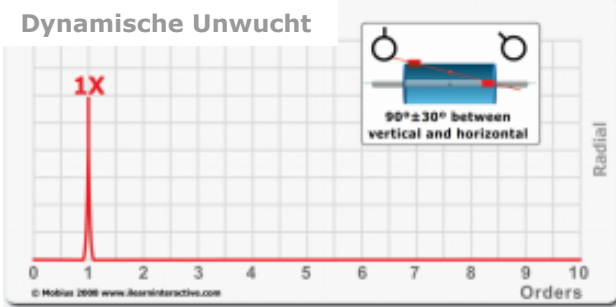
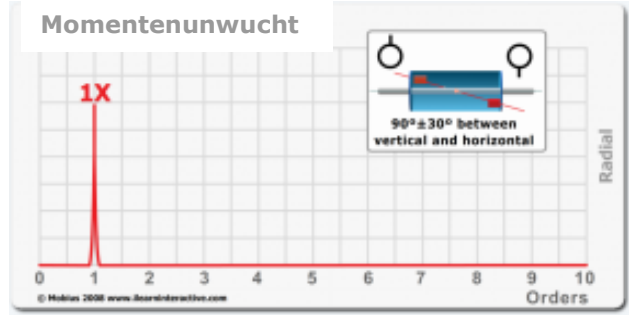
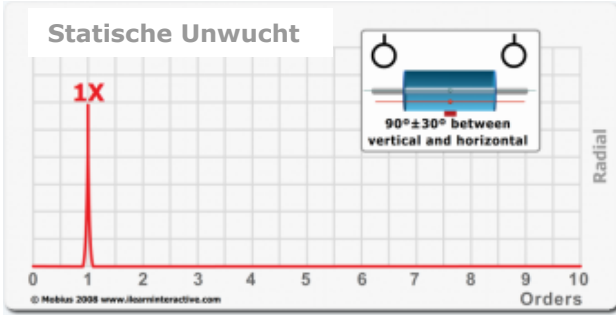
### Aufnehmerfrequenzgang - Verläufe

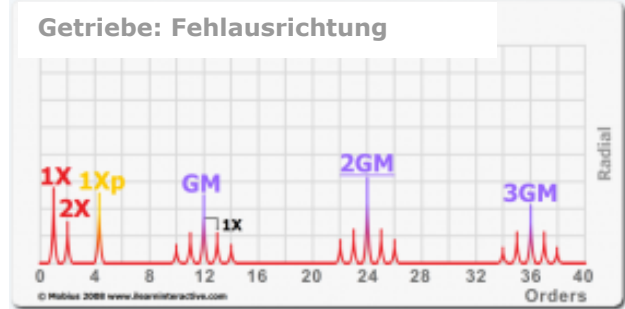
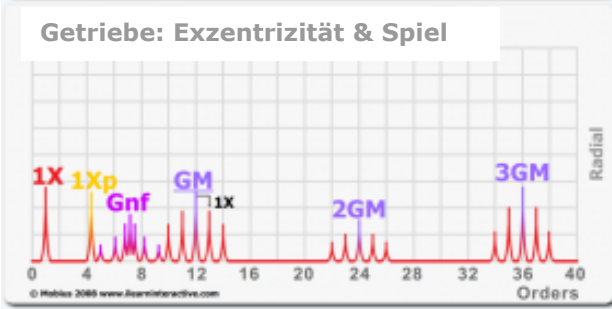
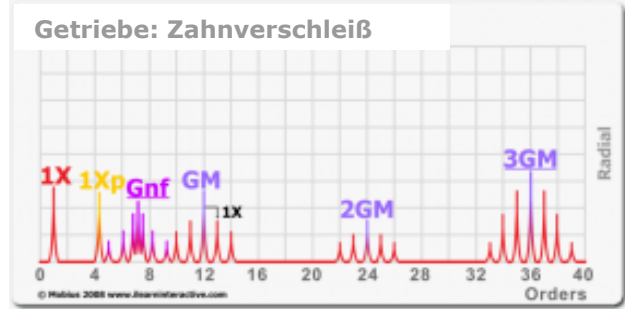
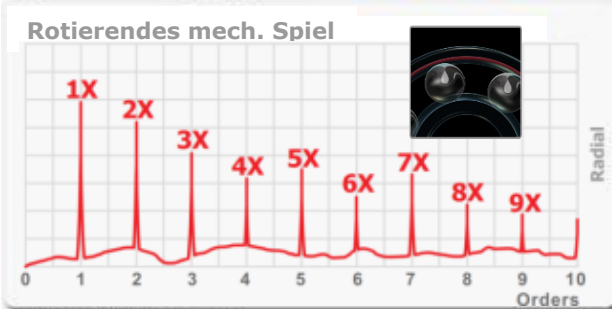
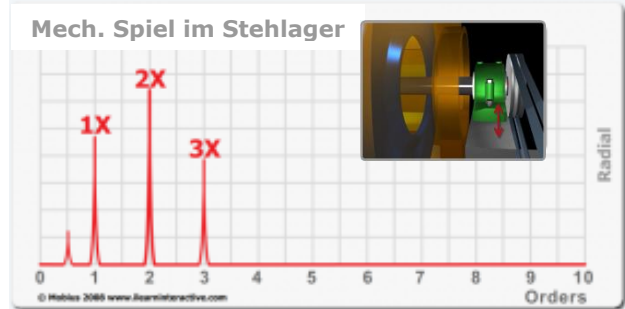
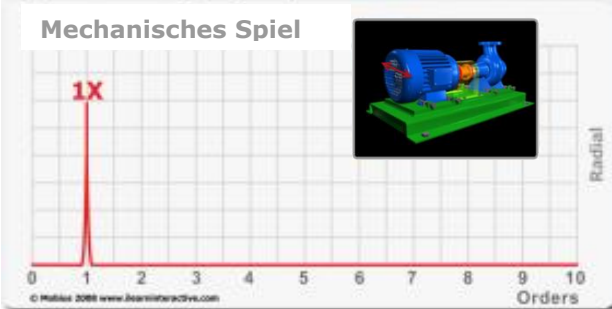
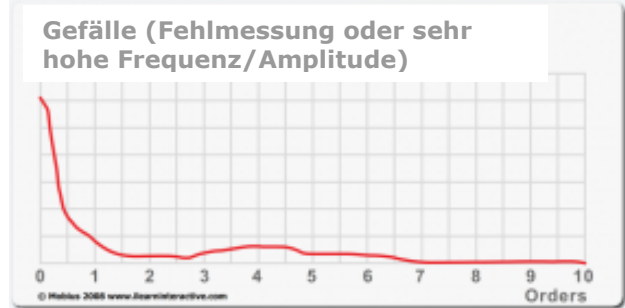
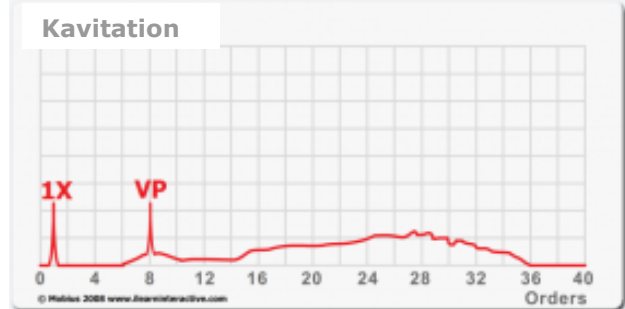
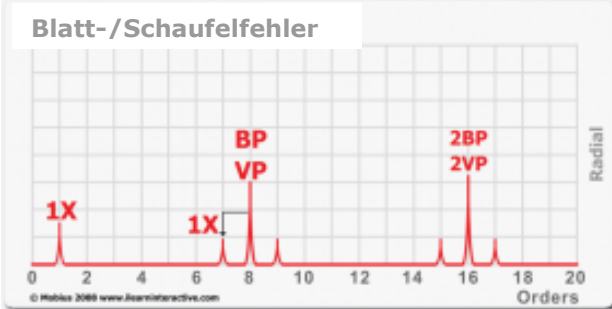
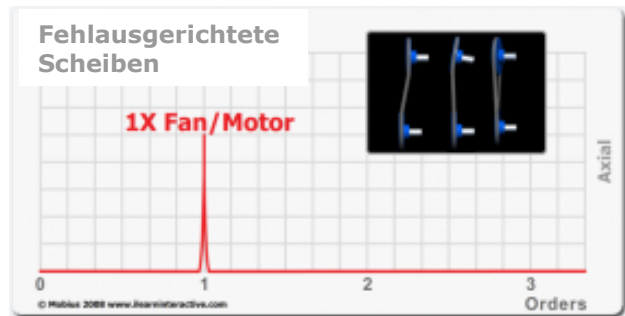
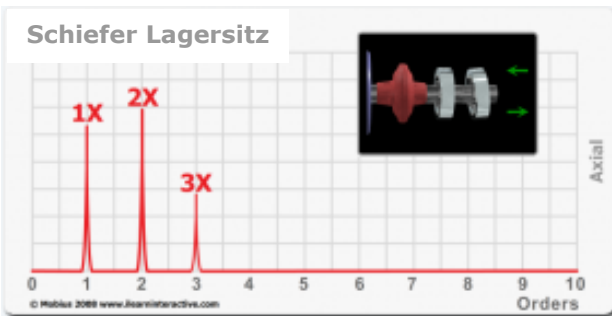


# Effektivitätsbereiche von Aufnehmern

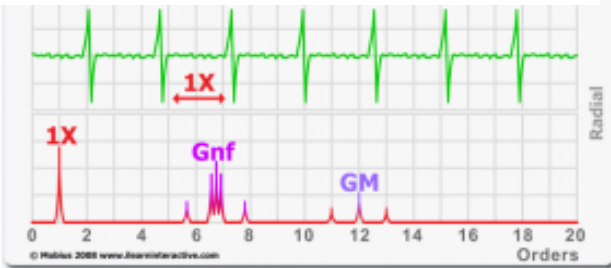


- 1 Piezo-electric accelerometer
- 2 Eddy-current proximity probe
- 3 Electro-mechanical velocity transducer

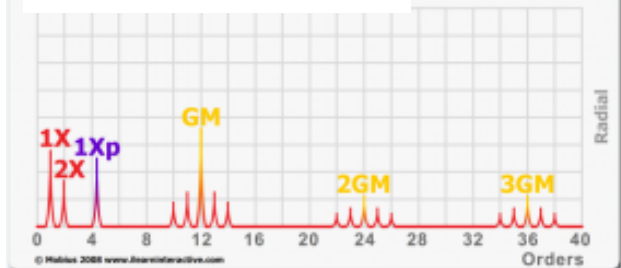




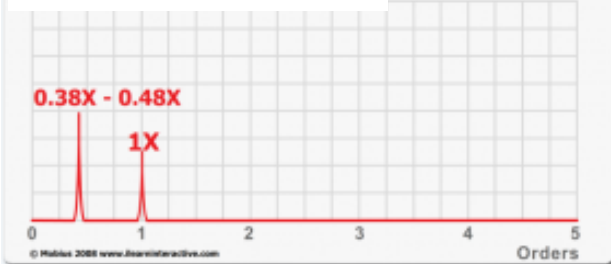
Getriebe: Angebrochener o. gebrochener Zahn



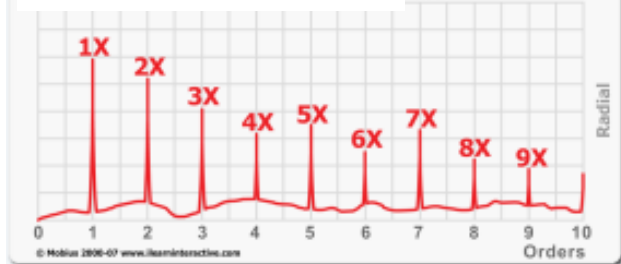
Getriebe: Zahnbelastung



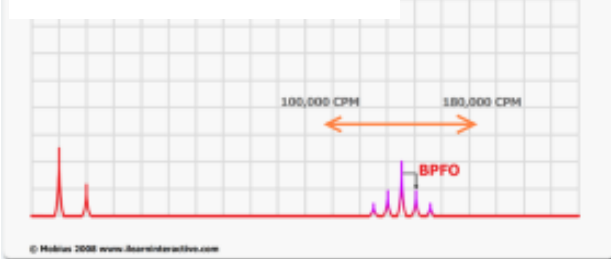
Ölwirbel (Gleitlager)



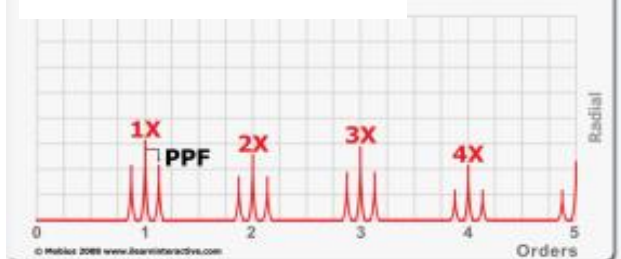
Lagerspiel (Gleitlager)



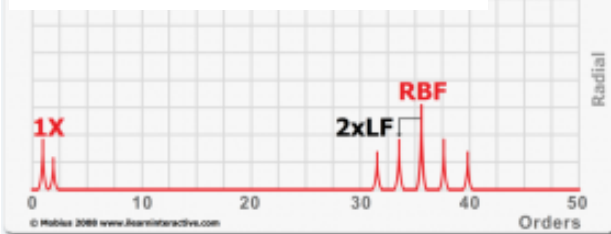
Lager: Stromdurchgang



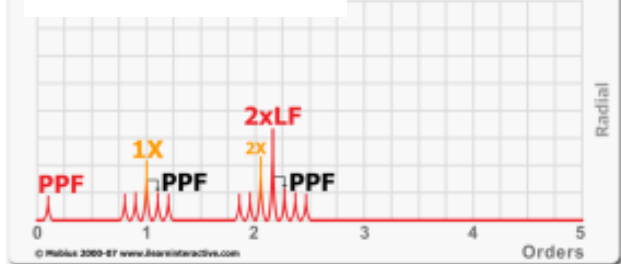
Gebrochene Rotorstäbe



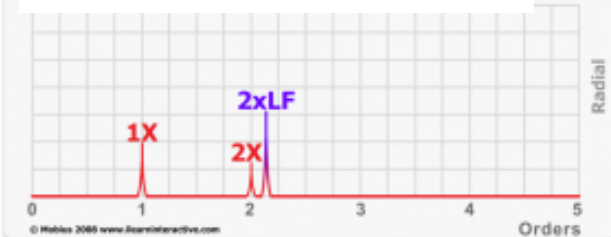
Gebrochene Rotorstäbe  
Lockere Rotorstäbe



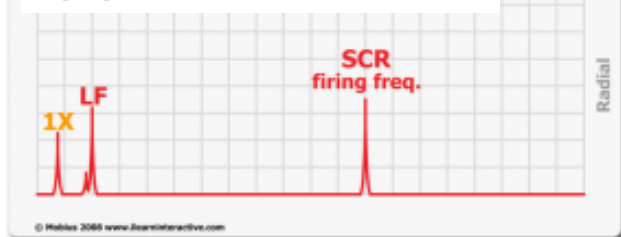
Exzentrischer Rotor



Exzentrischer Stator, lose Bleche  
kurzgeschlossene Bleche, Kippfuß



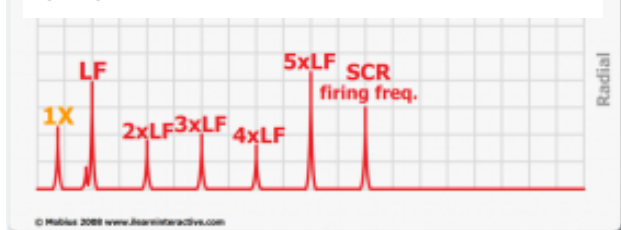
Erdungsfehler oder rotierender Fehler



Phasenausfall



Lockere Anschlüsse, Kurzschlüsse  
u.v.a.

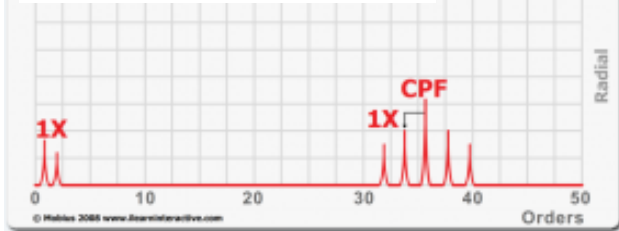




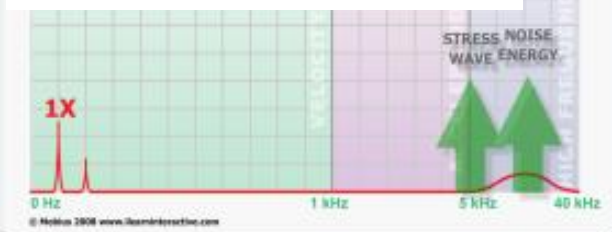
Fehler am Komparator (Drehzahlschwankung)



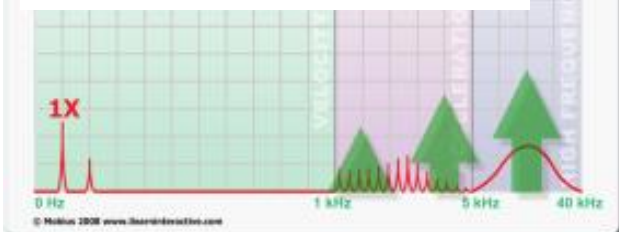
Lockere Statorwicklungen (Synchronmotor)



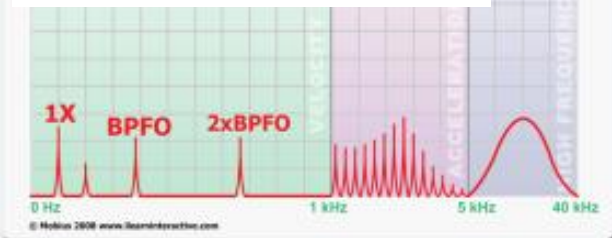
Stufe 1: Sehr hoher Frequenzbereich  
Ultraschall, SPM, Hüllkurve



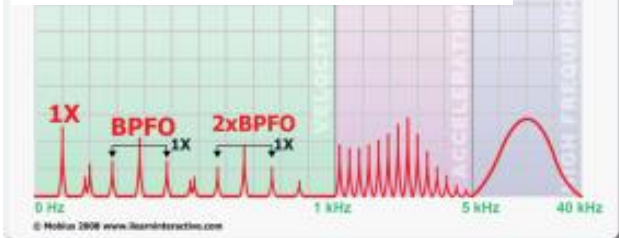
Stufe 2: Hoher Frequenzbereich  
Hüllkurve, Beschleunigungsspektrum



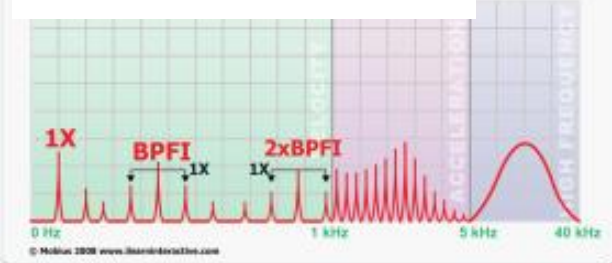
Stufe 3: Mittlerer Frequenzbereich  
Außenringschden (rot. Innenring)



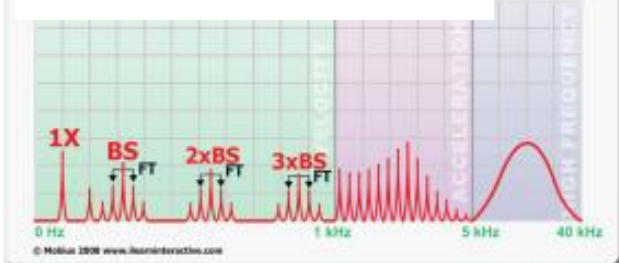
Stufe 3: Mittlerer Frequenzbereich  
Außenringschden (rot. Außenring)



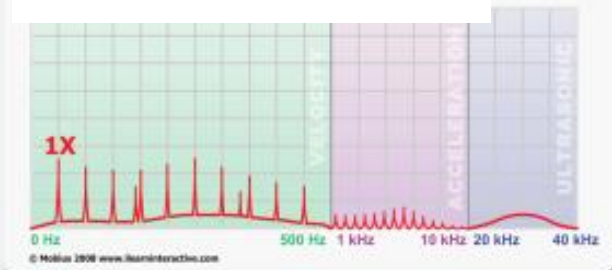
Stufe 3: Mittlerer Frequenzbereich  
Innenringschden (rot. Innenring)



Stufe 3: Mittlerer Frequenzbereich  
Wälzkörperschden (rot. Innenring)



Stufe 4: Niederer Frequenzbereich  
Außenringschden



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