

CERTIFICATION EXAM REFERENCE MATERIAL

РЕФЕРЕНТЕН МАТЕРИАЛ ЗА СЕРТИФИКАЦИОНЕН ИЗПИТ

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

T = Time required to collect the waveform

T = Време, необходимо за събиране на времевата извадка, s

T_s = Time between each sample

T_s = Времето между отчетите, s

F_s = Sampling rate = Samples per second

F_s = Честота на дискретизация, Hz

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

N = Брой отчети във времевия сигнал (1024,2048,4096..)

lines = Брой линии в спектъра

F_{max} = Максимална честота на спектъра, Hz

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

$$Резолюция = F_{max} / lines$$

$$Bandwidth =$$

$$Честотна лента =$$

$$Resolution \times Window factor$$

$$Резолюция \times \text{Коеф. на прозорец}$$

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

Separating frequency $\geq 2 \times$ Bandwidth $\geq 2 \times$ Resolution * Window Factor

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

Accuracy of frequency (at peak) = $\pm 1/2 \times$ Resolution

Prime numbers: 1, 2, 3, 5, 7, 11, 13, 17, 19...

Коефициент на прозорец = **1** (без прозорец/равномерен/правоъгълен) или **1.5** (прозорец на Ханинг)

Разделителна честота $\geq 2 \times$ честотна лента $\geq 2 \times$ разделителна способност * фактор на прозореца

Необходими спектрални линии $\geq 2 \times$ фактор на прозореца \times F_{max} / честота на разделяне

Точност на честотата (при пик) = $\pm 1/2 \times$ Разделителна способност

Прости числа: 1, 2, 3, 5, 7, 11, 13, 17, 19...

1 inch = 25.4 mm

1mm = 0.039 inches

Trial weight calculation:

Изчисляване на пробната тежест:

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

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

F = 10% от масата на ротора, разделена на броя на лагерите в kg

K = 0.011

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N = RPM/1000

N = RPM/1000

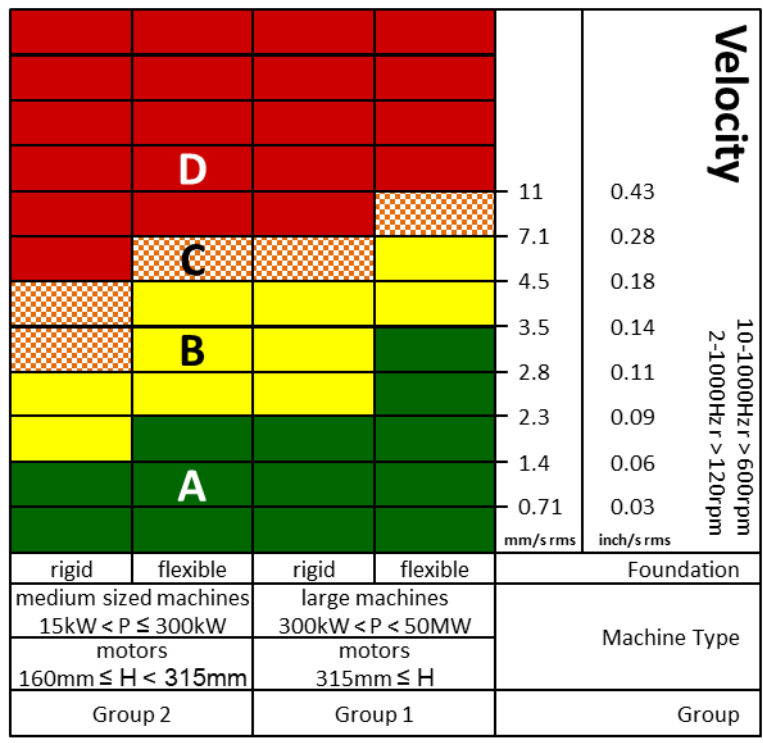
R = Radius in cm

R = Радиус в cm

Unit Conversions **Преобразувания на единици**

$D_{pk-pk} = \frac{19098 V_{pk}}{f_{cpm}} \quad V_{pk} = \frac{5217 A_{rms}}{f_{cpm}}$	$D_{pk-pk} = \frac{27009 V_{rms}}{f_{cpm}} \quad V_{rms} = \frac{93712 A_{rms}}{f_{cpm}}$
$D_{pk-pk} = \frac{9.958 \times 10^7 A_{rms}}{f_{cpm}^2} \quad A_{rms} = \frac{f_{cpm} V_{pk}}{5217}$	$D_{pk-pk} = \frac{2.53 \times 10^9 A_{rms}}{f_{cpm}^2} \quad A_{rms} = \frac{f_{cpm} V_{rms}}{93712}$
$V_{pk} = \frac{f_{cpm} D_{pk-pk}}{19098} \quad A_{rms} = \frac{f_{cpm}^2 D_{pk-pk}}{9.958 \times 10^7}$	$V_{rms} = \frac{f_{cpm} D_{pk-pk}}{27009} \quad A_{rms} = \frac{f_{cpm}^2 D_{pk-pk}}{2.53 \times 10^9}$
<p>D = Displacement: mils pk-pk Преместване V = Velocity: in/sec pk Скорост A = Acceleration: g rms Ускорение F = Frequency: CPM Честота / Обороти</p>	<p>D = Displacement: micron pk-pk Преместване V = Velocity: mm/s rms Скорост A = Acceleration: g rms Ускорение F = Frequency: CPM Честота / Обороти 1g rms = 9.8m/s²</p>

ISO 10816-3 Vibration Severity Chart
ISO 10816/20816 -3 Диаграма за интензивността на вибрациите



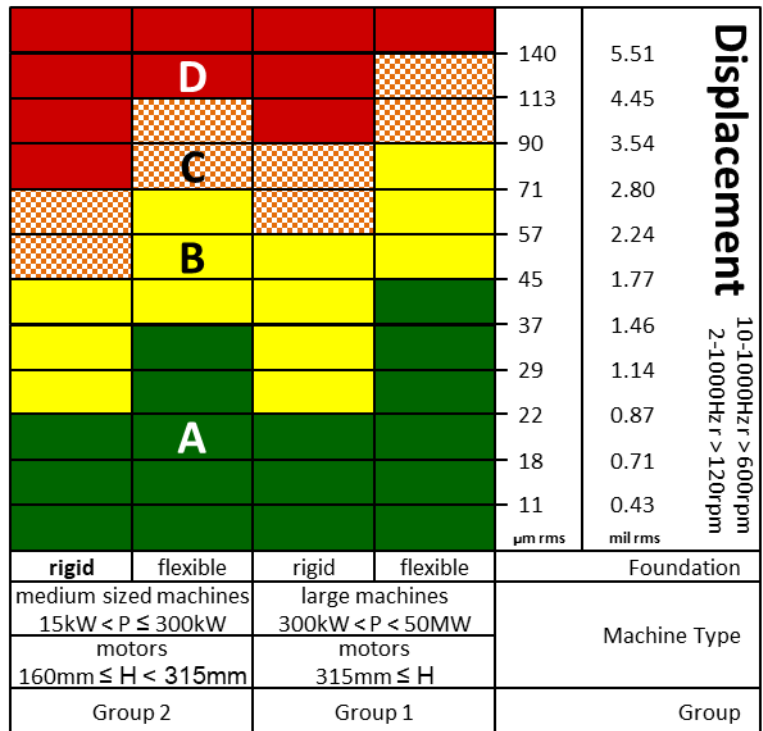
- A** New machine condition
- B** Unlimited long-term operation allowable
- C** Short-term operation allowable
- D** Vibration causes damage

A - Ново състояние на машината
B - Допуска се неограничена дългосрочна работа
C - Допуска се краткотрайна експлоатация
D - Вибрацията причинява щети

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 Vibration Severity Chart

ISO 10816/20816 -3 Диаграма за интензивността на вибрациите



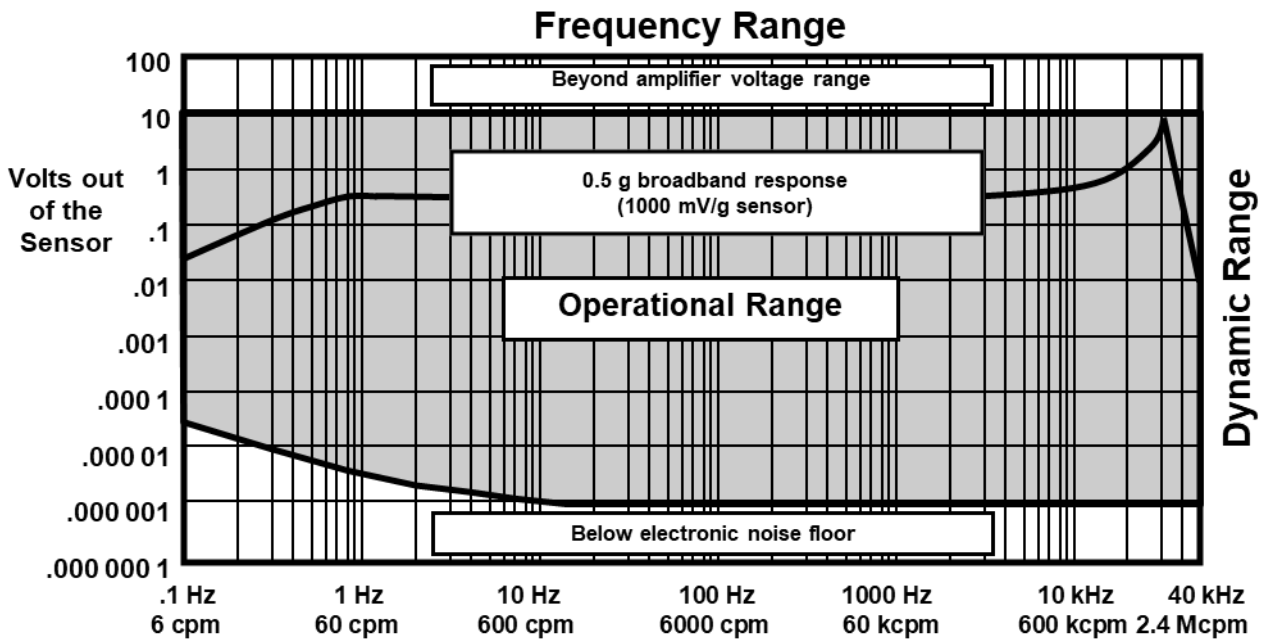
Преместване

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

- A - Ново състояние на машината
- B - Допуска се неограничена дългосрочна работа
- C - Допуска се краткотрайна експлоатация
- D - Вибрацията причинява щети

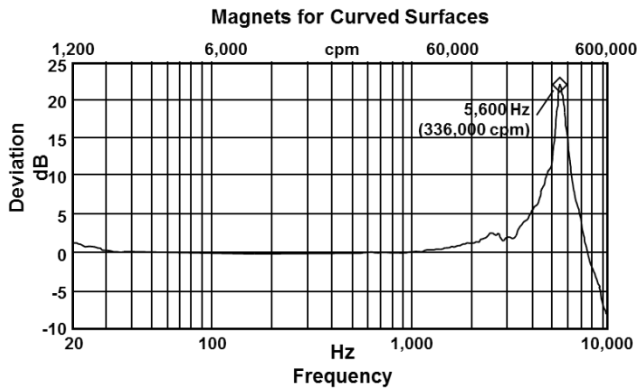
Transducer Operating Regions

Работни диапазони на трансдюсера / датчика



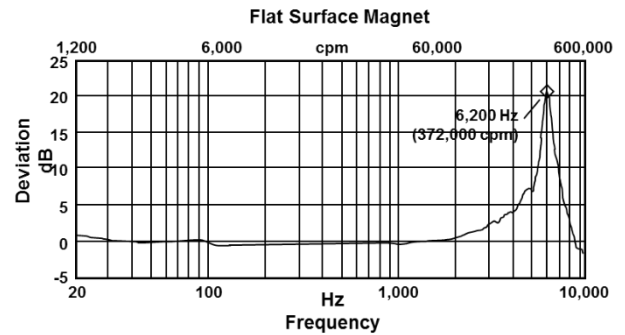
Transducer Frequency Response - Magnets on Curved Surfaces

Честотна характеристика на преобразувателя - магнити върху извити повърхности



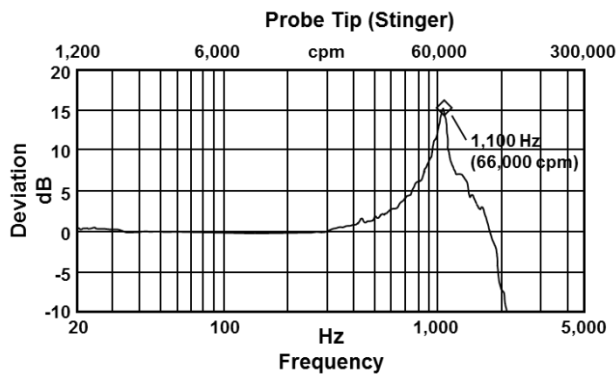
Transducer Frequency Response - Magnets on Flat Surfaces

Честотна характеристика на преобразувателя - магнити върху плоски повърхности



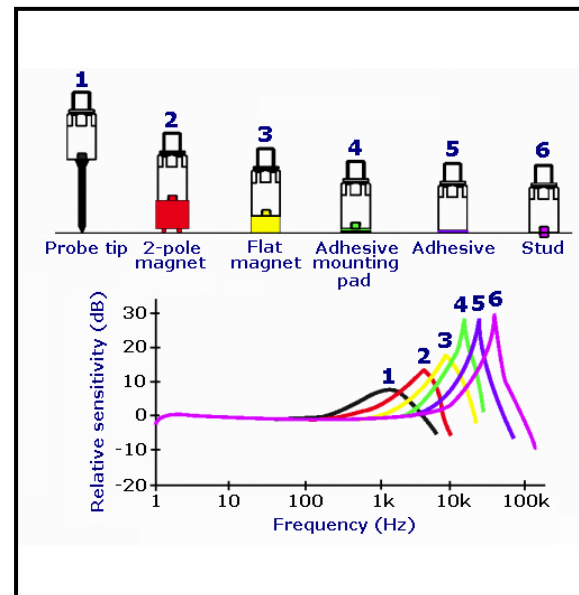
Transducer Frequency Response - Stingers or Hand Held Probes

Честотна характеристика на преобразувателя - Остриета или ръчни сонди



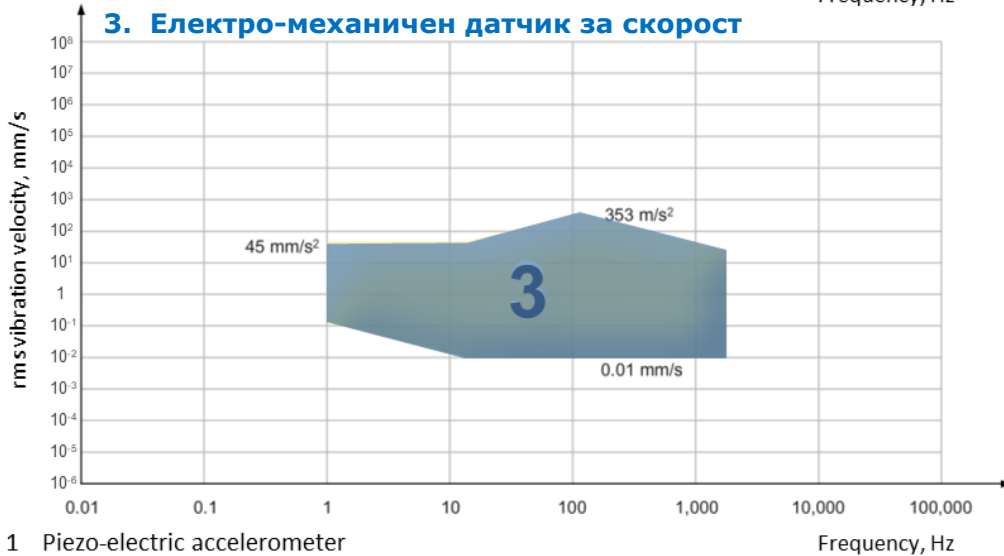
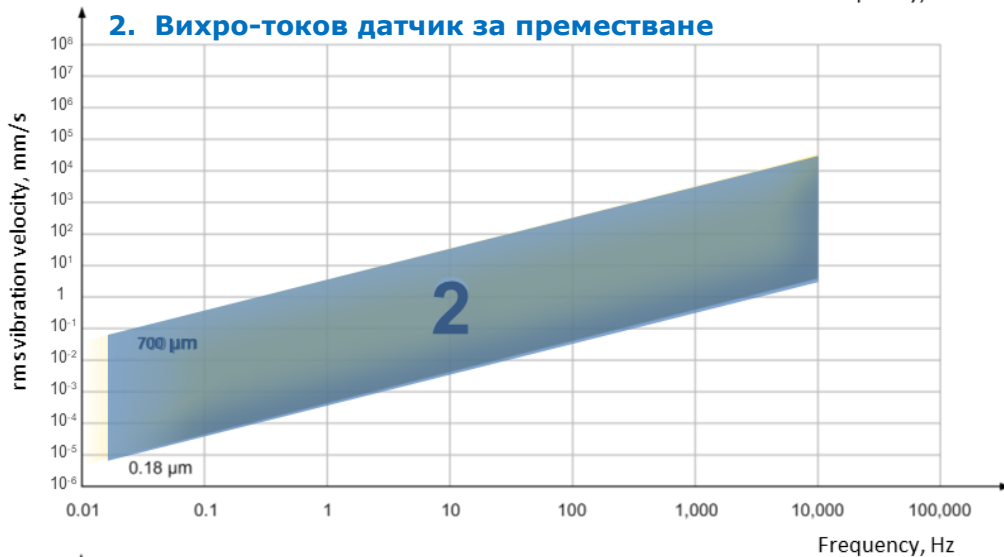
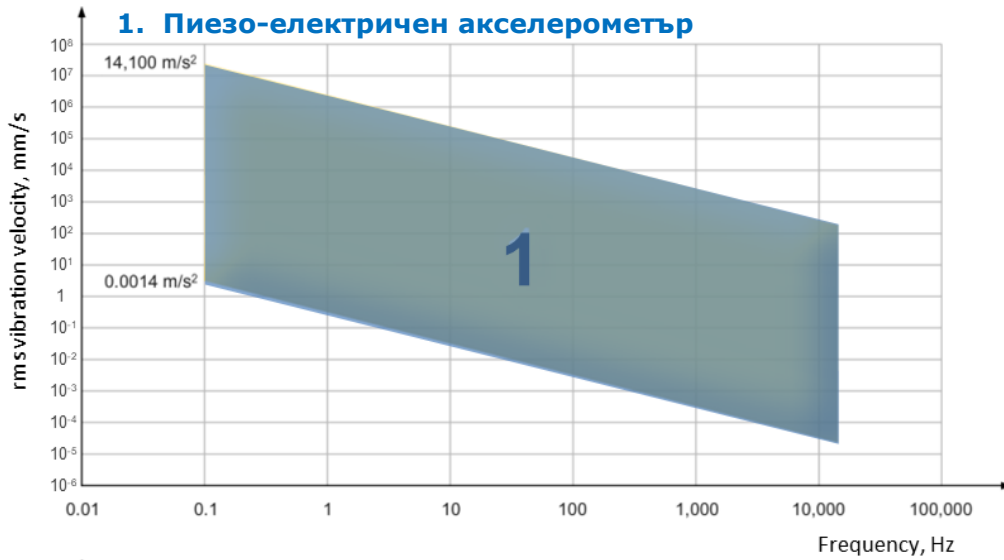
Transducer Frequency Response Curves

Криви на честотната характеристика на преобразувателя

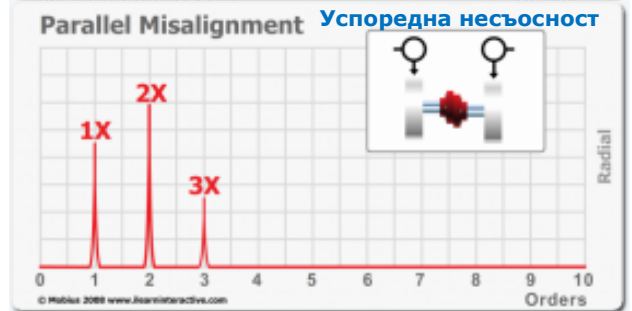
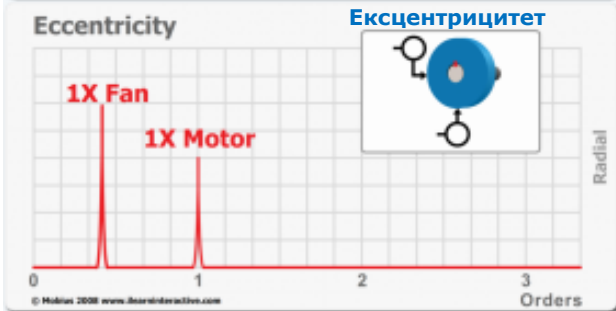
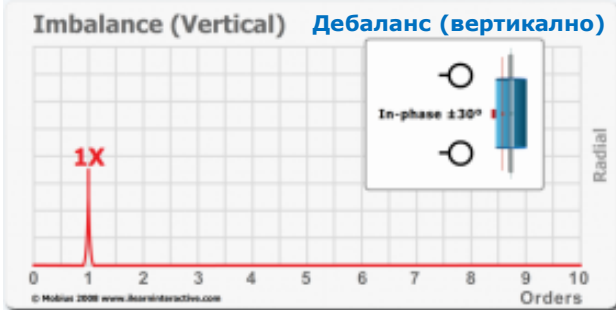
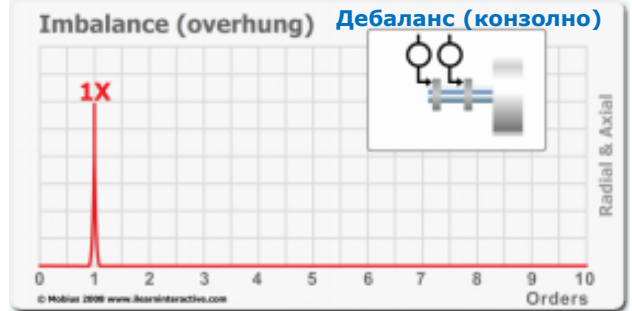
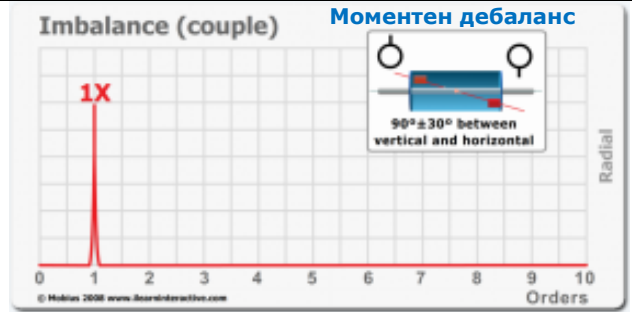
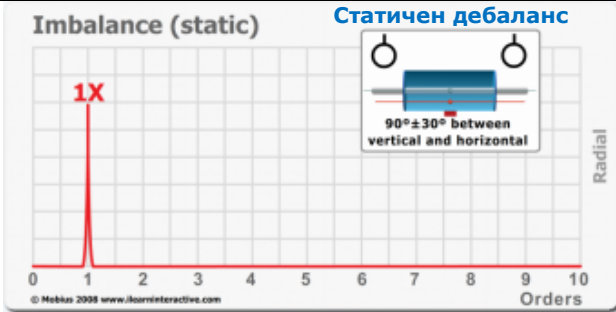


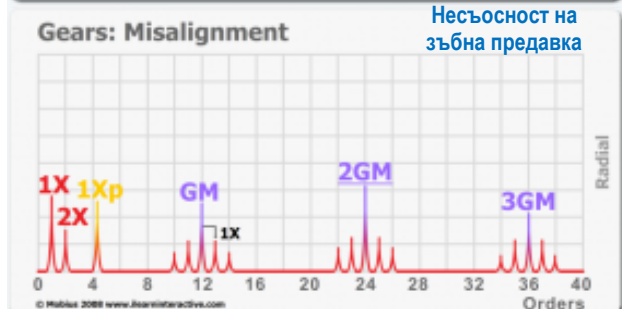
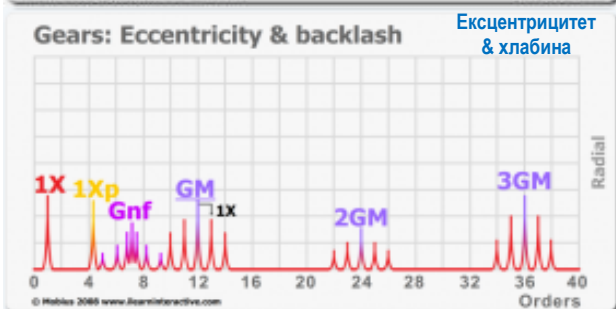
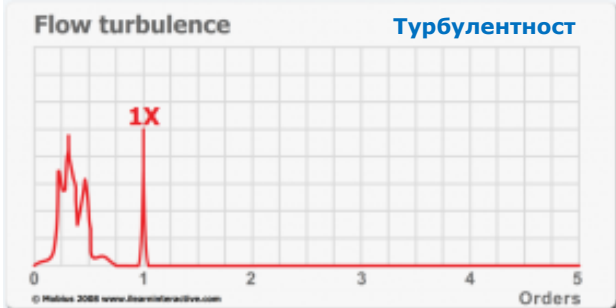
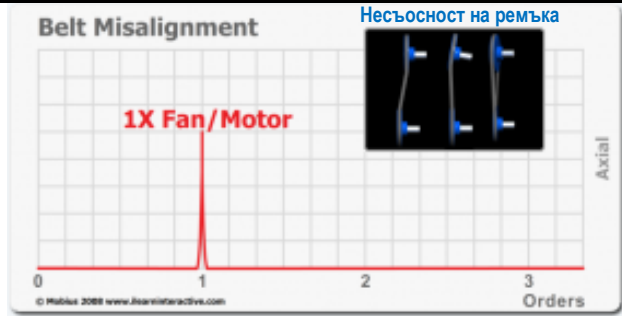
Transducer Effectiveness Regions

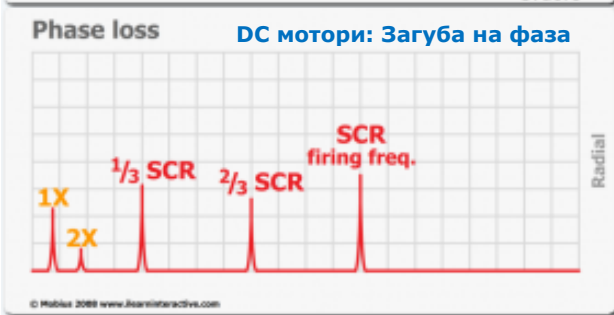
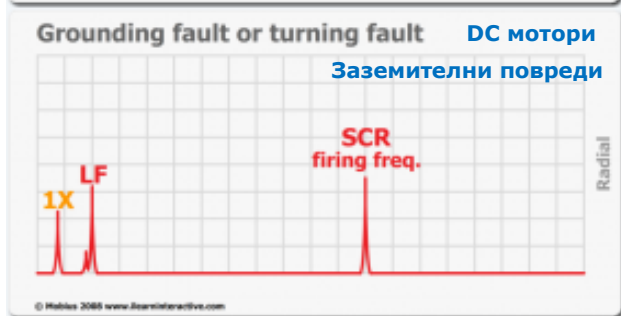
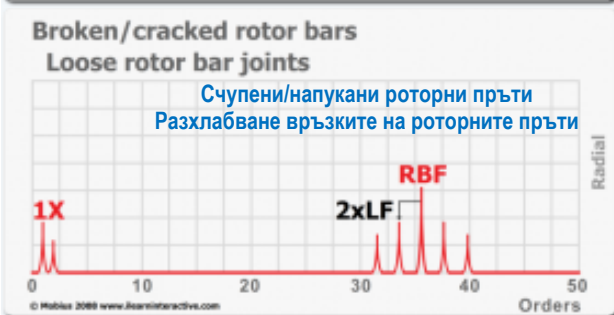
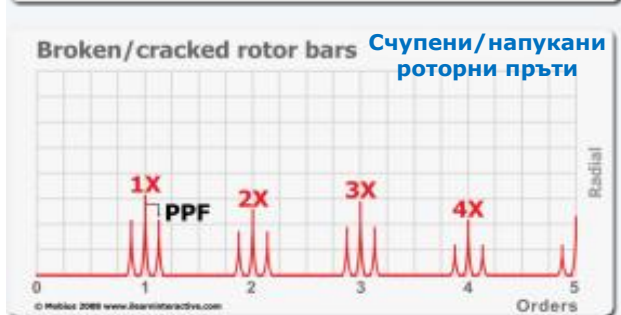
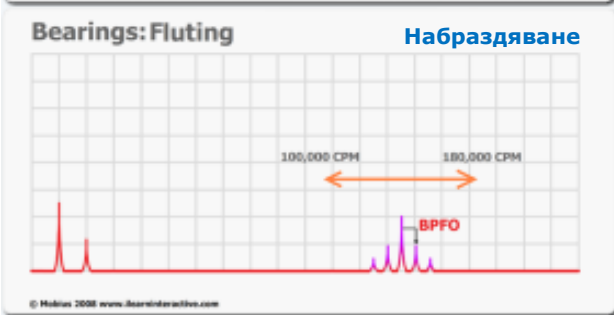
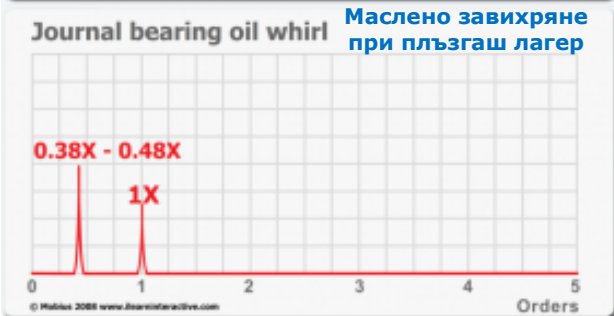
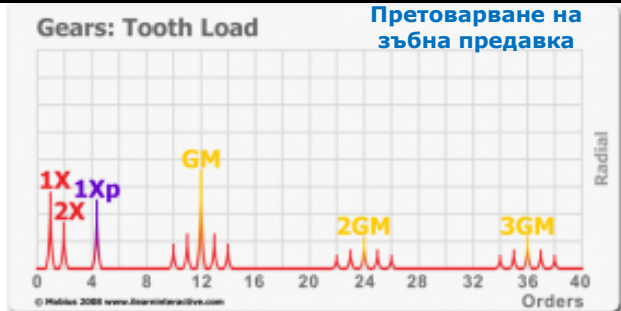
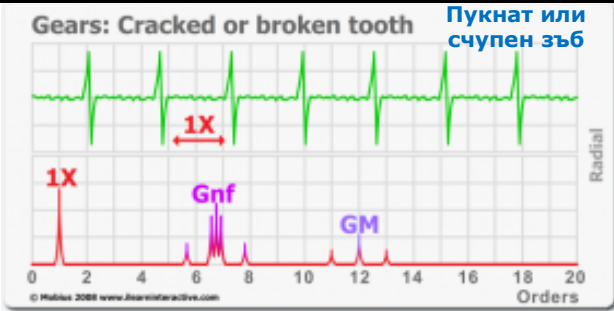
Области на ефективност на трансдюсера/датчика

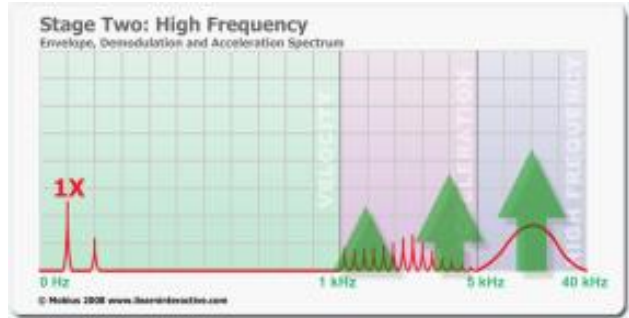
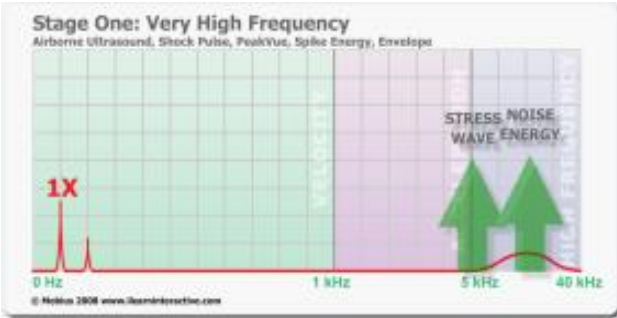
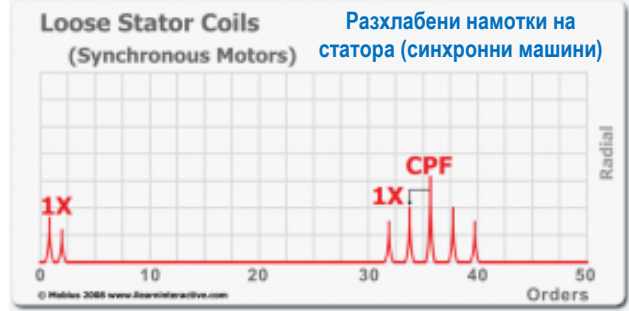
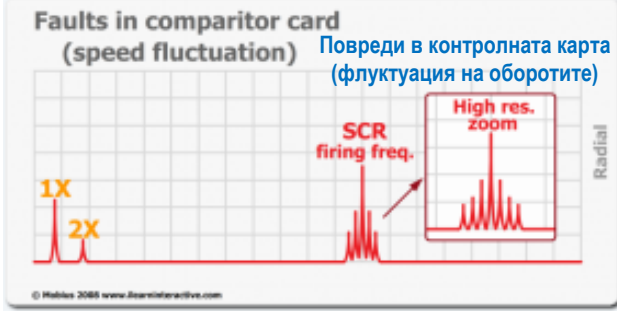


- 1 Piezo-electric accelerometer
- 2 Eddy-current proximity probe
- 3 Electro-mechanical velocity transducer



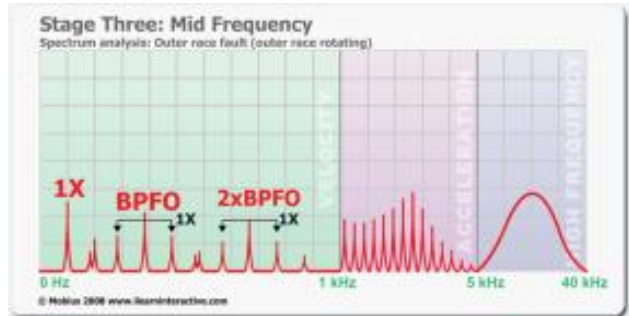
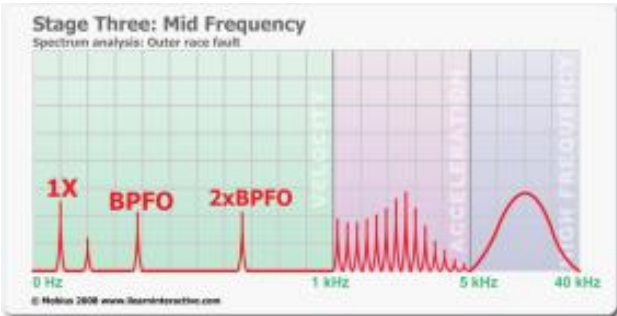






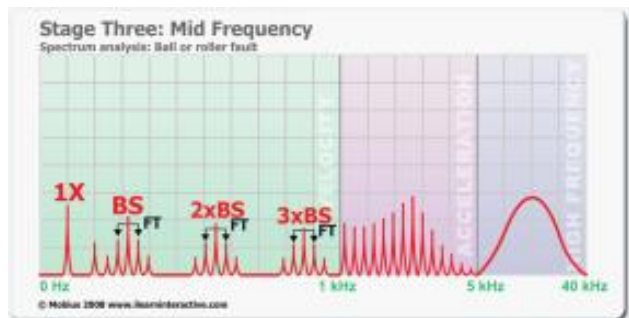
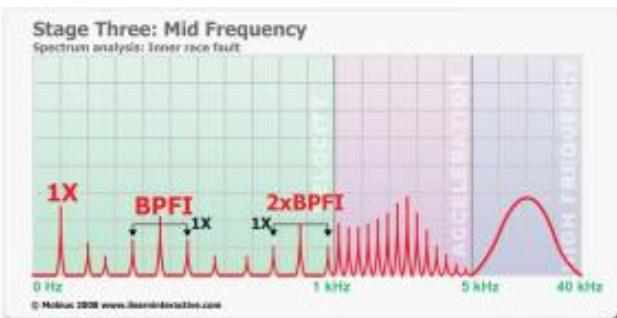
Етап I: Ултразвук, Shock Pulse, PeakVue, Spike Energy, Обвивка

Етап II: обвивка, демодуляция и спектър на ускорение



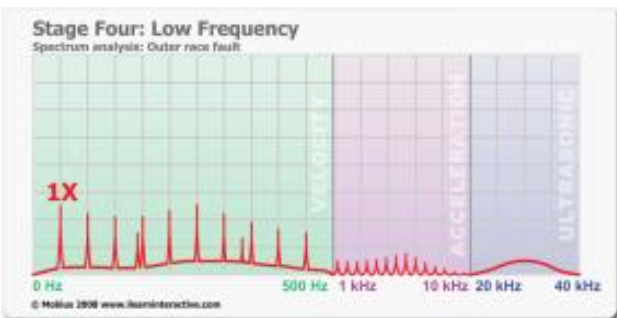
Етап III: Дефект по външната гривна (вътрешната гривна се върти)

Етап III: Дефект по външната гривна (външната гривна се върти)



Етап III: Дефект по вътрешната гривна (вътрешната гривна се върти)

Етап III: Неизправност на съзма или ролка (вътрешната гривна се върти)



Етап IV

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