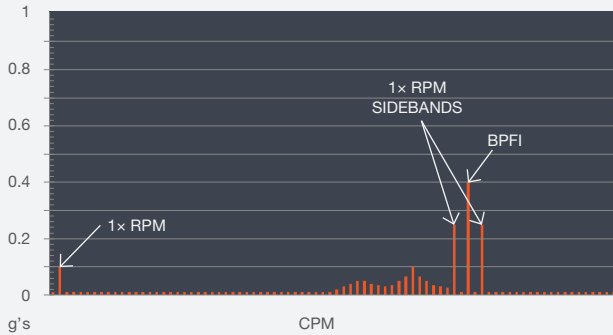


# 4 STAGES BEARING FAILURES



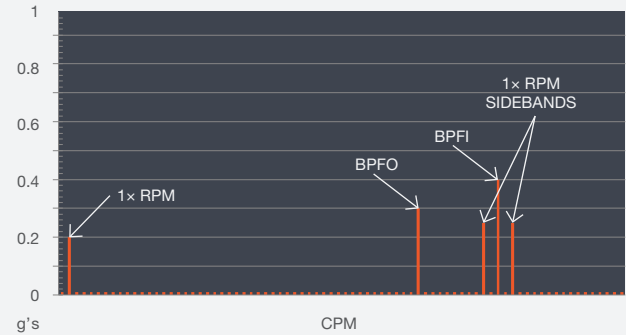
Bearing Defect Frequencies (BDF) are non-synchronous multiples of running speed. (i.e., 5.14× or 3.78×)  
This is helpful when the bearing manufacturer and model is unknown.



## STAGE 1

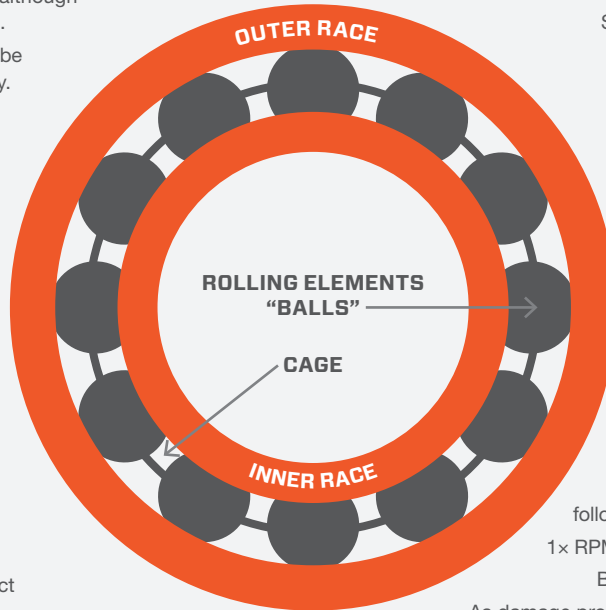
Typically, no obvious peaks at BDF.  
No visible surface damage may exist although subsurface asperities may be present.  
Appearance of BDF frequencies may be present due to a lubrication deficiency.  
Earliest indications of wear appear in the ultrasonic frequency range.  
Confirm with techniques such as:  
High Frequency Demodulation (g),  
Spike Energy (gSE) and  
Shock Pulse (dB).

ACCELERATION  
FFTs



## STAGE 2

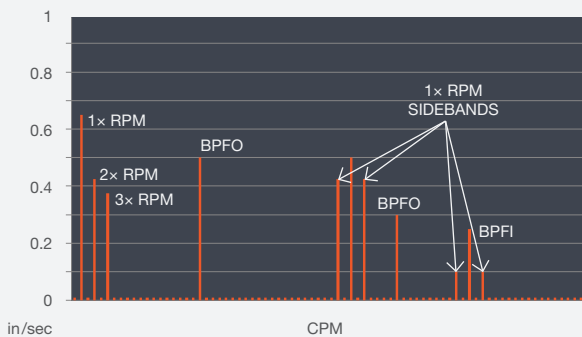
Peaks at the bearing natural frequencies appear between 30,000 to 90,000 CPM.  
Sidebands of running speed appear in the acceleration spectral data.  
Sidebands sometimes occur above and below the bearings natural frequency in the later stages of stage 2.  
Harmonics of the various BDF appear:  
BPFO - Ball Pass Frequency Outer  
BPFI - Ball Pass Frequency Inner  
BSF - Ball Spin Frequency  
FTF = Cage



## STAGE 3

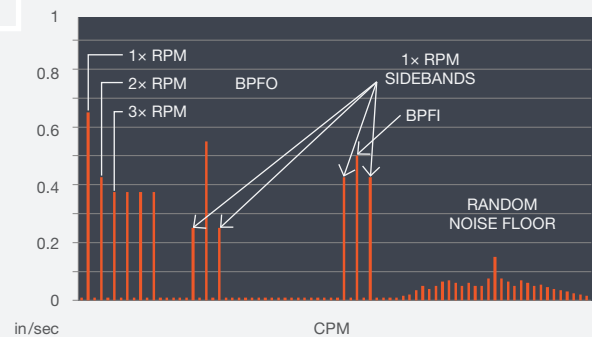
Elevated overall vibration.  
BDF appear in the Velocity Spectrum.  
Harmonics of the BDF are present.  
BPFI is typically the first bearing defect frequency to develop 1× sidebands.  
Wear is visible if the bearing is removed for inspection.  
1× sidebands appear alongside the other BDF.

VELOCITY  
FFTs



## STAGE 4

An increase in 1× RPM is observed followed by an increase in 1× RPM harmonics.  
1× RPM sidebands begin to develop around BDF.  
Bearing sound and temperature increases.  
As damage progresses BDF and other discrete “distinct” frequencies disappear and are replaced with random broadband frequencies (noise floor)



**NOTE:** Amplitude values are not representative of real-life values.