Linear, Log and VdB Vibration Velocity Units

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Introduction

Many people in the vibration field prefer to view their spectra using a linear amplitude scale. “The spectra are simpler and easier to read”, they say, without considering the fact that they may be simpler because they are providing less information, and often they are lacking important information. I’ve also heard people say that their machine’s bearings failed with no prior indication in the vibration spectrum, when reviewing their historical data in the linear amplitude domain, this appeared to be true, however, reviewing the same data in a LOG scale clearly showed well defined bearing tones increasing dramatically in amplitude over time.

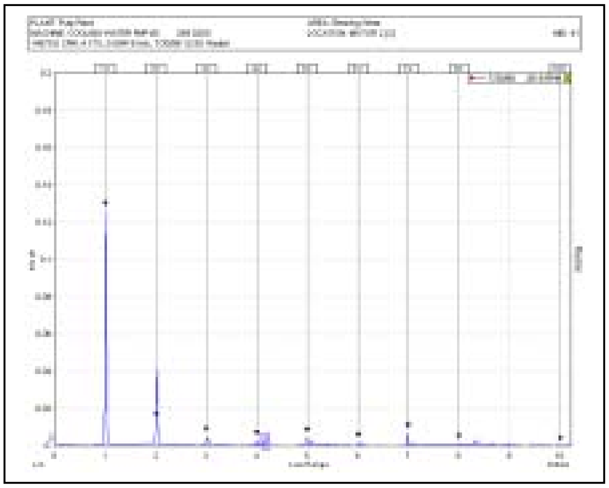
This paper will provide a brief introduction to linear, log and VdB vibration velocity units. More detailed information can be obtained from DLI Engineering.

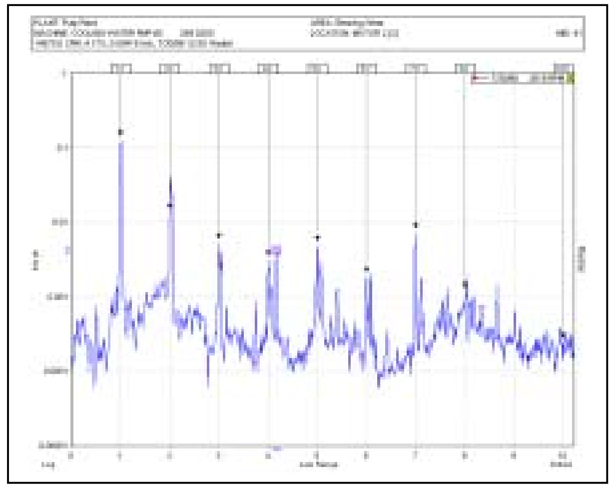
Linear Units

Linear units provide a true picture of vibration amplitudes and this domain is useful if the components of interest in a spectrum are all about the same level. Linear units make it easy to pick out high level components (such as shaft rate peaks) but make it very difficult to pick out other components that are relatively much lower in amplitude such as bearing tones.

Consider the fact that if the amplitude of a peak doubles, the energy associated with that peak is quadrupled. This implies that even if we have a relatively low amplitude bearing tone, knowing if its amplitude has doubled implies that a significant change has occurred in the fault. In the realm of Predictive Maintenance, this is exactly the information that is important, as we are most interested in how specific faults in the machine are progressing and how quickly. Because these faults can be related to individual peaks or components in our spectrum, we need to be able to see them and monitor how much they change, no matter how small they are relative to other components in the spectrum.

If we take a look at Figure 1, we will (barely) see a bearing tone at 4.1X, marked with a little square. Consider how the graph would look if this little peak doubled or even quadrupled in amplitude. It would still seem rather tiny compared to our 1X peak, and we may not even notice the change. This would be especially true if the 1X peak also doubled in amplitude at the same time due to an imbalance. Now take a look at Figure 2. This is the same exact data viewed in a log scale. In this graph, we can clearly see the bearing tone marked with the square. You may also notice that some other non-synchronous peaks are also now visible. These are the peaks that don’t fall on the vertical grid lines and they are also bearing tones.





(Figure 1 in/s linear) *(Figure 2 in/s log)*

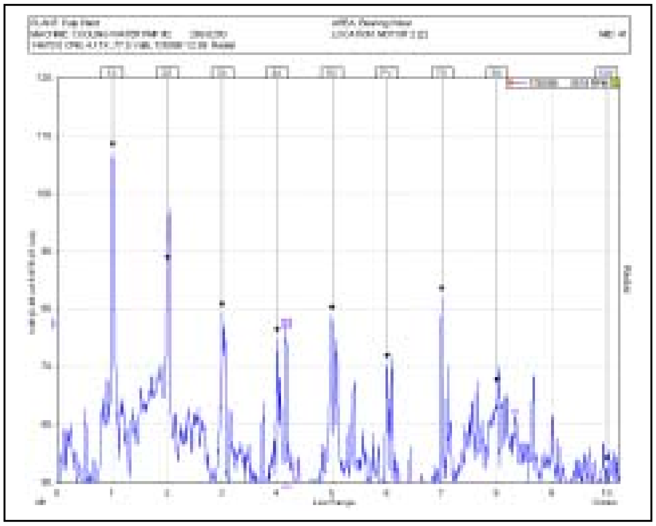
Log Units

As seen in Figure 2, viewing the same data in a log scale, one can more clearly see the relatively lower level components in the spectrum. One annoying feature of using a log scale however is that one cannot easily view a peak and know its level without placing a cursor on it. This is because the vertical scale is not linear, in other words, if your peak is between 1 and 2 on the vertical scale, it is not at 1.5. If you remember the log scaled graph paper you used to use in school, this will be clear to you. This is where VdB comes in.

VdB Units

VdB stands for Velocity Decibels. In laymen's terms, one can state that in this unit, the log part is built into the unit so that the vertical axis of the graph can be displayed in linear units. Figure 3 is the same data from Figures 1 and 2 displayed in a VdB scale. You'll note that the data looks identical to in/s log, but the vertical scale on the graph is now linear (you may need to zoom in to view the scale). This simply makes the graphs easier to read.

More detail on VdB units can be obtained from DLI engineering. In this paper, I will simply note that if a peak increases by 6 VdB, the amplitude has doubled, if it increases by 12 VdB it is quadrupled. A 20 VdB increase is 10x the vibration.



(Figure 3 VdB)

More Information

Most vibration software packages will allow the user to easily switch between linear and log formats and many allow the user to define their own units if VdB is not an option. If you have a software package, give it a try and take a look at the information you may have been missing. Also note that one can view acceleration units in linear, log or, in this case, AdB units, with the same results.

Conclusion

Log or VdB units essentially allow a user to see components that are small relative to other components in the spectrum where these same components may not even be visible in a linear format. Just because something is relatively small doesn’t mean it is not important, especially if it is a bearing tone. What is more important is to be able to see if these peaks are increasing in amplitude over time as this indicates that a fault is progressing. This is much easier to do when one is using log or VdB units.