ACQUIRING VALID TORQUE MEASUREMENTS DURING VIBRATION

A good, properly calibrated Torque Sensor will provide accurate, reliable torque measurements in the absence of significant vibration. On the other hand, because sustaining drive vibration requires power expenditure, significant driveline vibrations can lead to erroneous and misleading torque and efficiency results. Furthermore, vibration can cause reduced fatigue life and component failures. This memo will help you obtain valid, reliable measurements, avoid vibration-induced errors, component failures and limited fatigue life.

Background Information

Power is consumed to vibrate shaft elements and to sustain those vibrations. Consider ***measuring pump input power with a Torque Sensor installed between the pump and motor***. When vibration is present, the Torque Sensor measures the torque and power to move fluid. It also measures the torque and power to vibrate driveline components a part of which is a function of the test bed rather than the pump under test. ***Thus, if significant vibration is present, the pump input power will be overstated and its efficiency understated***. On the other hand, if your ***only objective is to measure the motor output as opposed to the pump input***, the results would be valid except for the part of motor output vibrating the motor itself. In any case, when significant vibration exists, you risk reduced fatigue life, component failure and unacceptable audible noise.

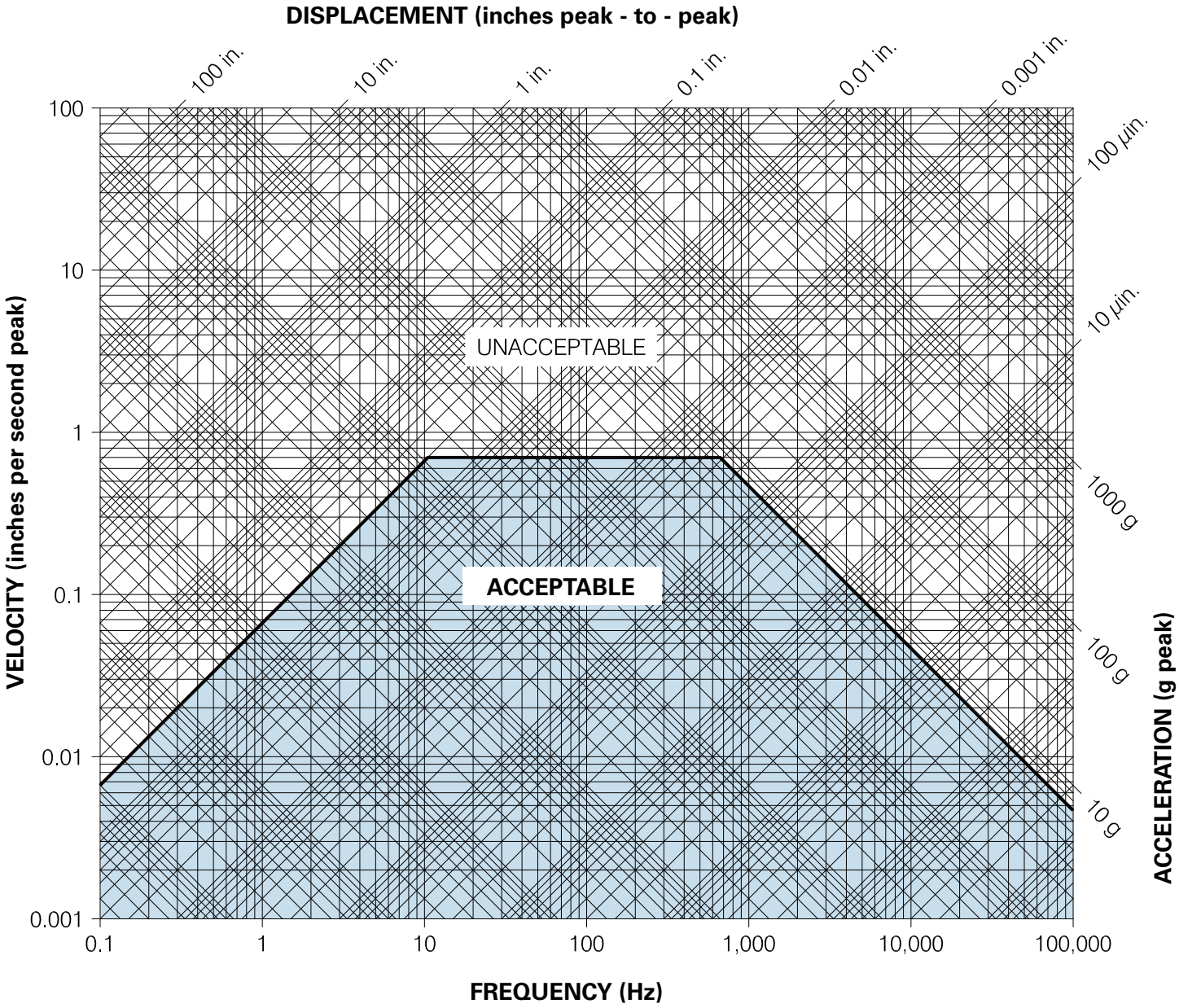
All drivelines have springs and inertias and therefore have one or more torsional resonant frequency. Those resonances will produce torque magnification when excited at the resonant frequency. Magnification amplitude is dependent on drive damping and operating conditions and ***will be accompanied by increased vibration***. That situation reduces fatigue life and can even cause outright failures. Although it takes hundreds of pounds, we have seen resonant-induced vibration cause foot mount fasteners to fail. Under such conditions it's only possible to make realistic, meaningful machine torque and efficiency measurements by reducing vibration to an acceptable level. See Application Note 221101D and Tech Memo 8150 for more information. See chart on page 2 for acceptable vibration levels.

COMMON CAUSES OF VIBRATION AND HOW TO REDUCE THEM

Common Cause of Vibration	Solution to Reduce Vibration	Reference Material
Rotor Unbalance	Balance each rotating component to reduce vibrations. When severe problems are present, first balance individual components and then balance the complete driveline. Balancing is most critical at high shaft speeds.	ISO 1940/1
Misalignment	To reduce those vibrations use suitable flexible couplings and accurately align rotating components.	Tech Memo 7850
Torsional Resonance	The solution is to avoid operating at speeds harmonically related to shaft resonant frequency(s); operate well below or well above each resonant frequency.	Tech Memo 8150
Torque ripple in the power source or other drive component	It is especially dangerous when harmonically related to a shaft resonant frequency. The solution is to reduce the ripple, replace the ripple source or shift the network resonant frequency(s).	

In Summary

To obtain accurate, reliable torque measurement or control your drive must be free of significant vibration. This chart can be used to establish acceptable ***vibration levels***. Use ISO 1940/1 as a guide to achieving acceptable ***balance levels***.



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