The Importance of Standard Test Conditions – Test Speed

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To illustrate the importance of standard test conditions, we can look at the simple case of attempting to diagnose a rotor imbalance. If an imbalance is present, we expect to see our vibration levels rise at the run speed of the machine in all directions radial to the shaft (in other words in the vertical and horizontal directions). To visualize this, consider a washing machine on the spin cycle with all of the clothes bunched up on one side. The more clothes that are bunched up on one side, the more the machine will rock back and forth as the weight spins around. The weight will spin around at the same speed as the shaft and thus the frequency of this vibration will be at the shaft rate.

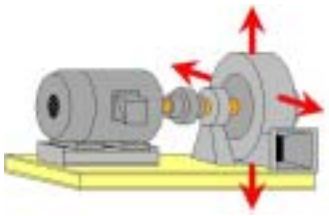
The force created by this imbalance is calculated by the equation:

$$F = Irw^2$$

F = Force
r = Radius
w = Rotational Velocity

Where I is the effective rotating mass, r is the radius of this mass from the axis of rotation, and w is the rotational velocity. What we can see from this equation is that if "I" or the mass is increased, so is the imbalance force and so should be the resultant vibration. This is exactly what we expect and that's why we look for an increase in amplitude of the rotational rate peak when we are trying to diagnose unbalance. The more interesting thing to note however is that if the rotation rate (or run speed) goes up (w), then the imbalance force rises by the velocity squared. In other words, this is going to increase the vibration more than an increased imbalance will!

The point of this is to say that if we are going to look at this run speed peak in our vibration spectrum to determine if our machine is becoming unbalanced, we have to test the machine at the same velocity every time. The only other viable option is to create baselines for each test speed so that the effect of the run speed can be removed from the analysis.



Is it unbalanced or is it just running faster than last time?