Vibration is one of the most damaging forces in the industrial environment. Vibration not only reduces the life of equipment, but can also adversely affect the quality of the product or the reliability of the production process. In addition to quality and performance issues, vibration costs money. You have to pay for the energy it takes to shake your equipment. Forces generated by unbalance are among the most common sources of vibration encountered in machinery-rich environments. Balancing is one of the most common corrective activities needed to resolve vibration issues.

**Seven Pre-Balance Checks to Ensure a Smooth Balance Job**

1. **Look before you Leap—Visual Inspection**
   A visual inspection of the fan is extremely important. Look for signs of blade rubbing or cracks in hubs. Correcting these issues prior to balancing is not only necessary for the machinery, but can also save your life.

   Many years ago, a maintenance crew at the Geysers Geothermal area in Northern California was investigating a five-bladed cooling tower cell which exhibited a high vibration at the fan RPM. The fan was running, so they did not visually inspect the fan (although they could have used a timing strobe light). The spectrum readings showed not only a large vibration at RPM but also a vibration at five times RPM and a very high 20 times RPM vibration. Not sure what was causing the very high reading, they decided to shut down and inspect the fan.

   They found cracks on the fan hub stemming from axial blade loading. There were four structural components directly in the airflow of the fan that supported the gearbox. The compression of air between the four gearbox supports and the five fan blades caused the 20 times running speed vibration. Just a few months before, another cooling tower cell had catastrophically failed due to a fan hub failure.
2. Perform a Vibration Analysis Prior to Balancing
This may sound obvious, but it is important to ensure the vibration’s source is really imbalance. If a fan has an eccentric pulley or is misaligned, balancing will not work.

A few years ago, a technician from a Seattle balancing shop captured a quick spectrum before a balance job and told the customer that the fan was in balance and the real problem was that it was misaligned. The customer insisted the fan was out of balance as they had just installed the fan and motor. The technician then set a laser alignment system and proceeded to show the customer that the misalignment did indeed exist. After alignment, the fan ran smoothly and required no balance correction.

3. Start-Up/Coast-Down—Check the Dynamic Operating Condition
It is important to understand the dynamic operating condition of the rotor. If possible, perform a coast-down or start-up and examine the resulting bode plot, Nyquist plot or cascade spectrum to help identify potential problem areas like running in shaft resonance.

In one mine in Nevada, a fan company’s field technician tried for a full week to balance a fan but was not successful. To be fair, he was new to balancing and had no vibration experience. As part of our initial balancing measurements, we performed both a start-up and coast-down Bode Plot. Not...
only was the fan grossly out of balance, but running RPM was also exciting the fan's support structure into an extremely high state of resonance. This situation made it extremely difficult to balance using the normal field balancing procedures. We managed to adjust the stiffness of the structure, which shifted the resonance enough to not interfere with the balance.

4. Clean Before Balance
Fan blades are especially susceptible to dust and crud buildup that can cause an imbalance. Composite cooling tower blades have drain holes that become plugged. A good cleaning before beginning to balance is imperative and can often save you from balancing. One company that had a continual problem with buildup on a fan blade installed a spray wash nozzle and gave the fan a quick cleaning weekly to solve the balance problem.

5. Remove that Weight
Repeatedly balancing a fan through the years can lead to an accumulation of weights. Any temporary clamp- or clip-type weights should be considered for removal prior to the balance job. Consider permanent correction weights if they can be easily removed. Old weights can loosen and fly off at the most inopportune times. It is counterproductive to place new correction weights directly opposite old balancing weights.
6. Check for Loose Parts

Fans go through many cycles of stress that loosen parts. Loose parts associated with a fan are extremely common. Due to the inherent operating conditions and repeated stress found in fan applications, components such as collars, pulley sheaves, fan hubs and base bolts are often loosened. A proper inspection often requires more than just simple visual observation. Vibration spectrums and slow motion studies with a strobe light are invaluable tools for observing small amounts of looseness.

7. Check your Orientation

Balancing a two-plane overhung rotor can be extremely confusing if one does not understand which bearing relates to which balancing plane. Getting confused in the middle of the balance job is both time consuming and embarrassing, so study the balancing manual in advance to balance correctly the first time. If the overhung rotor is narrow, do a single plane balance job first. In most cases, a single plane balance will bring a narrow overhung rotor into tolerance.

Balancing is often identified as the origin of a vibration without any thought to other conditions that can cause vibration. While the first reaction is often “that fan is out of balance again,” many other conditions can cause vibration. Running through a pre-balance checklist not only ensures a balance problem exists, but can also identify dangerous operating conditions. Running through a pre-balance check list takes a little time upfront, but ultimately pays big dividends.

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