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Why High Speed Balance Your Rotor?

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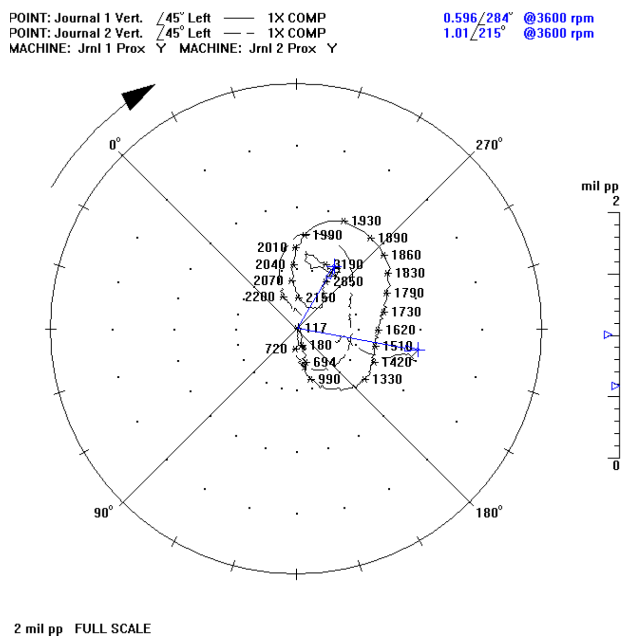
There are numerous advantages to high-speed balancing of generator and turbine rotors. These include:

- Smooth operation through the entire speed range up to overspeed.
- The ability to access optimal weight planes, which are not normally accessible during operation in the machine.
- Verification of the mechanical integrity of the rotor and any assembled components—up to overspeed.
- Electrical testing of generator rotors through their entire speed range can identify the existence of any speed related electrical faults.

Also, long and slender rotors may not be able to be balanced with the planes available in the field due to the reduced influence of these areas on the unbalance in the rotor.

Why not just perform a Low Speed Balance?

Generator rotors and many utility scale turbine rotors operate above their first and second modes, with some operating above their third mode. Generator rotors in particular are "flexible" due to their long and slender geometry. In addition to this, generator rotors tend to have an asymmetric stiffness, which further influences their vibration characteristics.



These effects can only be observed during a high speed balance. The effects of unbalance or other eccentricities can excite the bending modes of a rotor, causing high vibrations as the rotor passes through the critical speeds coinciding with these modes. Proper balance weight placement greatly mitigates the effects of unbalance. During a high speed balance, all weight planes are accessible, which allows for optimal weight placement for all modes.

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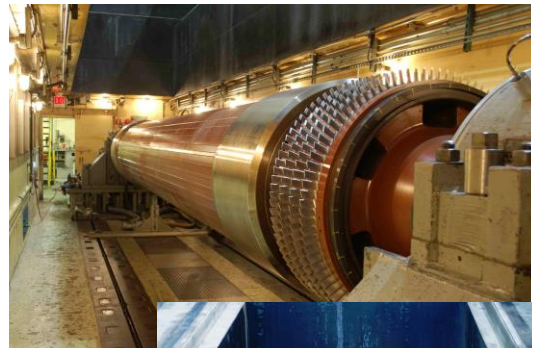
WHAT ROTORS ARE PARTICULARLY SUITED FOR A HIGH SPEED BALANCE?

In general, rotors that have had a change in their mechanical condition are best suited for a high speed balance. The following list identifies some of these mechanical changes that have benefited from a high speed balance:



- Changes made to the centers of rotation (also known as throwing journals).
- Generator rotors that have been completely rewound.
- Generator rotors that have been significantly disassembled, such as removal of retaining rings and some coils.
- Rotors that have had vibration problems produced by and/or repaired for the following reasons:
    - Permanent bowing due to rubs or water induction
    - Loss of mass due to rubbing or other means
    - Cracking
    - Thermal Instability
- Turbine rotors that have been re-bladed, especially if the blades were not moment weighted.
- Turbine rotors that have had significant blade repairs.
- Rotors that have had their journals, couplings or fits machined.

In general, long and slender rotors are the most well-suited for a high speed balance, but any rotor that has the aforementioned repairs or problems can benefit from high speed balancing.

DOES A HIGH SPEED BALANCE GUARANTEE A SMOOTH RUNNING MACHINE TRAIN?

Although a high speed balance does guarantee that the particular rotor that has been balanced will run smoothly through its operating speed range, it does not guarantee that it will run smoothly when assembled in the machine train. The following issues can increase vibration levels in the assembled machine train:

- Coupling/ bearing misalignment
- Excessive runouts in the coupling face, rabbet fit or coupling rim
- Coupling holes and bolt sizes that are not properly matched in size, weight and location
- Removal of balance weights during the high speed balance, which were used in the field to correct problems from adjacent rotors
- Misalignment of stationary components that may come into contact with the running rotor during operational transients.

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Increased vibration due to some of these problems can be mitigated by trim balancing in the field. However, if these defects are severe enough, the machine will not be able to start up due to very large vibration levels when crossing critical speeds. These problems can be avoided, by ensuring the following:

- All of the rotors' coupling faces are perpendicular to their running centerline.
- All of the rotors' rabbet fits and rims and running concentric to the running centerline.
- All of the rotors' in the train are properly balanced.
- All bearings are at their appropriate elevation to match the design catenary curve of the machine.
- Proper coupling alignment of the rotor train.
- Proper alignment and appropriate running clearances of stationary components.

If these items are addressed during the outage, the machine can be started up with no problems after the completion of the outage.

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