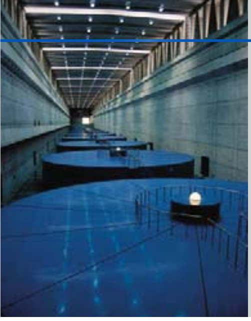

AN013

# Technique for Detecting Rotor Rim Vibration

Rotor rim vibration is detected by comparing sensor readings meticulously to look for subtle curve variations from one pole to another. The vibration occurs when the field is applied and resembles noise riding over the signal. The change of state is validated by comparing results with field applied against Speed No Load (SNL) not excited.

To be able to diagnose rim vibration, the rotor stability must be ensured as described in *Application Note AN004*.

Figure 1 of a Signature measurement is a typical example of a vibration-free rotor rim. It compares the rotor shape seen by all sensors at SNL as the overall and detailed shape of each curves is identical. The result of this SNL measurement confirms that the system is operating normally and accurately.

Figure 2 shows readings of the same four sensors at Full Load–Hot (FLH) – normal operating condition. Although the overall shape of the rotor is the same once the magnetic field is applied, it reveals rim vibration by small variations, similar to noise, from one curve to another and for each pole with respect to adjacent ones.

Figure 3 compares histograms of adjacent pole correlations – direction of gap variation – at both operating conditions. It displays the air gap variations uniformity from pole to pole for each sensor. A matching set consists of all four sensors measuring the same variation direction, regardless of the amplitude, and a near match is achieved when three out of four sensors are identicals.

The figure shows that the rotor rim is stable at SNL (top) as there are 51 matching sets and 7 near matches out of 64 pole sets. The lower histogram at FLH shows low stability as most sets are mixed. Only 22 matching sets and 9 near matches are displayed.

(continued on overleaf)

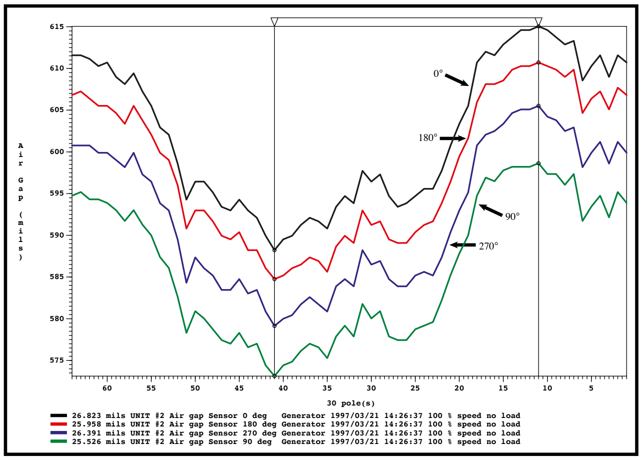


*Figure 1: Signature graph of a non-vibrating rotor rim at Speed No Load (SNL).*

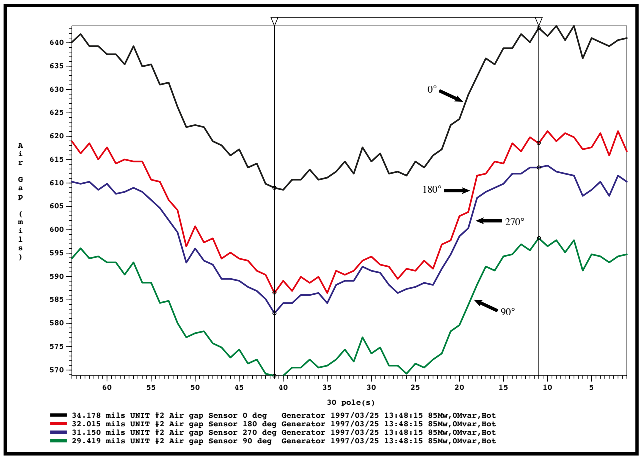


*Figure 2: Signature graph of the same rotor rim at Full Load – Hot (FLH) showing rim vibration.*

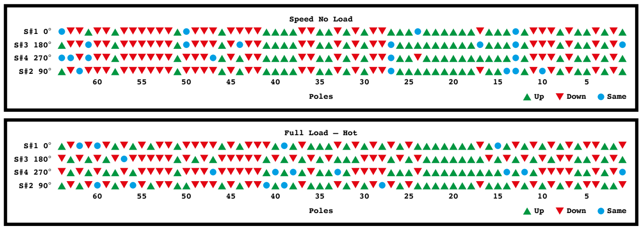


*Figure 3: Histogram of adjacent pole correlation at SNL and FLH. The correlation is much more uniform at SNL from one sensor to another with 51 matching sets out of 64 poles and 7 near matches. In comparison, the FLH result is mixed with only 22 matching sets and 9 near matches.*

Vibration of the rotor rim requires two main conditions: large air gap variation and low mechanical stiffness of the rim. Large air gap variation results from out-of-round and/or eccentric rotor and stator; rim mechanical stiffness depends on the thickness of the rim and the distance between spider arms. Other possible sources of rim vibration include: lateral wear of rim keys and weak spider arm structure.

Rotor rim vibration can lead to greater problems such as:

- loosening of rim on rotor spider (loss of shrink)
- mechanical imbalance of rotor
- unbalanced magnetic pull acting on rotor and stator
- stator core vibration, winding vibration, overheating of stator area
- radial shaft vibration and displacement, overheating of bearing

Trend monitoring of the main air gap parameters and yearly visual inspections of the rim-to-spider bracing system are recommended. Cracks at the bottom of the spider arms and presence of red powder near the keys should be investigated.

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