Improving Motor Quality by Trim Balancing

By Gary Herr • Demaria Electric Motor Services Inc.

Large electric motors 1 000 horsepower and up are often difficult to balance effectively, even with the sophisticated hard bearing machines of today. Typically, large wound rotors or migrating barred rotors with sleeve bearings will exhibit different characteristics at actual running speed as compared to slow turning balancing machines. Forces on rotor components at running speed, uneven thermal growth and bearing clearances can contribute to unexpected shaky test runs. It is especially a concern with two-pole sleeve bearing motors. A reasonably quick and simple motor quality procedure is to perform a balancing routine at running speed to trim out the effects of what the balancing machine may have missed.

Demaria Electric Motor Services Inc., in Wilmington, California, incorporates the SKF Condition Monitoring model CMVA 60 data collector with its built in Balancing Wizard to trim balance assembled motors in place at running speed (→ **fig. 1**).

A case history that reflects this premise is a Lake Mead pumping station that supplies Henderson, Nevada, with water. The station is equipped with six 1 250 horsepower synchronous motors coupled to pumps on each end. The 1940's vintage Westinghouse four-pole motors have a history of being difficult to rebuild and balance. The 3 350 pound wound rotor is in itself a winding marvel, as the entire rotor assembly is rotated to facilitate winding the four coils and maintain the integrity of the wedges.

The rotor is then balanced in a balancing machine. Weight is welded to the top of the balancing rings to keep the twelve 1.25 in. threaded holes free for subsequent shop and field balancing. The motor is then assembled and set up to run on the test floor. Balancing holes are marked precisely in 30 degree increments. The motor is run under normal synchronous uncoupled conditions until amplitudes and phase angles stabilize.

Fig. 1. Trim balancing 1 250 HP electric motor with CMVA 60 SKF Microlog data collector.

The SKF Microlog Balancing Wizard is now used to perform a two-plane dynamic balance. Following the wizard's steps of the reference run, trial runs, correction run and possible trim runs ensure remarkable results. If the trial weights do not influence the rotor properly, the wizard prompts the user to move the weight or add more weight. Once trial runs are complete, the SKF Microlog calculates the influence coefficients and offers the amount of balance correction weights and the angles to place them. Weights are then cut from all-thread stock and a screw driver slot is machined on one end for installation (→ **fig. 2**). If the results of the correction run are satisfactory, you may end the routine; if not, follow the prompt to further trim the rotor. Continuing with the trim run will often lower the 1x running speed amplitudes to below 0.005 inches per second (peak).

The time involved to achieve this precision is about three to four hours, with much of it spent cutting the exact weights. By following the wizard's suggestions to the exact gram and angle using built in splitting and combining weight utilities, the motor can be made to run very smoothly.

Typically, a total of only five starts and stops are required. Balancing jobs may also be stored in memory and calculated influence coefficients can be used in the field for ongoing trim balancing. All six of the Westinghouse motors have been rebuilt over the past five years. Excellent results have been consistently achieved on each motor, both on the shop floor and at the pumping station. The last rebuilt motor balance report shows better than 98% lower 1x running speed component after trim balancing.

Rebuilding a large electric motor is a process that can take days or even weeks. In most cases, the amount of time involved improving the quality of the balance condition from an acceptable 0.10 in. per second to a precision 0.01 in. per second is worthwhile and attainable. As conditions change in the field, the same balancing routine is used. With a balancing data collector like the CMVA 60 SKF Microlog, a fraction of the time invested in the motor repair can easily turn a good running motor into a great running motor.

Fig. 2. Adding a trim weight to the field balance ring. Note the slow speed balance stand weight welded on top of the balance ring in order to keep the balance ring holes open for trim balancing.

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