CASE STUDY

Motor Bearing Failure Due to Induced Shaft Voltage

In the year 2000, a major facility located near the Honolulu International Airport went through major air-conditioning and lighting systems renovations. The air-conditioning upgrade of the project involved the conversion of constant chilled water flow to variable primary flow and from a constant air volume system to a variable volume air distribution system. These new variable flow systems employed adjustable speed drives (ASDs).

Nineteen ASDs were installed throughout the facility to control air-handling unit blowers, chilled water pumps and cooling tower fans. Motor sizes ranged from 7-1/2 hp to 30 hp. Initially, the workers at the facility complained about air handler motor operating noise in certain work areas[1]. The local ASD representative visited the site and adjusted the "built-in" ASD settings from "normal" to "low noise" parameters, and this satisfied the workers noise concerns at that time.

A few months later; however, workers again complained about motor operating noise. This time the local representative was called in to assess the situation and concluded that the motor bearings had failed prematurely. A couple of motors were removed and sent to a repair shop for bearing replacement.

Each month thereafter, the facility experienced at least two motor bearing failures, which was unusual. The local motor supplier began blaming the failures on pulley mis-alignment and lack of maintenance. Motors from different motor manufacturers were also tried without success. HECO decided to call the original ASD manufacturer directly and found an engineer who was familiar with the problem. Prior to the engineer's visit to the site, samples of the failed bearing assemblies were sent to the ASD manufacturer's local representative for analysis. By cutting the bearing races in half, the representative found that the bearing races exhibited the characteristic "fluting" that results from common-mode current discharge through the bearings. Slight frosting on the surface of the bearings was also evident, although, this is a bit difficult to observe in the photos in this article.

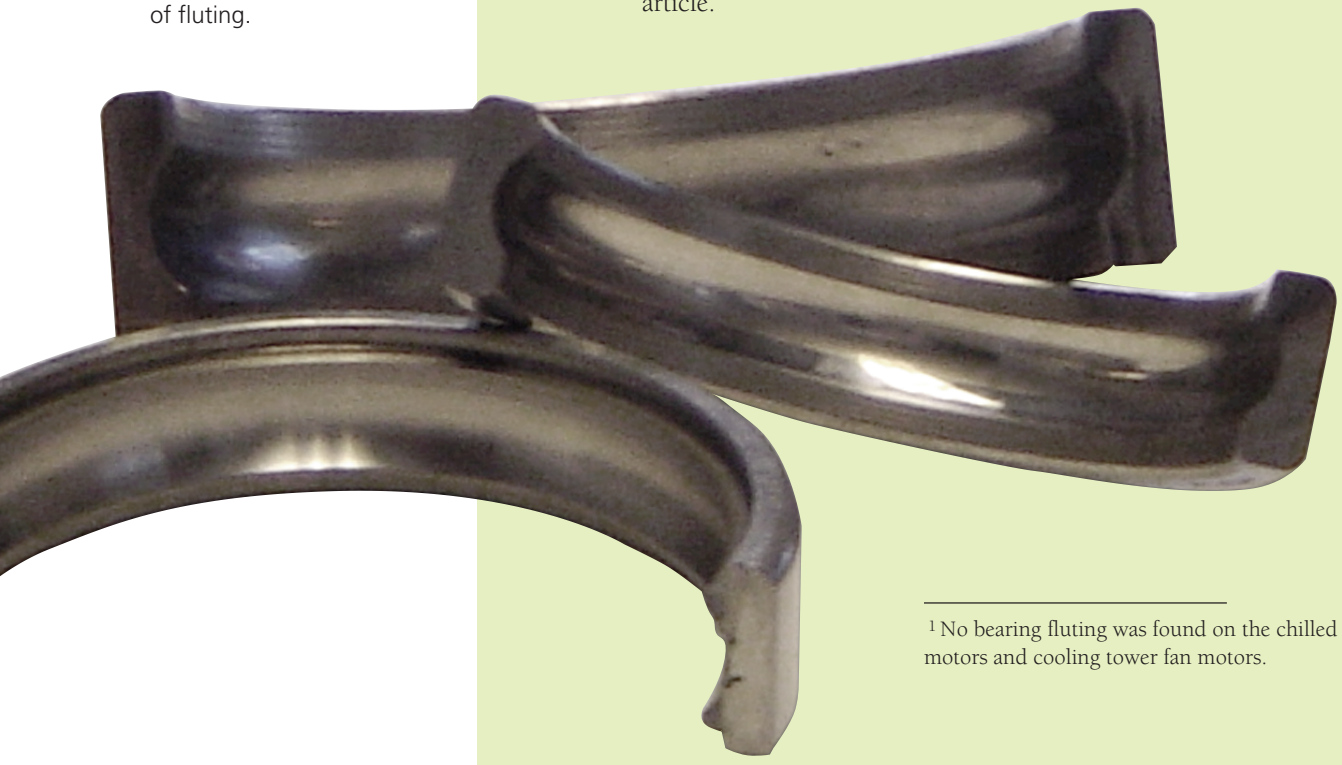

Fig. 1:
Bearing races showing signs of fluting.

[1] No bearing fluting was found on the chilled water pump motors and cooling tower fan motors.

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Fig. 2: Bearings beginning to show signs of surface "frosting"

A site visit by the engineer confirmed the presence of high frequency current flowing from the shaft, through the bearing lubricant, to the grounded motor frame on all of the air handler motors driven by ASDs. Site tests were performed to evaluate the effectiveness of two bearing current mitigation methods:

1) A common mode reactor was placed on all three-output conductors between the ASD and the motor power terminals. No reduction in shaft voltage or common-mode current was observed.

2) A Mercotac™ 110-T grounding device was installed on a motor shaft. A grounding wire connects the grounding device to the base of the air-handling unit and a reading from the oscilloscope confirmed this grounding device effectively reduced the level of the shaft voltage peak to an acceptable level.

The ASD manufacturer issued a written report of their findings and recommended that this shaft grounding device be installed on all the motors.

The Mercotac™ device is basically a conductive grommet that is installed into the center of a hole drilled into the shaft end (preferably on the non-pulley side of the motor)[2] . The grommet makes contact with a stationary terminal lug that is soldered to a wire connected to the grounded motor casing or other nearby ground point. The Mercotac™ 110-T grounding device is preferable to carbon brush type grounding systems as the brushes must be monitored for wear and replaced frequently. The cost of the Mercotac™ 110-T device itself is approximately $35; a small price to pay to avoid premature bearing failure!

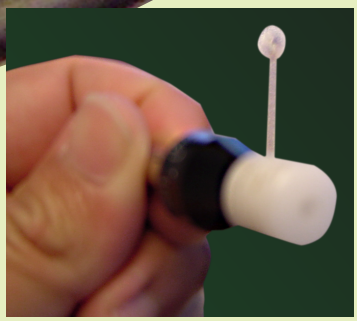

Fig. 3: Mercotac™ 110-T grounding device

[2] If you would like additional information on Mercotac™, see their website at http://www.mercotac.com. All references to Mercotac™ and its products are provided for information only and the Hawaiian Electric Company is not providing an endorsement or suitability of purpose, either express or implied. Use of any Mercotac™ products shall be at the user's sole discretion.