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DISCUSSION

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The variation in atmospheric humidity may have had an unknown effect on the results of Dr. Collins' tests. The literature indicates that humidity is an important variable and should be held constant unless it is under study.

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Almen[3] indicates that the bearings in automobiles shipped by railroad to the Pacific Coast have suffered more fretting damage in the winter when the humidity was low than in the summer when the humidity was high.

Uhlig, Feng, Tierney, and McClellan[4] report that they noted a significant difference in the weight lost by fretting action between summer and winter operation of their fretting test facility. After this discovery, they investigated the weight loss associated with the fretting action of mild steel on mild steel over a relative humidity range from 0 to 90 percent. Their results[5] show that 7 mg of material was removed at 0 percent relative humidity, 6.5 mg was removed at 30 percent relative humidity, 5.5 mg was removed at 70 percent relative humidity, while 5 mg was removed at 90 percent relative humidity. Each of these removals was made by 67,800 cycles of fretting. Thus, a 17 percent variation in fretting damage occurs over the relative humidity range from 30 percent to 70 percent.

An obvious test point is missing in Fig. 4 of Dr. Collins' paper. It is severe fretting (as defined by conditions of Table 1) with zero static stress in the specimen during the fretting application. This omission leaves some doubt about the shape of the severe fretting curve exhibited in Fig. 4.

Author's Closure

The comments presented by Dr. Foster are pertinent and well taken. The effects of atmospheric humidity on weight loss due to fretting have been noted by many investigators, and a clear correlation between weight loss and relative humidity can be demonstrated. However, no such correlation has been found between fretting-fatigue damage (for example, change in fatigue strength due to fretting) and relative humidity. An extensive testing program, involving more than three-hundred specimens subjected to various sets of fretting conditions, was conducted several years ago at The Ohio State University in an attempt to discover any correlation between weight loss and fatigue strength or fatigue strength and relative humidity. No correlation was found in either case. Based on these observations, and due to the practical difficulty of closely controlling humidity in the laboratory at the time the data for this paper were collected, it was decided to simply record the relative humidity and assume its effect on change in fatigue strength to be small.

The missing test point in Fig. 4 to which Dr. Foster refers, as well as numerous other interesting test points, will be presented as the data become available from the continuing experimental program.

[3] J. O. Almen, "Lubricants and False Brinelling of Ball and Roller Bearings," *Mechanical Engineering*, vol. 59, 1937, p. 415.

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[5] *Ibid.*, p. 44, Fig. 8.