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IS TERRORISM A NEW RISK?

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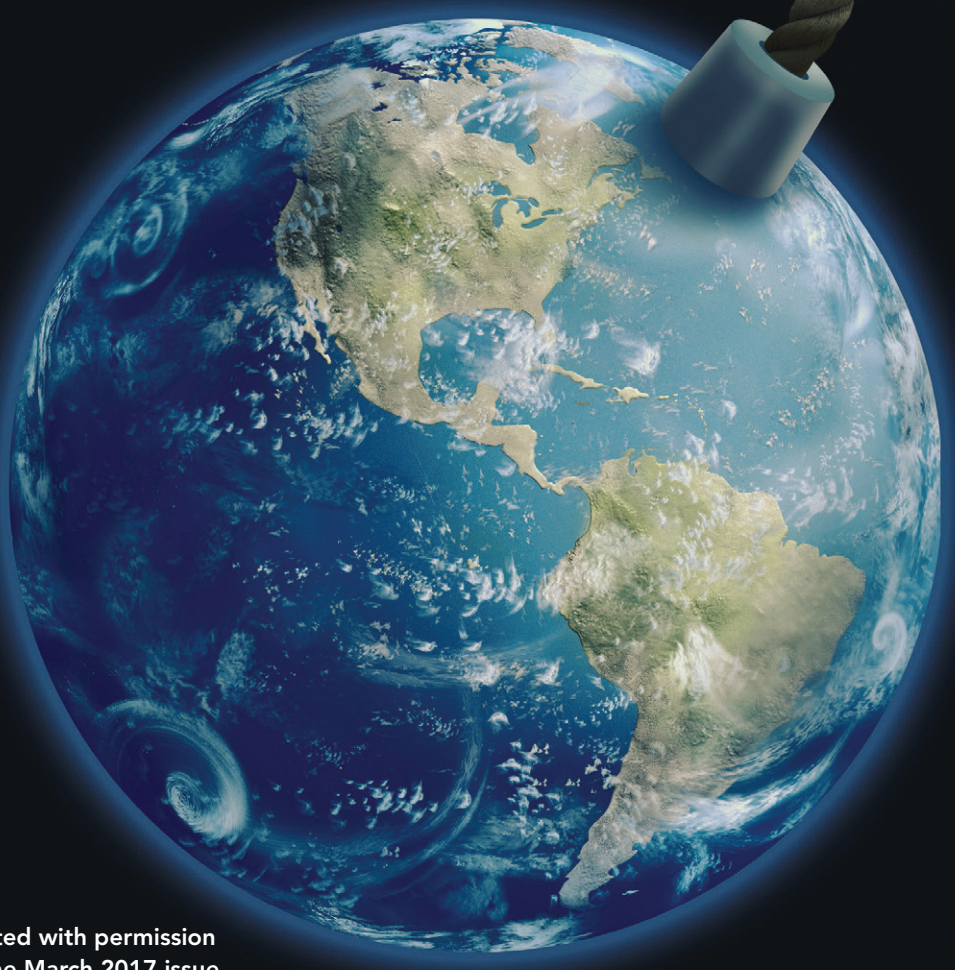

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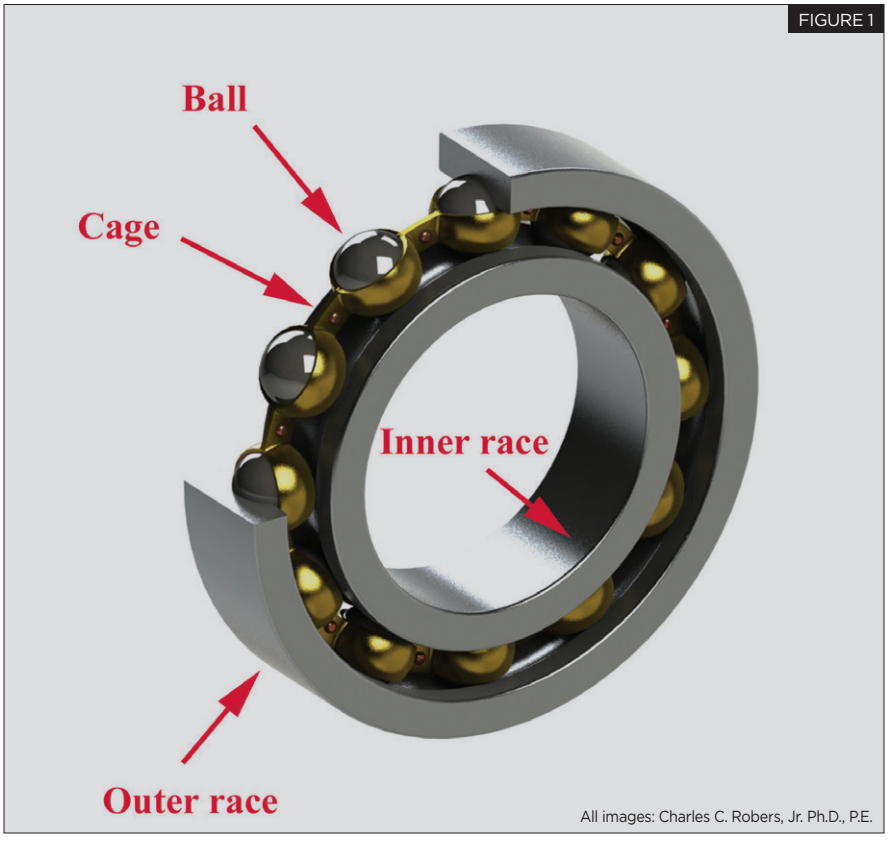
Bearing Failures Cause Large Losses

FIGURE 1



All images: Charles C. Robers, Jr. Ph.D., P.E.

Failures of bearings in machinery can cause large losses. A recent bearing failure in a large self-propelled combine harvester caused the loss of the machine valued at over $400,000.

There is a specific failure mode of bearings that has arisen in recent years which is associated with bearing failure, often referred to as cage failure.

Figure 1 is a view of a typical ball bearing. The balls roll in the gap between the inner and outer race guided by the cage, which keeps the balls separated. Roller bearings are similar in shape with the exception that the rolling elements are cylindrical in shape and are separated by a cage that matches this geometry.

Figure 2 is a view of a ball bearing cage, usually made of metal. Recently, plastic cages were introduced by manufacturers due to advantages in cost, smooth operation and ease of manufacture.

Figure 3 shows a typical plastic cage made of a polyamide such as nylon. A problem with the plastic cage is that the operating temperature of the bearing is restricted when compared to the metal cage. Equipment manufacturers may substitute a plastic caged bearing for a metallic caged bearing, ignoring the operating temperature bearing limitation.

Just because a particular metallic caged bearing has operated successfully in a machine since it was designed, does not mean a plastic caged bearing will operate in the same application. The metallic caged bearings tolerate temperature fluctuations caused by loading and environmental conditions.

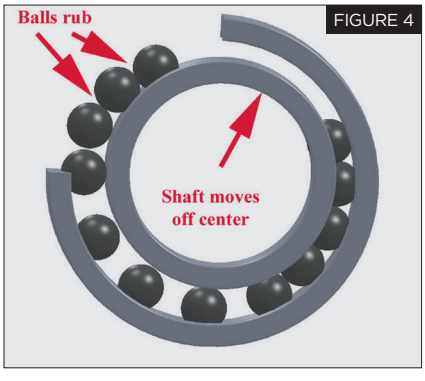
The high temperature limitation on polyamides is typically about 160 F. In an application, a plastic caged bearing may not tolerate a temperature fluctuation easily handled by a metallic caged bearing. The plastic cage can melt or soften, causing loss of bearing roller element spacing.

Figure 4 depicts what happens when the cage fails. Bearing balls lose the proper spacing in the bearing and rub together, creating excessive frictional heating and movement of the shaft off center, which can add to frictional heating with other components. The bearing can reach approximately 3000 F, causing a fire in the machinery and significant damage.

Figure 5 shows a failed bearing that started a fire, resulting in the total loss of the combine harvester. The shaft is off center and the rollers are missing.

Roller bearings are similar to ball bearings with the exception that the rollers are cylindrical in nature with cages of similar construction. It should be noted that the cage in Figure 5 was not found, suggesting that it may have been a plastic cage that was consumed in the fire.

FIGURE 4



Typically when a bearing fails and overheats, the metallic cage debris remains as shown in Figure 6, a ball bearing cage, and Figure 7, a roller bearing cage. When the claims analyst is faced with a bearing failure loss, the existence of cage

FIGURE 2

FIGURE 3

FIGURE 5

FIGURE 6

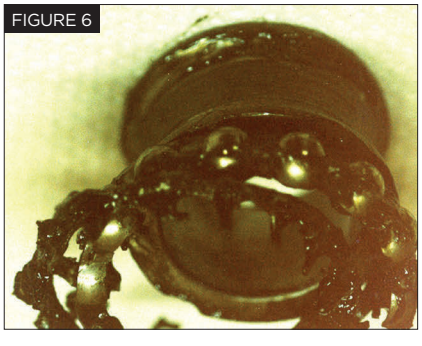


FIGURE 7

remains may offer a clue as to a deficiency in machine design. The absence of cage debris may suggest that the bearing was constructed with a plastic cage. Through discovery, if information is received that the original bearing had a metallic cage and that a plastic cage had been substituted, then a design related deficiency may be advanced as a probable cause of the loss.

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