



WARREN

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# Fires Involving Bearing Failures

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## **Fires**

A computer monitor beeps in the control room of a manufacturing plant during the night shift. A supervisor reads the alarm message flashing on the screen indicating a system error and the initiation of process equipment shutdown. Maintenance personnel are dispatched to the remote area of the plant where the monitored equipment is located. The maintenance technicians are surprised to discover a large growing fire in the equipment room. The fire department is able to extinguish the fire, but the damage sustained is extensive. The equipment and product were destroyed and the building itself severely damaged. The additional loss of production time and the required repairs created a very expensive loss.

Meanwhile, many miles away, a conveyor system operates unattended and unmonitored in a warehouse facility. A security guard happens to observe smoke rising from one of the warehouses and notifies the owners. The fire grew out of control and destroyed the entire building, creating another costly loss.

## **Common Ignition Source**

Although the two fires described above involved different types of processes and machinery, the cause of both fires was determined to be the same. In both cases, a **bearing failure** on the machinery created the ignition source and combustible materials within the proximity of the bearings supported and facilitated the spread of the fires.

## **Cause**

The failed bearings in both cases involved ball bearings supporting rotating shafts. In the case of the manufacturing facility, the bearing failure occurred on a large motor used to produce high torque and speeds. The motor was used to drive a batch-processing machine. Although an error was detected by the monitoring system, due to the nature of the process, the system was configured to allow the continuous operation of the motor until the product in the batch-processing machine was evacuated. Consequently, the electric motor continued to operate for a short period of time with the failed bearing at high torque and speed, generating extensive mechanical friction between the components. The mechanical friction produced extremely high temperatures igniting nearby combustible materials and compromising lubricating oil lines, allowing the fire to grow and spread quickly.

In the case of the warehousing facility, a small electric motor was used to drive the conveyor system at relatively low torque and low speeds. The system was operating inadvertently and unattended for an unknown period of time. The mechanical friction generated by a failed bearing supporting a pulley drive shaft produced hot metal slag, which fell into the product stored below the equipment. The system was unmonitored and the smoldering fire produced in the stored product grew substantially before it was detected.

### **Eliminating Potential Bearing Fires**

Bearings are mechanical devices used in machines primarily to reduce the mechanical friction between machine components that are moving relative to each other. The mechanical friction can quickly generate heat and temperatures hot enough to cause fires when oxygen and fuels are available. While this discussion has been limited to bearings on shafts, the concepts will generally apply to all bearings.



It is important to understand that all bearings will eventually fail even under ideal operating conditions if not replaced beforehand. Bearings have a calculated life expectancy dependent on the bearing capacity, imposed loading, operating speed and operating conditions. Any deviation from the ideal operating conditions can substantially reduce the normal life expectancy of a bearing, causing premature failure. Deviations from normal operating conditions include, but are not limited to, misalignment, overloading, corrosive environments, inadequate or improper lubrication, and vibration.

It is often important to parties involved in a machinery fire involving a bearing to know whether the bearing failed due to normal use and wear, or whether the failure can be attributed to another mechanism such as improper installation, inadequate design, or impact loading. In some cases, damaged bearings found after a machinery fire can be the result of the fire rather than the cause of the fire.

Premature bearing failures can result from one or more of the aforementioned conditions and a laboratory examination of the complete bearing assembly is generally required to provide the exact mode of failure. The Timken Company [bearing damage analysis chart](#)<sup>1</sup> is a tool often used by engineers when conducting an initial determination of a bearing failure mechanism.

Determining the cause of a fire in a large manufacturing or warehousing facility can be a daunting task, especially when complex machinery or other equipment may be involved. Beyond determination of a bearing failure as the cause of a fire it is often important to evaluate the adequacy and operation of fire alarm and suppression systems that could limit the fire damage resulting from a bearing failure. In both of the situations described above the fire damage could have been minimal if fire alarm and suppression systems had been present and operated correctly.

The engineers at The Warren Group are experienced in these areas and would be happy to assist with these investigations.

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<sup>1</sup> The Timken Company Bearing Damage Analysis Chart <http://www.timken.com/EN-US/products/bearings/productlist/roller/cylindrical/Documents/BDAPoster.pdf>