

# Zinc Whiskers Growing on Raised-Floor Tiles Are Causing Conductive Failures and Equipment Shutdowns

By Robert Sullivan, Ph.D.

Conductive contamination of computer-room equipment has been discovered to be a significant problem caused by “Zinc Whiskers” shorting out logic cards and power supplies. Only an estimated 1% of large system installations are affected, and the Zinc Whiskers do not pose a health hazard to humans. But the presence of Zinc Whiskers must be addressed as quickly as possible in order to minimize potential problems with installed computer hardware and any resulting impact on system availability. The only feasible recommendation for a fix is to replace all the affected tiles, and thoroughly clean the room.

Zinc Whiskers grow on metal stringers or off the bottom and sides of wood-core floor tiles that have a zinc electroplated-passivation coating on the sheet-metal pan. During the plating process, compressive stresses are imparted in the zinc coating causing the whiskers to grow. If the zinc is pure enough to create a regular crystalline structure, it will try to relieve this compressive stress by pushing whisker material out of the surface at specific locations in the lattice structure.

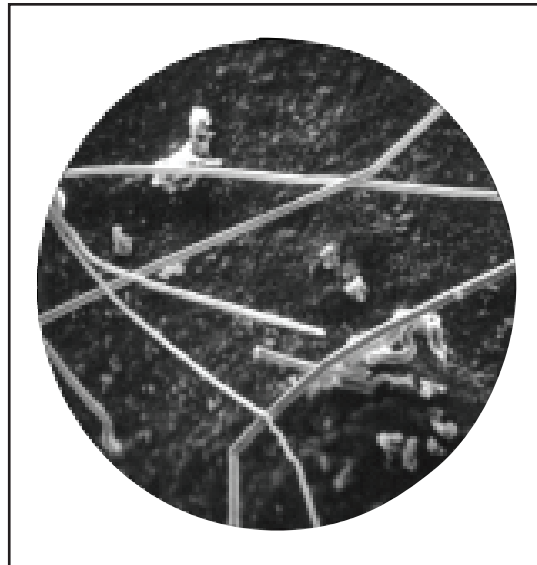
These Zinc Whiskers are about 2 microns in diameter and become a problem after approximately two years of growth when they reach a length of 500 microns. And they can grow to a length of over 2000 microns (2 mm) if left undisturbed for several years. The whiskers are so small that an attempt to use filters fine enough to trap them would dramatically reduce air flow and cooling capacity in the computer room.

As floor tiles are moved or disturbed, the Zinc Whiskers break off and become airborne in the turbulent air flow under the raised floor. Cooling fans in the computer equipment then draw the whiskers into the internal logic cages and power supplies of

the equipment. Once inside the hardware, the whiskers lodge themselves in the electronic components of logic cards and power supplies causing either a voltage or signal perturbation. At this point, the machine posts an error and can shut down.

Several sites have reported such failures in the power transistors of power supplies with one site experiencing seventy-seven power-supply failures in one week. This

high rate of failure is unusual since the whiskers completely vaporize at only 15 mA to 25 mA (milliamps), which usually is not sufficient current to cause shorting within a power transistor. Further investigation indicates these failures were from perturbations in the control circuitry of the power supplies, which allowed a short to occur between the voltage and ground planes of the transistor. Another phenomenon observed within power supplies is the ionization of air between two closely spaced high-voltage lands on a printed circuit board. The whisker is vaporized, creating an arc path across adjacent etchings on the board.



## Preventing Zinc Whisker Damage

The first step in preventing damage from Zinc Whiskers is to examine the data center to see if the condition exists. If wood-core floor tiles are present in the computer room, check to see if the bottom sheet-metal pan is passivated with a coating of hot-dipped galvanized (HDG) or electroplated zinc. The tiles should be free of whiskers if you find the spangle pattern associated with the HDG process. Electroplated zinc can be identified by a uniformly gray surface rather than a spangled surface.

Very often a bright-gray zinc surface has not yet begun to



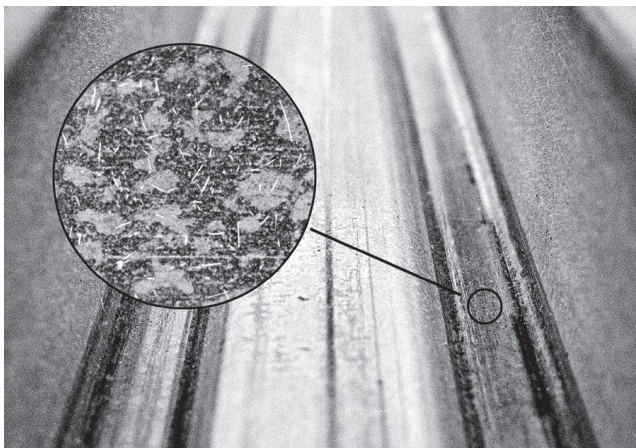
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grow whiskers, while a dull-gray surface indicates the presence of whisker growth. This is not an absolute determination, however, so a closer examination is required. Tip the suspected tile upright and examine the bottom and sides using a high-intensity light - either a work light or a bright flashlight will do. Position the light at various angles to the tile surfaces and look for tiny sparkles or twinkling. If present, there is a good chance the tiles are contaminated with Zinc Whiskers. Examine at least twenty-five tiles and the stringers supporting them before concluding that electroplated-zinc material is or is not present.

If evidence of Zinc Whiskers is found, carefully examine the entire raised floor to determine the extent of the contamination exposure. The level of risk will determine the recovery plan of action. If contamination is ten percent or less of the raised floor, purchase new HDG tiles and carefully install them in the room while the equipment remains operating. Dispose of contaminated tiles in sealed plastic trash bags, and contract to have the room thoroughly cleaned.

If the raised floor is grossly contaminated, define a more detailed work plan for replacing larger sections of floor or all the tiles. Identify areas of the floor to be replaced, move equipment as needed to isolate the affected areas, and be extraordinarily careful not to disturb any loose whiskers as you proceed with the cleanup.



### About the Author

Robert F. “Dr. Bob” Sullivan is a senior staff member at The Uptime Institute, Inc. Dr. Bob has probably helped diagnose and resolve more data center cooling problems than anyone else in the industry. He is a Stanford University Ph.D. mechanical engineer.

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