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CONTAMINATION CONTROL FOR LIFE SCIENCES AND MICROELECTRONICS

CASE STUDY:

The Birck Nanotechnology Center at Purdue University, West Lafayette, Indiana, houses over 20,000 square feet of climate-controlled cleanroom laboratories for cutting-edge nanotechnology research.

Purdue Nanotechnology Labs Employ Advanced Grounding Device to Ensure a Constant Flow of Clean Air

WILLIAM OH

A SINGLE SPECK OF DUST could spoil a whole experiment at Purdue University's new Birck Nanotechnology Center. To minimize the likelihood of such a scenario, the building's HVAC system has to be fast, forceful, and flawless. Such high performance is attained by carefully selected air-handling equipment that includes a new grounding device to extend motor life.

Adjacent to the Purdue campus in West Lafayette, Indiana, the 3-story Birck Center has many state-of-the-art laboratories for advanced nanotechnology research. The 71,000 square foot building is part of Purdue's Discovery Park, a 50 acre cluster of buildings devoted to interdisciplinary technological research in collaboration with corporations and government agencies.

The Birck Center's HVAC system maintains the labs at 30-50% relative humidity at all times and replaces the air at least 15 times per hour. Temperature is allowed to vary by no more than 1° C; a rise of just one degree causes microscopes and other equipment to expand by an amount equivalent to thousands of atoms.

Many of the labs (more than 20,000 square feet) are maintained as cleanrooms. The building's cleanrooms, equipped with vibration-isolation equipment and special filtration systems to keep the air nearly free of dust particles, are so tightly controlled that some have as many as 120 air changes per hour yet are not allowed temperature changes of more than 0.1° C.

Key to maintaining such conditions are high-volume fans, each equipped with a variable frequency drive (VFD) that enables the fans to automatically adapt to the weather outdoors, laboratory occupancy levels, and other factors by quickly changing speed. During construction of the Birck Center in the spring of 2005, the contract to supply eight of these HVAC fans went to Colby Equipment Co. Inc., headquartered in Indianapolis. Colby turned to Wisconsin-based Greenheck Fan Corp. for four 25 HP fans, each capable of moving more

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Figure 2: The AEGIS SGR™ Conductive MicroFiber™ Brush protects fan motors from damaging VFD-induced shaft currents, increasing bearing and motor life and HVAC system reliability.

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Mr. Oh has extensive design and application experience in both automation and product development, specializing in passive dissipative technology for mitigating unwanted electrical currents. He has developed products and manufacturing equipment for several companies and is a member of the Illinois Tool Works Patent Society. With an M.S. in Mechanical Engineering from the Korean Advanced Institute of Science and Technology and a B.S. in Mechanical Engineering from Pusan National University, he spent three years as a visiting researcher at the University of Massachusetts.

Electro Static Technology is involved in the elimination and/or mitigation of induced electrical charges on moving surfaces.

than 20,000 cfm of air; and four 5 HP fans, capable of moving more than 5,000 cfm each.

Colby specialist Tom Hall, a Purdue alumnus with a degree in mechanical engineering/technology, knew that without grounding devices, currents induced by the VFDs on the shafts of the fans' AC motors would discharge through the bearings, causing fusion craters on the bearing race walls. This phenomenon, if allowed to continue, would result in the race becoming severely pitted, leading to bearing (and motor) failure. Prior to failure, the pitting may cause noise and vibration that is magnified and transmitted by HVAC ducts. Because many of today's motors have sealed bearings to keep out dirt and other contaminants, electrical damage has become the most common cause of bearing failure in AC motors with VFDs. Depending on the business, the downtime and lost production resulting from such failures can cost many thousands of dollars in addition to the cost of replacing or repairing the motors.

In his search for grounding devices that would optimize the performance and durability of the variable-speed fans, Hall concluded that conventional metal grounding brushes would be difficult to attach, since the fans had already been installed. An Internet search turned up Electro Static Technology, a division of Illinois Tool Works and a Maine-based manufacturer of the AEGIS SGR™ Conductive MicroFiber Brush.

Consisting of a ring of conductive microfiber brushes that encircles a motor shaft, the SGR prevents electrical damage to AC motor bearings and extends motor life by providing a safe path to ground for harmful shaft currents. Maintenance-free, the SGR is unaffected by dirt, grease, or other contaminants and provides the long-lasting protection. Unlike conventional metal grounding brushes, the SGR's conductive microfibers work with virtually no friction or wear, have no RPM limitations, and last for the life of the motor.

Electro Static Technology was able to supply units compatible with the two motor types that power the Birck Center fans — NEMA frame 284T (with a shaft diameter of 1.875") and NEMA frame 184T (with a shaft diameter of 1.125").

"Purdue's engineers wouldn't let us turn the fans on until we had equipped them with grounding devices, so the main feature that sold me was the ease of installation in the field," Hall recalls. "All the installer had to do was remove the motor pulley, slide the ring onto the shaft, lock it in position with two screws, and slide the pulley back on. That was the beauty of the whole thing."

"Purdue has too much at stake for these fans to fail," Hall muses. "Who knows, but someday Purdue's Discovery Park might be the 'Silicon Valley' of nanotechnology. I'd hate to jeopardize that because fried fan bearings shut down a lab and held up some scientific breakthrough. I wouldn't want the glory going to some other school!"

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