

Humidity Control in Clean Rooms

Monitoring Relative Humidity in Moisture-Sensitive Environments

Many products manufactured and processed in a clean room environment are moisture-sensitive. For this reason, clean room specifications often include relative humidity (RH) control. These control points range from 35-65%RH for year-round operation. These RH levels generally are maintained in a narrow band ± 2 percent RH at temperatures below 70°F. The effects of higher humidity levels in close tolerance environments can be detrimental to product quality and production schedules.

In semiconductor manufacturing, when the humidity level fluctuates in a wafer fabrication area, a multitude of problems can occur. Bake-out times typically increase, and the entire process generally becomes harder to control. Humidity levels above 35 percent RH make the components vulnerable to corrosion. Additionally, as developer solvents are sprayed onto the wafer surface, the solvents evaporate rapidly, cooling the wafer enough to condense moisture from the air. This extra water can change the developer characteristics and be adsorbed onto the semiconductor layers. This can cause swelling and further product quality problems, necessitating additional process control.

In pharmaceutical manufacturing facilities, high humidity causes fine powders to adsorb moisture, clogging the powder feed to the tableting press. Powder inconsistency caused by moisture adsorption results in crumbling tablets and clogged tablet dies. Variations in humidity mean difficult adjustments in bed temperature and spraying rates, resulting in heat damage and moisture intrusion. Humidity in air ductwork creates moist places for bacterial colonies to grow and cause process contamination.

Two common approaches to humidity control are air conditioning and desiccants. Air conditioning lowers the temperature of a surface exposed to the clean room airstream below the dew point of that airstream. Excess water vapor condenses and the resulting air is dehumidified. The air must then be reheated to the proper control temperature and routed to the clean room. Standard refrigeration equipment can produce dew points of +40°F (4°C) on a reliable basis.

In a desiccant system, the process airstream passes through a desiccant medium. The desiccant adsorbs moisture directly from the airstream, and the resulting dehumidified air is routed to the clean room. Desiccant dehumidifiers can produce dew points below 0°F (-18°C), a fivefold reduction in the air moisture beyond what can be achieved with standard HVAC-grade refrigeration systems.

Either the General Eastern MDR series relative humidity probe or the MMR 31 series transmitter can be used to monitor the relative humidity and temperature of clean room environments. Housed in the tip of the MDR or MMR is a silicon-based polymer sensor to measure the moisture, as well as a platinum RTD to measure the temperature. The capacitive moisture sensor and RTD combine to provide relative humidity readings, with temperature compensation for maximum RH accuracy over the entire operating temperature range. A hydrophobic sintered stainless steel filter protects the sensor from water droplets and prevents sensor contamination. The rugged half-inch 316 stainless steel probe can be mounted in a variety of ways, using adjustable tube compression fittings. Various probe lengths are available, as is an optional flange mount probe, also with adjustable insertion depth.

The MDR series RH probe can be used with either the HygroTwin 2850 or RH-Plus 2250 moisture analyzers. The 2850 has two current outputs that can be assigned to the relative humidity or temperature values. The 2250 can be ordered with current outputs for both relative humidity and temperature. The current outputs of either analyzer may be utilized to continuously monitor clean room airstream conditions. The MMR 31 can be ordered with either one or two outputs for the same functions as above. This information could be used as feedback to the process control or the HVAC system to optimize the clean room environmental parameters. The alarm contacts of either analyzer may be set for relative humidity and temperature to indicate a system malfunction or warn of a condition that could be detrimental to production.

Possible Probe Locations in a Desiccant Clean Room System

