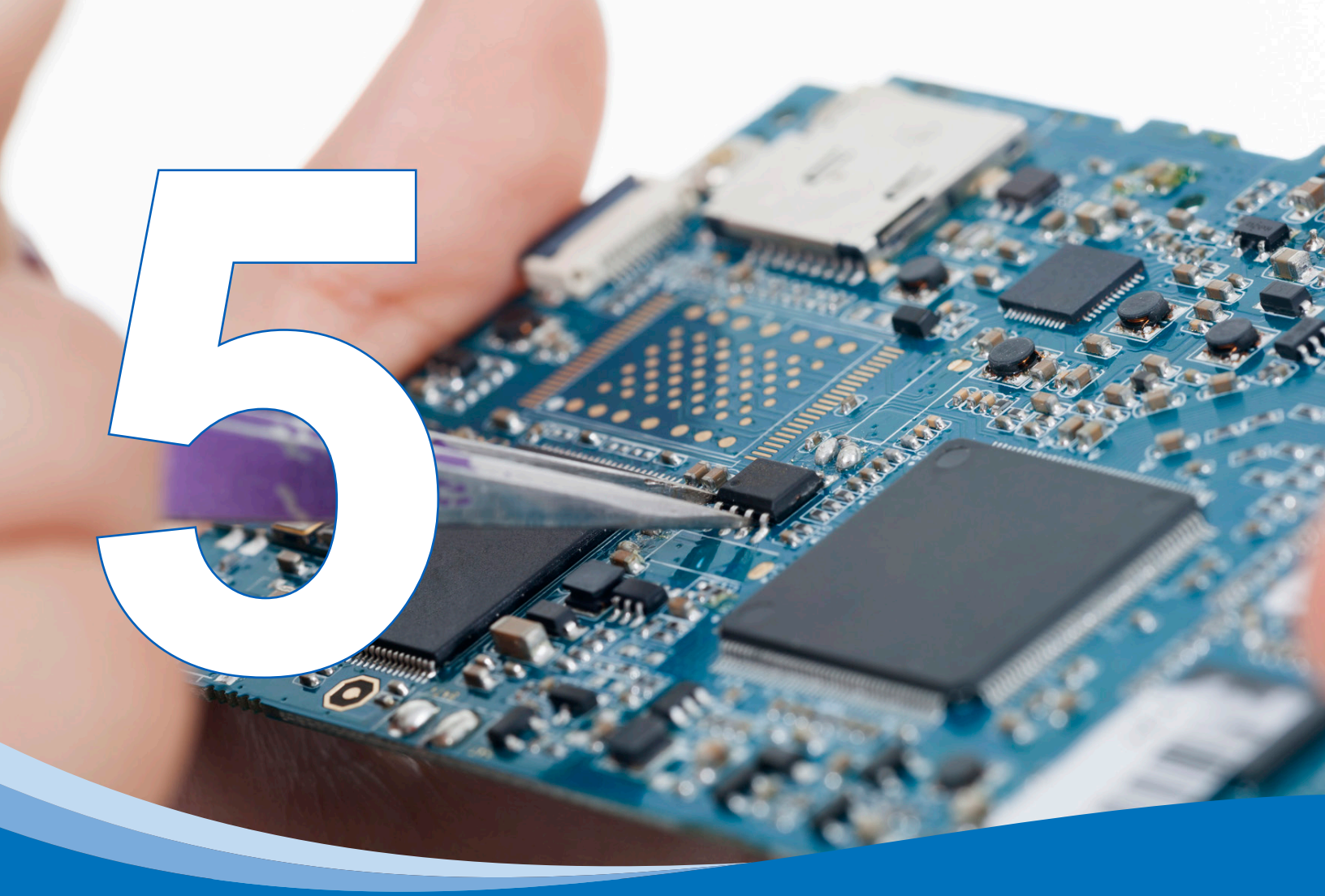


5

Trends Shaping the Future of Electronics Manufacturing Facilities Management

condair

Table of Contents

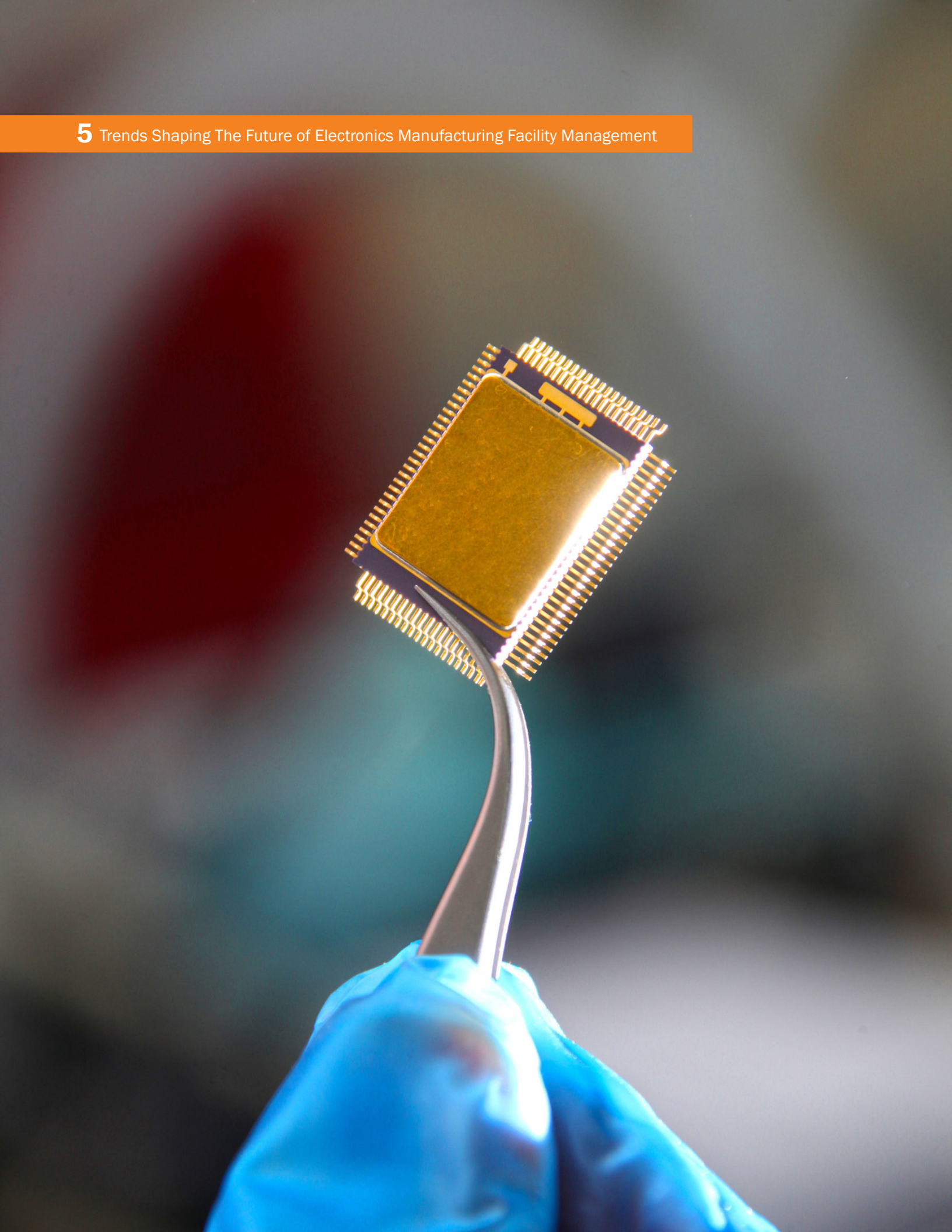
5 Trends Shaping The Future of Electronics Manufacturing Facility Management

Executive Summary

In 2011, 21 percent of the global electronics output came from the Americas.[1] In fact, according to New Venture Research, electronics manufacturing services (EMS) was a 430-billion-dollar business in 2015 and is predicted to grow to 580-billion by 2020, in part due to the rapidly changing technology field.[2] The increasing demand for electronics also means facility managers are under pressure to reduce energy use while increasing productivity. Additionally, they assume the responsibility of creating and maintaining optimum indoor environments for both their employees and the products being manufactured. In this industry, humidity control is critical in eliminating electrostatic discharge (ESD), reducing de-soldering occurrences and minimizing brittle components to decrease device failures and increase the long-term reliability and performance of electronic devices while maximizing ROI.

In an increasingly competitive market, facility managers can't afford to make costly mistakes. For this reason, staying ahead of the competition requires a focus on using the latest technologies available. This is the key to developing and maintaining efficient and cost effective solutions that meet the needs of the growing electronics industry.

5 Trends Shaping The Future of Electronics Manufacturing Facility Management



Industry Challenges

The electronics manufacturing industry provides a wide variety of electronic equipment, ranging from semiconductors to communications equipment. The industry began with manufacturing vacuum tubes, graduated to transistor and semiconductor diodes and now produces integrated circuits. However, these electronic devices, printed circuit boards, components and data are highly sensitive to ESD—the sudden flow of electricity between two electrically charged objects caused by contact. It's important to note that many ESD events occur without a visible or audible spark. An employee carrying a relatively small electric charge may not feel a discharge sufficient to damage sensitive electronic components. These forms of ESD can cause outright device failures or may affect the long-term reliability and performance of electronic devices.

Electrostatic induction is another cause of ESD damage. This occurs when an electrically charged object is placed near a conductive object isolated from ground. The presence of the charged object creates an electrostatic field that causes electrical charges on the surface of the other object to redistribute.

Most electronics manufacturers establish electrostatic protective areas free of static to minimize ESD. They use measures to prevent charging by avoiding highly charging materials and to remove static by grounding human workers or providing antistatic devices. In addition to these procedures, controlling the humidity in the facility is an optimal method to reduce ESD.

Controlling the humidity to a level above 40 percent relative humidity (RH), lowers the surface resistance on floors, carpets, table mats and other areas. Humidifiers add moisture to the air, and the moisture in the air forms a thin protective "film" on surfaces that serves as a natural conductor to dissipate electric charges. When humidity drops below 40 percent RH, this protection is greatly reduced and normal employee activities

CONTINUED....

Industry Challenges *continued*

contribute to objects becoming charged with static electricity.

Low humidity also contributes to problems in wave soldering and surface-mount technology (SMT) processes, such as the solvents found in solder paste quickly evaporating and drying out the paste. This may result in defect levels in wave soldering and SMT applications as well as insufficient solder joint defects. Conversely, in high humidity the solder paste and SMT glue may accept water and produce problems during soldering. Controlling moisture is critical during SMT reflow processes as well, where excess moisture trapped inside components can expand during the process and damage sensitive subcomponents.

Finally, defects and damage may occur in moisture-sensitive electronics components, leading to shorter shelf lives. This often occurs when excessive trapped moisture expands and contracts due to thermal variations during manufacturing causing delamination of plastic parts from the sub frames, poor wiring bonding or internal cracking. Components and parts may break during manufacturing, in house movement, storage and transportation, which can lead to poor production quality and lower customer satisfaction.

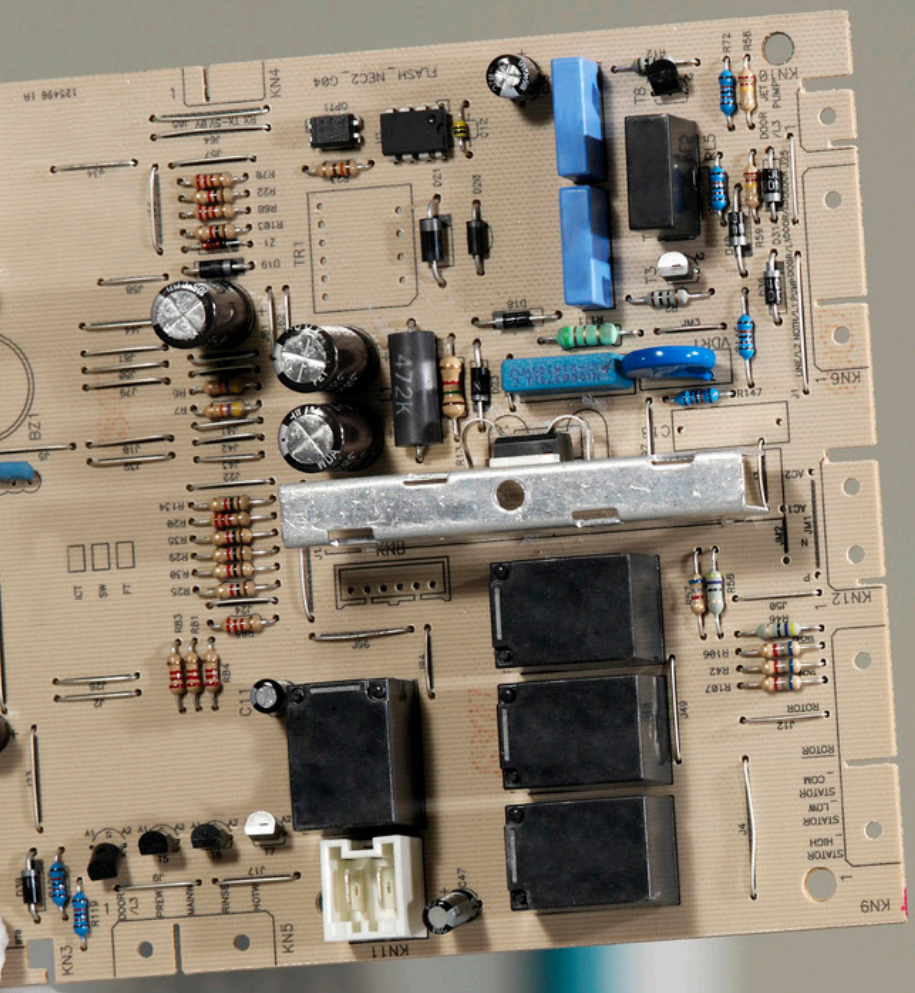
Electronics manufacturing facilities are challenged to establish electrostatic protective areas free of static while controlling both temperature and humidity to decrease defects and increase component shelf life. In addition, manufacturing facilities managers are encouraged, and sometimes regulated, to implement green technologies, including reducing electricity and water use and increasing the use of recycled materials. Advancements in humidifier technology have led to a greater controllability, reliability and efficiency, while evolving building designs have enabled greater HVAC performance. The humidifier systems of today are the ideal solution to reduce electrostatic discharge while contributing to improved indoor air quality, increased productivity and decreased energy and water waste.

5 Trends Shaping The Future of Electronics Manufacturing Facility Management

5 Trends in Electronics Manufacturing

Regulating the indoor environments of electronics manufacturing facilities is critical when inconsistent temperature and humidity levels can lead to equipment failure, unplanned downtime and loss of revenue. At the same time, the push for greater energy efficiency and greener options is creating a need for higher performing HVAC options. While today's facility managers continue to shoulder increased responsibility with ever changing technologies and market needs, more building regulations are adding to already full plates. The Energy Independence and Security Act of 2007 requires all new commercial facilities built after 2025 to achieve zero-net-energy use and owners of existing commercial buildings to upgrade by 2025.[3]

Achieving these energy saving goals in the time allotted will be challenging for electronics manufacturing facility managers. That is why it makes addressing these issues essential. In order to accomplish energy saving goals, here are five industry trends that are shaping internal environments in the electronics manufacturing industry.



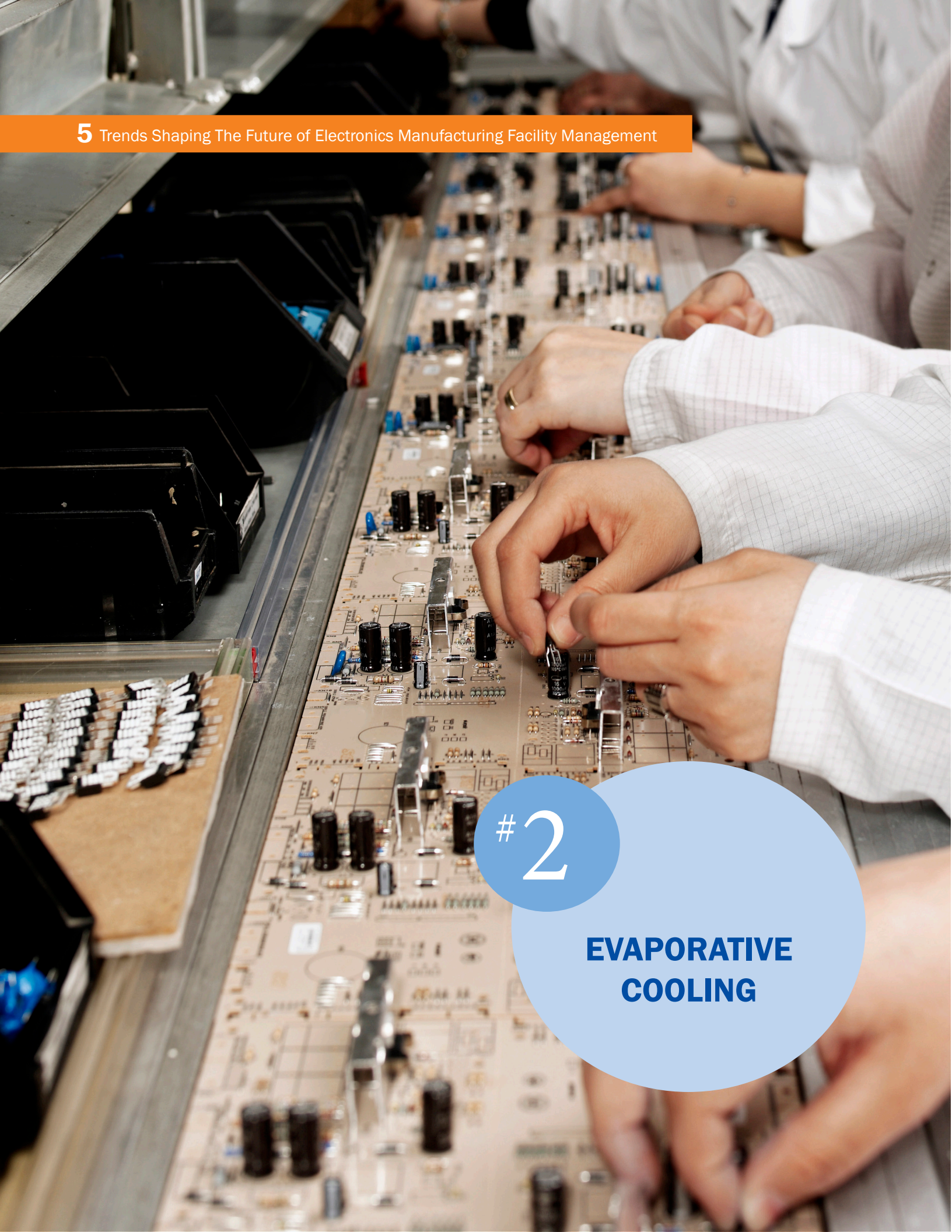
1

AIR QUALITY MANAGEMENT

#1 Air Quality Management

> “Air quality is an issue for employees as dust particles from the hazardous materials used to create electonic components can become airborne”

There are several air quality issues unique to the electronics industry. Dust is a primary concern for facility operators. Many electronic components must be manufactured in very clean conditions to avoid contamination of both the process and the products. Dust contributes to electrostatic charges, which short out electronics components. This problem is exacerbated in low humidity as airborne dust particles are attracted to static electricity. Additionally, many dust particles are hygroscopic, meaning they absorb and release moisture to balance with the environment around them. In dry environments, the dust particles lose the water weight that would otherwise help them settle out, and are more likely to remain suspended in the air. With higher concentrations of dust there is an increased risk of dust contamination and in extreme cases, dust combustion. In addition, air quality is an issue for employees as dust particles from the hazardous materials used to create electronic components can become airborne, increasing the inhalation risk. Implementing a humidity control system is one of the best solutions for managing the moisture content and other air quality issues is electronic manufacturing. In particular, evaporative humidification/cooling systems are very effective in these applications.



#2

EVAPORATIVE COOLING

#2 Evaporative Cooling (Direct and Indirect)

> "In climates with warm and humid outdoor conditions indirect evaporative cooling can be employed"

Electronics facilities generate a tremendous amount of heat from the machines that manufacture the electronics. This heat requires high cooling loads. Evaporative cooling helps offset cooling costs, saving money as well as the facility's chillers and air conditioning, while simultaneously providing humidity control.

Evaporative cooling is a process that introduces liquid water directly into the air without the need for adding thermal energy (heat) to the water. As the water evaporates, it draws heat from the air to drive the phase change from liquid to vapor. In fact, the process removes approximately 1,000 BTU of heat for every pound of water, reducing the air temperature significantly through an effect called evaporative cooling. This cooling effect generally requires very low input energy to operate the evaporative humidifier/cooler and directly reduces the need for mechanical cooling. Reducing mechanical cooling requirements offers significant energy savings.

There are two primary methods for evaporative cooling: direct and indirect. Direct evaporative cooling involves adding moisture directly to a primary airstream conditioning a space, or even adding moisture directly to the space itself. This process results in both cooling of the airstream and increased

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Evaporative Cooling (Direct and Indirect) *continued*

humidity in the space. In climates where direct evaporative cooling in the ventilation air stream is not practical due to existing humid conditions, a different approach called indirect evaporative cooling can be employed. Indirect evaporative cooling involves placing an evaporative cooler into the exhaust airstream. The exhaust air is cooled evaporatively as much as possible and directed through an air-air heat exchanger where it pre-cools incoming supply air. The moist air is then exhausted from the building. The result is a reduction in mechanical cooling requirements without adding moisture to the building.

Unfortunately, facility managers make the mistake of associating evaporative cooling with dampness, biological issues and odors. As a result, they miss out on the energy reducing opportunities of this process. Modern evaporative cooling systems address many of these issues with intelligent controls, drying and washing cycles and sterilization systems. Control accuracy has improved greatly over the years, which facilitates better tracking of set points and part load operation in the shoulder seasons.

3

LONG-TERM SUSTAINABILITY

#3 Long-term Sustainability

> "The global green building sector continues to double every three years, with survey respondents from 70 countries reporting 60 percent of their projects will be green by 2018."

For facility managers, long-term sustainability is a two-fold concern. From a financial standpoint, creating and maintaining a sustainable facility are costly. Updated equipment and the required operating software consume a substantial portion of any budget. For example, installing a more efficient $10 million HVAC unit may require an additional $40 million in operating costs over the life of the building. Maintaining sustainable environments also is a time management issue, especially with the push for LEED certification. According to Dodge Data & Analytics, a leading provider of data, analytics, news and intelligence serving the North American construction industry, "the global green building sector continues to double every three years, with survey respondents from 70 countries reporting 60 percent of their projects will be green by 2018".[4] Responsibility for measuring and recording the results of the energy savings falls on the shoulders of facility managers, adding to an already lengthy list of job responsibilities.

Energy management plays a significant role in maintaining a cost-efficient building. Achieving this goal requires a commitment to invest in best practices facility management. Yet, in committing to important issues such as energy savings, facility managers often under-estimate the impact of the HVAC system. Citing budget constraints or lack of available skilled staff, they ignore product updates and thus miss out on energy saving opportunities. Understanding the need for high-performing HVAC systems begins with recognizing how individual components interact. For instance, updating ventilation equipment to provide increased air flow falls short if existing sheet metal duct work cannot accommodate the increased pressure. Similarly, replacing something as simple as air filters will do more harm than good by releasing particles and contaminants throughout the building if existing ductwork is not cleaned beforehand. And,

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Long-term Sustainability *continued*

failure to accurately document replacement parts on work orders makes it difficult to identify problem areas when issues arise, order parts, and install them correctly. Consistent follow through is the key to getting the most out of any HVAC system. Regular maintenance of HVAC systems can reduce energy costs by 5 to 40 percent.[5] Overall, effective energy management requires checks and balances, the right people overseeing the system and monitoring energy savings to make sure expected goals are met.

With recent high profile water shortages in the United States, the push for more environmentally friendly workplaces and the desire for increased energy savings, water conservation is gaining a new importance in facility management. Because copious amounts of water are required to operate commercial HVAC systems, this can be challenging. In addition to the heating boilers, cooling towers and chilled water systems that are common in many buildings, central steam systems, increased cleaning and disinfection, and humidity control systems add to increased water usage. In particular, humidifiers contribute to the overall building water usage. Determining the amount of water necessary to humidify a facility begins by calculating the load, which is based in part upon the size of the facility and the number of spaces that require humidified air. Heating the air causes a significant decrease in relative humidity (RH) even though the actual mass of moisture in the air has not changed. This means that ventilating with outside air cooler than the building set point tends to dry the building, an effect that is especially pronounced in cold climates. Overall, stabilizing the humidity requires adding water to the air, increasing overall water usage. The humidity added to the air represents only part of the water required for continual operation. Also, all natural

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Long-term Sustainability *continued*

water contains minerals. While these minerals are beneficial in drinking water, they contribute to scale formation within HVAC and plumbing systems. Regardless of the process, whether utilizing boiled, evaporated or filtered water, keeping an HVAC system clean and running efficiently requires flushing out minerals. Depending upon the number of minerals present, the waste water used in the process can be considerable.

Many products that utilize water allow users to configure drainage, flushing and automatic cleaning cycles, but these are seldom adjusted from factory default parameters. Taking the time to understand and optimize these parameters can result in significant water savings and, at the same time, sustain the benefits the equipment offers to the building. Newer equipment may offer other benefits. Because efficiency levels of water treatment systems have increased in recent years, many new devices can tolerate broader water quality ranges resulting in less water treatment. In areas where water treatment is required to remove hardness and minerals from the water, consider using blended streams of treated and municipal water directly to reduce the loads on the treatment system. The tradeoff will involve an increase in descaling of equipment, but will often reduce overall water losses at the treatment system.

4

HUMIDIFICATION / DEHUMIDIFICATION

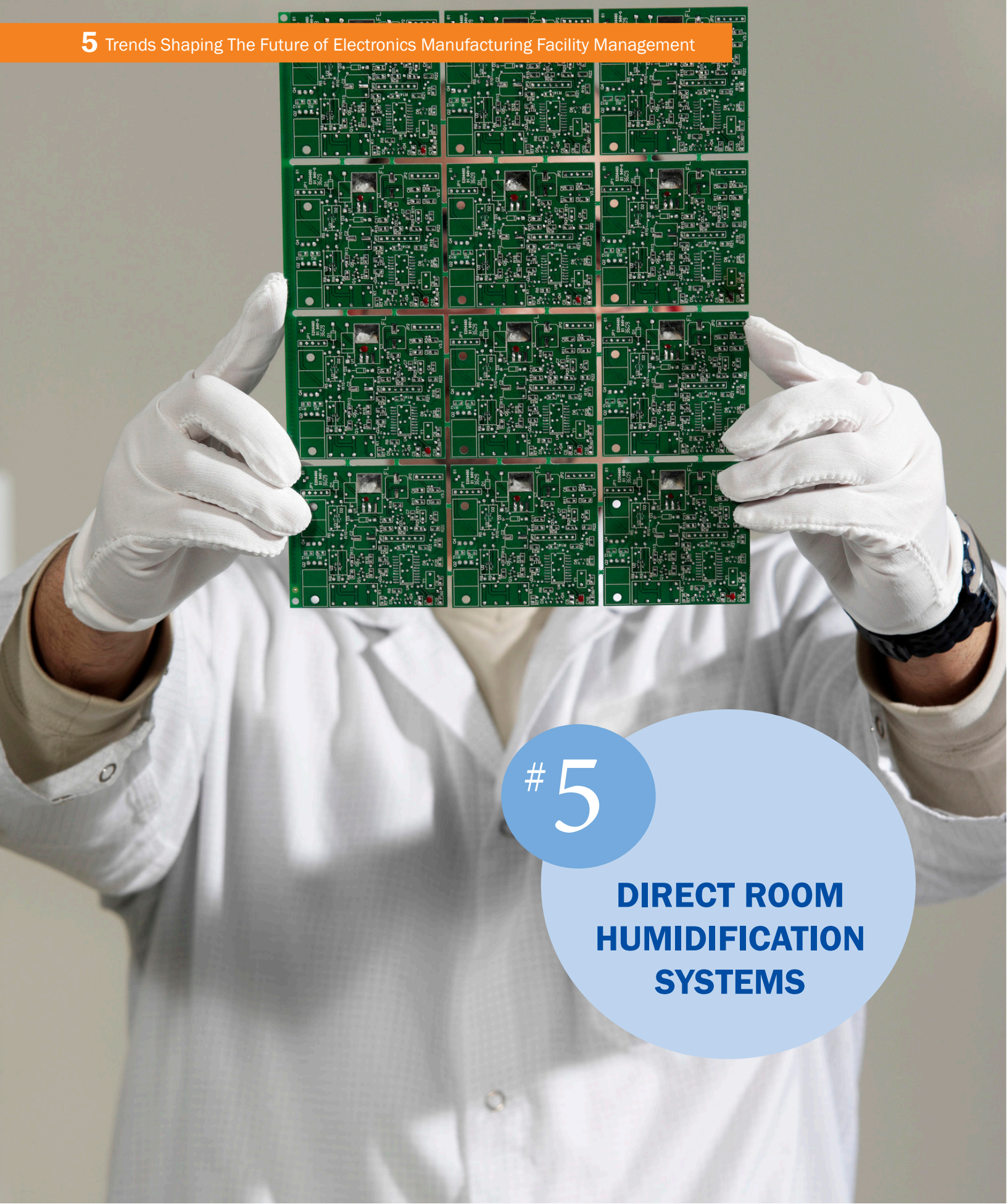
#4 Humidification / Dehumidification

> “Humidity and temperature ranges must be maintained for the equipment to optimally perform”

The word humidity often conjures up negative connotations, from muggy summers to dangerous mold growth. It’s no surprise that many facility managers assume humid indoor air is a problem. High humidity causes many problems for electronics manufacturers, especially with condensation and moisture on internal components. This can cause the electronics to malfunction.

Equally important is the effect low humidity has on electronics manufacturing facilities. In low humidity, static electricity increases, which can damage electronic components. However, with a humidity level of 40 percent RH, surface resistance is lowered on floors, carpets, table mats and other areas, decreasing static electricity.

Many facilities are equipped already with humidification equipment; however, it is not always used or maintained to the fullest capacity. Tracking moisture levels in the building over the course of all seasons can help facility managers identify dryness issues and maintain appropriate levels. In most North American climate regions, additional moisture needs to be added in the facility environment during the cooler months to compensate for dryer air. Many electronics manufacturing processes operate under very controlled conditions, which means specific humidity and temperature ranges must be maintained for the equipment to optimally perform as well as to keep it under warranty. Evaluating the state of humidification equipment, ensuring it is correctly installed and commissioned and regularly inspected all contribute to efficient and trouble free operation when moisture is required. Many manufacturers offer service programs or regular maintenance kits that can greatly simplify the upkeep of equipment.



#5

DIRECT ROOM HUMIDIFICATION SYSTEMS

#5 Direct Room Humidification Systems

> “Energy-saving opportunities and ease of operation of the high pressure direct room systems set them apart”

Indoor air humidification is typically associated with in-duct humidifiers. Humidity introduced through the HVAC equipment is distributed by means of the ventilation ductwork. Direct room high-pressure humidification systems change this equation. Using a high-pressure pump system, these systems deliver an ultrafine mist directly into a space, providing humidity control exactly where it is needed. While these systems may not be suitable for all types of clean rooms, they do have many valuable benefits in other areas of electronics manufacturing, in particular the final assembly of electronic products. In spray cooling, the air is cooled via an ultrafine mist sprayed into the air. As the water evaporates, the air temperature is decreased. By only spraying water when needed, both water and energy are conserved, offering significant operational savings.

Additionally, energy-saving opportunities and ease of operation of the high pressure direct room systems set them apart. Without the need for an air handler and ductwork, these systems can operate autonomously or in locations where ducted systems are impractical. They also can simplify retrofit costs by reducing the need to install additional ventilation systems to resolve humidity issues. High pressure systems can respond very quickly to changes in space conditions, regardless of the temperature settings. In addition, they are

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Direct Room Humidification Systems *continued*

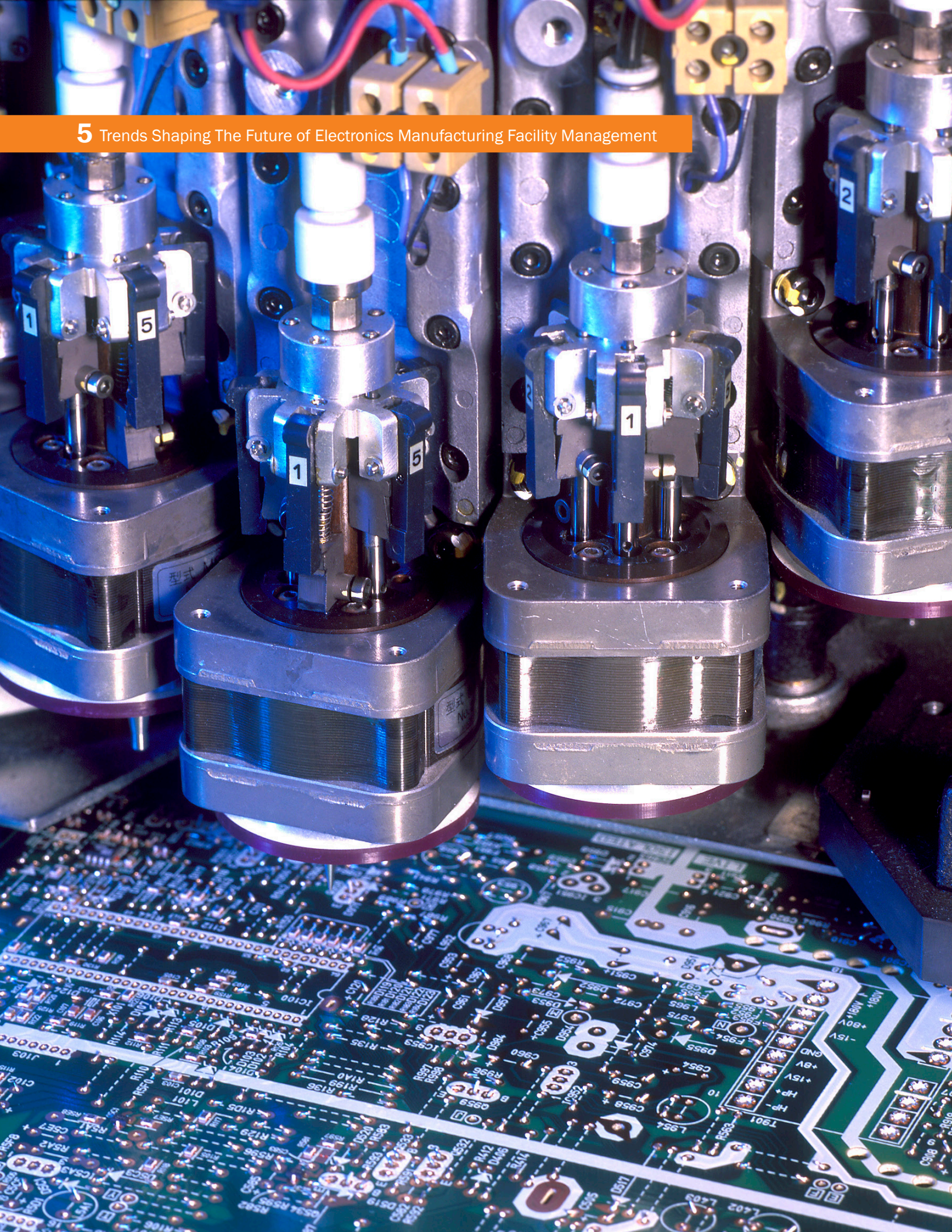
able to track set points with a high level of precision. Pumps and water treatment systems can be located in a separate mechanical room from the spray nozzles so that business operations are not disrupted during servicing. This results in less down time and lost revenue. As a bonus, the cooling effect of water evaporation can provide cooling directly to the room, reducing mechanical cooling requirements.
The system lessens the HVAC workload, which is particularly important for organizations with spaces that require year round cooling.
Facility managers may assume that the fine mist can lead to water issues. As a result, some are hesitant to invest in this humidification process. However, this resistance is unfounded. Benefits of a direct room high pressure system and ease of operation make this system ideal for many facilities.

5 Trends Shaping The Future of Electronics Manufacturing Facility Management

Industry Solutions

Facility managers are confronted with a pressing need to control the humidity of the air in their facilities. Being able to precisely configure the humidity throughout the production process is an essential factor in ensuring product quality remains consistently high. Using dehumidifiers and dryers helps to ensure that these processes remain safe and stable. Additionally, humidification levels play a critical role when it comes to reduction of static in the air. Depending on the type of machinery, friction caused by static can reduce speed and efficiency. Static can impact the success of chemical reactions and can be highly detrimental for electronics, where friction has been shown to short out circuit boards. Finally, from a safety standpoint, such as working with flammable liquids, high levels of static can lead to explosions. The main goal of electronics manufacturing facility managers is to meet the needs of their facilities by maintaining operations and preventing downtime. Providing exceptional air quality is an essential part of this puzzle.

5 Trends Shaping The Future of Electronics Manufacturing Facility Management



Eight Environmental Tips for Electronics Manufacturing Facility Managers

The following tips can help facility managers stay on top of the rapid changes in the industry and produce better internal environments:

The following tips can help facility managers stay on top of the rapid changes in the industry and produce better internal environments:

1. Use effective, efficient, cutting edge HVAC equipment. Seek out advances in hygiene, energy and sustainability that are changing the marketplace.

2. Monitor building conditions consistently. Create a systematic process for review and maintenance. Be willing to adapt to changing conditions.

3. Seek feedback from operators and staff to gauge the facility's performance. Often, early signs of failure appear as complaints from staff.

4. Work with quality managers to identify patterns in first time pass yields. Sometimes, these can be improved by altering ambient conditions.

5. Implement enhanced maintenance and control strategies to meet the new regulations for hygiene in water systems. Review ASHRAE's new Legionella Standard for useful advice.

6. Maintain RH levels between 40 and 60 percent. Invest in reliable humidity indicators to ensure precision control.

7. Outsource maintenance to companies that employ knowledgeable, skilled and certified staff. Be willing to share in the responsibility of keeping the facility functioning at top levels.

8. Stay current on evolving trends. Continuously look to industry leaders for products, procedures and technologies that can improve facility efficiency.

5 Trends Shaping The Future of Electronics Manufacturing Facility Management

Conclusion

Today, regardless of the industry, a clean, uncontaminated, indoor environment is essential and expected. For electronics manufacturing facility managers and owners, who face an expanding global market, this reality takes on a whole new importance. For this reason, choosing a HVAC system that meets need of the specific facility is essential along with recognizing the relationship between humidification levels and productivity, quality and efficiency. Creating and maintaining an overall program of static electricity reduction helps to increase productivity, decrease waste from damaged components and improve indoor air quality for both manufacturing and employee health.

Overall, an increasingly competitive market demands cutting edge technology, progressive thinking and the ability to embrace changes coming down the pipeline. Facility managers who see the bigger picture, demonstrate leadership by challenging the status quo and seek new technologies and solutions are confidently moving their electronics companies forward today and into the future.

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About Condair

Condair is the leading manufacturer and provider of complete solutions in the areas of humidification and evaporative cooling, with a comprehensive portfolio including products, services, experience and know-how. This enables us to create the ideal indoor climate while keeping energy consumption low and reducing impact on the environment. The company also offers humidifier design, manufacturing, supply, installation, and maintenance, as well as solutions for bacteria control, bacteria testing and energy efficiencies to significantly improve facilities and production. Today, with approximately 600 employees, Condair operates production sites in Europe, North America and China, are represented in 15 counties by its own sales and service organizations and is supported by distribution partners in more than 50 locations worldwide.

For more information or to contact your local Condair representative visit www.condair.com or call 1.866.667.8321.