5 Trends Shaping The Future of Aerospace Facility Management

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Executive Summary

The most important task faced by aerospace facility management is accuracy control. Experienced managers recognize the complexity of assuring control of all elements from clean rooms, with extremely sensitive environments, to production where controllability is always a major concern. In an increasingly competitive market, facility managers cannot afford to make costly and potentially catastrophic mistakes.

A paramount but preventable problem is electrostatic discharge (ESD), an ever-present risk in environments that lack humidification. Improperly controlled ESD can ruin electronics and chips. Variables that compound this threat are easily controlled with a humidification process designed for aerospace facilities, yet many managers choose to limit their plant's humidification capability. While this decision is often due to budgetary reasons, it is likely to put their facilities at risk.

Coating is another process that exemplifies the need for humidification. Many parts and components have to be coated in specific temperature and humidity ranges depending on the type of product and curing time. Tolerance ranges can vary from three to 10 percent relative humidity (RH). Since there is minimal margin for error, mistakes can prove expensive for every aerospace manufacturer.

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Evolution of the Industry

From its origins in fabrics and wood in the dawn of aviation, today's aerospace industry relies more on composite materials and less on aluminum to achieve greater performance and lessen the need for maintenance. "Aerospace Products and Parts Manufacturing," a report released by Hoover's Inc., (Aug. 23, 2016), lists business trends that are inevitably impacted by climate control. One that stands out is "increasing use of automated controls." Hoover's report cites the emphasis on automation in general and avionics in particular for military, business and commercial aircraft. "Avionics and related parts suppliers must keep pace with this technological innovation to remain competitive," it states.

Add to the list greater tolerances, expedited construction, and the growing use of composite materials instead of aluminum airframes. All these variables occur in environments that must be tightly controlled to reduce the possibility of increasing defect rates. Facility audits tend to focus on these shortcomings, and their findings should be the proverbial wake-up call. Humidity control deserves to be among the highest of priorities.

Analysis should begin with the facility's heating, ventilation and air conditioning systems (HVACs). As aerospace environments have evolved, so has HVAC. Advancements in technology have led to increasing thermal and humidity effects while evolving building designs prompt the necessity of greater HVAC performance. The increasing complexity behooves managers to be proactive for several reasons, including reduction of risk, improving the facility's competitive position and ensuring corporate profitability.

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5 Trends in Facility Management

While today's facility managers continue to shoulder increased responsibilities, building regulations add to already full plates. Consider the Energy Independence and Security Act (EISA) of 2007. EISA requires that all newly constructed facilities achieve net zero energy use by 2030, and that existing commercial buildings, including aerospace complexes, upgrade in 20 years. Achieving energy savings goals by EISA's deadlines will be mandatory for facility managers charged with addressing these long-range issues today. Regulatory compliance is just one of several challenges that include energy and cost efficiencies, climate control and risk reduction. Five industry trends that shape internal environments are helping aerospace facility managers effectively respond. These trends are:

#1 AIR QUALITY MANAGEMENT

#1 Air Quality Management

> “Aerospace, air quality management goes a step further because of the dual requirements of a dust-free environment and static control for clean rooms.”

For every type of facility, air quality management means efficient and cost-effective use of ventilation to ensure an indoor environment with appropriate temperature, humidity and concentrations of pollutants. However for aerospace, air quality management goes a step further because of the dual requirements of a dust-free environment and static control for clean rooms. The problem is that each clean room has different specifications, so a control system for one may not work for another even in the same facility.

One answer involves establishing the correct humidity level for each clean room.

Dust particles are hygroscopic materials and absorb moisture gaining mass. As they become heavier, they will settle to the floor, which keeps them out of workspaces and sensitive areas. The process ensures that cleanroom ventilation systems operate at optimal efficiency. As demonstrated above, humidity variations can cause production issues, which can be costly in terms of product quality, readjustments and labor. What is needed is a robust humidification strategy that takes into account service requirements, energy consumption, operating costs and accuracy control.

#2 LONG-TERM SUSTAINABILITY

#2 Long-Term Sustainability

> "Overall, effective energy management requires checks and balances, the right people overseeing the system, and monitoring energy savings to ensure goals are met."

Aerospace manufacturing is an energy and water intensive process, so it makes sense for energy management to play a significant role in maintaining a cost-efficient building. Achieving this goal requires a commitment to best practices facility management. Yet despite that commitment, facility managers often underestimate the impact of an HVAC system. Citing budget restraints or lack of available skilled staff, they tend to ignore updates and miss out on energy savings opportunities.

Understanding the necessity of high-performing HVAC systems, especially for aerospace, begins with knowledge of the interaction of individual components. For instance, updating ventilation equipment to provide increased air flow falls short if existing sheet metal duct work cannot accommodate the increased pressure. Replacing air filters will do more harm than good if existing ductwork is not cleaned beforehand. The result will be the release of particles and contaminants throughout the building.

Another problem is the failure to accurately document replacement parts on work orders. Insufficient documentation is generally responsible for either incorrect ordering or installation of parts because the exact problem areas may not have been identified.

Overall, effective energy management requires checks and balances, the right people overseeing the system, and monitoring energy savings to ensure goals are met. Consistent follow through is essential to getting the most out of any HVAC system. According to a report by the Institute for Building Efficiency (Sept. 2011), regular maintenance of HVAC systems can reduce energy usage by 10 to 20 percent regardless of climate zone.

For aerospace facility managers, long-term sustainability can be a financial headache

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Long-Term Sustainability - *continued*

without proper planning. A sustainable facility is costly to create and maintain, especially since some of the bigger aerospace buildings have 30-40 year lifespans. Updated equipment and 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.
Now factor in the push for LEEDs certification that shows the facility is properly addressing all sustainability issues. Aerospace corporations, in particular the industry giants, have moved towards LEEDs because of energy savings and reduction of their carbon footprint. Responsibility for measuring and recording the results of energy savings falls upon the shoulders of facility managers adding to an already lengthy list of job responsibilities. One of the most important on that list is to capture dollars lost perhaps frivolously due to an inefficient HVAC system. All play vital roles in assuring sustainability and efficient building operations.

Along with recent highly-publicized water shortages, the push for more environmentally-friendly buildings coupled with the ongoing demand for energy savings have increased in importance for facility managers. Copious amounts of water are required to operate HVAC systems—a two-pronged challenge for savings and for environmental compliance. Aerospace, electronics and chip manufacturers have even more with which to contend. Humidity control systems can add to increased water usage as do heating boilers, cooling towers, chilled water systems and central steam systems common to most buildings.

Determining the amount of water necessary to humidify a facility begins by calculating the load, which is based on the size of the facility and the number of spaces requiring humidified air. Heating the air causes

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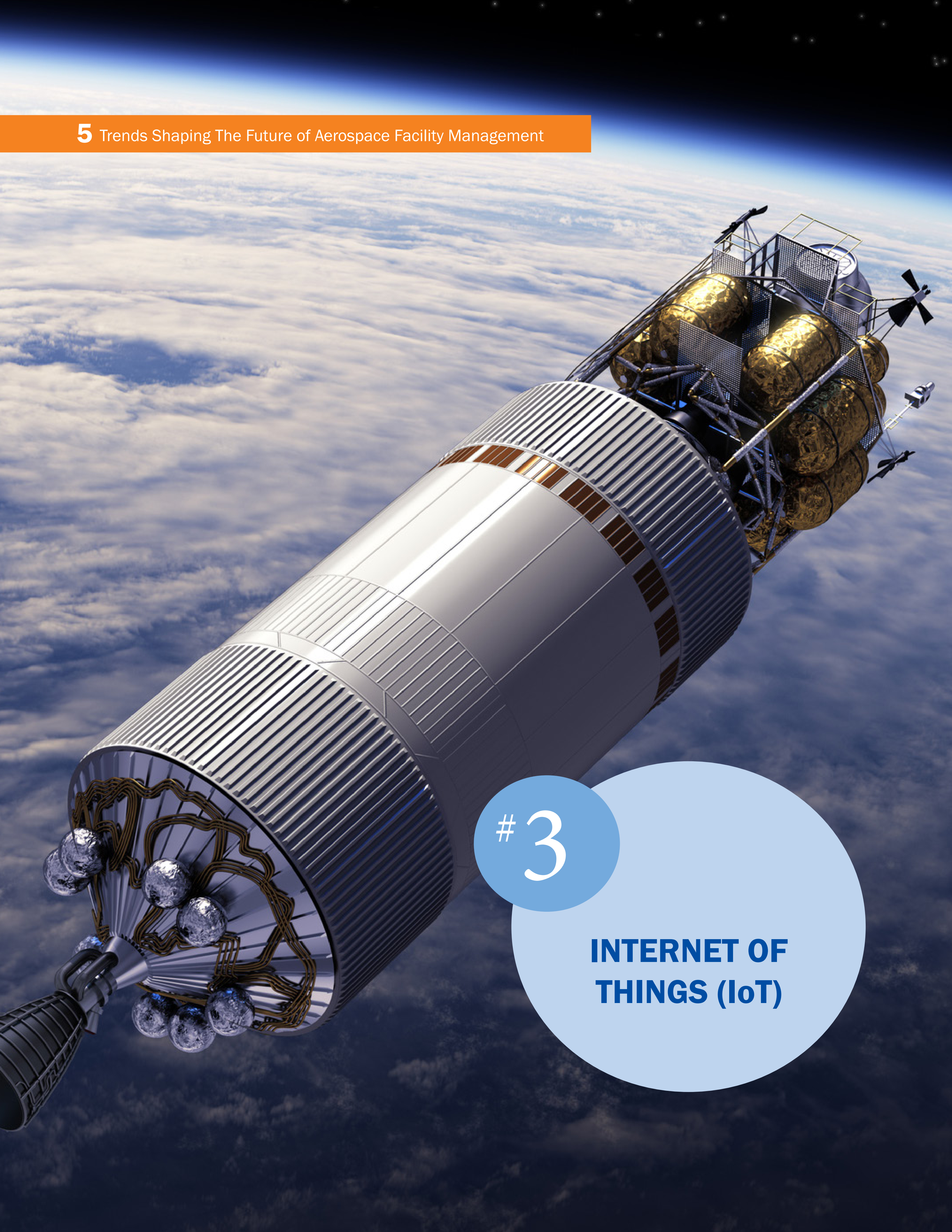
Long-Term Sustainability - *continued*

a significant decrease in RH even though the actual mass of moisture in the air has not changed. Ventilation through the use of an outside air cooler instead of the set point tends to dry the building, an effect that is especially pronounced in cold climates. Stabilizing humidity requires adding water to the air, thus increasing overall water usage. In this example, the addition of humidity to the air is only a part of the water required for continual operations.

Minerals in natural water, although beneficial for drinking for the most part, constitute a scale formation problem for HVACs and plumbing systems. Whether the water is boiled, evaporated or filtered, those minerals have to be flushed out if the system is to be kept continuously clean and operating efficiently. Waste water use can be considerable and expensive depending on the amount of minerals present.

Products and processes that utilize water allow users to configure drainage, flushes and automatic cleaning cycles, but those are seldom, if ever, adjusted from factory default parameters. Taking the time to understand and optimize these parameters often results in significant water savings while sustaining the benefits of the system. Newer equipment may offer more 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 those areas where treatment is necessary to remove hardness and minerals from the water, consider using blended streams of municipal and treated water directly to reduce the loads on the treatment system. Though the tradeoff involves an increase in descaling of equipment, it often reduces overall water losses at the treatment system.



#3 INTERNET OF THINGS (IoT)

#3 Internet of Things (IoT)

> “Intelligent maintenance and diagnostics along with better interactivity between the individual products that make up a system will have a positive impact on internal environments.”

The Cisco Internet Business Solutions Group (IBSG) defines the Internet of Things (IoT) as the point in time when more “things or objects” are connected to the internet than people. Gartner, Inc., the world’s leading information technology research and advisory company, forecasts 25 billion connected things by 2020, up 30 percent from 2014.

Why is this important to aerospace facility managers? Today, many HVAC technologies are reaching their “peak” physical limits of performance and efficiency. This condition creates several opportunities for improving performance in the future. Intelligent maintenance and diagnostics along with better interactivity between the individual products that make up a system will have a positive impact on internal environments.

The IoT opens up new opportunities to achieve both goals. By allowing individual components of the same system to “talk” to each other, the efficiency of the system as a whole can be increased by enabling individual components to operate longer at their peak level. Utilizing IoT technology increases the ability to operate and run buildings more effectively by ensuring less conflict between devices (simultaneous heating and cooling or operating humidification) when the cooling system is drawing moisture out of the air. Further, the IoT goes hand-in-hand with building automation, permitting facility managers to oversee multiple automated buildings simultaneously.

IoT-enabled devices provide facility and production managers with the ability to interact on a higher level with equipment and systems and troubleshoot more effectively. Their increased internal intelligence allows the devices to signal maintenance schedules, indicate issues, and suggest fixes. All contribute to an increase in overall system reliability and the ability to remediate small problems before they become major failures.

Because of integration complexity associated with IoT,

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Internet of Things (IoT) - *continued*

skills and IT training that go beyond those of the traditional controls contractor are required. The result is that new smart device connectivity blurs the lines between building controls and IT. That's why ensuring the right skills is essential to a smooth integration of IoT enabled devices. Security is another issue that has to be addressed during the planning stage. A hacker who shuts down the heating or cooling system could render the facility unusable until the system is restored. The result is the cessation of all data transfer from personal emails to critical business transactions.

With advanced technology such as smart devices and building automation, today's facility managers can monitor facilities from a central control room. This cost-cutting technology reduces the amount of staff and effort needed for onsite monitoring of individual buildings. At the same time, remote monitoring allows manufacturers to provide new levels of service previously unavailable. For instance, when issues arise with a device or a piece of equipment, a call to the manufacturer's support hotline allows expert factory service technicians to remotely access the device, understand the complexity of the situation, diagnose the problem and determine the appropriate fix.

In addition, remote monitoring technology can reduce the number of non-essential and expensive service visits; e.g. problems resulting from incorrectly configured controls or questions concerning equipment operations or general maintenance. Simple changes to HVAC systems can be made remotely, enabling the system to resume operations without having to send someone to the site. Remote monitoring allows technicians to simultaneously identify and order the spare parts or replacements necessary to resolve the problem, thereby further reducing costs by eliminating the need for replacement visits.

Remote technology is a winning strategy for the end user as well as the manufacturer. Yet because it involves the installation of additional IT equipment and requires extra operational training, some facility managers hesitate to take advantage of this technology.

#4 EVAPORATIVE COOLING

#4 Evaporative Cooling

> "Evaporative or adiabatic systems used directly in a ventilation airstream result in both increased humidity and cooling of the air."

Traditional mechanical HVAC systems are effective at controlling indoor environments, but are often very energy intensive when cooling is required. An effective alternative is evaporative cooling, a process that introduces liquid water directly into the air without the need for adding thermal energy (heat) to boil the water. As the water evaporates, it draws heat from the air to drive the phase change from liquid to vapor. Evaporative or adiabatic systems used directly in a ventilation airstream result in both increased humidity and cooling of the air. 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 primary airstream conditioning or adding moisture directly to the space itself. This process cools the airstream and increases humidity. For climates where direct evaporative cooling in the ventilation air stream is not practical due to existing humid conditions, indirect evaporative cooling provides an alternative. In this process, an evaporative cooler is placed into the exhaust airstream. Air is then cooled 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. As a result, they overlook the energy reducing opportunities of this process.

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Evaporative Cooling - *continued*

Modern evaporative cooling systems address many of these issues with intelligent controls, drying and washing cycles, and sterilization systems. Control accuracy has improved greatly, which facilitates better tracking of set points and load operation. Use of evaporative cooling offers added benefits of improved or additional levels of humidification.

Evaporative cooling is often mistakenly viewed as a low-tech solution when, in fact, it has evolved into a system that integrates cost-efficiencies and energy-savings in its application. Evaporative cooling offers an added benefit—additional cooling savings. Yet many facility managers miss out on the energy savings opportunities of this process.

#5 HUMIDIFICATION / DEHUMIDIFICATION

#5 Humidification / Dehumidification

> "Humidity and temperature ranges must be maintained for the equipment to optimally perform."

The word "humidity" often conjures up negative connotations that include muggy summers and mold growth. Yet it is surprising that some aerospace facility managers who are well aware of the issues associated with an overly dry indoor environment consider humidity to be an interior climate problem. In fact, the dangers associated with an inadequate humidification process are especially acute for aerospace because of the threats of electrostatic discharge and inadequate RH control which can lead to loss of process control.

Consider the latter in the context of a coating or curing process. The curing time for paints and coatings is strongly dependent on the environment, specifically temperature and humidity. Depending on the product being applied, temperature humidity levels may vary, but need to stay within a tight specification to ensure proper adhesion and avoid shrinking and cracking. The same is true for curing of adhesives and ordnance mixtures in which temperature and humidity control are crucial to final product quality.

Equally critical is prevention of ESD, which is one of the major justifications for a humidification system. Facility managers are not oblivious about the perils of ESD. Expenditures for apparel, shoes and grounding are part and parcel of aerospace budgeting along with special floor coatings and grounding paint. Managers, however, should be aware of the impact of moisture levels on static electricity. Static charges accumulate on objects through processing, handling and friction effects. If charges accumulate to a sufficient level, the likely result is either discharge through a spark or static cling, potentially damaging the products. In drier environments, static electricity is more likely to accumulate to

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Humidification / Dehumidification - *continued*

higher voltages, but in more humid environments, moisture in the air acts as a conductor and dissipates the charges throughout the room, thus averting accumulation of imbalanced charges and sparks.

The potential for static charge accumulation is a prevention priority during processing of modern composite materials. Static charge accumulation can reduce the effectiveness of the process and substantially reduce product quality and consistency. Electronics in general and avionics, especially sensitive circuitry, are susceptible to damage from static electricity. Failure to manage ESD is likely to result in production delays or rework. An effective preventive measure is humidity control to a midrange.

Direct room humidification systems (DRS) have been proven to be very useful for the aerospace industry. Traditionally, humidity is introduced into HVAC equipment and distributed by ventilation ductwork. Direct room humidification systems change this equation. Utilizing a high-pressure pump system, these systems deliver an ultrafine mist directly into a space providing humidity control exactly where it is needed.

Energy saving opportunities and the ease of operation of high-pressure direct room systems set them apart. Without the need for an air handler or ductwork, these systems can work autonomously or in locations where ducted systems are impractical. They can also simplify retrofit costs by reducing the need to install ventilating systems to resolve humidity issues. Strictly a humidification process, high-pressure systems can respond very quickly to changes in space conditions regardless of ventilation settings. In addition, they are able to track set points with a high level of precision, which can be crucial for aerospace facilities. Pumps and water treatment facilities are often

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Humidification / Dehumidification - *continued*

located in a separate mechanical room from the spray nozzles. Business operations are not disrupted during servicing, which lessens downtime and lost revenue. As an additional bonus, water evaporation provides evaporative cooling directly to the room, thereby reducing mechanical cooling requirements. This lessens the HVAC workload, which is particularly important to facilities that require year-round cooling.

Some facility managers may still be hesitant to invest in this humidification process because of an incorrect and unfounded assumption that fine mist can lead to water issues. The truth is that the benefits of a high-pressure direct room system and its ease of operation make it ideal for many facilities. For those environments requiring dehumidification, managers can choose either mechanical cooling or dedicated dehumidification equipment.

Eight Environmental Tips for Aerospace 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 increase internal process control effectiveness:

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

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

3. Set the bar high. Look for opportunities to use ambient outdoor conditions, and economizer strategies to reduce mechanical cooling loads.

4. Invest in evaporative cooling systems. The cooling effect of evaporating water reduces mechanical cooling requirements and maintains proper moisture levels.

5. Invest in reliable controls and sensors for temperature and moisture. Having the correct data allows for fine tuning of systems. Operating HVAC equipment at optimum efficiency reduces energy consumption and saves money.

6. Consider outsourcing equipment management to companies that employ experts who are knowledgeable, skilled and certified on a given manufacturer's equipment. This ensures the equipment is maintained to a high standard and keeps the facility functioning at top levels.

7. Stay current on evolving trends. Continuously look to industry leaders for products, procedures and technologies that can improve facility efficiency. Review new strategies to help further drive efficiency.

8. Remember to include a humidification strategy in your aerospace facility to improve your internal process control and product quality which then leads to higher productivity and profitability.

Conclusion

For today's aerospace facility and production managers who face an expanding global market, a growing dependency on online communication, and increased pressure to reduce energy costs, the challenges are many. For those reasons, an HVAC system is an essential component for product and process quality that reduces defects.

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