AEROSPACE & DEFENSE
CONTROLLED CONDITIONS FACILITIES

Q&A WITH THE AUSTIN COMPANY'S DONNA LORENZEN, PE

Ahead of the **American Aerospace & Defense Summit 2018**, we spoke with The Austin Company's Donna Lorenzen to discuss controlled conditions facilities and best available technologies in the Aerospace & Defense Industry. As a Chief Mechanical Engineer with The Austin Company, Donna's experience in the design and engineering of facilities for the Aerospace and Defense industry is considerable and current. Donna has over 27 years of professional experience in the design and engineering of mechanical systems for aerospace and defense industry facilities, 24 years with The Austin Company.

With increased demand for composite materials and non-metallics in both commercial and military aviation, how has this impacted the facility environmental HVAC systems relating to controlling tight tolerances for temperature and relative humidity

The main change has been that previously, manufacturing and assembly operations were performed in unconditioned spaces, often where they opened the doors to the ambient environment outside. Now, manufacturing and assembly operations are requiring much higher cleanliness and temperature and humidity control to the extent that, at times, if these conditions go out of spec -- say the temperature is too high or too low, humidity is outside of the range or particulate counts are too high -- engineers may have to shut down program manufacturing operations, whether it be manufacturing or testing, within that space, until the situation is remedied.

In some cases, that can even lead to discarding parts or assemblies because those critical environmental constraints were not met. Given this, the main change has been establishing a greater understanding of the temperature and humidity requirements, as they can vary greatly.

There are times where temperature or humidity must be maintained within a particular range. As engineers, we often create a box around the low and high temperature and the low and high humidity that are allowed, and design based on a central point. Another factor taken into consideration is weather conditions that are not apparent in the standard weather tables. If a facility has requirements to maintain the interior environment at all times (24/7/365), the engineer must take into consideration record temperatures, highs and lows, and other phenomenon such as tropical weather that may occur in an ordinarily dry climate.

How are these systems adapted to maintain these critical environmental tolerances within large wide-span aircraft and spacecraft assembly centers or hangars with clear heights in access of 80’ or more?

When we have these large spans, particularly the heights, we have to find out what zone is actually required to be controlled. In some cases, we have large heights for transporting objects from one station to another, and the function may only require the environmental controls in the first 20 to 30 feet above the floor. Or, it may need to be maintained all the way up to 50 to 100 feet above the floor, where objects are being transported by cranes and still need to be maintained within environmental control. Once we know what zone needs to be maintained -- meaning the volume that needs to be maintained -- one of the main methods we apply is doing full-flooding of that volume with air flow.

We typically do that by placing the air distribution within the truss space area outside of the crane path or outside of the production or testing area. We use a combination of air control devices to create that full flood, so we have some devices that are throwing the air horizontally to create an upper level “blanket,” while other devices throw the air vertically down to the floor level to ensure an even distribution of air. Along with that, we add extra filtration into the air handling equipment to meet the cleanliness factor. Equipment such as humidifiers may be added to increase humidity and chilled water systems may be designed to lower supply temperatures to achieve increased dehumidification to meet the humidity requirements.

How is destratification achieved in such large envelopes, especially within harsh regional winter and summer temperature variations, such as the high desert conditions in Western U.S. vs. humid conditions in the Southeast?

When doing a full-flood of the air flow throughout the space, less expensive methods can be considered, such as displacement equipment, to help achieve destratification. However, most of our program users do not care for that type of system because it tends to take up floor space and can also create undesirable air flow patterns within the production area. That type of system is better suited to low bay spaces; therefore, we tend to not go with that type of system for facilities with high bay or hangar envelopes. The full-flood method better addresses the variable conditions in the high desert of the Western U.S. or high humidity conditions in the Southeast by creating consistent environment throughout the space.

In the high desert of California, there are periods in the summer where a tropical condition can occur. Ordinarily, the California high desert is dry year-round. If a tropical condition in the summer with warm or hot temperatures occurs, along with high humidity, this is when maintaining controlled conditions becomes critical. It is important to make sure the HVAC systems are capable of wringing the moisture out during those conditions, even though it does not show up in the normal weather charts.

In the Southeast – in Florida and South Carolina, as examples -- hot and humid conditions are the summer norm. This means that as engineers we often must be concerned with dehumidification, as well as sealing the building envelope so moisture from outside is not leaking into the building (as moisture will tend to want to reach a state of equilibrium and will work its way through every tiny crack and openings). We must be very conscious of how the envelope is designed, as well as how it is constructed, to ensure it is tight to maintain the required temperatures and especially the humidity conditions within those spaces.

With increased focus on energy efficiency, sustainability and lifecycle cost, how has the industry responded with best available technologies?

There are a number of areas that have been changing because these environments have become critical when they had not been in the past. Now there's an emphasis on installing central plants, because in the long run they tend to be more efficient than individualized equipment. We are specifying higher efficiency equipment, even though the initial cost is higher. Because these are high-energy consuming facilities, they end up having rather quick paybacks because they're not using as much energy given their high-efficiency.

We are also specifying utility usage monitoring based on different utilities, zones and functions within the facility, so facility engineers can see where the energy is being consumed, and if they're trying to cut back, they can focus on those areas and determine if there are upgrades or system modifications that can help reduce energy usage in those areas. We're doing things like adding air flow monitoring and temperature set-backs. For example, if you're running a critical process, you may have a tighter tolerance and you're only running the mechanical equipment to that level during that process. But when the space is idle and that critical environment is not required, those performance constraints can be relaxed, and thus conserve energy.

In manufacturing processes that involve fugitive emissions, particulates, NOx and VOC's, how are current capture technologies responding to evolving EPA requirements?

This is an area that is constantly changing due to EPA requirements. A lot of focus now centers around encapsulating processes. If the process is causing emissions, the design objective is separating those processes away from the rest of the facility systems. That way, the air flow requirements for exhausting can be minimized, while maintaining safe operating environments.

We're putting an emphasis on using higher efficiency equipment to consume less fuel or energy. We're cleaning the air -- whether it be through scrubbers or filtration -- to prevent emissions from escaping into the environment. In some cases, we're able to clean the captured air enough to return part of that air back into the conditioned space, as opposed to releasing that air to the atmosphere and having to bring in and condition additional outside air.

When it's possible, we work to implement some form of energy recovery, whether it's using a water loop from one side of the system to the other, or a heat exchange wheel to capture a portion of conditioning.

THE AUSTIN COMPANY

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Austin serves the defense industry's leading contractors, subcontractors, suppliers and government agencies, creating highly technical and complex operations and production facilities to support critical aerospace and defense programs that reinforce our nation's security. From facilities that develop unmanned aerial vehicles to those that mitigate electronic threats, Austin's experience with cutting-edge technologies and high-reliability systems is industry-leading.

Austin has been a leading planner, designer, engineer and constructor of aviation facilities for the air transportation industry since the 1910's. Today, Austin continues to provide solutions for major U.S. airlines and airports, commercial and military aircraft manufacturers, business jet manufacturers, military installations, and related companies, including air cargo and package express carriers, third party aircraft maintenance companies, and catering companies.

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