

NEUTRALIZING NATURE

Controlling the
Environment in Aerospace

By Michael Wetzel, P.E.
President and CEO, Air Innovations



Varying climates around the world add immeasurably to the joy of life. Tourists fly thousands of miles to experience the dense humidity of a tropical rain forest, the thin, bracing air of a mountain range, a fresh salt breeze by the ocean or the dry heat of the desert.

Yet if your goal is to send a billion-dollar satellite into space or to maintain precision defense systems aboard aircraft tasked with defending the nation, environmental variations aren't so much the spice of life as an endless minefield of potential hazards that could destroy your mission. In the unforgiving aerospace sector, the idea is not to celebrate nature but to neutralize it, creating artificial environments that remain precisely clean and stable, wherever the equipment or payload you're assembling, transporting and sending aloft happens to be.

As environmental control specialists, we believe our mission is to make that happen so that you can focus on *your* mission without fear of a potentially catastrophic failure caused by external conditions. As designers and builders of highly [specialized environmental control units for aerospace](#) and other industries, we scour the world for the best available technologies and components and then adapt them into unique, customized solutions.



We scour the world for the best available technologies and components and then adapt them into unique, customized solutions.

DEPENDING ON OUR CLIENT'S OBJECTIVES, WE MUST CONTROL FOUR BASIC ENVIRONMENTAL FACTORS



TEMPERATURE

Most people think of air-conditioning as relating to human comfort. While aerospace projects sometimes include human astronauts, a far more complex set of challenges involves maintaining nonhuman payloads, sensors and controls within precise temperature ranges, replicating the conditions they'll operate in during the mission.



HUMIDITY

An environment that's too dry (or not dry enough) can damage payloads, interfere with optics or worse. Some situations, such as fueling rockets, require extremely low dew points (to minus 22°C) to avoid icing that can destroy a mission.



PARTICLES

Microscopic particles that people routinely breathe in and out with no damage to their lungs can devastate a piece of aerospace equipment. One of the most destructive forces is salt, all too common in the coastal areas that many aerospace projects use as launch sites. Salt-proofing individual wires and components is not an option, since salt can eat through many grades of stainless material. The only way to be sure of removing salt and other dangerous particles is through highly sensitive HEPA filters capable of removing 99.999 percent of particles larger than 0.3 microns. (For reference, a red blood cell is around 6 microns wide.)



MOLECULES

Going a step smaller from particles to the molecular level, aerospace equipment must be protected from hydrocarbons and other gases that can corrupt delicate controls and sensors. Hydrocarbons, of course, are an inevitable byproduct of the engines and generators used to power and move equipment. Precise filters must ensure that virtually no traces of those gases infiltrate the payload.

PUTTING IT ALL TOGETHER

Controlling for these factors, though demanding, would be a fairly straightforward proposition if needs were similar from mission to mission and if the resulting systems could all be delivered in the same size and shape. In reality, each situation calls for a precise combination of temperature and humidity control and particle and molecular filtration. Systems may be as small as a breadbox or the size of a room. They may need to be explosion proof if used around highly volatile rocket fuel. While some systems will be anchored in place, others must be portable and durable enough to protect delicate equipment over many miles of uneven roads to a launch site.



Each situation calls for a precise combination of temperature and humidity control and particle and molecular filtration.

A laser focus

THE NEED: Take, for example, a project we completed not long ago for an aerospace and defense contractor on the U.S. military's airborne laser defense system. The defense system was based on a six-headed laser designed to destroy enemy missiles, with a directional turret mounted in the nose cone of a modified Boeing 747. Each time the 747 landed, the delicate optical equipment in the nose needed maintenance. Yet any contamination of particles on those lenses could have been catastrophic. Our challenge was to create a cleanroom environment that could roll along the runway to meet the aircraft and then extend all the way into the nose of the plane.

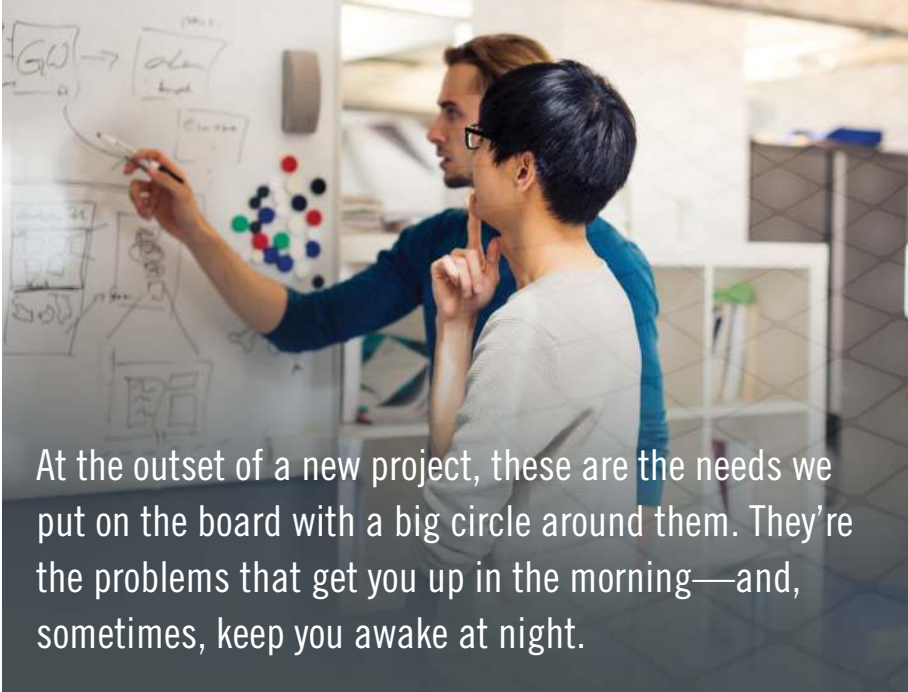
SOLUTION: We met the need with a cleanroom system on wheels, delivering precise cooling, heating, humidification and filtration. Thanks to flexible ductwork, maintenance teams in the nose could manipulate the airflow with the ease of a leaf-blower, piping clean air directly onto the optics equipment as needed.

Pre-launch precision

THE NEED: Before embarking on its satellite mission in outer space, the Antares rocket system needed precise control to protect its payload and core in an earthbound environment fraught with fluctuating temperatures, humidity and corrosive salt air. Working with NASA partner Orbital Science Corp., we needed to develop a custom environmental control system that could travel horizontally with the rocket on its mile-long journey to the launch site. Our system not only needed to meet and maintain precise temperature, humidity and filtration requirements, but it also had to be remotely controlled and work seamlessly through each stage.

SOLUTION: We engineered and built a trailer-mounted, air-cooled [portable environmental control system \(PEC\)](#) that moved along with the rocket on its way to the launch. As the rocket moved to a vertical position, three separate water-cooled systems (located on the launch pad) took over, protecting the precious payload right up through launch.

No two situations are quite alike. And, frankly, we wouldn't have it any other way. The joy and satisfaction of what we do comes from finding successful solutions to problems that may never have arisen before, and for which there's no off-the-shelf, ready-made solution. These are the times when engineers and designers must call on their accrued knowledge and experience to come up with completely new approaches.



At the outset of a new project, these are the needs we put on the board with a big circle around them. They're the problems that get you up in the morning—and, sometimes, keep you awake at night.

QUESTIONS BEFORE ANSWERS

We start our process by learning from our customers, many of whom are initially surprised by the number of questions we ask. We want to know your processes and how you go about your business. That will help us identify environmental contingencies you may not have thought of. Say, for example, you need to strictly control the environment in an 8-foot-by-8-foot room. What do you plan to move in and out of that space and how will you do it? Each movement could have a significant impact on the delicate environment in that space and will need to be accounted for.

And we want to know more about the factors you most need to control for, so we can pressure test your assumptions. Say, for example, you've identified an acceptable temperature range of 50–80°F and a relative humidity range of 25–75 percent. Have you considered the impact if temperature and humidity hit the outer limits of those ranges at same time? In other words could your payload survive the challenging environment of 80°F and 75 percent humidity? In the world of fully customized aerospace solutions, it's our job to be sure.

Once we fully understand a customer's project, processes and needs, our next step is figuring out what resources we'll need to create a solution. (See sidebar "Countdown to Success.") What can we draw upon from our experience in working on other projects that may apply to this one? The answers may come from previous aerospace projects or from our environmental control projects in other demanding industries, such as semiconductors, pharmaceuticals and homeland security. Our engineers pull together the components they need and then find new and innovative uses. We may not have invented that ultrasonic humidifier, but we'll ask it to do things that the supplier never thought of.

Then there's another group of needs—ones we've never faced before. Ones that initially have us stumped. At the outset of a new project, these are the needs we put on the board with a big circle around them. They're the problems that get you up in the morning—and, sometimes, keep you awake at night. Yet, just like a mission into uncharted territory, they're why we love doing what we do. In the world of environmental control, there's nothing quite so satisfying as creating solutions and bringing them together in a fail-proof system that helps a critical mission succeed.

COUNTDOWN TO SUCCESS

When the stakes are high, these steps are essential to creating a flawless aerospace climate system.

05 / DETAILED QUESTIONS

At Air Innovations, before suggesting a solution we need to know your challenges inside and out. What are your processes? What do you want to accomplish? How will the system be used?

04 / SKETCHES

This is the phase when your need starts transforming into a custom solution. If we can't sketch it on a pad or whiteboard, it's time to ask more questions.

03 / DESIGN AND BUILD

Whether design requires two months or a year, close collaboration with your team assures the build phase is a matter of fulfilling a detailed plan.

02 / TESTING

In aerospace, all systems must perform the first time and every time. That means exhaustive testing in our on-site Psychrometric Testing Facility lab, with full participation and input from your team.

01 / TRAINING

Comprehensive training once the system is installed helps you use your system to best effect.

MISSION ACCOMPLISHED.

With climate variations taken out of the equation, all systems are go.

At Air Innovations, all of our equipment is custom designed for particular applications. Unlike other companies who build commercial-off-the-shelf type equipment, we create a solution that's tailored to your unique challenges. If you have an idea you would like to find an environmental control solution for, a challenging environmental control issue that's yet to be addressed, or a project coming up that requires specialty environmental control, we would like to talk to you before you write your specification or release an RFQ – we are climate control experts, after all.

So whether it's an environmental control application for aerospace, the military, a research lab, the pharmaceutical industry or a medical device—or an out-of-the-box concept you'd like to explore—simply fill out our contact form at airinnovations.com/contact-us or give us a call. We're looking forward to talking to you!

For more information about our aerospace projects or to learn more visit us at:
airinnovations.com

Or call:
800-825-3268 or 315-452-7400



AIR INNOVATIONS