

Q&A REGARDING THE ACA AIRBORNE and GROUND AIR/SURFACE PURIFICATION SYSTEM

1. What is the long-term efficacy?

Speaking to the underlying ionization units themselves, the calculated MTBF of the airborne units is 87,530 hours. There is no required maintenance of the units once installed in the aircraft. That said, it is common for operators to perform an elective annual simple test with the handheld ion counter to ensure the ion levels are being maintained in the aircraft. In the 8 years of system installations and operations there has yet be any failure of any system components of any kind. As of May 1, 2020, the ACA components have been installed in at least 109 total aircraft (not including the greater than 350 customers using the ground unit worldwide). The installed base is increasing daily and currently includes a multitude of business jet aircraft and several VIP versions of airliners including the 737, the A320, the A330 with several additional installations happening at the moment to include the 767 and 787. It is important to note that the feedback includes more than the positive effect on pathogens as the pro-active effect on odors and breathing improvement are also obvious and maybe more tangible for the flying passengers as a distinct and highly noticeable attribute of the system.

2. How you know when it is not working?

Each STC installation includes an indication panel which also houses an on/off switch and an optional 'push to test' button in the event the panel is installed in the aft cockpit area for convenience and consistency (the location is very flexible). Our research indicated that varying aircraft layouts/configurations identified the P61 panel as a good opportunity to have a uniform location across fleets like SW where the aircraft have varying original heritage). The panel simply indicates that power is applied to the system. Any time power is applied, the system will be active. The system can remain in the 'on' position indefinitely without further crew interaction at the discretion of the operator. The design allows for the flexibility to increase or decrease the number of installed units depending on aircraft make or model and the indicator panel would be configured to match the installed condition. A very simple test with a handheld ion testing meter can determine that the system is operating. Upon initial installation, we recommend a very quick check with the handheld Alpha Air Ion Meter to confirm operation. As mentioned above, this process can be performed for confidence at any interval desired but is not necessary based on data to date. Because of the passive nature of the system operation, and non-critical status for aircraft operation and performance (essentially a comfort enhancement not too different than a tray table or coffee maker), the system is not considered to be included in the MEL. It is also important to note that the ACA ionizer components are DO-160 certified.

The underlying GPS bi-polar ionization components have been installed in thousands of applications including high profile residences like the White House and the Presidential Palace of Abu Dhabi, Sheikh Zayas Grand Mosque, Shams gate tower in Abu Dhabi, Google in San Jose and Chicago and many other high-traffic/volume commercial locations such as schools, universities and hospitals including Operating Rooms.

The aircraft application has been installed on no less than 109 aircraft with greater than 350 customers also using the ground ionization units. During the last 8 years, the installations include

numerous aircraft and helicopter makes and models. We have previous installations on the A330-200, Boeing 737 series, Airbus 320 series, Leonardo AW189, AW139, AW169 Helicopters, Falcon aircraft, Bombardier Aircraft and STCs on the G450/GV/G550 and G650/G650ER aircraft. Installations are currently ongoing on the B767, B787 and planned for the B747. The ALOFT AML STC will be capable of including all Part 25 aircraft as configurations for installation under the same STC with necessary deviations approved by the in-house ALOFT ODA or locally by the installing entity under its own minor change authority.

3. Any BIT feedback/ monitoring?

Yes. The device has alarm “dry/binary” contact.

4. What is that maximum level permitted of Ozone? And how is this level going to affect us?

The ionizer components do not produce Ozone (O₃) because the system is specifically designed to generate ions below 12.0eV (electron Voltage Potential). Ozone is produced when systems operate over 12.07eV. The component technology is patented specifically because of this advancement in the generation of ions. Each unit generates approximately 3,500,000 positive and negative ions every second without any production of O₃ or any harmful gases or chemicals. The technology has been UL867 and UL2998 qualified as ozone free technology. Below is a link to the ozone test report from ACA.

https://www.aviationcleanair.com/uploads/6/1/1/6/6116687/gtr-aca-oz-0001_rev_nc-aca_ionizer_ozone_emission_test_results_june_2019.pdf

Since there is no ozone generated, below we have included various excerpts and links to international assessments of ionization and humans.

The Russian Healthcare Federation is the only government source that has published any specific definition for ‘maximum air ion density’ which they have identified as 50,000 ions/cc. It would be almost impossible to hit that level in the breathing zone. According to the Chief Technical Expert at GPS, it’s hard to imagine how you could ‘over ionize’ a space as eventually you reach an ion saturation point where the ion creating is then limited by the ions recombining at generation. Excerpts from the Russian Government study are included in the brief and informative link below. They also establish minimum levels for optimal conditions.

<https://iopscience.iop.org/article/10.1088/1742-6596/142/1/012052>

In the following paper, they link to the positive benefits of ionization and the potentially negative effect of ion deprivation. They even mention long haul flights as being an issue for ion deprivation on the first page, bottom left paragraph.

<https://www.continuitycentral.com/HealthyBuildings.pdf>

Also, below, are two related articles published by the National Institute of Health which provide varying information on ions.

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6213340/>

5. How do we measure the efficacy of this ionization? How many pathogens, microorganisms it traps by electrostatically charging in a certain cubic foot for instance? Do they have an actual Lab Test Results to illustrate that for us?

We believe you are asking the efficacy in varying viral loads. Of course, we will share all existing lab analysis which shows specific efficacy on individual pathogen specimens tested by EMSL and collaborative research with other global organization. The viral load within the test parameters will be noted in each pathogen efficacy study. We are also working now with a lab to test the Covid-19 strain of the Corona Virus. This new test we are doing is also testing against several different levels of viral loads specifically to show the neutralization/die off rate at varying virus concentration levels.

The STC installation offers the flexibility to increase the ions generated by adding additional ionization units into the aircraft ECS system. The current installation of 4 units in a 737-700/800/900 is based on testing we have performed in the lab to ensure the best efficacy of the system in an environment with constantly changing (additional) viral loads. The typical number of ionization units recommended per aircraft type is intended to yield higher positive and negative ions than the levels that were used during lab tests to neutralize the pathogens being tested.

[COVID-19 Successfully Neutralized in Testing of Aviation Clean Air's Interior Purification System.](#) We are also in the process of creating additional test plans for different mutations of the Covid-19 corona virus as well which will also be available in the coming weeks.

6. This is an electrical-related question, to allow me to understand the safety side effects of this technology and to think outside the box with Engineering - Knowing the Ionization technology, the human and atmosphere airborne will be electrostatically charged by the Anion (Negative ions) and Cation (Positive Ions), both produced by the ionizer installed in our airplanes, the molecules in turn are then attracted to any nearby grounded conductors à how will those charged particles be grounded if the airplane is flying and ionizers are running? Does this ionizer have some sort of grounding plates built in or the charged particles will be attracted to walls and ceilings creating a strong static electricity inside the airplane? Trying to have some understanding on the electrical discharge side of this.

This system does not use charged or grounded plates. We create equal quantities of positive and negative ions which neutralize static electricity in the cabin. It has been shown through the very old 1960s vintage ASHRAE Journal article attached that ions will reach the space in high velocity designs. The plane is a high velocity duct and as shown through testing, high levels of ions get to the space. Previous testing in building's show high levels of ions entering the space. Our unit does not require grounding to work. In fact, the airplane unit is a DC device and we do not require a ground to operate. The way we designed the circuit, we come off the high voltage transformer with a voltage multiplier circuit, one for + high voltage and the other phased for - high voltage, without the need for a ground. The ions will make particles agglomerate, thereby increasing in mass/surface area and allow them to be pushed to the HEPA filter for removal.

7. What are the typical levels of ions generated? And to what extent do the number and placement of the devices affect the total effective output into the cabin? Explain the time basis, duration, or dwell-time of the ion supply; to what extent might the ions never reach the surfaces in the passenger cabin?

Each of the individual ACA ionization units produces approximately 3,500,000 ion/cm³ every second. The recommend installation for a typical 737-700/800/900 is 4 units, which can be installed in various areas of the ECS duct system. The goal of the installation (locations and # of units) is to achieve a constant flow of positive and negative ions that exceed the recommended minimum average of 6,000 ion/cm³. Because the average flight duration of the 737 in a commercial operation is 120 minutes, gate to gate, the optimal goal is to reach a threshold faster to assure effective ion saturation on shorter duration flight segments as well. The longer routes will provide more than adequate time to build ion saturation. In general, you can expect ions generated and cabin readings will decrease on passenger loading but increase over time as the positive and negative ions fill the cabin space. Typically, you will see an increase in ions within the first 1-2 minutes in the cabin from when the ECS system is activated. The dwell time of the ion supply from our ion generators is constant, and ions will typically stay in the air for up to 60 seconds, but again, as more ions are generated and distributed, more areas will receive the higher ion counts as the ions fill the airspace. The variation within each cabin environment (passengers and particulates for example) will affect the rate of ion saturation which is part of the benefit of the ions by agglomerating the particulates on a curve until they are mitigated from the breathing zones by falling to the floor or filters etc. This is also true for odors and allergens which are mitigated over time during the constant saturation process.

8. Explain why bipolar ion generators are used rather than negative ion generators? Why is one better than the other?

The bi-polar ionization system is proactive, producing only negative ions is a passive system – just like filters and UV lights. Production of both positive and negative ions is a duplication of nature’s natural cleansing process with nothing else added or created. The unit is effectively an acceleration of nature’s cleansing process. The ACA components reduce exposure time to existing, as well as new pathogens exponentially, and therefore reduces the chance of cross-contamination from several days (that viruses can survive on surfaces) to minutes.

Producing only negative ions does not duplicate nature’s process. To be effective by any measure producing only negative ions would require a corresponding positively charged plate and an additional artificially produced air flow back to those positively charged plates to remove only the air borne particles/pathogens/allergens [which may carry viruses/pathogens]. This “pitch and catch” [negative only] system would not be effective on surface pathogens/allergens. The plates would also require constant cleaning/maintenance and the costs that would be associated with that maintenance. The ACA system overcomes these obstacles by being Bipolar and produces both positive and negative ions.

There are different benefits for both negative and positive ions. In short, negative ions disrupt and sever the hydrogen molecule in a pathogen/spore, while positive ions dismantle the structure of certain gases. Positive ions also work to agglomerate airborne particulate to remove them out of the breathing zone. We know that certain pathogens use particulates as a carrier for the spread of the pathogen and by removing the particulate you increase the health benefits

not just for ease of breathing with limited particulate in the air, but also to mitigate the migration of pathogens on the airborne particulates. Positive Ions have also been studied to help moods and have been shown to promote a feeling of well-being and positive moods. Some of these aspects are also covered in the linked articles above.

9. Would it be practical to measure the ion concentration in-service or during a routine mx check?

Yes. It is practical to perform a 'confidence' test at any interval desired with the Ion Counter test unit by Alpha Labs. This can be used to measure the levels of ions in the cabin to ensure you have the recommended average levels throughout the cabin and to verify the units are operating properly. If the LED lights are working there should be no need to test, but a routine MX check would be advisable and an extremely simple and non-invasive addition to any schedule mx visits.

10. We are not comfortable ruling out the possibility of ozone generation based upon the data available on the ACA website. Is any additional data available?

ALOFT has tested for ozone during each stage of the STC cert testing process with no measurable ozone detected at any time. This correlates with the ozone free technology certification of the GPS technology and the testing ACA has done as well to confirm this conclusion.

11. What is the relationship (if any) between ACA and Global Plasma Solutions (the latter is referenced in each of several bipolar ionization system efficacy test reports by EMSL Analytical). When were these tests conducted?

GPS is the patent holder and manufacturer of the bi-polar ionization technology. ACA has exclusive rights and without restriction to sell and market the product to the aircraft industry worldwide., and additionally holds two Patents and FAA PMA. ALOFT is the STC and integration engineering partner for the airline customer base.

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