



Boeing Live Virus Testing

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Confident Travel Initiative

One Mission, Three Layers, Three Horizons

One Mission

Leadership in the global effort to provide passengers and crew a safe, healthy and efficient travel experience

Three Layers of Protection

- Prevent the virus from reaching the airplane
- Keep the airplane free of viruses
- Minimize transmission of viruses on the airplane

Three Time Horizons

- Near term: **respond** to the immediate needs of the industry and **reassure** passengers and crews
- Mid term: **enhance, stabilize and standardize** guidance, recommendations, and solutions to provide a predictable travel experience
- Long term: continue to **improve the system**



Boeing's Clean Airplane Program

Helping airlines protect passengers from viruses



CHEMICAL DISINFECTANTS

20 tested, 9 Boeing approved disinfectants



ELECTROSTATIC SPRAYERS

Efficient application for hard to reach areas



CABIN AIRFLOW

Complete air exchange every 2-3 minutes



HIGH EFFICIENCY PARTICULATE AIR (HEPA)

99.9+% effective at removing particulates



ANTIMICROBIAL COATINGS

Application of a persistent disinfectant on surfaces that protects against viruses



THERMAL DISINFECTION

Eliminating viruses with heat



TOUCHLESS LAVATORY FEATURES

Reduces touchpoints within the lavatory



UV WAND

Boeing developed and licensed UV Wand operates at 222nm for use in flight deck and cabin

TOMORROW'S POTENTIAL SOLUTIONS

 = UNDER STUDY



BOEING ANTIMICROBIAL COATING

Breakthrough antimicrobial with high kill rate, long life



ADDITIONAL TOUCHLESS FEATURES

Researching additional touchless features within throughout the cabin



UV BUILT INTO THE AIRPLANE

Continuous disinfection through the travel journey

Clean Airplane Program validated by live virus testing

Boeing partnership with University of Arizona

The Situation

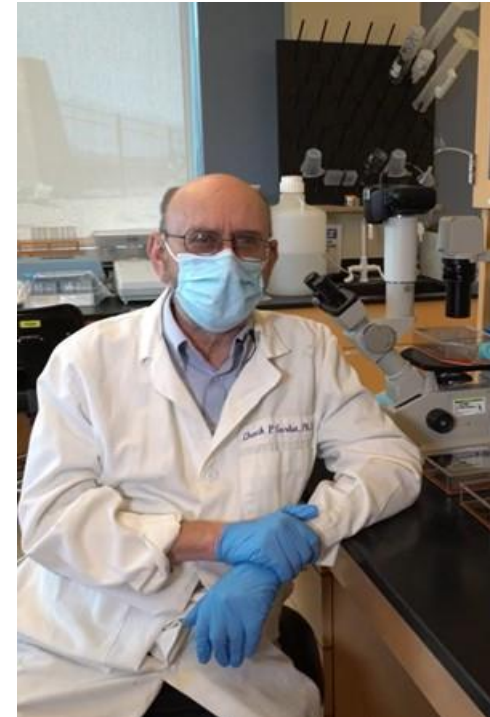
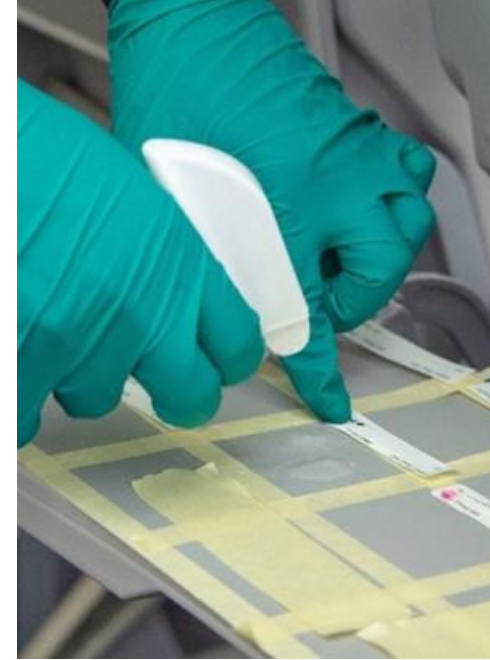
- Boeing implemented an innovative, first-of-its-kind test with the University of Arizona to validate cleaning recommendations against a human-safe live virus (MS2) in a working airplane cabin

The Method

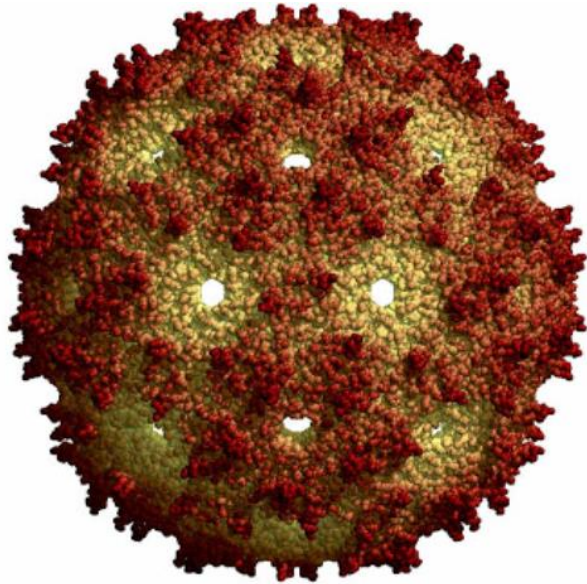
- The team placed the virus on strategic points throughout the cabin and disinfected using these techniques:
 - Chemical disinfectants
 - Antimicrobial coatings
 - Electrostatic sprayer
 - Ultraviolet wand

The Result

- The University of Arizona found all recommended products, methods, and technologies successfully destroyed the MS2 virus, which is more difficult to kill than COVID-19
- Correlating those results to the virus that causes COVID-19
- Boeing and the University of Arizona continue testing work for new technologies

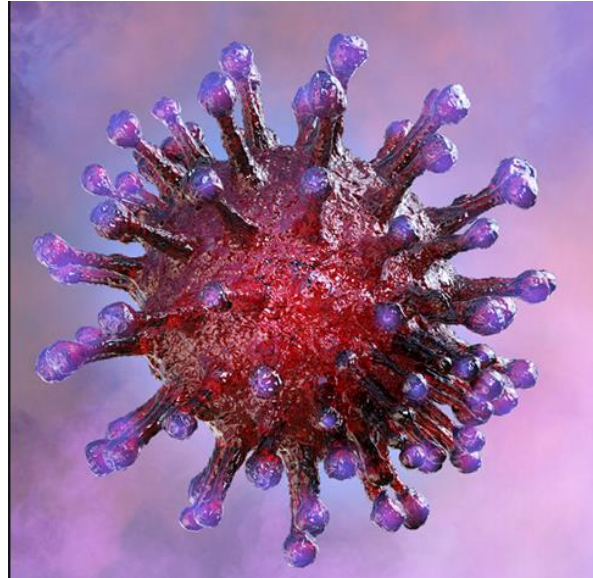


Virus Particle Comparison



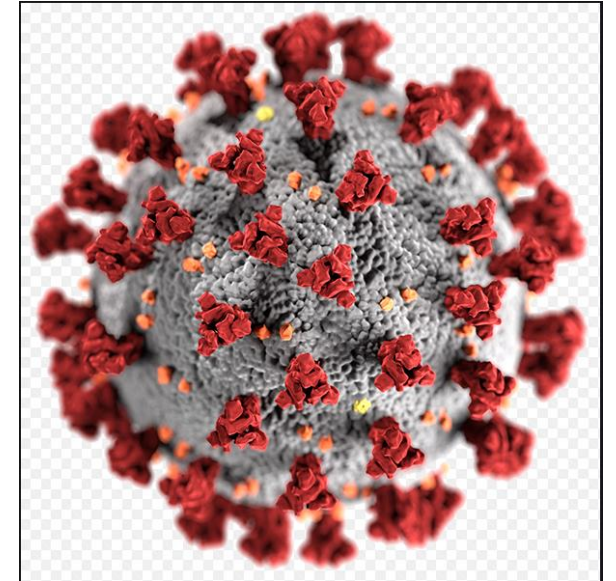
MS2 Virus

- Humanly safe
- More resistant than SARS-CoV-2



229E Virus

- Human coronavirus
- Common Cold



SARS-CoV-2 Virus

- Virus that causes Covid-19 disease

Live Virus Testing – Test Locations & Entities

Mockup

- Boeing AIC, Everett WA
- CSIRO, Australia
- CCDC/CBC, Dugway



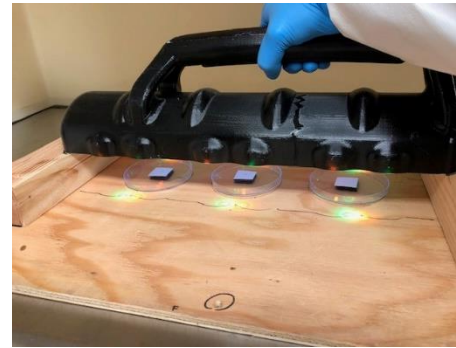
Airplane

- Boeing Field, Seattle WA



Laboratory

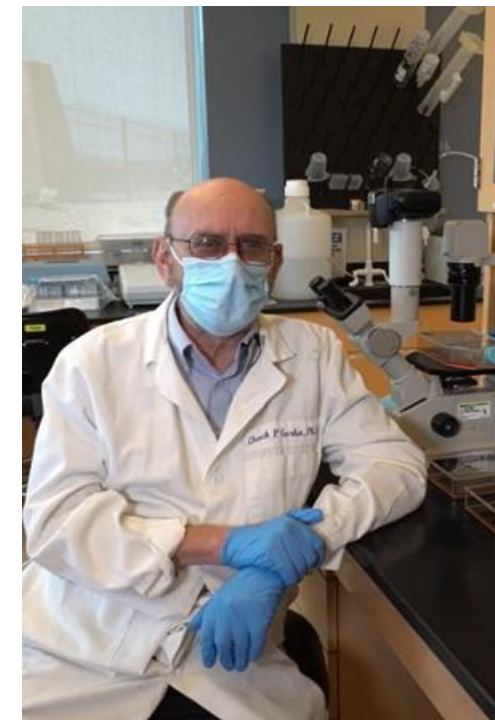
- Univ of Arizona, Tucson AZ
- CSIRO, Australia
- Univ of Queensland, Australia
- CCDC/CBC, Dugway



BOEING PROPRIETARY

Clean Airplane Program validated by live virus testing

Efficacy Testing Results		
Solution / Technology	Avg Reduction MS2 / 229E	Avg Reduction SARS-CoV-2
Chemical Disinfectants	229E	
Wipe - IPA 70 Standard (Cloth)	> 99.9%	99.99%
Wipe Calla 1452 Standard	> 99%	99.99%
Anti-Microbial Coatings	MS2	SARS-CoV-2
Boeing Microactive Protection	> 99.9%	99.999%
mPale	< 90%	99.98%
Surfacewise 2	< 90%	99.95%
UV Technology	MS2	SARS-CoV-2
UV Wand - 222nm	> 99%	99.9%
Electrostatic Sprayer	MS2	SARS-CoV-2
Calla or AeroDis	< 90% (MS2)	< 90%
Calla or AeroDis + dry wipe	> 99% (229E)	> 99%
Thermal Disinfection @ 20% RH	229E	SARS-CoV-2
40° C / 104° F @ 5 hours 5 min	N/A	99.9%
50° C / 122° F @ 3 hours 20 min	< 99%	99.9%
60° C / 140° F @ 2 hours 14 min	> 99%	99.9%
Ionization	MS2 / Staph	229E
Surface: 30,000 Ions/cm ³ @ 60min	< 60%	< 60%



Summary & Key Findings

Clean Airplane Program

- Boeing has proven that aircraft cabins and flight deck can be disinfected effectively through live virus testing
- All recommended cabin disinfection solutions resulted in a greater than 99% log reduction of SARS-CoV-2 virus or surrogates
- Antimicrobial Coatings and built-in UV light are a focus area for the future as they are long lasting and effective against viruses and bacteria.

Thank you to our customers, partners, and collaborators for working together with Boeing on the Clean Airplane Program and ensuring safe travel during the COVID-19 pandemic



Research Link

Boeing Live Virus Testing White Paper

<https://www.boeing.com/confident-travel/research/clean-airplane-program-live-virus-validation-testing.html>

Or google: “Boeing Live Virus Testing”