Cabin Disinfection Methods

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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 partners in flight

A Multi-layered Approach to Protect the Air Travel Journey

HOME | **DEPARTURE AIRPORT** | **AIRPLANE** | **INFLIGHT** | **ARRIVAL AIRPORT**

CLEAN AIR

CHECK-IN & SELF EVALUATION

ENHANCED PROCEDURES
Superior Air Quality

CLEANED AND DISINFECTED

New Technologies

Cabin airflow

2-3 minutes

HEPA

Face mask

ENHANCED PROCEDURES
Superior Air Quality

DATA-DRIVEN OPTIMIZATION

Boeing’s Clean Airplane Program

Helping airlines protect passengers from viruses

TODAY’S SOLUTIONS

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

Air flow & filtration in the airplane cabin is designed to keep passengers and flight crews healthy

Outside air continuously flows into the cabin

1

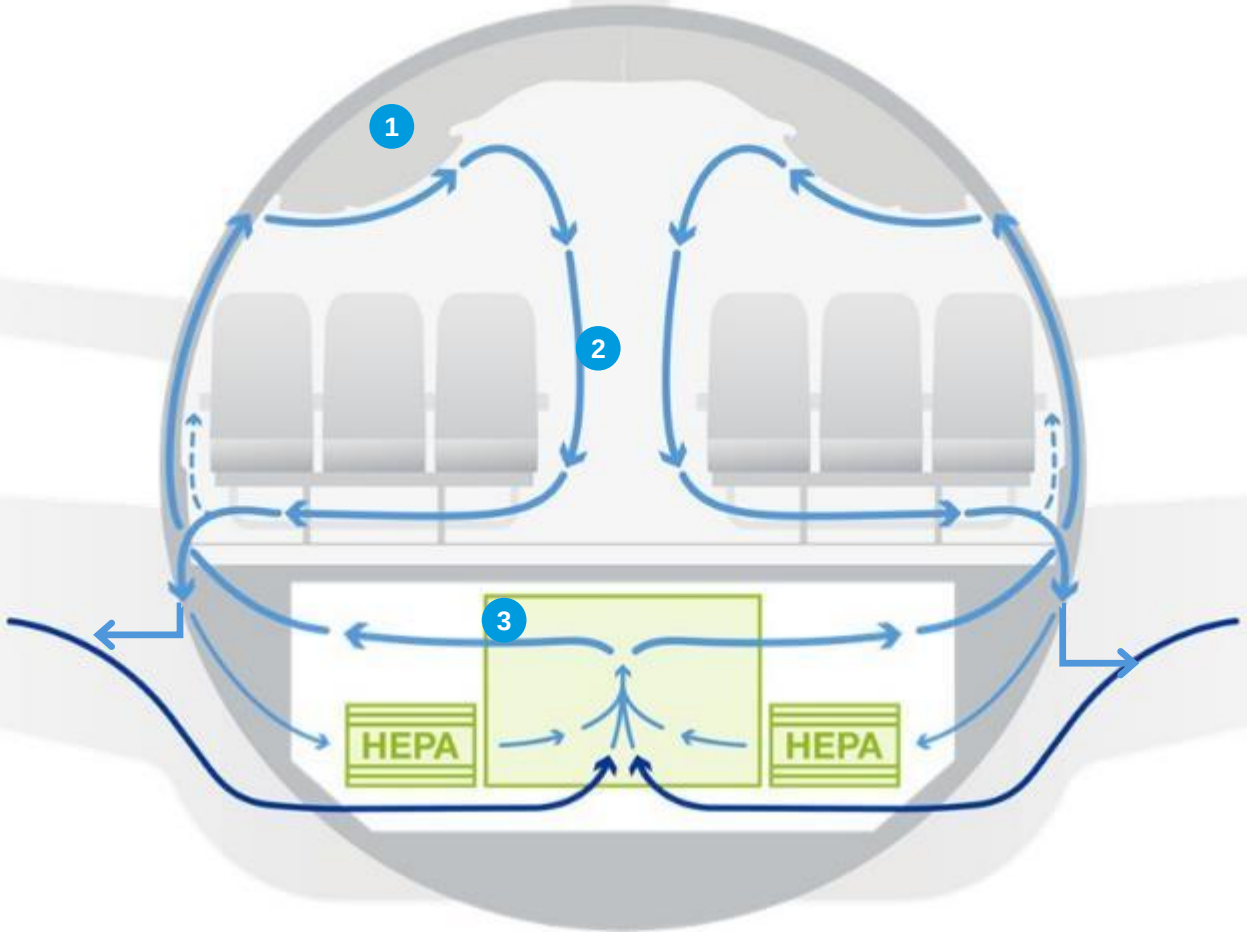
Air is supplied to the cabin from overhead outlets. The volume of cabin air is exchanged **EVERY 2 TO 3 MINUTES**.

2

Air flows primarily **CEILING TO FLOOR**, not front to back, to minimize the spread of contaminants.

3

Air passes through **HIGH EFFICIENCY PARTICULATE AIR (HEPA)** filters which are **99.9%+** effective at trapping viruses and bacteria.



Risk of virus spread on airplanes is low

Increased airflow and stronger filters remove more particulates

How often is the air exchanged?

TYPICAL RESIDENCE

ONCE AN HOUR, OR LONGER

OFFICE & BUSINESSES

EVERY 12 – 30 MINUTES

AIRPORTS

EVERY 6 – 10 MINUTES

AIRPLANES

EVERY 2 – 3 MINUTES

What is filtered out of the air?
(Based on typical air filter [MERV] ratings.)

Particulates Removed (MERV 2-6):

- ✓ Dust/Lint
- ✓ Pollen

Particulates Removed (MERV 5-8):

- ✓ Mold
- ✓ Dust Mites
- ✓ Dust/Lint
- ✓ Pollen

Particulates Removed (MERV 13+):

- ✓ Some Viruses
- ✓ Bacteria
- ✓ Allergens
- ✓ Smog
- ✓ Smoke
- ✓ Pet Dander
- ✓ Mold
- ✓ Dust Mites
- ✓ Dust/Lint
- ✓ Pollen

Particulates Removed (MERV 17+):

- ✓ Virus
- ✓ Bacteria
- ✓ Allergens
- ✓ Smog
- ✓ Smoke
- ✓ Pet Dander
- ✓ Mold
- ✓ Dust Mites
- ✓ Dust/Lint
- ✓ Pollen

Clean Airplane Program validated by live virus testing

Boeing partnership with University of Arizona

The Situation

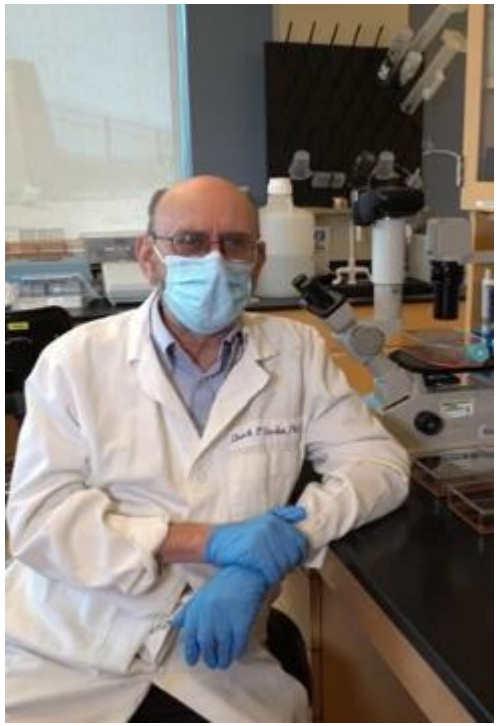
- Boeing implemented an innovative, first-of-its-kind test with the University of Arizona to validate cleaning recommendations against a human-safe live virus (MS2) in a working airplane cabin

The Method

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



Disinfecting the cabin

Clean Airplane Program

Consistently providing recommendations for certain techniques

Boeing provides airlines guidance on disinfecting the passenger cabin

Identification of high-touch surfaces

Working with operators to evaluate new disinfectant application techniques

Summary & Key Findings

Clean Airplane Program

- Boeing has proven that aircraft cabins and flight deck can be disinfected effectively
- The primary path of transmission for SARS-CoV-2 is aerosol. Links to fomite (surface) transmission information provided for airline consideration
- 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 for working together with Boeing on the Clean Airplane Program and ensuring safe travel during the COVID-19 pandemic

Research Link

Go behind the stories and see our research on COVID-19 and healthy travel for yourself.

APRIL 2021 **Use of Bipolar Ionization for Disinfection within Airplanes**	MARCH 2021 **Role of Persistent Disinfectants in Reducing Disease Transmission from Contaminated Surfaces**	MARCH 2021 **Comparison of Cough Particle Exposure for Indoor Commercial and Aircraft Cabin Spaces**
FEBRUARY 2021 **Thermal Disinfection of SARS-CoV-2 within an Airplane**	FEBRUARY 2021 **Compatibility of Aircraft Interior Surfaces with 222 nm Far-UV Light Exposure**	JANUARY 2021 **Engineered Physical Distance Equivalence for a Cough**
DECEMBER 2020 **Clean Airplane Program Live Virus Validation Testing**	DECEMBER 2020 **Chemical Disinfectant Evaluation and Approval for the Aerospace Industry**	DECEMBER 2020 **Safety of 222 nm Band-Pass Filtered Irradiation**
DECEMBER 2020 **Disinfection with Far-UV (222 nm Ultraviolet light)**	DECEMBER 2020 **Selection and Characterization of Semi-Automated Disinfection Devices**	NOVEMBER 2020 **Computational Fluid Dynamics Modeling and the Transport of Cough Particles in an Aircraft Cabin**
JUNE 2021 **Far UV-C (222nm) Light Exposure Surface Efficacy Study**	JUNE 2021 **Covid-19 Screening Strategy Comparison**	NOVEMBER 2020 **Probability and Estimated Risk of SARS-CoV-2 Transmission in the Air Travel System**