WHITE PAPER

Opentrons Flex™ HEPA/UV Module

The Opentrons Flex HEPA/UV Module keeps your automated applications free of contaminants with UV-C sterilization and filters meeting HEPA standards.

Written by
Opentrons Labworks, Inc.

Product Details

The Opentrons Flex HEPA/UV Module is engineered to facilitate controlled and sterile environments for critical scientific applications. It integrates high-efficiency particulate air (HEPA) filtration technology and UV-C (254 nm) disinfection capabilities to ensure precise environmental control within your lab.

Specifications

Efficiency	H14 HEPA filter, 99.99% for 0.3 µm biological particles
Dimensions	87 cm x 64 cm x 140 cm
Weight	42 lbs / 20 kg
Voltage	110V - 220V
Noise level	70 decibels
Power supply (AC)	**Input:** 2.2 A at 115 VAC, 1.1 A at 230 VAC **Output:** 24 VDC, 8.4 A, 201 W max
Power consumption	75.5 watts - 160 watts
Operating space	20 cm / 8” (minimum) of side and top clearance

Illustration of contaminants filtered through the HEPA/UV module into the Flex

Data

The HEPA/UV module utilizes continuous filtered airflow to create positive pressure inside the Flex. To confirm the filter efficiency, an airborne particle counter was positioned in a HEPA/UV module equipped Opentrons Flex twice during the intermediate phase of an ongoing protocol to detect particulates with a size greater than 0.3 microns or greater than 0.5 microns. The measurements were captured at 30-second intervals, extending up to 180 seconds. Six Flex units were evaluated with the HEPA filter activated, and a concurrent test was conducted on a Flex without HEPA/UV module for comparison. The results indicated a significant improvement in airborne particulate concentration when the robot was equipped with an operational HEPA filter (Figure 1). Although the particle counts rose when the robot door was briefly opened to position the particle counter on the working deck, within less than 2 minutes, the particle concentrations rapidly reduced, achieving compliance with ISO 5 standards (for > 0.3 micron, less than 10 200 particles per cubic meter and for > 0.5 micron, less than 3520 particles per cubic meter) (Figure 2).

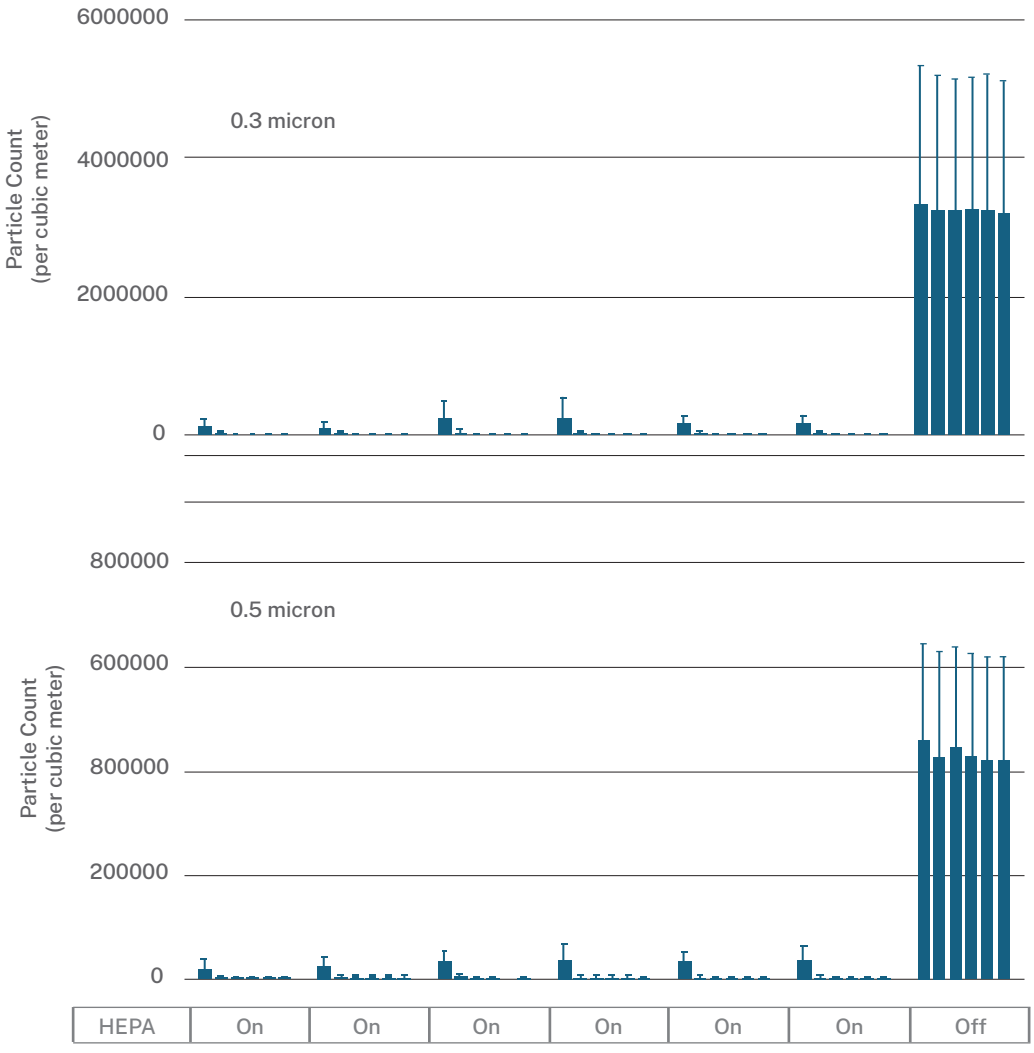

Figure 1. Six particle counts were obtained with 30-second interval from seven Flex units at work (six equipped with an operational HEPA/UV module and one without). The chart presents the mean and STD of the readings collected twice a day for five days.

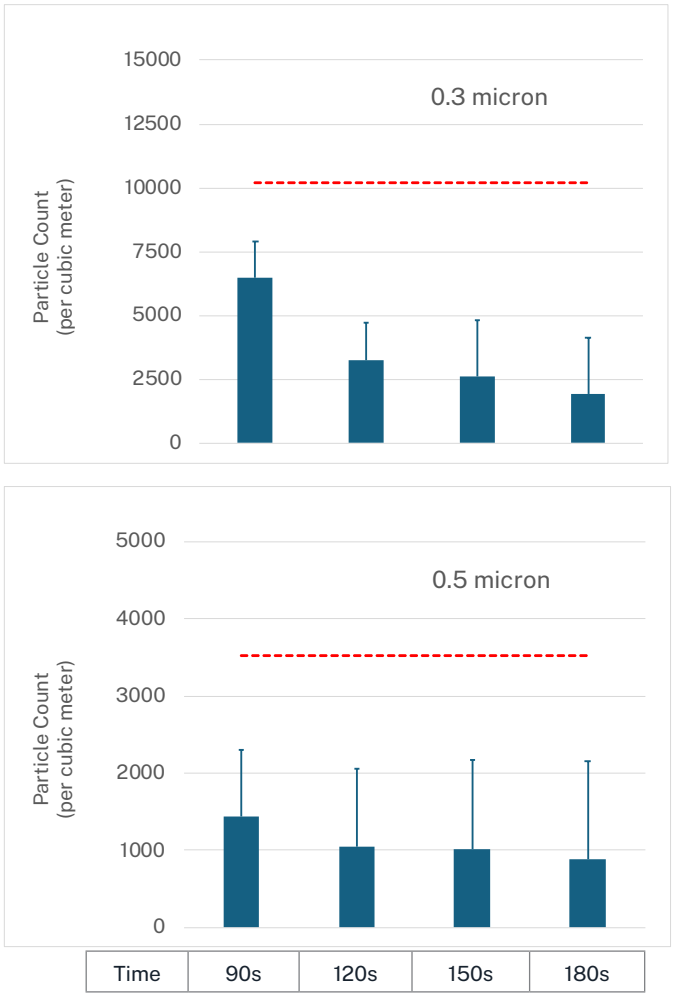

Figure 2. The chart presents the mean and STD of particle counts obtained from assessing six HEPA/UT module equipped Flex units twice a day for five days. The red dash line indicates ISO 5 standards for particular particle size.

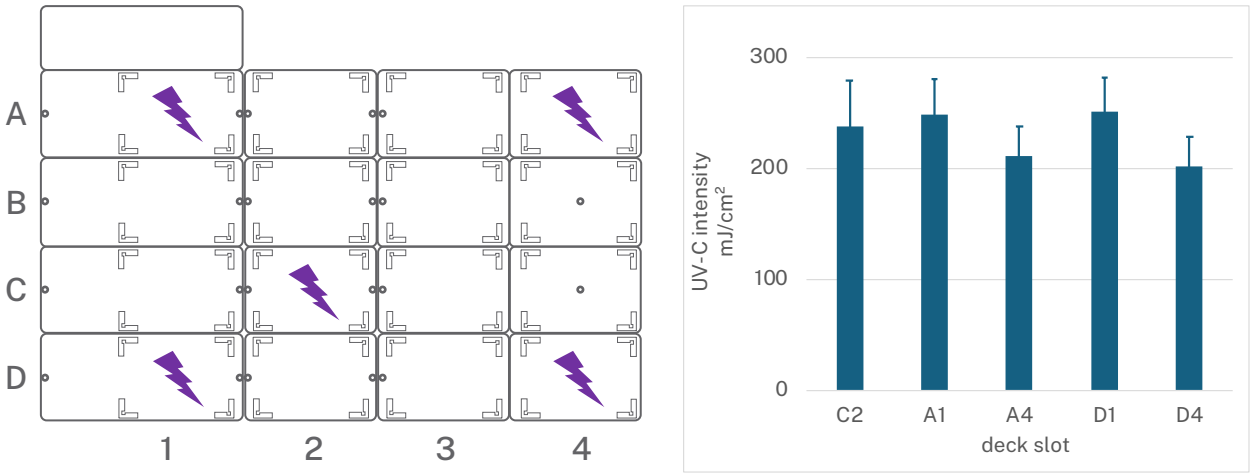

Figure 3. UV light intensities were detected at five slots across the deck of Flex platform, and total UV-C dosages calculated based on the exposure time (i.e., 15 minutes).

During a 15-minute duration, the HEPA/UV module administered a UV-C irradiation dosage exceeding 200 mJ/cm^2 across five separate slots, located at the center and four corners of the working deck, indicating its capacity in preventing biological contamination (Figure 3).

To further demonstrate the competence of HEPA/UV module on preserving aseptic conditions in the Flex to support workflows prone to biological contamination, such as cell culture maintenance and cell-based assays, repeating pipetting to transfer culture medium between labware was conducted on the Flex equipped with HEPA/UV module, and the growth of microorganisms was investigated to evaluate the effective protection. Before initiating the protocol, both HEPA filter and UV light were activated. UV was deactivated after a 15-minute period whereas HEPA stayed on until the protocol was completed. The first protocol performed distribution of Dulbecco's Modified Eagle Medium (DMEM), a common culture medium suitable for a variety of cell types, from 15 mL conical tubes to every well of all 12-well plates on the deck. All 12-well plates with DMEM were maintained under standard culture conditions (i.e., 37 degree C, 5% CO_2 and 95% humidity) for 72 hours and subjected to turbidity measurement at 600 nm to detect bacterial growth (Figure 4). The second protocol executed pipetting on nutrient rich media including Luria-Bertani (LB) broth, the culture medium for bacteria, and yeast extract peptone dextrose (YPD) for culturing yeast. Both media were transferred from 50 mL conical tubes to 1.5 mL microcentrifuge tubes and then to 15 mL conical tubes, which were incubated on a culture shaker at 37 degree C, and the presence of microorganism determined by turbidimetry at 24, 48 and 72 hours (Figure 5). The results obtained from these two sets of experiments confirmed that the HEPA/UV module can effectively protect workflows that are highly susceptible to contamination.

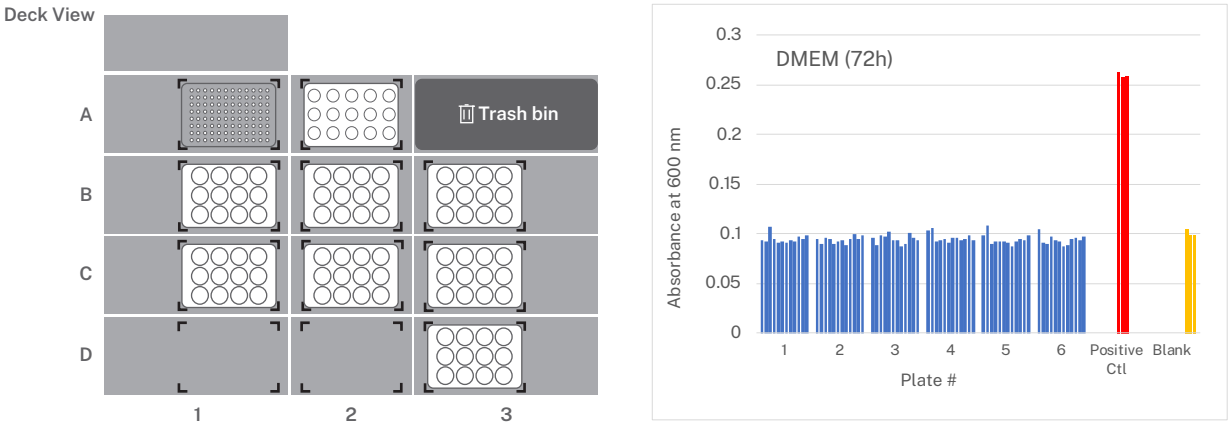

Figure 4. Six 12-well plates were prepared on the Flex equipped with HEPA/UV module and incubated under standard cell culture conditions for 74 hours. Turbidity of each well on each was measured at 600 nm by a plate reader. Three readings obtained from *E. coli* culture serve as positive controls, and three readings from fresh DMEM are blanks.

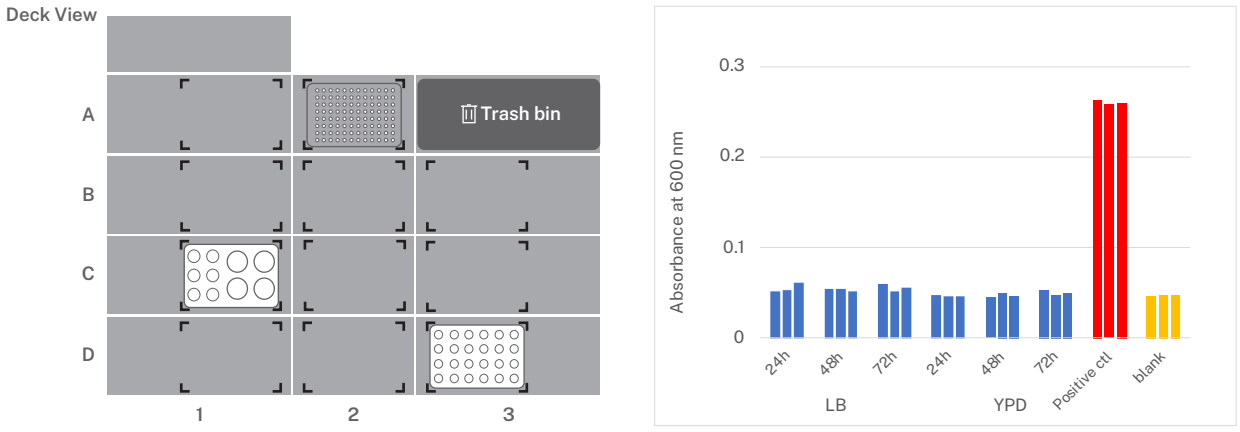

Figure 5. Six 15 mL conical tubes (three for LB and three for YPD) were prepared on the Flex equipped with HEPA/UV module and incubated on a culture shake at 37 degree C. Turbidity of each tube at 24, 48 and 72 hours were measured at 600 nm by a plate reader. Three readings obtained from *E. coli* culture serve as positive controls, and three readings from fresh DMEM serve as blanks.

Dimensional Drawings