## Engineering Research Report

# Development of a Dry Decontamination Method for Mass Casualty Events – the NIOSH DryCon System

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## Disclaimer

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## Abstract

This report describes the development of a prototype dry decontamination system (DryCon) for use in the event of a mass casualty incident involving a dusty contaminant. Wet decontamination is currently used almost exclusively in such cases, although it may be infeasible in cold weather, and there may be compliance issues with the requirement to disrobe. During disrobing, dusty contamination could also re-aerosolize, leading to inhalation of contaminants.

NIOSH's prototype DryCon system uses air jets for dry decontamination, avoiding some of these drawbacks. The system is portable, and can run on building-supplied or generator power. Multiple casualties can be treated rapidly, one after the other, using this system.

DryCon has been tested in a controlled environment, using a manikin and three different types of fabric squares to investigate its effectiveness, with a decontamination time of 60 seconds. At the higher airflow tested, 90% of full blower speed, or approximately 540 cfm, mean decontamination efficiencies of 56.8%, 70.3% and 80.7% were measured for firefighter turnout fabric, cotton denim, and polyester double knit fabric, respectively. Removal of this easily-re-aerosolized contamination helps to protect personnel from further inhalation exposures.

The results demonstrate the promise of this technique for use as an alternative to wet decontamination, as a first step before disrobing for wet decontamination, or in an industrial setting for post-work-shift decontamination. Further research will be necessary to prove the effectiveness of this technique in real-world applications.

# Background

## Control Technology Studies

The National Institute for Occupational Safety and Health (NIOSH) is the primary Federal agency engaged in occupational safety and health research. Located in the Department of Health and Human Services, it was established by the Occupational Safety and Health Act of 1970. This legislation mandated NIOSH to conduct a number of research and education programs separate from the standard setting and enforcement functions carried out by the Occupational Safety and Health Administration (OSHA) in the Department of Labor. An important area of NIOSH research deals with methods for controlling occupational exposure to potential chemical and physical hazards. The Engineering and Physical Hazards Branch (EPHB) of the Division of Applied Research and Technology has been given the lead within NIOSH to study the engineering aspects of health hazard prevention and control.

Since 1976, EPHB has conducted a number of assessments of health hazard control technology on the basis of industry, common industrial process, or specific control techniques. Examples of these completed studies include the foundry industry; various chemical manufacturing or processing operations; spray painting; and the recirculation of exhaust air. The objective of each of these studies has been to document and evaluate effective control techniques for potential health hazards in the industry or process of interest, and to create a more general awareness of the need for or availability of an effective system of hazard control measures.

The reports from these studies are then used as a basis for preparing technical reports and journal articles on effective hazard control measures. Ultimately, the information from these research activities builds the database of publicly available information on hazard control techniques for use by health professionals and equipment manufacturers who are responsible for preventing occupational illness and injury.

## Mass Casualty Decontamination

The preparedness and response community must be ready at any moment to respond to public health emergencies and incidents. These emergencies and incidents could include a mass contamination incident (e.g., dirty bomb, weaponized biological hazard, chemicals in aerosol form) at a building, stadium or other venue. External contamination of multiple victims can result from airborne release of hazardous substances or direct contact with the contaminant [Cibulsky et al. 2015].

In their Radiological Dispersal Device Playbook [U.S. Department of Health and Human Services: Office of the Assistant Secretary for Preparedness and Response 2015], officials of the Office of the Assistant Secretary for Preparedness and Response (ASPR) of the U.S. Department of Health and Human Services (DHHS) estimate that, during a “dirty bomb” scenario, hundreds of injured people would require decontamination in the course of medical treatment. Thousands more uninjured people would likely need some degree of decontamination [U.S.

Department of Health and Human Services: Office of the Assistant Secretary for Preparedness and Response 2015].

Guidance on accomplishing mass decontamination has been developed by the military [Lake et al. 2013] and by the U.S. Departments of Homeland Security and Health and Human Services [Cibulsky et al. 2015]. In a mass casualty contamination event, decontamination is typically accomplished with wet showers, utilizing water and/or other decontamination fluids. A 2016 article reported the results of an online survey of 68 emergency response professionals across the U.S. on decontamination practices. Over 70% of respondents reported using a ladder-pipe system for mass decontamination, in which fire department ladders and hoses are positioned to create a shower corridor. The vast majority of those responding stated that the temperature of the shower water could not be controlled.

The first step in wet decontamination is removal of clothing, a process that could re-aerosolize contamination, causing more contamination to be inhaled or spread to adjacent areas. Re-aerosolization of particulate contamination has been measured from surfaces and clothing [Layshock et al. 2012; McDonagh and Byrne 2014a].

Wet decontamination may be infeasible in cold weather or when the contaminant is water-reactive, and the clothing removal requirement could cause unknown compliance issues, due to modesty or cultural concerns [Carter et al. 2016; Carter et al. 2012; USFA 1997]. Lake et al. recommend wet decontamination for outdoor temperatures as low as 36ºF. Below this temperature, a dry method such as removal of clothing and blotting with a paper towel is recommended until a heated facility can be accessed [Lake et al. 2013]. When water-based decontamination is contraindicated, Cibulsky et al. recommend employing other media such as neutralizing agents, chemical-specific decontaminants, and absorbent or adsorbent materials [Cibulsky et al. 2015].

## Air Showers

Air showers are used in the electronics industry for removal of small quantities of particulate matter from personnel before they enter clean rooms. An air shower is a fixed chamber using recirculating air with high-efficiency particulate air (HEPA) filtration. The chamber typically has multiple air nozzles distributed across its walls and/or ceiling, delivering air at a linear velocity of 4500 - 7500 feet per minute [Loughran and Shea 1996; Tsepelev 2016]. Although air showers have been in use for many years, there are no U.S. or international design standards for them, and performance data is scant [Tsepelev 2016]. In general, it is reported that higher air velocity results in improved contaminant removal, but the effectiveness of air showers in cleanroom contamination control is a subject of debate [Loughran and Shea 1996].

Air showers at secondary lead smelters were studied by Simonson and Mecham in 1983 [NIOSH 1983]. They found that lead dust removal from two different types of cloth samples in two different styles of air showers ranged from 5 – 72%. In laboratory simulations of air shower treatment, 15 – 83% of lead dust was removed from three different types of cloth samples. Some penetration of the fabric by lead dust during simulated air shower treatment was observed, ranging from 0.1% to

1.9%. The amount of penetration seemed to be dependent on the type of cloth [NIOSH 1983].

Air showers have sometimes been employed at shooting ranges to help remove lead particulate from the skin and clothing of shooters. Studies of lead contamination at shooting ranges have reported levels of contamination on the order of micrograms per square centimeter. In a study at the Uniformed Services University of the Health Sciences, the effect of various angles and speeds of air flow inside a commercial air shower was studied for the removal of shooting range lead from Army combat uniform fabric. Reductions in contamination levels ranging from 8.2% to 56.1% were measured [Tsepelev 2016].

Slagley et al. evaluated the use of an air shower for removal of a model soil, sodium bicarbonate, from heavily-contaminated fire-resistant coveralls worn by a manikin. The research demonstrated that use of the air shower gave results comparable to HEPA vacuuming of the coveralls, but required less time than vacuuming. The air shower was significantly better than no decontamination in reducing the personal breathing zone (PBZ) concentrations of both total and respirable dust for the manikin when the coveralls were subsequently doffed. The mean airborne concentrations of total dust by weight were reduced by over 97%, while the mean concentrations of respirable dust were reduced by over 89% [Slagley et al. 2017].

## Particulate Removal

Particulate matter adhering to a surface, such as hair, skin or clothing, is held in place by molecular-level forces. These adhesion forces may include van der Waals forces, electrostatic forces (especially in non-conductive materials), chemical bonds and the capillary action of moisture on the surface [Fletcher et al. 2008; Ranade 1987; Ziskind et al. 1995]. The strength of these forces is dependent on the particle size, the properties of the particle and the surface, the relative humidity of the air and the length of time that the particle has been on the surface [Ibrahim et al. 2004; Ibrahim et al. 2008]. Longer residence time on a surface may allow moisture to condense in small gaps between the particle and the surface, increasing the adhesion force. Even if this moisture is subsequently dried, crystallized impurities may remain, helping to “cement” the particle to the surface [Ranade 1987]. This highlights the need to remove contamination quickly before adhesion forces increase.

In a flowing air stream, the forces acting to detach a particle from a surface include lift, drag and torque. These aerodynamic forces are dependent on the size of the particle and the speed of the air stream [Harris and Davidson 2008]. When the particle starts to detach, it may move by lift-off, sliding or rolling [Phares et al. 2000]. Experimentally, particles have been observed to roll before detaching from a surface, so torque may be an important component of the forces involved in removing a particle from a surface, especially because rolling detachment occurs at a much lower shear stress than sliding detachment [Harris and Davidson 2008]. Several researchers have additionally noted a time-dependence of particle suspension from a surface by an air jet, attributed to turbulence effects [Smedley et al. 1999; Ziskind et al. 1995].

In order to remove particles from surfaces using air jets, the speed and impact force of the air jet must be sufficient for the aerodynamic forces working to detach the particle to exceed the adhesion forces tending to keep the particle on the surface. Experimentally, particle removal efficiency has been shown to increase with increasing air jet pressure, decreasing jet height above the surface, and increasing particle diameter [Smedley et al. 1999]. These results have also been verified for particles adhering to cloth [Fletcher et al. 2008].

### Previous NIOSH Research

Workers in the mining industry often experience significant respiratory exposures by re-aerosolization of dust on their work clothing. Compressed air hoses were sometimes used to blow off the dust on work clothing, a practice prohibited both by the Mine Safety and Health Administration (MSHA) and by OSHA. The only method approved by MSHA at one time was vacuuming the dusty clothes, using a HEPA-filtered vacuum, a method which is difficult and time-consuming. The NIOSH Clothes Cleaning System was developed for cleaning of work clothing of miners and other workers subject to dusty contamination [Pollock et al. 2006].

The system uses regulated air from an air compressor to supply a manifold of flat-fan air spray nozzles for decontamination of personnel and their clothing. Air is delivered at about 600 cfm for around 18 seconds. Testing using limestone dust on poly/cotton coveralls showed that about 83% of contamination could be removed [Cecala et al. 2008]. This system requires refilling of an air reservoir between each treatment. It has limited portability.

Contaminants on firefighter turnout clothing and equipment can be a source of ongoing exposures to firefighters. The Rapid Dry Field Decontamination System for Firefighters (RDFFDS) was developed as a handheld, inexpensive, highly portable intervention for use by firefighters following fire response. A prototype modified leaf blower gave good results for this service, demonstrating an average of 81% removal of a simulated dusty contaminant from firefighter turnout fabric in laboratory trials [NIOSH 2017]. This method has no provision for capture of removed contaminants.

## Prototype Development

### DryCon Design

The objective of this study was to develop and test a rapid, dry field decontamination (DryCon) method to be used in a mass exposure incident to decontaminate large numbers of first responders or civilians. The DryCon system takes advantage of aerodynamic forces of lift, drag and torque to effect dry decontamination. This system can be used in place of, or as a preliminary step before, wet decontamination during a mass casualty contamination event. The method was developed based on previous NIOSH research on the RDFFDS [NIOSH 2017] and the NIOSH Clothes Cleaning System [Pollock et al. 2006]. DryCon uses air jets in a compact, portable, relatively inexpensive system to accomplish quick field decontamination, avoiding the need to remove clothing and leaving casualties dry after decontamination. Unlike the NIOSH Clothes Cleaning System, the DryCon system uses a blower instead of compressed air for decontamination. This makes it possible to treat casualties one right after the other, without waiting for the compressed air reservoir to refill. In this way, the system is similar to an air shower. The advantage of DryCon when compared to the RDFFDS is that removed contaminants are captured.

DryCon requires only electric power or a fuel-powered generator for operation. The DryCon system uses high-velocity air jets supplied by a high-efficiency blower to remove dusty contamination from skin and clothing. A personnel chamber connected to a HEPA-filtered exhaust blower is used to capture the removed contamination. All components are mounted on wheels for portability. In previous research, the importance of the linear velocity of air in removing contamination was recognized, in addition to the volumetric flow rate of the air [NIOSH 2017]. In order to produce a high linear air velocity, a blower must generate considerable static pressure.

Seventeen different blower manufacturers were contacted, but only one could provide a centrifugal blower that achieves the required combination of volumetric flow rate and static pressure in a relatively light and compact blower (Vortron Industrial, Channel Islands, CA). The chosen blower is a high-efficiency belt-driven centrifugal blower, rated to deliver 500 – 600 cfm at a pressure of approximately 1 psi. The blower is mounted inside a filtered, sound-reducing enclosure, and controlled using a variable frequency drive (Toshiba, Tokyo, Japan), and a programmable logic controller (Rockwell Automation, Milwaukee, WI). A 3-D printed adapter was designed using SOLIDWORKS® software (Dassault Systemes, Vélizy-Villacoublay, France), and printed from polylactic acid (PLA) plastic using a Raise3D N2 Plus 3-D printer (Raise3D, Irvine, CA). The adapter was employed to split the flow from the 3-1/2” outlet of the blower to connect with two 6”-diameter static dissipative polyurethane hoses, reinforced with bronze coated spring steel wire (Flexaust, Warsaw, IN), which connect with two manifolds of nozzles.

Prior research on the NIOSH Clothes Cleaning System showed improved performance for flat-fan type nozzles when compared to round nozzles [Pollock 2006], so the DryCon system was designed using a row of 3-D printed flat nozzles, closely spaced. The polyurethane hoses connect to one manifold of 10 nozzles blowing horizontally, and one manifold of 4 nozzles blowing vertically down. The total discharge area of the nozzles is 0.367 square inches, providing a maximum air velocity at the nozzle of 16,800 feet per minute. Figure 1 shows a photograph of the DryCon system. Figure 2 shows one of the nozzle manifolds.

The DryCon system has several differences from a commercial air shower, in that its nozzles are arrayed in a straight line, giving essentially straight-through flow, as in the NIOSH Clothes Cleaning System, instead of being somewhat randomly distributed throughout the decontamination chamber. The DryCon system does not use recirculated air as an air shower does, but uses fresh air. Also, while most air showers are permanently fixed, the DryCon is intended to be portable.

A commercially-available, portable personnel chamber, typically used as an enclosure for asbestos abatement, was adapted to the needs of this system, the Aire Guardian AB3000MCCK (Abatement Technologies, Suwanee, GA). The chamber, with a footprint of 30" by 60", was modified by adding rigid clear acrylic doors on both sides to enable quick access and egress and good control of contaminants. A commercial HEPA-filtered exhaust blower (Omnitec Design, Inc., Mukilteo, WA), rated at 400 – 1600 cfm, is connected to the chamber to maintain it at a slight negative pressure and capture contaminants.

### DryCon Usage

To begin, a person to be decontaminated dons earplugs and safety glasses, enters the chamber, and the operator closes the entry door. The person is instructed to stand as near the air nozzles as possible, and to rotate slowly with their arms held above their head or out from their sides. Pressing a button on the programmable controller panel starts the exhaust blower first to provide a slight negative pressure inside the personnel chamber and control contamination. After a short pre-programmed delay, the positive pressure blower starts up and runs for a preset length of time (usually 60 seconds) to remove dusty contamination from skin, hair and clothing. The air flows generally from top front to bottom rear of the chamber to move contamination away from the breathing zone.

When the positive pressure blower shuts down, the exhaust blower keeps running to help prevent any possible release of contaminants. The exhaust blower incorporates HEPA filtration to collect the particulate removed. The exit door on the opposite side of the chamber is opened and the decontaminated person exits. The earplugs and safety glasses are discarded. The exit door is closed behind the person, and the chamber is ready for the next person. The entire procedure takes less than 5 minutes.

This report presents the results of laboratory-scale testing of the DryCon system to determine its effectiveness in removing a dusty model soil.

## Research Methodology

Tests were conducted in the NIOSH Engineering Controls Research Area to measure the effectiveness of the DryCon system in removing a model soil from fabric swatches. Two fabric swatches, each 6" x 6" (15.24 cm x 15.24 cm), were affixed to a flexible male manikin (Zing Display, Rancho Santa Margarita, CA) standing on a turntable (Vestil Manufacturing, Angola, IN) inside the DryCon chamber. The turntable rotated at 3.5 RPM to simulate a person turning slowly in front of the air jets. See Figure 2.

One fabric swatch was affixed to the front of the manikin's shirt, and one was affixed to the leg of the pants, using a hook and loop fastener square in each corner. The fastener squares were stapled or safety-pinned in place to prevent them from being dislodged. See Figures 3 and 4 for the placement of the fabric swatches. As in previous NIOSH research [NIOSH 2017], a fluorescent dust, Dust Chaser Leak Detection Compound (W.H. Kingsmill, Ltd., Burlington, ON, Canada), was used as a model soil. The dust is composed of calcium carbonate, colored with a polymeric resin. The size distribution of this dust was measured by an analytical laboratory using scanning electron microscopy. A photomicrograph of the fluorescent dust is shown in Figure 5. Over 99% of the dust was measured to be smaller than 10 µm in diameter. A graph of the size distribution is given in Figure 6. The dust was distributed onto the surface of the fabric swatch using a pesticide duster (PF Harris, Cartersville, GA), and a custom-made application chamber, created on a 3-D printer. See Figures 7 and 8.

The fluorescence of the fabric swatch dusted with the fluorescent powder was measured before and after DryCon treatment. A 3-D printed support held the fabric swatch, a Scorpion Master 100 LED Blacklight Flashlight (Shawshank LEDz Inc., Chandler, AZ) and an Extech Model SDL400-NIST light meter (FLIR Systems, Inc., Nashua, NH) at the same distances and angles for each measurement. The LED blacklight flashlight is used to illuminate the fluorescent powder. This flashlight was modified to operate on AC power in place of battery power, eliminating light output changes due to battery voltage variation. The luminous emittance, or fluorescence, of the surface stimulated by the blacklight (in lux) is measured using the light meter. Photographs of the 3-D printed support, with and without the blacklight flashlight and light meter in place, are given in Figures 9 and 10.

For each run, two clean fabric swatches were weighed using an analytical balance, Mettler AE163 (Mettler-Toledo, Columbus, OH). The fluorescence of the clean swatches was measured using the 3-D printed support. The swatches were then soiled using the application chamber, weighed, and the fluorescence measured again. The swatches were affixed to the shirt and the pants leg of the manikin, and DryCon treatment was carried out for 60 seconds. The swatches were then detached from the manikin, weighed, and their fluorescence measured for a third time. Fabric swatches were washed using dishwashing detergent and air-dried in between runs.

Three different types of fabric were tested, as shown in Table 1: a polyester double-knit fabric (DK), a fabric used in firefighter turnout coats (FF) and 100% cotton denim (DM). A photograph of the three fabrics is shown in Figure 11. Tests were run at 80% and 90% of maximum blower speed (approximately 480 and 540 cfm), and nozzles were oriented either directly facing the manikin ($0^o$) or with the 10-nozzle manifold (blowing horizontally) adjusted to a $10^o$ angle to the direct line, towards the entrance door.

For each combination of fabric, blower speed and angle, three runs were made, each one using 10 fabric swatches (5 separate trials of 2 swatches at a time), for a total of 30 swatches tested at each set of conditions. In one case, a blower hose came loose on the last trial and the results on the 2 fabric swatches tested were discarded, so only 28 data points were collected. In another case, the manikin had developed a leaning posture and was straightened up again. An additional run was completed to make sure results were consistent with earlier runs, so 40 data points were collected for that set of conditions. In total, 368 data points were used in data analysis.

All fabric swatches tested were black, but all exhibited some level of fluorescence, even when clean. The luminous emittance of a fabric square, $M_v$, in lux, was measured using the light meter. For decontamination effectiveness analysis, the fluorescence (lux) due to the model soil on a given test sample was determined by subtracting $M_v$ of the clean swatch from $M_v$ of the soiled swatch. In this manner, the baseline-corrected reduction in fluorescence between pre- and post-decontaminated fabric test samples was calculated using Equation 1.

$$\%\ Fluroescence\ Removal\ Efficiency = \left[1 - \left[\frac{(M_{v\ decon} - M_{v\ clean})}{(M_{v\ soiled} - M_{v\ clean})}\right]\right] * 100 \qquad (1)$$

where:

$$M_v = luminous\ emittance\ of\ the\ surface\ (lux)$$

## Results

Use of the 3-D printed application chamber improved the reproducibility of application of model soil, but the amount applied to each fabric swatch was still difficult to control. The weight of soil applied ranged between 0.0182 g and 0.3069 g. Most of the soil weights, 328 of 368, or 89%, fell between 0.02 and 0.16 g. The fluorescence of a “soiled” swatch ranged from 92 to 381 lux, and that of a decontaminated swatch ranged from 63 to 192 lux. The reduction in fluorescence for fabric swatches varied between 28.6% and 94.3% after decontamination. The complete dataset is attached as Appendix III.

An analysis of variance of the dataset was performed using PROC GLM in SAS/STAT 12.1 (SAS Institute, Inc., Cary, NC). Independent variables were fabric, angle and blower speed. Results of the analysis of variance are summarized in Table 2. A boxplot of all the results by each combination of fabric/speed/angle is shown in Figure 12, indicating that three of the 368 data points appear to be outliers. Statistically significant differences were observed among the fabrics and between the different blower speeds. Boxplots of the results by fabric and the results by blower speed are shown in Figures 13 and 14.

The combination of fabric and speed and the combination of fabric and angle also exhibited significant differences. Figure 15 shows the interaction plot for fluorescence removed by fabric and speed. The significant interaction between fabric and speed is shown by the lines not being parallel. Percent fluorescence removed did not significantly improve with increasing blower speed from 80% to 90% of maximum for the DK fabric, but it did improve for the FF and DM fabric. Mean percent fluorescence removed is shown in Table 3 by fabric and blower speed.

The difference in angle did not give statistically significant results, nor did the combination of angle and speed. The mean percent fluorescence removed by fabric and angle is shown in Table 4.

## Discussion

There was a strong effect of fabric type on the efficiency of decontamination using the DryCon system. The DK fabric was most effectively decontaminated, followed by the DM fabric, followed by the FF fabric. A mean decontamination efficiency of over 82.7% was achieved with the DK fabric in experiments at a $0^o$ angle.

The difference in decontamination performance on the different fabric types could be a result of several different properties of the fabrics. It was readily apparent that the DK fabric had the least amount of stiffness of the three. This could have allowed more "flapping" to occur during decontamination. The flapping motion could have resulted in better release of particulate. Other properties of the fabrics could also have affected the effectiveness of decontamination, such as the electrostatic charge, the weave making it more or less likely to trap particulate, or the degree of roughness of the fibers. In a NIOSH study of removal of lead oxide dust from fabric by use of an air shower, more dust was removed from a lighter weight fabric (presumably less stiff) than a heavier weight fabric [NIOSH 1983]. McDonagh and Byrne concluded from their investigations that the weave of a fabric was the most important factor in the amount of particulate resuspended from a fabric during vigorous physical activity [McDonagh and Byrne 2014a].

In the current investigation, experiments were conducted at two different angles due to the belief that blowing air directly at contaminated fabric, at an angle of $0^o$, might cause some particulate to become embedded in the fabric weave rather than removed. The manikin was rotating during the experiment, so the amount of time that air was actually blowing perpendicular to any given surface was small, even when the nozzles were oriented at $0^o$. The decontamination results for DM and FF fabric showed no significant effect due to the change from $0^o$ to a $10^o$ angle for the 10-nozzle manifold, but the results for DK fabric actually showed a small but statistically significant decrease in decontamination effectiveness at $10^o$. In Tsepelev's study of the removal of gunshot residue from army combat uniform fabric using an air shower, he found no significant effect of varying the angle from $0^o$ to $45^o$ to $90^o$ [Tsepelev 2016].

Several investigators have found that increasing air speed increases removal of particulate matter [Fletcher et al. 2008; Mukai et al. 2009; Tsepelev 2016]. In general, that is also the case with the current study. Results averaged across all fabrics showed a statistically significant 3.5% increase in decontamination effectiveness with an increase in blower speed from 80% to 90% of maximum. For DM and FF fabrics individually, a statistically significant increase was also measured. A small, statistically insignificant, decrease with increasing blower speed was measured for the DK fabric. This seems to indicate that the decontamination efficiencies achieved for DK fabric are approaching the maximum possible by use of air jets. At the higher airflow tested, 90% of full speed, mean fluorescence removal efficiencies of 56.8%, 70.3% and 80.7% were measured for the FF, DM and DK fabrics, respectively.

The adhesive forces on particles have been described by a log-normal distribution, with some particles being easier to remove than others [Ziskind et al. 1995]. This explains why air jets never removed 100% of the model soil. The force exerted by the air jet on the surface particles is proportional to a threshold surface shear, $\tau$, which is the change in air velocity with distance from the surface. The shear, in turn, is dependent on the air velocity leaving the nozzle [Smedley et al. 1999].

Several studies have shown that larger particles (up to 25 µm in diameter) are easier to resuspend than smaller particles [Kesavan et al. 2017; McDonagh and Byrne 2014b; Mukai et al. 2009]. This research did not measure the particle size distribution of resuspended particles, but it is likely that the larger particles were preferentially resuspended. For this investigation, over 66% of model soil particles were larger than 1 µm diameter. The particles left behind on the fabric swatches after decontamination were most likely those at the lower end of the particle size distribution.

The weight of model soil added to each fabric swatch correlated well with the amount of fluorescence added. Fluorescence measurement was used in preference to weight to determine the effectiveness of decontamination because weight could be lost during decontamination due to removal of fibers from the fabric as well as removal of model soil. Fluorescence was considered to be a more reliable measure of decontamination effectiveness.

The soil loading of a fabric swatch ranged from 0.0182 g to 0.3069 g. There was concern that the decontamination effectiveness for more heavily contaminated fabric swatches might be higher than that for less-contaminated swatches. This did not appear to be the case. When percent fluorescence removed was plotted vs. the quantity of soil loaded in grams, no visible trend could be discerned. A straight line fitted to the data had a very low coefficient of determination, $R^2$, of 0.0187, showing that less than 2% of the variation in percent fluorescence removed could be predicted from the loading of model soil (Figure 16). Similarly, there was no significant overall difference between the efficiency of soil removal from the fabric swatch affixed to the shirt and to the pants of the manikin.

## Conclusions and Future Research

This project developed a workable prototype for a dry decontamination system. Further development and field testing of the DryCon system could provide emergency responders with a rapid and efficient field decontamination system when initial conditions do not lend themselves to the use of wet decontamination. It could also be used as a first step before disrobing for wet decontamination, or in an industrial setting for removal of dusty contamination at the end of a work shift.

The DryCon system has been demonstrated capable of removing an average of 53% - 83% of simulated dusty contamination from three different fabric types under controlled conditions. The most easily re-aerosolized particulates are removed by this method, greatly reducing the immediate inhalation risk for personnel.

The system could be further studied and improved in several ways. The concentration of particles in the breathing zone of someone being decontaminated has not been measured. The direction of airflow has been designed to conduct removed particles down and away from the breathing zone, but measurements are needed to verify the effectiveness of this approach. If the airflow is not sufficiently protective, it may be necessary to provide personnel with respiratory protection during decontamination.

This investigation was done using a manikin. It was not possible to position the arms of the manikin above the head, the recommended posture for decontamination. Also, the manikin was positioned so that no part of the body would strike the nozzles or the sides of the enclosure while rotating on the turntable. This means that the manikin was not always as close to the nozzles as possible during decontamination. It is possible that decontamination results for actual casualties will be better than those measured in this laboratory investigation when personnel are holding their arms above their heads and standing as close to the nozzles as possible. Experiments with people in the chamber would help to answer this question.

Particles may be forced into the weave of clothing fabric, through the fabric, or redeposited on other parts of clothing or the personnel chamber during decontamination. In fact, the bright pink color of the model soil made it easy to observe some redeposition on clothing and the chamber during experimentation. Over 30 grams of model soil were used in total during this study. The great majority of this soil was captured on the HEPA filters in the exhaust blower.

No measurements of particle penetration through fabric were made during this research, but other researchers have measured “breakthrough” particulate following air decontamination by various means. A NIOSH study showed breakthrough amounts from 0.2% to 1.4% in fabric patches treated by a handheld nitrogen nozzle [NIOSH 1983]. Tsepelev found only one out of nine tests showing breakthrough above the limit of quantitation after decontamination by an air shower [Tsepelev 2016].

Although several fabrics were tested, only one type of model soil was used. Other soils may behave differently in the DryCon system. Studies using other types of model soils would be useful in demonstrating the effectiveness of this system on a range of contaminant types. Measurement of the size range of removed particulate could help to verify whether larger particle sizes are preferentially removed.

The prototype DryCon system has only been tested in a laboratory setting. In order to be useful in a mass casualty event, it must be portable and able to be powered by a generator. Modifications are currently being made to the system to improve its portability. The possibility of an inflatable personnel chamber is also being investigated.

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# Appendices

## Appendix I. Figures


**Figure 1. The DryCon system consists of three major components, a HEPA-filtered exhaust blower, a personnel chamber and a positive-pressure blower, from left to right, all mounted on wheels. (Photo credit: NIOSH)**

**Figure 2. Manikin standing on turntable inside of chamber; one of the nozzle manifolds is visible with one side of the chamber opened. (Photo credit: NIOSH)**

**Figure 3. Research manikin showing placement of fabric swatch on the shirt. (Photo credit: NIOSH)**

Figure 4. Research manikin showing placement of fabric swatch on the leg. (Photo credit: NIOSH)

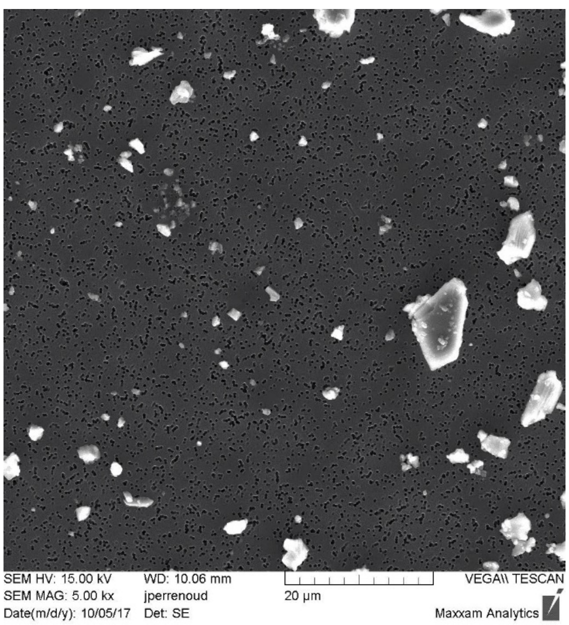


Figure 5. Photomicrograph of the fluorescent dust used as a model soil at 5000X magnification by scanning electron microscopy. (Photo credit: Maxxam Analytics)

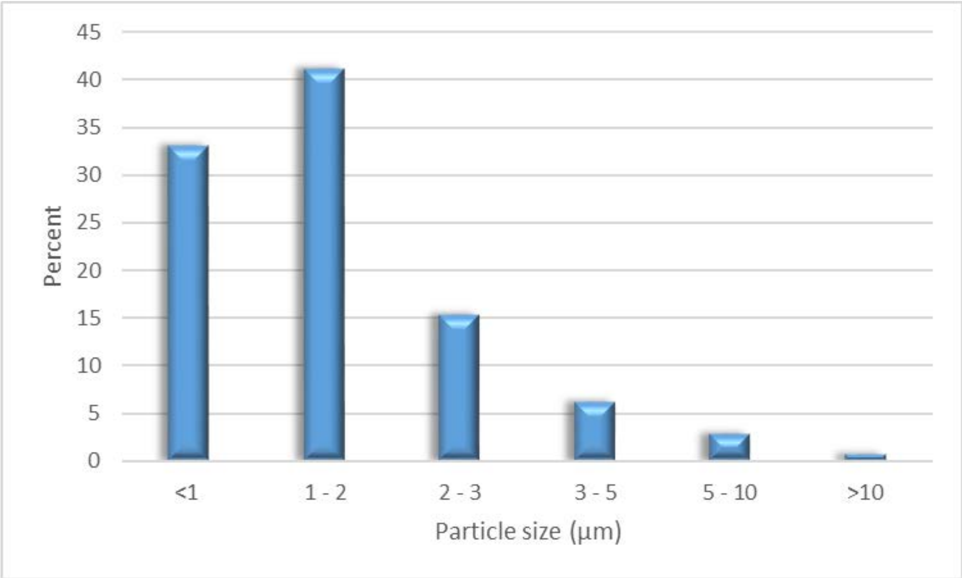


**Figure 6. Size distribution of the fluorescent dust used as a model soil, as determined by scanning electron microscopy.**

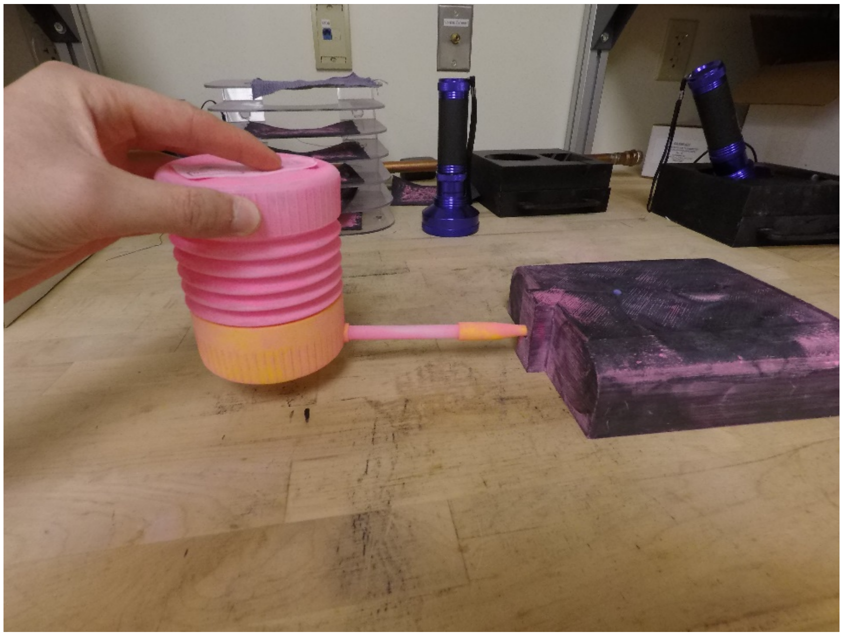

**Figure 7. Method of applying model soil to a fabric swatch, using a pesticide duster and a 3-D printed application chamber. The fabric is placed beneath the chamber. (Photo credit: NIOSH)**

**Figure 8. The bottom of the 3-D application chamber, showing the blue pin that deflects and scatters injected model soil. (Photo credit: NIOSH)**

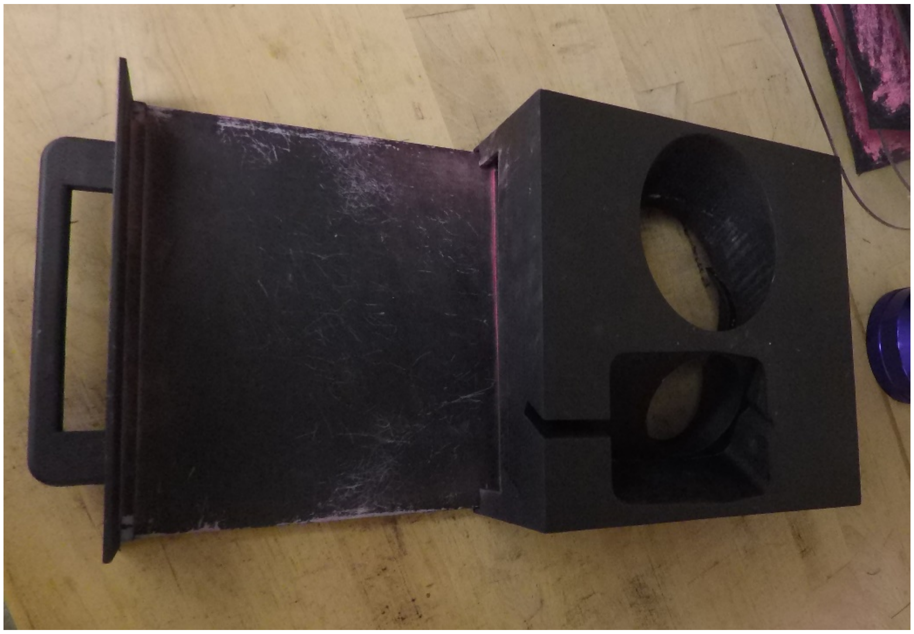

**Figure 9. Support used for measuring the fluorescence of a fabric swatch. The swatch is placed in the open drawer at left and slid inside the support. (Photo credit: NIOSH)**

**Figure 10. Support used for measuring fluorescence of a fabric swatch, with the swatch drawer closed and the blacklight flashlight and light meter in place. (Photo credit: NIOSH)**

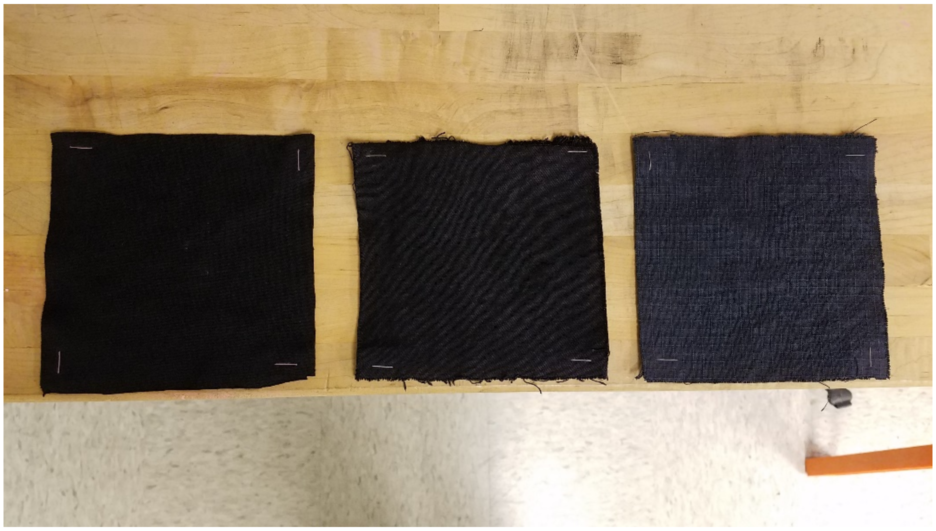

**Figure 11. Swatches of the three different fabrics used in experiments. From left to right, polyester double-knit (DK), cotton denim (DM) and firefighter turnout fabric (FF). Staples in the four corners of each swatch hold small squares of Velcro in place. (Photo credit: NIOSH)**

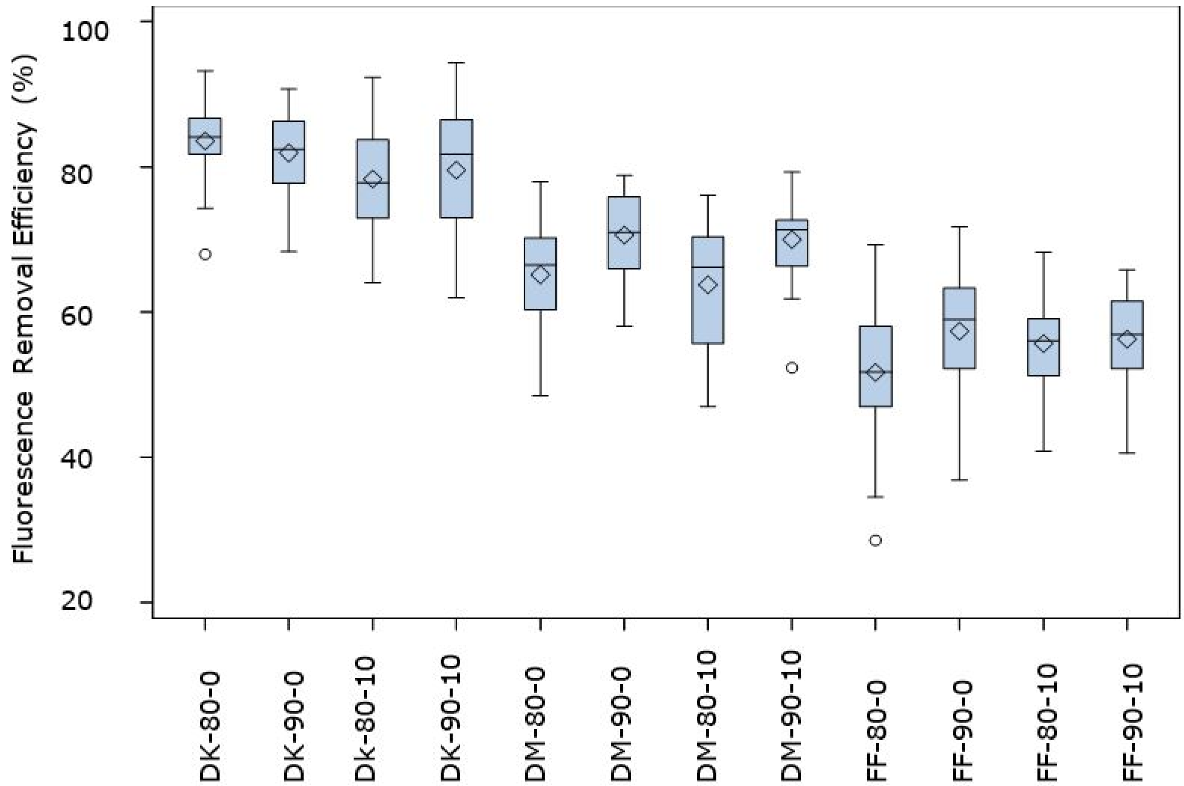


**Figure 12. Boxplot of fluorescence removal efficiency by fabric-blower speed-angle, for polyester double-knit (DK), cotton denim (DM) and firefighter fabric (FF).**

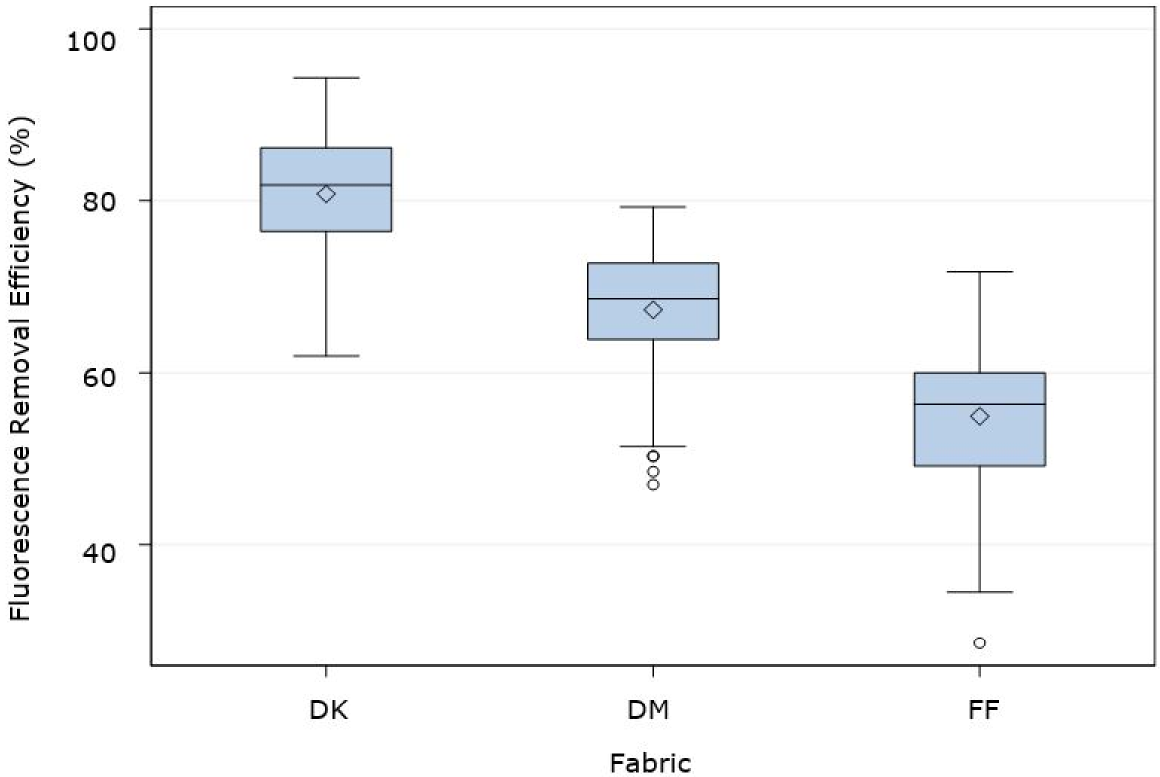


**Figure 13. Boxplot of fluorescence removal efficiency vs. fabric – Polyester double-knit (DK), cotton denim (DM) and firefighter turnout fabric (FF).**

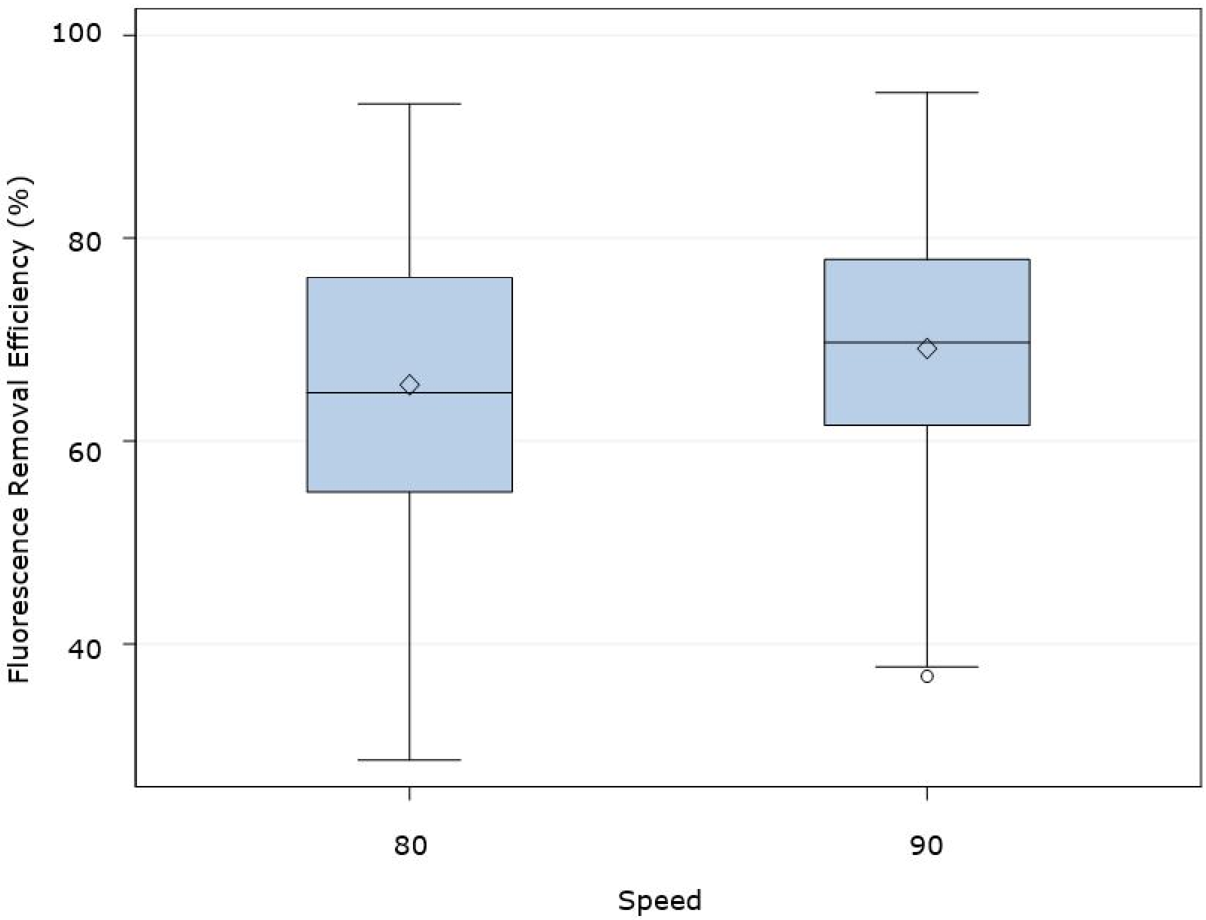


**Figure 14. Boxplot of fluorescence removal efficiency vs. blower speed (% of maximum).**

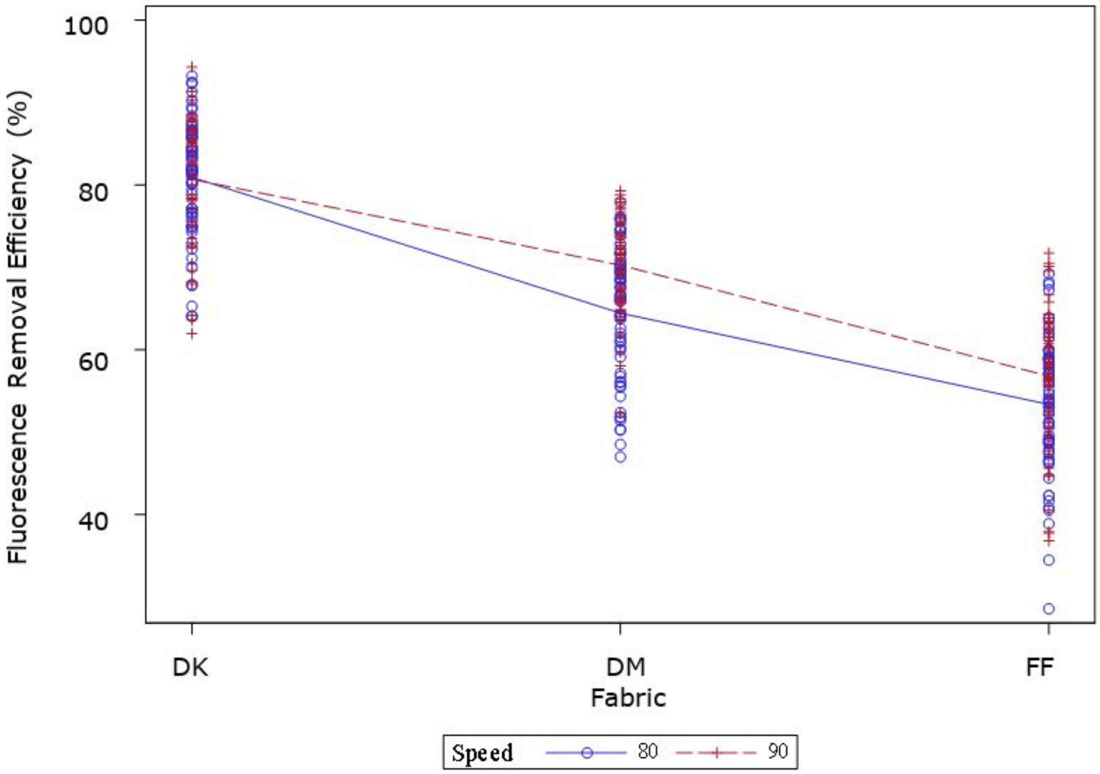


**Figure 15. Interaction plot of fluorescence removal efficiency by fabric and blower speed, showing that interaction is statistically significant.**

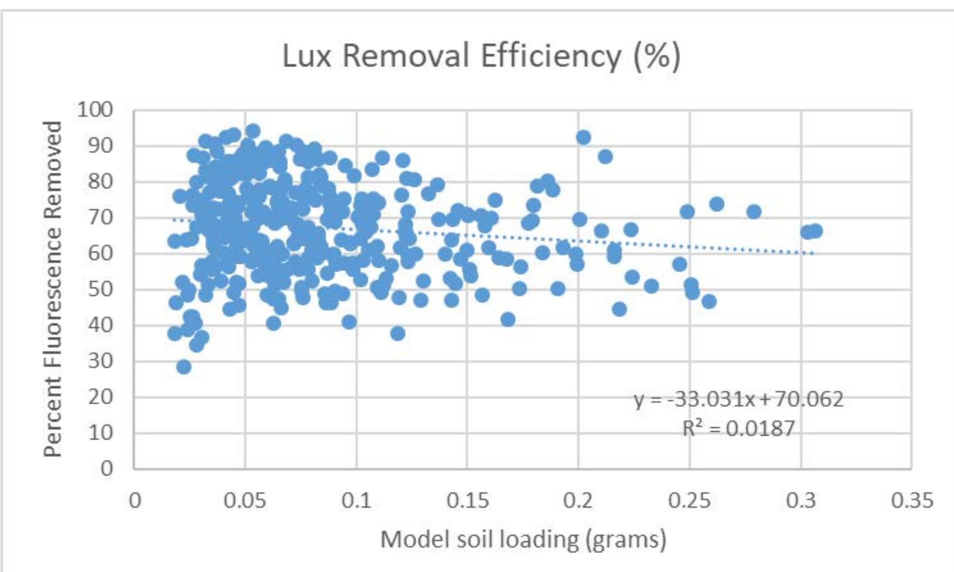


**Figure 12. Percent fluorescence removed showed negligible dependence on model soil loading.**

## Appendix II. Tables

**Table 1. Fabrics used in DryCon testing**

| Fabric | Description | Manufacturer |
|---|---|---|
| Double-knit (DK) | 100% polyester double knit, black | Ben Textiles Inc., Los Angeles, CA |
| Firefighter (FF) | Tencate Advance fabric, DuPont Kevlar & DuPont Nomex, black | TenCate Protective Fabrics, Union City, GA |
| Denim (DM) | 100% cotton, 10 oz. bull denim, black | NY Fashion Center Fabrics, New York, NY |

**Table 2. Summary of analysis of variance of the data**

| Source | DF | Type III SS | Mean Square | F Value | Pr > F |
|---|---|---|---|---|---|
| **Fabric** | 2 | 40567.09498 | 20283.54749 | 376.60 | <.0001* |
| **Angle** | 1 | 103.92167 | 103.92167 | 1.93 | 0.1657 |
| **Speed** | 1 | 814.39220 | 814.39220 | 15.12 | 0.0001* |
| **Fabric*Angle** | 2 | 448.04481 | 224.02240 | 4.16 | 0.0164* |
| **Fabric*Speed** | 2 | 536.17898 | 268.08949 | 4.98 | 0.0074* |
| **Angle*Speed** | 1 | 9.03378 | 9.03378 | 0.17 | 0.6824 |

* Results meet the test for statistical significance at $p < 0.05$.

Table 3. Mean fluorescence removal efficiency by fabric and blower speed.

| Fabric | Mean fluorescence removal efficiency (%) | N | Speed (%) |
|---|---|---|---|
| DK | 80.9 | 60 | 80 |
| | 80.7 | 58 | 90 |
| DM | 64.5 | 60 | 80 |
| | 70.3 | 60 | 90 |
| FF | 53.4 | 70 | 80 |
| | 56.8 | 60 | 90 |

Table 4. Mean fluorescence removal efficiency by fabric and angle of the air jets.

| Fabric | Mean fluorescence removal efficiency (%) | N | Angle (degrees) |
|---|---|---|---|
| DK | 82.7 | 58 | 0 |
| | 78.9 | 60 | 10 |
| DM | 67.9 | 60 | 0 |
| | 66.9 | 60 | 10 |
| FF | 54.1 | 70 | 0 |
| | 56.0 | 60 | 10 |

## Appendix III. Complete Dataset

| | | | | Weight (g) | | | | | | Fluorescence (Lux) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Angle | Fabric | Percent blower | Sample # | Clean | Soiled | DeCON | Mass Loaded | Mass Removed | Mass Removal Efficiency (%) | Clean | Soiled | DeCON | Lux added | Lux Removed | Fluorescence Removal Efficiency (%) |
| 0 | DK | 80 | 1L | 5.5188 | 5.5694 | 5.5373 | 0.0506 | 0.0321 | 63.44 | 67 | 117 | 76 | 50 | 41 | 82.0 |
| 0 | DK | 80 | 1S | 5.1216 | 5.1633 | 5.1363 | 0.0417 | 0.027 | 64.75 | 66 | 110 | 74 | 44 | 36 | 81.8 |
| 0 | DK | 80 | 2L | 5.2454 | 5.2991 | 5.2601 | 0.0537 | 0.039 | 72.63 | 59 | 144 | 70 | 85 | 74 | 87.1 |
| 0 | DK | 80 | 2S | 5.3437 | 5.4164 | 5.3666 | 0.0727 | 0.0498 | 68.50 | 56 | 152 | 78 | 96 | 74 | 77.1 |
| 0 | DK | 80 | 3L | 5.3797 | 5.5821 | 5.4245 | 0.2024 | 0.1576 | 77.87 | 59 | 324 | 79 | 265 | 245 | 92.5 |
| 0 | DK | 80 | 3S | 5.037 | 5.1359 | 5.0664 | 0.0989 | 0.0695 | 70.27 | 59 | 179 | 81 | 120 | 98 | 81.7 |
| 0 | DK | 80 | 4L | 5.3551 | 5.4299 | 5.3803 | 0.0748 | 0.0496 | 66.31 | 59 | 153 | 72 | 94 | 81 | 86.2 |
| 0 | DK | 80 | 4S | 5.3163 | 5.4234 | 5.3464 | 0.1071 | 0.077 | 71.90 | 57 | 190 | 79 | 133 | 111 | 83.5 |
| 0 | DK | 80 | 5L | 5.6256 | 5.6863 | 5.644 | 0.0607 | 0.0423 | 69.69 | 56 | 134 | 67 | 78 | 67 | 85.9 |
| 0 | DK | 80 | 5S | 5.3755 | 5.4347 | 5.3962 | 0.0592 | 0.0385 | 65.03 | 59 | 135 | 67 | 76 | 68 | 89.5 |
| 0 | DK | 80 | 1L | 5.3442 | 5.3855 | 5.3595 | 0.0413 | 0.026 | 62.95 | 64 | 129 | 74 | 65 | 55 | 84.6 |
| 0 | DK | 80 | 1S | 5.2805 | 5.3617 | 5.3003 | 0.0812 | 0.0614 | 75.62 | 66 | 168 | 77 | 102 | 91 | 89.2 |
| 0 | DK | 80 | 2L | 5.6273 | 5.6692 | 5.6425 | 0.0419 | 0.0267 | 63.72 | 63 | 123 | 74 | 60 | 49 | 81.7 |
| 0 | DK | 80 | 2S | 5.3092 | 5.3585 | 5.3256 | 0.0493 | 0.0329 | 66.73 | 63 | 132 | 74 | 69 | 58 | 84.1 |
| 0 | DK | 80 | 3L | 5.3735 | 5.4683 | 5.4009 | 0.0948 | 0.0674 | 71.10 | 65 | 175 | 82 | 110 | 93 | 84.5 |
| 0 | DK | 80 | 3S | 5.2654 | 5.3103 | 5.2788 | 0.0449 | 0.0315 | 70.16 | 67 | 126 | 71 | 59 | 55 | 93.2 |
| 0 | DK | 80 | 4L | 5.4925 | 5.5604 | 5.5176 | 0.0679 | 0.0428 | 63.03 | 62 | 135 | 77 | 73 | 58 | 79.5 |
| 0 | DK | 80 | 4S | 5.2145 | 5.294 | 5.2404 | 0.0795 | 0.0536 | 67.42 | 67 | 159 | 88 | 92 | 71 | 77.2 |
| 0 | DK | 80 | 5L | 5.4959 | 5.5326 | 5.5134 | 0.0367 | 0.0192 | 52.32 | 65 | 109 | 72 | 44 | 37 | 84.1 |
| 0 | DK | 80 | 5S | 5.1221 | 5.1555 | 5.138 | 0.0334 | 0.0175 | 52.40 | 66 | 109 | 74 | 43 | 35 | 81.4 |
| 0 | DK | 80 | 1L | 5.3169 | 5.4005 | 5.3444 | 0.0836 | 0.0561 | 67.11 | 64 | 147 | 79 | 83 | 68 | 81.9 |
| 0 | DK | 80 | 1S | 5.3606 | 5.4073 | 5.3838 | 0.0467 | 0.0235 | 50.32 | 65 | 135 | 83 | 70 | 52 | 74.3 |
| 0 | DK | 80 | 2L | 5.3862 | 5.5725 | 5.4404 | 0.1863 | 0.1321 | 70.91 | 63 | 245 | 99 | 182 | 146 | 80.2 |
| 0 | DK | 80 | 2S | 5.3742 | 5.4155 | 5.392 | 0.0413 | 0.0235 | 56.90 | 69 | 122 | 86 | 53 | 36 | 67.9 |
| 0 | DK | 80 | 3L | 5.2626 | 5.3129 | 5.2768 | 0.0503 | 0.0361 | 71.77 | 65 | 133 | 73 | 68 | 60 | 88.2 |

| | | | | Weight (g) | | | | | | Fluorescence (Lux) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Angle | Fabric | Percent blower | Sample # | Clean | Soiled | DeCON | Mass Loaded | Mass Removed | Mass Removal Efficiency (%) | Clean | Soiled | DeCON | Lux added | Lux Removed | Fluorescence Removal Efficiency (%) |
| 0 | DK | 80 | 3S | 5.3586 | 5.4796 | 5.391 | 0.121 | 0.0886 | 73.22 | 62 | 175 | 78 | 113 | 97 | 85.8 |
| 0 | DK | 80 | 4L | 5.5157 | 5.5628 | 5.5328 | 0.0471 | 0.03 | 63.69 | 63 | 125 | 74 | 62 | 51 | 82.3 |
| 0 | DK | 80 | 4S | 5.4128 | 5.4783 | 5.4329 | 0.0655 | 0.0454 | 69.31 | 68 | 157 | 82 | 89 | 75 | 84.3 |
| 0 | DK | 80 | 5L | 5.5457 | 5.6338 | 5.5714 | 0.0881 | 0.0624 | 70.83 | 63 | 168 | 77 | 105 | 91 | 86.7 |
| 0 | DK | 80 | 5S | 5.2982 | 5.349 | 5.3173 | 0.0508 | 0.0317 | 62.40 | 63 | 127 | 71 | 64 | 56 | 87.5 |
| 0 | DK | 90 | 1L | 5.548 | 5.596 | 5.5635 | 0.048 | 0.0325 | 67.71 | 62 | 116 | 70 | 54 | 46 | 85.2 |
| 0 | DK | 90 | 1S | 5.1421 | 5.1929 | 5.1586 | 0.0508 | 0.0343 | 67.52 | 66 | 121 | 78 | 55 | 43 | 78.2 |
| 0 | DK | 90 | 2L | 5.4903 | 5.5282 | 5.5025 | 0.0379 | 0.0257 | 67.81 | 60 | 102 | 67 | 42 | 35 | 83.3 |
| 0 | DK | 90 | 2S | 5.2887 | 5.3309 | 5.3002 | 0.0422 | 0.0307 | 72.75 | 61 | 102 | 67 | 41 | 35 | 85.4 |
| 0 | DK | 90 | 3L | 5.3927 | 5.429 | 5.4074 | 0.0363 | 0.0216 | 59.50 | 59 | 102 | 63 | 43 | 39 | 90.7 |
| 0 | DK | 90 | 3S | 5.2531 | 5.298 | 5.262 | 0.0449 | 0.036 | 80.18 | 59 | 100 | 72 | 41 | 28 | 68.3 |
| 0 | DK | 90 | 4L | 5.3161 | 5.3809 | 5.3446 | 0.0648 | 0.0363 | 56.02 | 56 | 127 | 77 | 71 | 50 | 70.4 |
| 0 | DK | 90 | 4S | 5.3785 | 5.4599 | 5.405 | 0.0814 | 0.0549 | 67.44 | 56 | 167 | 84 | 111 | 83 | 74.8 |
| 0 | DK | 90 | 1L | 5.5312 | 5.5751 | 5.5516 | 0.0439 | 0.0235 | 53.53 | 65 | 123 | 76 | 58 | 47 | 81.0 |
| 0 | DK | 90 | 1S | 5.4258 | 5.469 | 5.4393 | 0.0432 | 0.0297 | 68.75 | 65 | 113 | 77 | 48 | 36 | 75.0 |
| 0 | DK | 90 | 2L | 5.3749 | 5.4868 | 5.4011 | 0.1119 | 0.0857 | 76.59 | 67 | 188 | 83 | 121 | 105 | 86.8 |
| 0 | DK | 90 | 2S | 5.0453 | 5.1043 | 5.0592 | 0.059 | 0.0451 | 76.44 | 67 | 142 | 76 | 75 | 66 | 88.0 |
| 0 | DK | 90 | 3L | 5.5122 | 5.5879 | 5.5308 | 0.0757 | 0.0571 | 75.43 | 62 | 158 | 73 | 96 | 85 | 88.5 |
| 0 | DK | 90 | 3S | 5.3133 | 5.3782 | 5.3316 | 0.0649 | 0.0466 | 71.80 | 62 | 167 | 74 | 105 | 93 | 88.6 |
| 0 | DK | 90 | 4L | 5.35 | 5.405 | 5.3655 | 0.055 | 0.0395 | 71.82 | 62 | 136 | 71 | 74 | 65 | 87.8 |
| 0 | DK | 90 | 4S | 5.367 | 5.4082 | 5.3789 | 0.0412 | 0.0293 | 71.12 | 64 | 113 | 71 | 49 | 42 | 85.7 |
| 0 | DK | 90 | 5L | 5.5484 | 5.6138 | 5.5685 | 0.0654 | 0.0453 | 69.27 | 61 | 135 | 78 | 74 | 57 | 77.0 |
| 0 | DK | 90 | 5S | 5.29 | 5.3285 | 5.3012 | 0.0385 | 0.0273 | 70.91 | 65 | 109 | 75 | 44 | 34 | 77.3 |
| 0 | DK | 90 | 1L | 5.5242 | 5.5757 | 5.5402 | 0.0515 | 0.0355 | 68.93 | 68 | 127 | 77 | 59 | 50 | 84.7 |
| 0 | DK | 90 | 1S | 5.0427 | 5.079 | 5.0603 | 0.0363 | 0.0187 | 51.52 | 67 | 113 | 77 | 46 | 36 | 78.3 |

| | | | | Weight (g) | | | | | | Fluorescence (Lux) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Angle | Fabric | Percent blower | Sample # | Clean | Soiled | DeCON | Mass Loaded | Mass Removed | Mass Removal Efficiency (%) | Clean | Soiled | DeCON | Lux added | Lux Removed | Fluorescence Removal Efficiency (%) |
| 0 | DK | 90 | 2L | 5.3804 | 5.423 | 5.3971 | 0.0426 | 0.0259 | 60.80 | 65 | 121 | 73 | 56 | 48 | 85.7 |
| 0 | DK | 90 | 2S | 5.4285 | 5.4564 | 5.4406 | 0.0279 | 0.0158 | 56.63 | 63 | 103 | 71 | 40 | 32 | 80.0 |
| 0 | DK | 90 | 3L | 5.3496 | 5.4173 | 5.3696 | 0.0677 | 0.0477 | 70.46 | 65 | 143 | 80 | 78 | 63 | 80.8 |
| 0 | DK | 90 | 3S | 5.385 | 5.4189 | 5.3966 | 0.0339 | 0.0223 | 65.78 | 68 | 116 | 79 | 48 | 37 | 77.1 |
| 0 | DK | 90 | 4L | 5.5103 | 5.5682 | 5.5326 | 0.0579 | 0.0356 | 61.49 | 64 | 134 | 73 | 70 | 61 | 87.1 |
| 0 | DK | 90 | 4S | 5.3204 | 5.364 | 5.3377 | 0.0436 | 0.0263 | 60.32 | 62 | 124 | 71 | 62 | 53 | 85.5 |
| 0 | DK | 90 | 5L | 5.5366 | 5.6625 | 5.568 | 0.1259 | 0.0945 | 75.06 | 65 | 179 | 87 | 114 | 92 | 80.7 |
| 0 | DK | 90 | 5S | 5.4934 | 5.5772 | 5.5189 | 0.0838 | 0.0583 | 69.57 | 66 | 168 | 85 | 102 | 83 | 81.4 |
| 0 | FF | 80 | 1L | 7.1797 | 7.2015 | 7.1864 | 0.0218 | 0.0151 | 69.27 | 72 | 95 | 83 | 23 | 12 | 52.2 |
| 0 | FF | 80 | 1S | 7.007 | 7.1202 | 7.0473 | 0.1132 | 0.0729 | 64.40 | 73 | 186 | 126 | 113 | 60 | 53.1 |
| 0 | FF | 80 | 2L | 7.2795 | 7.4476 | 7.3412 | 0.1681 | 0.1064 | 63.30 | 73 | 193 | 143 | 120 | 50 | 41.7 |
| 0 | FF | 80 | 2S | 7.1093 | 7.1354 | 7.1204 | 0.0261 | 0.015 | 57.47 | 72 | 98 | 87 | 26 | 11 | 42.3 |
| 0 | FF | 80 | 3L | 7.3024 | 7.3326 | 7.3128 | 0.0302 | 0.0198 | 65.56 | 72 | 118 | 92 | 46 | 26 | 56.5 |
| 0 | FF | 80 | 3S | 7.0868 | 7.2437 | 7.1468 | 0.1569 | 0.0969 | 61.76 | 70 | 218 | 146 | 148 | 72 | 48.6 |
| 0 | FF | 80 | 4L | 7.3164 | 7.5407 | 7.3958 | 0.2243 | 0.1449 | 64.60 | 71 | 323 | 188 | 252 | 135 | 53.6 |
| 0 | FF | 80 | 4S | 7.2004 | 7.2253 | 7.2093 | 0.0249 | 0.016 | 64.26 | 73 | 99 | 88 | 26 | 11 | 42.3 |
| 0 | FF | 80 | 5L | 7.2442 | 7.2632 | 7.2486 | 0.019 | 0.0146 | 76.84 | 72 | 100 | 87 | 28 | 13 | 46.4 |
| 0 | FF | 80 | 5S | 7.0188 | 7.0814 | 7.0421 | 0.0626 | 0.0393 | 62.78 | 72 | 154 | 115 | 82 | 39 | 47.6 |
| 0 | FF | 80 | 1L | 6.8933 | 7.0045 | 6.9324 | 0.1112 | 0.0721 | 64.84 | 76 | 192 | 135 | 116 | 57 | 49.1 |
| 0 | FF | 80 | 1S | 6.8117 | 6.8703 | 6.8322 | 0.0586 | 0.0381 | 65.02 | 75 | 126 | 96 | 51 | 30 | 58.8 |
| 0 | FF | 80 | 2L | 6.9716 | 7.019 | 6.9877 | 0.0474 | 0.0313 | 66.03 | 76 | 125 | 96 | 49 | 29 | 59.2 |
| 0 | FF | 80 | 2S | 6.5591 | 6.5831 | 6.5716 | 0.024 | 0.0115 | 47.92 | 74 | 110 | 96 | 36 | 14 | 38.9 |
| 0 | FF | 80 | 3L | 6.9333 | 7.0265 | 6.9646 | 0.0932 | 0.0619 | 66.42 | 72 | 174 | 109 | 102 | 65 | 63.7 |
| 0 | FF | 80 | 3S | 6.8977 | 6.9201 | 6.9086 | 0.0224 | 0.0115 | 51.34 | 71 | 92 | 86 | 21 | 6 | 28.6 |
| 0 | FF | 80 | 4L | 6.8046 | 6.8466 | 6.8211 | 0.042 | 0.0255 | 60.71 | 73 | 112 | 85 | 39 | 27 | 69.2 |

| | | | | Weight (g) | | | | | | Fluorescence (Lux) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Angle | Fabric | Percent blower | Sample # | Clean | Soiled | DeCON | Mass Loaded | Mass Removed | Mass Removal Efficiency (%) | Clean | Soiled | DeCON | Lux added | Lux Removed | Fluorescence Removal Efficiency (%) |
| 0 | FF | 80 | 4S | 6.8389 | 6.9579 | 6.8875 | 0.119 | 0.0704 | 59.16 | 74 | 216 | 148 | 142 | 68 | 47.9 |
| 0 | FF | 80 | 5L | 7.1881 | 7.3112 | 7.2277 | 0.1231 | 0.0835 | 67.83 | 73 | 170 | 114 | 97 | 56 | 57.7 |
| 0 | FF | 80 | 5S | 7.1351 | 7.1631 | 7.1499 | 0.028 | 0.0132 | 47.14 | 72 | 101 | 91 | 29 | 10 | 34.5 |
| 0 | FF | 80 | 1L | 7.1251 | 7.2163 | 7.1545 | 0.0912 | 0.0618 | 67.76 | 84 | 170 | 121 | 86 | 49 | 57.0 |
| 0 | FF | 80 | 1S | 7.0538 | 7.2722 | 7.1358 | 0.2184 | 0.1364 | 62.45 | 83 | 272 | 188 | 189 | 84 | 44.4 |
| 0 | FF | 80 | 2L | 7.1997 | 7.2898 | 7.2287 | 0.0901 | 0.0611 | 67.81 | 82 | 187 | 135 | 105 | 52 | 49.5 |
| 0 | FF | 80 | 2S | 6.8584 | 6.9524 | 6.8978 | 0.094 | 0.0546 | 58.09 | 80 | 166 | 124 | 86 | 42 | 48.8 |
| 0 | FF | 80 | 3L | 7.1683 | 7.1999 | 7.1763 | 0.0316 | 0.0236 | 74.68 | 80 | 112 | 94 | 32 | 18 | 56.3 |
| 0 | FF | 80 | 3S | 6.5313 | 6.5759 | 6.5488 | 0.0446 | 0.0271 | 60.76 | 81 | 140 | 111 | 59 | 29 | 49.2 |
| 0 | FF | 80 | 4L | 7.2417 | 7.3888 | 7.2878 | 0.1471 | 0.101 | 68.66 | 82 | 262 | 157 | 180 | 105 | 58.3 |
| 0 | FF | 80 | 4S | 6.9654 | 7.0513 | 7.0002 | 0.0859 | 0.0511 | 59.49 | 82 | 168 | 126 | 86 | 42 | 48.8 |
| 0 | FF | 80 | 5L | 7.2934 | 7.3736 | 7.3147 | 0.0802 | 0.0589 | 73.44 | 79 | 175 | 116 | 96 | 59 | 61.5 |
| 0 | FF | 80 | 5S | 7.165 | 7.2513 | 7.203 | 0.0863 | 0.0483 | 55.97 | 82 | 166 | 127 | 84 | 39 | 46.4 |
| 0 | FF | 80 | 1L | 6.933 | 6.965 | 6.9432 | 0.032 | 0.0218 | 68.12 | 80 | 117 | 99 | 37 | 18 | 48.6 |
| 0 | FF | 80 | 1S | 6.5258 | 6.7254 | 6.5922 | 0.1996 | 0.1332 | 66.73 | 79 | 237 | 147 | 158 | 90 | 57.0 |
| 0 | FF | 80 | 2L | 7.2072 | 7.2344 | 7.2136 | 0.0272 | 0.0208 | 76.47 | 83 | 120 | 105 | 37 | 15 | 40.5 |
| 0 | FF | 80 | 2S | 7.1816 | 7.2166 | 7.197 | 0.035 | 0.0196 | 56.00 | 86 | 129 | 105 | 43 | 24 | 55.8 |
| 0 | FF | 80 | 3L | 7.1383 | 7.2052 | 7.1582 | 0.0669 | 0.047 | 70.25 | 83 | 158 | 113 | 75 | 45 | 60.0 |
| 0 | FF | 80 | 3S | 7.0518 | 7.0849 | 7.0636 | 0.0331 | 0.0213 | 64.35 | 83 | 124 | 103 | 41 | 21 | 51.2 |
| 0 | FF | 80 | 4L | 7.1711 | 7.329 | 7.2086 | 0.1579 | 0.1204 | 76.25 | 80 | 239 | 131 | 159 | 108 | 67.9 |
| 0 | FF | 80 | 4S | 6.9861 | 7.0501 | 7.0075 | 0.064 | 0.0426 | 66.56 | 82 | 167 | 121 | 85 | 46 | 54.1 |
| 0 | FF | 80 | 5L | 7.3042 | 7.3635 | 7.3229 | 0.0593 | 0.0406 | 68.47 | 83 | 158 | 113 | 75 | 45 | 60.0 |
| 0 | FF | 80 | 5S | 6.9715 | 7.1359 | 7.0302 | 0.1644 | 0.1057 | 64.29 | 81 | 212 | 135 | 131 | 77 | 58.8 |
| 0 | FF | 90 | 1L | 7.2317 | 7.3504 | 7.2678 | 0.1187 | 0.0826 | 69.59 | 76 | 211 | 160 | 135 | 51 | 37.8 |
| 0 | FF | 90 | 1S | 7.0012 | 7.0196 | 7.0107 | 0.0184 | 0.0089 | 48.37 | 73 | 102 | 91 | 29 | 11 | 37.9 |

| | | | | Weight (g) | | | | | | Fluorescence (Lux) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Angle | Fabric | Percent blower | Sample # | Clean | Soiled | DeCON | Mass Loaded | Mass Removed | Mass Removal Efficiency (%) | Clean | Soiled | DeCON | Lux added | Lux Removed | Fluorescence Removal Efficiency (%) |
| 0 | FF | 90 | 2L | 7.2707 | 7.3061 | 7.2827 | 0.0354 | 0.0234 | 66.10 | 73 | 120 | 90 | 47 | 30 | 63.8 |
| 0 | FF | 90 | 2S | 6.9923 | 7.0375 | 7.0107 | 0.0452 | 0.0268 | 59.29 | 74 | 135 | 99 | 61 | 36 | 59.0 |
| 0 | FF | 90 | 3L | 7.2846 | 7.3831 | 7.317 | 0.0985 | 0.0661 | 67.11 | 73 | 197 | 126 | 124 | 71 | 57.3 |
| 0 | FF | 90 | 3S | 7.101 | 7.3245 | 7.1678 | 0.2235 | 0.1567 | 70.11 | 73 | 226 | 124 | 153 | 102 | 66.7 |
| 0 | FF | 90 | 4L | 7.3022 | 7.3372 | 7.3124 | 0.035 | 0.0248 | 70.86 | 73 | 118 | 93 | 45 | 25 | 55.6 |
| 0 | FF | 90 | 4S | 7.0789 | 7.1091 | 7.0913 | 0.0302 | 0.0178 | 58.94 | 74 | 112 | 98 | 38 | 14 | 36.8 |
| 0 | FF | 90 | 5L | 7.2921 | 7.4483 | 7.3339 | 0.1562 | 0.1144 | 73.24 | 75 | 231 | 121 | 156 | 110 | 70.5 |
| 0 | FF | 90 | 5S | 7.1971 | 7.2823 | 7.228 | 0.0852 | 0.0543 | 63.73 | 76 | 144 | 103 | 68 | 41 | 60.3 |
| 0 | FF | 90 | 1L | 6.8926 | 6.967 | 6.9191 | 0.0744 | 0.0479 | 64.38 | 77 | 147 | 108 | 70 | 39 | 55.7 |
| 0 | FF | 90 | 1S | 6.9109 | 7.0163 | 6.948 | 0.1054 | 0.0683 | 64.80 | 76 | 166 | 111 | 90 | 55 | 61.1 |
| 0 | FF | 90 | 2L | 7.1629 | 7.3056 | 7.2086 | 0.1427 | 0.097 | 67.97 | 78 | 178 | 131 | 100 | 47 | 47.0 |
| 0 | FF | 90 | 2S | 6.5689 | 6.6111 | 6.5901 | 0.0422 | 0.021 | 49.76 | 76 | 124 | 97 | 48 | 27 | 56.3 |
| 0 | FF | 90 | 3L | 7.2783 | 7.3109 | 7.284 | 0.0326 | 0.0269 | 82.52 | 79 | 125 | 93 | 46 | 32 | 69.6 |
| 0 | FF | 90 | 3S | 7.106 | 7.1589 | 7.1248 | 0.0529 | 0.0341 | 64.46 | 79 | 150 | 109 | 71 | 41 | 57.7 |
| 0 | FF | 90 | 4L | 7.2374 | 7.2924 | 7.2537 | 0.055 | 0.0387 | 70.36 | 78 | 151 | 108 | 73 | 43 | 58.9 |
| 0 | FF | 90 | 4S | 7.0176 | 7.0749 | 7.0375 | 0.0573 | 0.0374 | 65.27 | 79 | 139 | 101 | 60 | 38 | 63.3 |
| 0 | FF | 90 | 5L | 6.9373 | 6.9833 | 6.9496 | 0.046 | 0.0337 | 73.26 | 80 | 130 | 99 | 50 | 31 | 62.0 |
| 0 | FF | 90 | 5S | 7.1675 | 7.2132 | 7.1818 | 0.0457 | 0.0314 | 68.71 | 80 | 126 | 102 | 46 | 24 | 52.2 |
| 0 | FF | 90 | 1L | 6.7699 | 6.8049 | 6.7841 | 0.035 | 0.0208 | 59.43 | 79 | 117 | 95 | 38 | 22 | 57.9 |
| 0 | FF | 90 | 1S | 6.8037 | 6.8678 | 6.8271 | 0.0641 | 0.0407 | 63.49 | 82 | 169 | 108 | 87 | 61 | 70.1 |
| 0 | FF | 90 | 2L | 6.905 | 6.9404 | 6.9084 | 0.0354 | 0.032 | 90.40 | 81 | 129 | 99 | 48 | 30 | 62.5 |
| 0 | FF | 90 | 2S | 6.7892 | 6.8441 | 6.802 | 0.0549 | 0.0421 | 76.68 | 77 | 129 | 96 | 52 | 33 | 63.5 |
| 0 | FF | 90 | 3L | 7.2754 | 7.3639 | 7.291 | 0.0885 | 0.0729 | 82.37 | 80 | 172 | 106 | 92 | 66 | 71.7 |
| 0 | FF | 90 | 3S | 7.0915 | 7.1158 | 7.101 | 0.0243 | 0.0148 | 60.91 | 78 | 109 | 94 | 31 | 15 | 48.4 |
| 0 | FF | 90 | 4L | 6.8605 | 6.9034 | 6.871 | 0.0429 | 0.0324 | 75.52 | 80 | 127 | 106 | 47 | 21 | 44.7 |

| | | | | Weight (g) | | | | | | Fluorescence (Lux) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Angle | Fabric | Percent blower | Sample # | Clean | Soiled | DeCON | Mass Loaded | Mass Removed | Mass Removal Efficiency (%) | Clean | Soiled | DeCON | Lux added | Lux Removed | Fluorescence Removal Efficiency (%) |
| 0 | FF | 90 | 4S | 7.3982 | 7.582 | 7.4645 | 0.1838 | 0.1175 | 63.93 | 79 | 202 | 128 | 123 | 74 | 60.2 |
| 0 | FF | 90 | 5L | 7.2416 | 7.295 | 7.2457 | 0.0534 | 0.0493 | 92.32 | 80 | 157 | 109 | 77 | 48 | 62.3 |
| 0 | FF | 90 | 5S | 7.0724 | 7.097 | 7.0787 | 0.0246 | 0.0183 | 74.39 | 80 | 106 | 93 | 26 | 13 | 50.0 |
| 0 | DM | 80 | 1L | 10.168 | 10.2217 | 10.1696 | 0.0537 | 0.0521 | 97.02 | 64 | 132 | 86 | 68 | 46 | 67.6 |
| 0 | DM | 80 | 1S | 10.3125 | 10.3766 | 10.2949 | 0.0641 | 0.0817 | 127.46 | 65 | 151 | 87 | 86 | 64 | 74.4 |
| 0 | DM | 80 | 2L | 10.27 | 10.3934 | 10.2897 | 0.1234 | 0.1037 | 84.04 | 65 | 192 | 101 | 127 | 91 | 71.7 |
| 0 | DM | 80 | 2S | 10.25 | 10.3135 | 10.2558 | 0.0635 | 0.0577 | 90.87 | 65 | 135 | 87 | 70 | 48 | 68.6 |
| 0 | DM | 80 | 3L | 10.222 | 10.31 | 10.2265 | 0.088 | 0.0835 | 94.89 | 66 | 177 | 95 | 111 | 82 | 73.9 |
| 0 | DM | 80 | 3S | 10.2834 | 10.3241 | 10.2769 | 0.0407 | 0.0472 | 115.97 | 65 | 115 | 82 | 50 | 33 | 66.0 |
| 0 | DM | 80 | 4L | 10.3246 | 10.3803 | 10.3227 | 0.0557 | 0.0576 | 103.41 | 67 | 136 | 92 | 69 | 44 | 63.8 |
| 0 | DM | 80 | 4S | 10.3915 | 10.4621 | 10.3897 | 0.0706 | 0.0724 | 102.55 | 66 | 158 | 91 | 92 | 67 | 72.8 |
| 0 | DM | 80 | 5L | 10.2425 | 10.33 | 10.2346 | 0.0875 | 0.0954 | 109.03 | 69 | 205 | 99 | 136 | 106 | 77.9 |
| 0 | DM | 80 | 5S | 10.4176 | 10.474 | 10.4019 | 0.0564 | 0.0721 | 127.84 | 67 | 154 | 88 | 87 | 66 | 75.9 |
| 0 | DM | 80 | 1L | 10.4522 | 10.4855 | 10.4608 | 0.0333 | 0.0247 | 74.17 | 67 | 112 | 82 | 45 | 30 | 66.7 |
| 0 | DM | 80 | 1S | 10.2865 | 10.3337 | 10.3021 | 0.0472 | 0.0316 | 66.95 | 67 | 148 | 106 | 81 | 42 | 51.9 |
| 0 | DM | 80 | 2L | 10.4405 | 10.4767 | 10.454 | 0.0362 | 0.0227 | 62.71 | 63 | 120 | 88 | 57 | 32 | 56.1 |
| 0 | DM | 80 | 2S | 10.3114 | 10.3526 | 10.3268 | 0.0412 | 0.0258 | 62.62 | 65 | 142 | 98 | 77 | 44 | 57.1 |
| 0 | DM | 80 | 3L | 10.3081 | 10.3646 | 10.3011 | 0.0565 | 0.0635 | 112.39 | 67 | 150 | 98 | 83 | 52 | 62.7 |
| 0 | DM | 80 | 3S | 10.3291 | 10.4051 | 10.3356 | 0.076 | 0.0695 | 91.45 | 67 | 184 | 109 | 117 | 75 | 64.1 |
| 0 | DM | 80 | 4L | 10.2426 | 10.287 | 10.2244 | 0.0444 | 0.0626 | 140.99 | 66 | 140 | 91 | 74 | 49 | 66.2 |
| 0 | DM | 80 | 4S | 10.244 | 10.2803 | 10.228 | 0.0363 | 0.0523 | 144.08 | 66 | 157 | 101 | 91 | 56 | 61.5 |
| 0 | DM | 80 | 5L | 10.1683 | 10.2087 | 10.1462 | 0.0404 | 0.0625 | 154.70 | 66 | 124 | 89 | 58 | 35 | 60.3 |
| 0 | DM | 80 | 5S | 10.2147 | 10.2747 | 10.2062 | 0.06 | 0.0685 | 114.17 | 66 | 167 | 118 | 101 | 49 | 48.5 |
| 0 | DM | 80 | 1L | 10.8056 | 10.8351 | 10.7933 | 0.0295 | 0.0418 | 141.69 | 67 | 113 | 88 | 46 | 25 | 54.3 |
| 0 | DM | 80 | 1S | 10.3086 | 10.4306 | 10.33 | 0.122 | 0.1006 | 82.46 | 68 | 219 | 116 | 151 | 103 | 68.2 |

| | | | | Weight (g) | | | | | | Fluorescence (Lux) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Angle | Fabric | Percent blower | Sample # | Clean | Soiled | DeCON | Mass Loaded | Mass Removed | Mass Removal Efficiency (%) | Clean | Soiled | DeCON | Lux added | Lux Removed | Fluorescence Removal Efficiency (%) |
| 0 | DM | 80 | 2L | 10.4447 | 10.4892 | 10.4415 | 0.0445 | 0.0477 | 107.19 | 68 | 113 | 83 | 45 | 30 | 66.7 |
| 0 | DM | 80 | 2S | 10.3585 | 10.481 | 10.3822 | 0.1225 | 0.0988 | 80.65 | 65 | 219 | 120 | 154 | 99 | 64.3 |
| 0 | DM | 80 | 3L | 10.275 | 10.4151 | 10.3085 | 0.1401 | 0.1066 | 76.09 | 65 | 205 | 121 | 140 | 84 | 60.0 |
| 0 | DM | 80 | 3S | 10.4705 | 10.573 | 10.4865 | 0.1025 | 0.0865 | 84.39 | 65 | 176 | 100 | 111 | 76 | 68.5 |
| 0 | DM | 80 | 4L | 10.6459 | 10.6913 | 10.6383 | 0.0454 | 0.053 | 116.74 | 64 | 121 | 81 | 57 | 40 | 70.2 |
| 0 | DM | 80 | 4S | 10.3704 | 10.4367 | 10.3683 | 0.0663 | 0.0684 | 103.17 | 65 | 143 | 88 | 78 | 55 | 70.5 |
| 0 | DM | 80 | 5L | 10.515 | 10.561 | 10.5068 | 0.046 | 0.0542 | 117.83 | 65 | 136 | 88 | 71 | 48 | 67.6 |
| 0 | DM | 80 | 5S | 10.3875 | 10.4467 | 10.39 | 0.0592 | 0.0567 | 95.78 | 65 | 156 | 105 | 91 | 51 | 56.0 |
| 0 | DM | 90 | 1L | 10.5124 | 10.6328 | 10.5193 | 0.1204 | 0.1135 | 94.27 | 65 | 234 | 105 | 169 | 129 | 76.3 |
| 0 | DM | 90 | 1S | 10.3558 | 10.4377 | 10.3679 | 0.0819 | 0.0698 | 85.23 | 67 | 193 | 113 | 126 | 80 | 63.5 |
| 0 | DM | 90 | 2L | 10.251 | 10.2966 | 10.2427 | 0.0456 | 0.0539 | 118.20 | 67 | 129 | 86 | 62 | 43 | 69.4 |
| 0 | DM | 90 | 2S | 10.3691 | 10.4414 | 10.3689 | 0.0723 | 0.0725 | 100.28 | 67 | 169 | 100 | 102 | 69 | 67.6 |
| 0 | DM | 90 | 3L | 10.311 | 10.352 | 10.2929 | 0.041 | 0.0591 | 144.15 | 68 | 119 | 86 | 51 | 33 | 64.7 |
| 0 | DM | 90 | 3S | 10.3006 | 10.4105 | 10.2967 | 0.1099 | 0.1138 | 103.55 | 67 | 226 | 108 | 159 | 118 | 74.2 |
| 0 | DM | 90 | 4L | 10.5238 | 10.591 | 10.5081 | 0.0672 | 0.0829 | 123.36 | 67 | 153 | 93 | 86 | 60 | 69.8 |
| 0 | DM | 90 | 4S | 10.2212 | 10.4007 | 10.2244 | 0.1795 | 0.1763 | 98.22 | 67 | 249 | 115 | 182 | 134 | 73.6 |
| 0 | DM | 90 | 5L | 10.6687 | 10.7922 | 10.6747 | 0.1235 | 0.1175 | 95.14 | 67 | 196 | 119 | 129 | 77 | 59.7 |
| 0 | DM | 90 | 5S | 10.3372 | 10.3651 | 10.318 | 0.0279 | 0.0471 | 168.82 | 67 | 110 | 81 | 43 | 29 | 67.4 |
| 0 | DM | 90 | 1L | 10.5245 | 10.5998 | 10.5081 | 0.0753 | 0.0917 | 121.78 | 68 | 168 | 95 | 100 | 73 | 73.0 |
| 0 | DM | 90 | 1S | 10.4645 | 10.4995 | 10.4404 | 0.035 | 0.0591 | 168.86 | 68 | 112 | 83 | 44 | 29 | 65.9 |
| 0 | DM | 90 | 2L | 10.1525 | 10.2166 | 10.1248 | 0.0641 | 0.0918 | 143.21 | 69 | 166 | 94 | 97 | 72 | 74.2 |
| 0 | DM | 90 | 2S | 10.2367 | 10.369 | 10.2119 | 0.1323 | 0.1571 | 118.75 | 68 | 248 | 110 | 180 | 138 | 76.7 |
| 0 | DM | 90 | 3L | 10.3102 | 10.4132 | 10.2868 | 0.103 | 0.1264 | 122.72 | 69 | 212 | 129 | 143 | 83 | 58.0 |
| 0 | DM | 90 | 3S | 10.321 | 10.5025 | 10.3005 | 0.1815 | 0.202 | 111.29 | 68 | 271 | 111 | 203 | 160 | 78.8 |
| 0 | DM | 90 | 4L | 10.2436 | 10.3045 | 10.2019 | 0.0609 | 0.1026 | 168.47 | 69 | 198 | 97 | 129 | 101 | 78.3 |

| | | | | Weight (g) | | | | | | Fluorescence (Lux) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Angle | Fabric | Percent blower | Sample # | Clean | Soiled | DeCON | Mass Loaded | Mass Removed | Mass Removal Efficiency (%) | Clean | Soiled | DeCON | Lux added | Lux Removed | Fluorescence Removal Efficiency (%) |
| 0 | DM | 90 | 4S | 10.3424 | 10.389 | 10.2994 | 0.0466 | 0.0896 | 192.27 | 66 | 151 | 88 | 85 | 63 | 74.1 |
| 0 | DM | 90 | 5L | 10.1991 | 10.3764 | 10.229 | 0.1773 | 0.1474 | 83.14 | 69 | 247 | 125 | 178 | 122 | 68.5 |
| 0 | DM | 90 | 5S | 10.222 | 10.323 | 10.2169 | 0.101 | 0.1061 | 105.05 | 68 | 179 | 101 | 111 | 78 | 70.3 |
| 0 | DM | 90 | 1L | 10.4731 | 10.523 | 10.4454 | 0.0499 | 0.0776 | 155.51 | 66 | 145 | 92 | 79 | 53 | 67.1 |
| 0 | DM | 90 | 1S | 10.2574 | 10.2811 | 10.2168 | 0.0237 | 0.0643 | 271.31 | 65 | 115 | 83 | 50 | 32 | 64.0 |
| 0 | DM | 90 | 2L | 10.201 | 10.2528 | 10.1715 | 0.0518 | 0.0813 | 156.95 | 68 | 155 | 89 | 87 | 66 | 75.9 |
| 0 | DM | 90 | 2S | 10.2844 | 10.3919 | 10.2616 | 0.1075 | 0.1303 | 121.21 | 66 | 203 | 100 | 137 | 103 | 75.2 |
| 0 | DM | 90 | 3L | 10.3021 | 10.3488 | 10.2664 | 0.0467 | 0.0824 | 176.45 | 68 | 125 | 88 | 57 | 37 | 64.9 |
| 0 | DM | 90 | 3S | 10.1633 | 10.1815 | 10.1127 | 0.0182 | 0.0688 | 378.02 | 67 | 100 | 79 | 33 | 21 | 63.6 |
| 0 | DM | 90 | 4L | 10.1033 | 10.1972 | 10.0857 | 0.0939 | 0.1115 | 118.74 | 68 | 195 | 104 | 127 | 91 | 71.7 |
| 0 | DM | 90 | 4S | 10.3014 | 10.3217 | 10.2558 | 0.0203 | 0.0659 | 324.63 | 68 | 114 | 79 | 46 | 35 | 76.1 |
| 0 | DM | 90 | 5L | 10.1301 | 10.1864 | 10.1006 | 0.0563 | 0.0858 | 152.40 | 67 | 153 | 86 | 86 | 67 | 77.9 |
| 0 | DM | 90 | 5S | 10.3 | 10.342 | 10.2548 | 0.042 | 0.0872 | 207.62 | 67 | 141 | 84 | 74 | 57 | 77.0 |
| 10 | DK | 80 | 1L | 5.493 | 5.5713 | 5.5159 | 0.0783 | 0.0554 | 70.75 | 70 | 182 | 91 | 112 | 91 | 81.3 |
| 10 | DK | 80 | 1S | 5.4489 | 5.4843 | 5.4606 | 0.0354 | 0.0237 | 66.95 | 70 | 118 | 83 | 48 | 35 | 72.9 |
| 10 | DK | 80 | 2L | 5.3085 | 5.3389 | 5.3205 | 0.0304 | 0.0184 | 60.53 | 77 | 122 | 90 | 45 | 32 | 71.1 |
| 10 | DK | 80 | 2S | 5.3261 | 5.3673 | 5.3466 | 0.0412 | 0.0207 | 50.24 | 77 | 129 | 81 | 52 | 48 | 92.3 |
| 10 | DK | 80 | 3L | 5.331 | 5.3769 | 5.3492 | 0.0459 | 0.0277 | 60.35 | 76 | 142 | 87 | 66 | 55 | 83.3 |
| 10 | DK | 80 | 3S | 5.381 | 5.413 | 5.3943 | 0.032 | 0.0187 | 58.44 | 72 | 119 | 80 | 47 | 39 | 83.0 |
| 10 | DK | 80 | 4L | 5.5039 | 5.5462 | 5.5244 | 0.0423 | 0.0218 | 51.54 | 72 | 132 | 86 | 60 | 46 | 76.7 |
| 10 | DK | 80 | 4S | 5.253 | 5.2797 | 5.2637 | 0.0267 | 0.016 | 59.93 | 73 | 105 | 77 | 32 | 28 | 87.5 |
| 10 | DK | 80 | 5L | 5.4864 | 5.5123 | 5.4981 | 0.0259 | 0.0142 | 54.83 | 76 | 115 | 90 | 39 | 25 | 64.1 |
| 10 | DK | 80 | 5S | 5.0081 | 5.04 | 5.022 | 0.0319 | 0.018 | 56.43 | 74 | 120 | 78 | 46 | 42 | 91.3 |
| 10 | DK | 80 | 1L | 5.336 | 5.3719 | 5.3571 | 0.0359 | 0.0148 | 41.23 | 71 | 130 | 90 | 59 | 40 | 67.8 |
| 10 | DK | 80 | 1S | 5.1752 | 5.211 | 5.1891 | 0.0358 | 0.0219 | 61.17 | 74 | 118 | 82 | 44 | 36 | 81.8 |

| | | | | Weight (g) | | | | | | Fluorescence (Lux) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Angle | Fabric | Percent blower | Sample # | Clean | Soiled | DeCON | Mass Loaded | Mass Removed | Mass Removal Efficiency (%) | Clean | Soiled | DeCON | Lux added | Lux Removed | Fluorescence Removal Efficiency (%) |
| 10 | DK | 80 | 2L | 5.4511 | 5.5055 | 5.4775 | 0.0544 | 0.028 | 51.47 | 76 | 140 | 92 | 64 | 48 | 75.0 |
| 10 | DK | 80 | 2S | 5.2781 | 5.3168 | 5.2917 | 0.0387 | 0.0251 | 64.86 | 76 | 137 | 88 | 61 | 49 | 80.3 |
| 10 | DK | 80 | 3L | 5.5876 | 5.6142 | 5.6008 | 0.0266 | 0.0134 | 50.38 | 76 | 110 | 84 | 34 | 26 | 76.5 |
| 10 | DK | 80 | 3S | 5.2185 | 5.2492 | 5.2324 | 0.0307 | 0.0168 | 54.72 | 76 | 116 | 86 | 40 | 30 | 75.0 |
| 10 | DK | 80 | 4L | 5.4812 | 5.5151 | 5.4997 | 0.0339 | 0.0154 | 45.43 | 73 | 133 | 91 | 60 | 42 | 70.0 |
| 10 | DK | 80 | 4S | 5.0923 | 5.1232 | 5.1061 | 0.0309 | 0.0171 | 55.34 | 72 | 117 | 78 | 45 | 39 | 86.7 |
| 10 | DK | 80 | 5L | 5.4611 | 5.5417 | 5.4926 | 0.0806 | 0.0491 | 60.92 | 76 | 187 | 103 | 111 | 84 | 75.7 |
| 10 | DK | 80 | 5S | 5.355 | 5.3938 | 5.3722 | 0.0388 | 0.0216 | 55.67 | 71 | 114 | 78 | 43 | 36 | 83.7 |
| 10 | DK | 80 | 1L | 5.467 | 5.5322 | 5.5023 | 0.0652 | 0.0299 | 45.86 | 74 | 158 | 94 | 84 | 64 | 76.2 |
| 10 | DK | 80 | 1S | 5.281 | 5.3645 | 5.3102 | 0.0835 | 0.0543 | 65.03 | 74 | 200 | 99 | 126 | 101 | 80.2 |
| 10 | DK | 80 | 2L | 5.3112 | 5.3722 | 5.3364 | 0.061 | 0.0358 | 58.69 | 73 | 163 | 92 | 90 | 71 | 78.9 |
| 10 | DK | 80 | 2S | 5.3091 | 5.3744 | 5.3275 | 0.0653 | 0.0469 | 71.82 | 74 | 165 | 87 | 91 | 78 | 85.7 |
| 10 | DK | 80 | 3L | 5.2254 | 5.2923 | 5.2542 | 0.0669 | 0.0381 | 56.95 | 73 | 156 | 94 | 83 | 62 | 74.7 |
| 10 | DK | 80 | 3S | 5.096 | 5.143 | 5.1137 | 0.047 | 0.0293 | 62.34 | 73 | 147 | 83 | 74 | 64 | 86.5 |
| 10 | DK | 80 | 4L | 5.4932 | 5.5723 | 5.5336 | 0.0791 | 0.0387 | 48.93 | 74 | 163 | 106 | 89 | 57 | 64.0 |
| 10 | DK | 80 | 4S | 5.3356 | 5.3875 | 5.3543 | 0.0519 | 0.0332 | 63.97 | 76 | 148 | 101 | 72 | 47 | 65.3 |
| 10 | DK | 80 | 5L | 5.4745 | 5.5426 | 5.5043 | 0.0681 | 0.0383 | 56.24 | 78 | 168 | 103 | 90 | 65 | 72.2 |
| 10 | DK | 80 | 5S | 5.2455 | 5.3183 | 5.2691 | 0.0728 | 0.0492 | 67.58 | 76 | 178 | 86 | 102 | 92 | 90.2 |
| 10 | DK | 90 | 1L | 5.2801 | 5.3572 | 5.3086 | 0.0771 | 0.0486 | 63.04 | 72 | 163 | 92 | 91 | 71 | 78.0 |
| 10 | DK | 90 | 1S | 5.3283 | 5.5406 | 5.3619 | 0.2123 | 0.1787 | 84.17 | 72 | 265 | 97 | 193 | 168 | 87.0 |
| 10 | DK | 90 | 2L | 5.2117 | 5.2601 | 5.234 | 0.0484 | 0.0261 | 53.93 | 70 | 147 | 98 | 77 | 49 | 63.6 |
| 10 | DK | 90 | 2S | 5.3261 | 5.3748 | 5.3428 | 0.0487 | 0.032 | 65.71 | 74 | 140 | 82 | 66 | 58 | 87.9 |
| 10 | DK | 90 | 3L | 5.3033 | 5.3496 | 5.3204 | 0.0463 | 0.0292 | 63.07 | 71 | 145 | 91 | 74 | 54 | 73.0 |
| 10 | DK | 90 | 3S | 5.2985 | 5.352 | 5.313 | 0.0535 | 0.039 | 72.90 | 72 | 160 | 77 | 88 | 83 | 94.3 |
| 10 | DK | 90 | 4L | 5.4634 | 5.5861 | 5.5053 | 0.1227 | 0.0808 | 65.85 | 71 | 223 | 100 | 152 | 123 | 80.9 |

| | | | | Weight (g) | | | | | | Fluorescence (Lux) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Angle | Fabric | Percent blower | Sample # | Clean | Soiled | DeCON | Mass Loaded | Mass Removed | Mass Removal Efficiency (%) | Clean | Soiled | DeCON | Lux added | Lux Removed | Fluorescence Removal Efficiency (%) |
| 10 | DK | 90 | 4S | 5.0845 | 5.1217 | 5.0997 | 0.0372 | 0.022 | 59.14 | 71 | 131 | 78 | 60 | 53 | 88.3 |
| 10 | DK | 90 | 5L | 5.3283 | 5.3701 | 5.3466 | 0.0418 | 0.0235 | 56.22 | 71 | 133 | 88 | 62 | 45 | 72.6 |
| 10 | DK | 90 | 5S | 5.2693 | 5.3204 | 5.2848 | 0.0511 | 0.0356 | 69.67 | 71 | 143 | 78 | 72 | 65 | 90.3 |
| 10 | DK | 90 | 1L | 5.284 | 5.327 | 5.3012 | 0.043 | 0.0258 | 60.00 | 73 | 130 | 82 | 57 | 48 | 84.2 |
| 10 | DK | 90 | 1S | 5.0095 | 5.0513 | 5.0241 | 0.0418 | 0.0272 | 65.07 | 76 | 133 | 86 | 57 | 47 | 82.5 |
| 10 | DK | 90 | 2L | 5.5083 | 5.5595 | 5.534 | 0.0512 | 0.0255 | 49.80 | 74 | 156 | 94 | 82 | 62 | 75.6 |
| 10 | DK | 90 | 2S | 5.338 | 5.3782 | 5.353 | 0.0402 | 0.0252 | 62.69 | 73 | 138 | 87 | 65 | 51 | 78.5 |
| 10 | DK | 90 | 3L | 5.4933 | 5.5316 | 5.5128 | 0.0383 | 0.0188 | 49.09 | 72 | 130 | 88 | 58 | 42 | 72.4 |
| 10 | DK | 90 | 3S | 5.4505 | 5.519 | 5.4705 | 0.0685 | 0.0485 | 70.80 | 76 | 157 | 83 | 81 | 74 | 91.4 |
| 10 | DK | 90 | 4L | 5.3349 | 5.3705 | 5.35 | 0.0356 | 0.0205 | 57.58 | 73 | 123 | 89 | 50 | 34 | 68.0 |
| 10 | DK | 90 | 4S | 5.3854 | 5.4431 | 5.4037 | 0.0577 | 0.0394 | 68.28 | 73 | 140 | 82 | 67 | 58 | 86.6 |
| 10 | DK | 90 | 5L | 5.3106 | 5.3369 | 5.3267 | 0.0263 | 0.0102 | 38.78 | 74 | 108 | 83 | 34 | 25 | 73.5 |
| 10 | DK | 90 | 5S | 5.256 | 5.3139 | 5.2766 | 0.0579 | 0.0373 | 64.42 | 73 | 140 | 83 | 67 | 57 | 85.1 |
| 10 | DK | 90 | 1L | 5.3279 | 5.392 | 5.3662 | 0.0641 | 0.0258 | 40.25 | 70 | 141 | 97 | 71 | 44 | 62.0 |
| 10 | DK | 90 | 1S | 5.2797 | 5.3265 | 5.2973 | 0.0468 | 0.0292 | 62.39 | 75 | 138 | 86 | 63 | 52 | 82.5 |
| 10 | DK | 90 | 2L | 5.4659 | 5.5526 | 5.51 | 0.0867 | 0.0426 | 49.13 | 76 | 188 | 110 | 112 | 78 | 69.6 |
| 10 | DK | 90 | 2S | 5.1803 | 5.2588 | 5.2111 | 0.0785 | 0.0477 | 60.76 | 74 | 206 | 93 | 132 | 113 | 85.6 |
| 10 | DK | 90 | 3L | 5.485 | 5.5505 | 5.5164 | 0.0655 | 0.0341 | 52.06 | 74 | 162 | 93 | 88 | 69 | 78.4 |
| 10 | DK | 90 | 3S | 5.2223 | 5.2745 | 5.2461 | 0.0522 | 0.0284 | 54.41 | 77 | 159 | 91 | 82 | 68 | 82.9 |
| 10 | DK | 90 | 4L | 5.5909 | 5.6408 | 5.6253 | 0.0499 | 0.0155 | 31.06 | 73 | 140 | 97 | 67 | 43 | 64.2 |
| 10 | DK | 90 | 4S | 5.3628 | 5.4189 | 5.3885 | 0.0561 | 0.0304 | 54.19 | 73 | 147 | 86 | 74 | 61 | 82.4 |
| 10 | DK | 90 | 5L | 5.346 | 5.4287 | 5.3802 | 0.0827 | 0.0485 | 58.65 | 78 | 174 | 91 | 96 | 83 | 86.5 |
| 10 | DK | 90 | 5S | 5.0977 | 5.1828 | 5.1268 | 0.0851 | 0.056 | 65.80 | 73 | 186 | 97 | 113 | 89 | 78.8 |
| 10 | FF | 80 | 1L | 7.2295 | 7.2854 | 7.2527 | 0.0559 | 0.0327 | 58.50 | 89 | 169 | 126 | 80 | 43 | 53.8 |
| 10 | FF | 80 | 1S | 7.0555 | 7.1216 | 7.0821 | 0.0661 | 0.0395 | 59.76 | 89 | 184 | 133 | 95 | 51 | 53.7 |

| | | | | Weight (g) | | | | | | Fluorescence (Lux) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Angle | Fabric | Percent blower | Sample # | Clean | Soiled | DeCON | Mass Loaded | Mass Removed | Mass Removal Efficiency (%) | Clean | Soiled | DeCON | Lux added | Lux Removed | Fluorescence Removal Efficiency (%) |
| 10 | FF | 80 | 2L | 7.2668 | 7.4183 | 7.3221 | 0.1515 | 0.0962 | 63.50 | 87 | 265 | 169 | 178 | 96 | 53.9 |
| 10 | FF | 80 | 2S | 7.0542 | 7.1105 | 7.0757 | 0.0563 | 0.0348 | 61.81 | 86 | 151 | 113 | 65 | 38 | 58.5 |
| 10 | FF | 80 | 3L | 6.9418 | 7.193 | 7.0566 | 0.2512 | 0.1364 | 54.30 | 87 | 250 | 170 | 163 | 80 | 49.1 |
| 10 | FF | 80 | 3S | 6.5344 | 6.5992 | 6.5645 | 0.0648 | 0.0347 | 53.55 | 87 | 188 | 140 | 101 | 48 | 47.5 |
| 10 | FF | 80 | 4L | 7.2013 | 7.2794 | 7.231 | 0.0781 | 0.0484 | 61.97 | 88 | 198 | 124 | 110 | 74 | 67.3 |
| 10 | FF | 80 | 4S | 7.177 | 7.2509 | 7.2068 | 0.0739 | 0.0441 | 59.68 | 88 | 195 | 122 | 107 | 73 | 68.2 |
| 10 | FF | 80 | 5L | 7.3046 | 7.5631 | 7.4026 | 0.2585 | 0.1605 | 62.09 | 88 | 270 | 185 | 182 | 85 | 46.7 |
| 10 | FF | 80 | 5S | 7.0684 | 7.2672 | 7.1368 | 0.1988 | 0.1304 | 65.59 | 86 | 268 | 159 | 182 | 109 | 59.9 |
| 10 | FF | 80 | 1L | 6.8592 | 6.9717 | 6.9107 | 0.1125 | 0.061 | 54.22 | 88 | 254 | 169 | 166 | 85 | 51.2 |
| 10 | FF | 80 | 1S | 7.0609 | 7.3065 | 7.1449 | 0.2456 | 0.1616 | 65.80 | 86 | 319 | 186 | 233 | 133 | 57.1 |
| 10 | FF | 80 | 2L | 6.9365 | 7.0664 | 6.9918 | 0.1299 | 0.0746 | 57.43 | 89 | 232 | 157 | 143 | 75 | 52.4 |
| 10 | FF | 80 | 2S | 7.0789 | 7.1764 | 7.1143 | 0.0975 | 0.0621 | 63.69 | 88 | 222 | 138 | 134 | 84 | 62.7 |
| 10 | FF | 80 | 3L | 7.275 | 7.3845 | 7.319 | 0.1095 | 0.0655 | 59.82 | 88 | 238 | 162 | 150 | 76 | 50.7 |
| 10 | FF | 80 | 3S | 6.9859 | 7.0743 | 7.0243 | 0.0884 | 0.05 | 56.56 | 88 | 233 | 166 | 145 | 67 | 46.2 |
| 10 | FF | 80 | 4L | 7.143 | 7.2372 | 7.1757 | 0.0942 | 0.0615 | 65.29 | 89 | 227 | 148 | 138 | 79 | 57.2 |
| 10 | FF | 80 | 4S | 7.0625 | 7.1496 | 7.0973 | 0.0871 | 0.0523 | 60.05 | 87 | 208 | 142 | 121 | 66 | 54.5 |
| 10 | FF | 80 | 5L | 7.2414 | 7.3834 | 7.303 | 0.142 | 0.0804 | 56.62 | 87 | 238 | 158 | 151 | 80 | 53.0 |
| 10 | FF | 80 | 5S | 6.875 | 7.0018 | 6.9279 | 0.1268 | 0.0739 | 58.28 | 89 | 256 | 156 | 167 | 100 | 59.9 |
| 10 | FF | 80 | 1L | 6.8791 | 7.022 | 6.9328 | 0.1429 | 0.0892 | 62.42 | 90 | 306 | 168 | 216 | 138 | 63.9 |
| 10 | FF | 80 | 1S | 7.0745 | 7.1525 | 7.1034 | 0.078 | 0.0491 | 62.95 | 88 | 207 | 137 | 119 | 70 | 58.8 |
| 10 | FF | 80 | 2L | 7.1527 | 7.2366 | 7.186 | 0.0839 | 0.0506 | 60.31 | 91 | 212 | 137 | 121 | 75 | 62.0 |
| 10 | FF | 80 | 2S | 6.991 | 7.0722 | 7.0224 | 0.0812 | 0.0498 | 61.33 | 91 | 201 | 136 | 110 | 65 | 59.1 |
| 10 | FF | 80 | 3L | 7.2375 | 7.47058 | 7.3181 | 0.23308 | 0.15248 | 65.42 | 92 | 296 | 192 | 204 | 104 | 51.0 |
| 10 | FF | 80 | 3S | 7.0563 | 7.1385 | 7.0914 | 0.0822 | 0.0471 | 57.30 | 92 | 204 | 138 | 112 | 66 | 58.9 |
| 10 | FF | 80 | 4L | 7.2799 | 7.3763 | 7.3232 | 0.0964 | 0.0531 | 55.08 | 87 | 207 | 158 | 120 | 49 | 40.8 |

| | | | | Weight (g) | | | | | | Fluorescence (Lux) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Angle | Fabric | Percent blower | Sample # | Clean | Soiled | DeCON | Mass Loaded | Mass Removed | Mass Removal Efficiency (%) | Clean | Soiled | DeCON | Lux added | Lux Removed | Fluorescence Removal Efficiency (%) |
| 10 | FF | 80 | 4S | 6.8075 | 6.8616 | 6.8326 | 0.0541 | 0.029 | 53.60 | 87 | 172 | 122 | 85 | 50 | 58.8 |
| 10 | FF | 80 | 5L | 6.9 | 6.9585 | 6.9263 | 0.0585 | 0.0322 | 55.04 | 87 | 167 | 123 | 80 | 44 | 55.0 |
| 10 | FF | 80 | 5S | 7.4065 | 7.4791 | 7.437 | 0.0726 | 0.0421 | 57.99 | 90 | 199 | 136 | 109 | 63 | 57.8 |
| 10 | FF | 90 | 1L | 7.1259 | 7.2279 | 7.1624 | 0.102 | 0.0655 | 64.22 | 88 | 190 | 136 | 102 | 54 | 52.9 |
| 10 | FF | 90 | 1S | 6.9666 | 7.0337 | 6.993 | 0.0671 | 0.0407 | 60.66 | 86 | 178 | 130 | 92 | 48 | 52.2 |
| 10 | FF | 90 | 2L | 6.7563 | 6.8662 | 6.7991 | 0.1099 | 0.0671 | 61.06 | 83 | 219 | 140 | 136 | 79 | 58.1 |
| 10 | FF | 90 | 2S | 6.7718 | 6.9649 | 6.8313 | 0.1931 | 0.1336 | 69.19 | 83 | 252 | 148 | 169 | 104 | 61.5 |
| 10 | FF | 90 | 3L | 6.8839 | 6.9823 | 6.9198 | 0.0984 | 0.0625 | 63.52 | 87 | 218 | 145 | 131 | 73 | 55.7 |
| 10 | FF | 90 | 3S | 6.7936 | 6.8516 | 6.8169 | 0.058 | 0.0347 | 59.83 | 86 | 151 | 113 | 65 | 38 | 58.5 |
| 10 | FF | 90 | 4L | 6.8466 | 7.0143 | 6.9107 | 0.1677 | 0.1036 | 61.78 | 86 | 276 | 165 | 190 | 111 | 58.4 |
| 10 | FF | 90 | 4S | 7.387 | 7.4631 | 7.4217 | 0.0761 | 0.0414 | 54.40 | 86 | 197 | 144 | 111 | 53 | 47.7 |
| 10 | FF | 90 | 5L | 7.2531 | 7.4271 | 7.3129 | 0.174 | 0.1142 | 65.63 | 86 | 272 | 167 | 186 | 105 | 56.5 |
| 10 | FF | 90 | 5S | 6.8525 | 6.9431 | 6.8869 | 0.0906 | 0.0562 | 62.03 | 86 | 197 | 132 | 111 | 65 | 58.6 |
| 10 | FF | 90 | 1L | 6.759 | 6.8222 | 6.7824 | 0.0632 | 0.0398 | 62.97 | 86 | 177 | 125 | 91 | 52 | 57.1 |
| 10 | FF | 90 | 1S | 6.53 | 6.6522 | 6.5681 | 0.1222 | 0.0841 | 68.82 | 89 | 276 | 153 | 187 | 123 | 65.8 |
| 10 | FF | 90 | 2L | 7.3166 | 7.4064 | 7.3505 | 0.0898 | 0.0559 | 62.25 | 90 | 220 | 142 | 130 | 78 | 60.0 |
| 10 | FF | 90 | 2S | 7.186 | 7.2831 | 7.2224 | 0.0971 | 0.0607 | 62.51 | 89 | 225 | 139 | 136 | 86 | 63.2 |
| 10 | FF | 90 | 3L | 7.2085 | 7.2802 | 7.2372 | 0.0717 | 0.043 | 59.97 | 89 | 199 | 130 | 110 | 69 | 62.7 |
| 10 | FF | 90 | 3S | 6.7844 | 6.8455 | 6.8065 | 0.0611 | 0.039 | 63.83 | 88 | 172 | 121 | 84 | 51 | 60.7 |
| 10 | FF | 90 | 4L | 7.2545 | 7.3259 | 7.2831 | 0.0714 | 0.0428 | 59.94 | 88 | 200 | 137 | 112 | 63 | 56.3 |
| 10 | FF | 90 | 4S | 6.9914 | 7.0741 | 7.0185 | 0.0827 | 0.0556 | 67.23 | 89 | 201 | 129 | 112 | 72 | 64.3 |
| 10 | FF | 90 | 5L | 7.1741 | 7.294 | 7.2207 | 0.1199 | 0.0733 | 61.13 | 86 | 203 | 131 | 117 | 72 | 61.5 |
| 10 | FF | 90 | 5S | 7.0923 | 7.1942 | 7.1384 | 0.1019 | 0.0558 | 54.76 | 83 | 198 | 124 | 115 | 74 | 64.3 |
| 10 | FF | 90 | 1L | 7.259 | 7.3221 | 7.2806 | 0.0631 | 0.0415 | 65.77 | 89 | 175 | 131 | 86 | 44 | 51.2 |
| 10 | FF | 90 | 1S | 7.0991 | 7.1463 | 7.117 | 0.0472 | 0.0293 | 62.08 | 88 | 145 | 119 | 57 | 26 | 45.6 |

| | | | | Weight (g) | | | | | | Fluorescence (Lux) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Angle | Fabric | Percent blower | Sample # | Clean | Soiled | DeCON | Mass Loaded | Mass Removed | Mass Removal Efficiency (%) | Clean | Soiled | DeCON | Lux added | Lux Removed | Fluorescence Removal Efficiency (%) |
| 10 | FF | 90 | 2L | 7.1773 | 7.2528 | 7.2056 | 0.0755 | 0.0472 | 62.52 | 88 | 199 | 144 | 111 | 55 | 49.5 |
| 10 | FF | 90 | 2S | 6.5172 | 6.5925 | 6.5465 | 0.0753 | 0.046 | 61.09 | 91 | 194 | 142 | 103 | 52 | 50.5 |
| 10 | FF | 90 | 3L | 6.756 | 6.8717 | 6.799 | 0.1157 | 0.0727 | 62.83 | 88 | 238 | 153 | 150 | 85 | 56.7 |
| 10 | FF | 90 | 3S | 7.1905 | 7.2511 | 7.2139 | 0.0606 | 0.0372 | 61.39 | 91 | 180 | 132 | 89 | 48 | 53.9 |
| 10 | FF | 90 | 4L | 6.919 | 6.988 | 6.9438 | 0.069 | 0.0442 | 64.06 | 91 | 181 | 131 | 90 | 50 | 55.6 |
| 10 | FF | 90 | 4S | 6.8652 | 6.9371 | 6.8917 | 0.0719 | 0.0454 | 63.14 | 89 | 192 | 127 | 103 | 65 | 63.1 |
| 10 | FF | 90 | 5L | 7.2637 | 7.3298 | 7.2922 | 0.0661 | 0.0376 | 56.88 | 88 | 166 | 131 | 78 | 35 | 44.9 |
| 10 | FF | 90 | 5S | 7.078 | 7.1407 | 7.103 | 0.0627 | 0.0377 | 60.13 | 87 | 161 | 131 | 74 | 30 | 40.5 |
| 10 | DM | 80 | 1L | 10.462 | 10.5222 | 10.4441 | 0.0602 | 0.0781 | 129.73 | 73 | 184 | 121 | 111 | 63 | 56.8 |
| 10 | DM | 80 | 1S | 10.246 | 10.3535 | 10.2312 | 0.1075 | 0.1223 | 113.77 | 70 | 242 | 120 | 172 | 122 | 70.9 |
| 10 | DM | 80 | 2L | 10.7345 | 10.7908 | 10.7247 | 0.0563 | 0.0661 | 117.41 | 68 | 154 | 94 | 86 | 60 | 69.8 |
| 10 | DM | 80 | 2S | 10.273 | 10.4163 | 10.2751 | 0.1433 | 0.1412 | 98.53 | 70 | 247 | 124 | 177 | 123 | 69.5 |
| 10 | DM | 80 | 3L | 10.5833 | 10.7072 | 10.59 | 0.1239 | 0.1172 | 94.59 | 67 | 215 | 120 | 148 | 95 | 64.2 |
| 10 | DM | 80 | 3S | 10.3064 | 10.5556 | 10.3326 | 0.2492 | 0.223 | 89.49 | 68 | 340 | 145 | 272 | 195 | 71.7 |
| 10 | DM | 80 | 4L | 10.2052 | 10.3787 | 10.2547 | 0.1735 | 0.124 | 71.47 | 67 | 250 | 158 | 183 | 92 | 50.3 |
| 10 | DM | 80 | 4S | 10.4121 | 10.5165 | 10.4231 | 0.1044 | 0.0934 | 89.46 | 68 | 235 | 125 | 167 | 110 | 65.9 |
| 10 | DM | 80 | 5L | 10.3761 | 10.5922 | 10.4382 | 0.2161 | 0.154 | 71.26 | 70 | 244 | 138 | 174 | 106 | 60.9 |
| 10 | DM | 80 | 5S | 10.2813 | 10.4421 | 10.3048 | 0.1608 | 0.1373 | 85.39 | 71 | 281 | 134 | 210 | 147 | 70.0 |
| 10 | DM | 80 | 1L | 10.6385 | 10.7184 | 10.654 | 0.0799 | 0.0644 | 80.60 | 63 | 189 | 123 | 126 | 66 | 52.4 |
| 10 | DM | 80 | 1S | 10.1631 | 10.2227 | 10.1612 | 0.0596 | 0.0615 | 103.19 | 65 | 156 | 92 | 91 | 64 | 70.3 |
| 10 | DM | 80 | 2L | 10.3866 | 10.4576 | 10.3936 | 0.071 | 0.064 | 90.14 | 67 | 139 | 89 | 72 | 50 | 69.4 |
| 10 | DM | 80 | 2S | 10.1213 | 10.2093 | 10.1291 | 0.088 | 0.0802 | 91.14 | 67 | 180 | 94 | 113 | 86 | 76.1 |
| 10 | DM | 80 | 3L | 10.2127 | 10.3349 | 10.2414 | 0.1222 | 0.0935 | 76.51 | 61 | 183 | 102 | 122 | 81 | 66.4 |
| 10 | DM | 80 | 3S | 10.0565 | 10.1465 | 10.0591 | 0.09 | 0.0874 | 97.11 | 61 | 163 | 87 | 102 | 76 | 74.5 |
| 10 | DM | 80 | 4L | 10.2012 | 10.2918 | 10.2049 | 0.0906 | 0.0869 | 95.92 | 65 | 180 | 101 | 115 | 79 | 68.7 |

| | | | | Weight (g) | | | | | | Fluorescence (Lux) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Angle | Fabric | Percent blower | Sample # | Clean | Soiled | DeCON | Mass Loaded | Mass Removed | Mass Removal Efficiency (%) | Clean | Soiled | DeCON | Lux added | Lux Removed | Fluorescence Removal Efficiency (%) |
| 10 | DM | 80 | 4S | 10.112 | 10.2211 | 10.1301 | 0.1091 | 0.091 | 83.41 | 67 | 217 | 124 | 150 | 93 | 62.0 |
| 10 | DM | 80 | 5L | 10.1336 | 10.2625 | 10.165 | 0.1289 | 0.0975 | 75.64 | 61 | 195 | 132 | 134 | 63 | 47.0 |
| 10 | DM | 80 | 5S | 10.3527 | 10.5152 | 10.3672 | 0.1625 | 0.148 | 91.08 | 60 | 238 | 105 | 178 | 133 | 74.7 |
| 10 | DM | 80 | 1L | 10.6236 | 10.712 | 10.63 | 0.0884 | 0.082 | 92.76 | 63 | 196 | 104 | 133 | 92 | 69.2 |
| 10 | DM | 80 | 1S | 10.1546 | 10.4054 | 10.2141 | 0.2508 | 0.1913 | 76.28 | 64 | 274 | 166 | 210 | 108 | 51.4 |
| 10 | DM | 80 | 2L | 10.2723 | 10.4882 | 10.3273 | 0.2159 | 0.1609 | 74.53 | 61 | 269 | 146 | 208 | 123 | 59.1 |
| 10 | DM | 80 | 2S | 10.0953 | 10.245 | 10.1287 | 0.1497 | 0.1163 | 77.69 | 60 | 232 | 127 | 172 | 105 | 61.0 |
| 10 | DM | 80 | 3L | 10.4275 | 10.5723 | 10.4668 | 0.1448 | 0.1055 | 72.86 | 66 | 207 | 134 | 141 | 73 | 51.8 |
| 10 | DM | 80 | 3S | 10.1981 | 10.3491 | 10.2219 | 0.151 | 0.1272 | 84.24 | 67 | 191 | 122 | 124 | 69 | 55.6 |
| 10 | DM | 80 | 4L | 10.1609 | 10.239 | 10.1704 | 0.0781 | 0.0686 | 87.84 | 67 | 177 | 116 | 110 | 61 | 55.5 |
| 10 | DM | 80 | 4S | 10.2934 | 10.3697 | 10.2869 | 0.0763 | 0.0828 | 108.52 | 61 | 197 | 94 | 136 | 103 | 75.7 |
| 10 | DM | 80 | 5L | 10.2625 | 10.4532 | 10.35 | 0.1907 | 0.1032 | 54.12 | 66 | 217 | 141 | 151 | 76 | 50.3 |
| 10 | DM | 80 | 5S | 10.2407 | 10.3864 | 10.2856 | 0.1457 | 0.1008 | 69.18 | 65 | 244 | 115 | 179 | 129 | 72.1 |
| 10 | DM | 90 | 1L | 10.4414 | 10.5241 | 10.4472 | 0.0827 | 0.0769 | 92.99 | 63 | 220 | 117 | 157 | 103 | 65.6 |
| 10 | DM | 90 | 1S | 10.3222 | 10.3566 | 10.2824 | 0.0344 | 0.0742 | 215.70 | 68 | 154 | 97 | 86 | 57 | 66.3 |
| 10 | DM | 90 | 2L | 10.1238 | 10.1765 | 10.1007 | 0.0527 | 0.0758 | 143.83 | 70 | 151 | 93 | 81 | 58 | 71.6 |
| 10 | DM | 90 | 2S | 10.314 | 10.4055 | 10.2906 | 0.0915 | 0.1149 | 125.57 | 67 | 211 | 108 | 144 | 103 | 71.5 |
| 10 | DM | 90 | 3L | 10.1553 | 10.2292 | 10.1444 | 0.0739 | 0.0848 | 114.75 | 68 | 178 | 107 | 110 | 71 | 64.5 |
| 10 | DM | 90 | 3S | 10.1513 | 10.1903 | 10.1119 | 0.039 | 0.0784 | 201.03 | 67 | 132 | 98 | 65 | 34 | 52.3 |
| 10 | DM | 90 | 4L | 10.2905 | 10.3553 | 10.2684 | 0.0648 | 0.0869 | 134.10 | 68 | 180 | 99 | 112 | 81 | 72.3 |
| 10 | DM | 90 | 4S | 10.2775 | 10.3544 | 10.2404 | 0.0769 | 0.114 | 148.24 | 69 | 201 | 99 | 132 | 102 | 77.3 |
| 10 | DM | 90 | 5L | 10.1806 | 10.2727 | 10.174 | 0.0921 | 0.0987 | 107.17 | 69 | 186 | 101 | 117 | 85 | 72.6 |
| 10 | DM | 90 | 5S | 10.3148 | 10.365 | 10.2795 | 0.0502 | 0.0855 | 170.32 | 63 | 168 | 100 | 105 | 68 | 64.8 |
| 10 | DM | 90 | 1L | 10.4563 | 10.5504 | 10.48 | 0.0941 | 0.0704 | 74.81 | 65 | 158 | 88 | 93 | 70 | 75.3 |
| 10 | DM | 90 | 1S | 10.3972 | 10.4994 | 10.4161 | 0.1022 | 0.0833 | 81.51 | 62 | 184 | 92 | 122 | 92 | 75.4 |

| | | | | Weight (g) | | | | | | Fluorescence (Lux) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Angle | Fabric | Percent blower | Sample # | Clean | Soiled | DeCON | Mass Loaded | Mass Removed | Mass Removal Efficiency (%) | Clean | Soiled | DeCON | Lux added | Lux Removed | Fluorescence Removal Efficiency (%) |
| 10 | DM | 90 | 2L | 10.2721 | 10.4084 | 10.2802 | 0.1363 | 0.1282 | 94.06 | 65 | 205 | 94 | 140 | 111 | 79.3 |
| 10 | DM | 90 | 2S | 10.2129 | 10.2889 | 10.1903 | 0.076 | 0.0986 | 129.74 | 65 | 123 | 81 | 58 | 42 | 72.4 |
| 10 | DM | 90 | 3L | 10.4189 | 10.5207 | 10.4168 | 0.1018 | 0.1039 | 102.06 | 60 | 173 | 90 | 113 | 83 | 73.5 |
| 10 | DM | 90 | 3S | 10.3131 | 10.6161 | 10.3443 | 0.303 | 0.2718 | 89.70 | 62 | 238 | 122 | 176 | 116 | 65.9 |
| 10 | DM | 90 | 4L | 10.1526 | 10.2106 | 10.1308 | 0.058 | 0.0798 | 137.59 | 63 | 155 | 89 | 92 | 66 | 71.7 |
| 10 | DM | 90 | 4S | 10.1523 | 10.2589 | 10.1281 | 0.1066 | 0.1308 | 122.70 | 63 | 167 | 97 | 104 | 70 | 67.3 |
| 10 | DM | 90 | 5L | 10.595 | 10.7322 | 10.595 | 0.1372 | 0.1372 | 100.00 | 63 | 188 | 101 | 125 | 87 | 69.6 |
| 10 | DM | 90 | 5S | 10.3225 | 10.5107 | 10.3143 | 0.1882 | 0.1964 | 104.36 | 61 | 258 | 105 | 197 | 153 | 77.7 |
| 10 | DM | 90 | 1L | 10.4169 | 10.5958 | 10.4446 | 0.1789 | 0.1512 | 84.52 | 62 | 266 | 125 | 204 | 141 | 69.1 |
| 10 | DM | 90 | 1S | 10.1289 | 10.4079 | 10.1576 | 0.279 | 0.2503 | 89.71 | 66 | 381 | 155 | 315 | 226 | 71.7 |
| 10 | DM | 90 | 2L | 10.1418 | 10.3421 | 10.1583 | 0.2003 | 0.1838 | 91.76 | 66 | 262 | 126 | 196 | 136 | 69.4 |
| 10 | DM | 90 | 2S | 10.2738 | 10.5359 | 10.2834 | 0.2621 | 0.2525 | 96.34 | 65 | 252 | 114 | 187 | 138 | 73.8 |
| 10 | DM | 90 | 3L | 10.2276 | 10.5345 | 10.2982 | 0.3069 | 0.2363 | 77.00 | 67 | 284 | 140 | 217 | 144 | 66.4 |
| 10 | DM | 90 | 3S | 10.2807 | 10.3865 | 10.2946 | 0.1058 | 0.0919 | 86.86 | 68 | 191 | 103 | 123 | 88 | 71.5 |
| 10 | DM | 90 | 4L | 10.0833 | 10.2938 | 10.1214 | 0.2105 | 0.1724 | 81.90 | 68 | 219 | 119 | 151 | 100 | 66.2 |
| 10 | DM | 90 | 4S | 10.1456 | 10.2962 | 10.1543 | 0.1506 | 0.1419 | 94.22 | 67 | 255 | 122 | 188 | 133 | 70.7 |
| 10 | DM | 90 | 5L | 10.1393 | 10.2988 | 10.1561 | 0.1595 | 0.1427 | 89.47 | 67 | 219 | 125 | 152 | 94 | 61.8 |
| 10 | DM | 90 | 5S | 10.3268 | 10.4765 | 10.3205 | 0.1497 | 0.156 | 104.21 | 62 | 266 | 121 | 204 | 145 | 71.1 |

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