



Development of a Dry Decontamination System for Personnel Decontamination and Emergency Response – the NIOSH DryCon System

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Current Decon Practices for Mass Casualty Events-Issues

Wet decontamination is the standard for mass casualty events

- Demonstrated to be highly effective
- Steps in wet decontamination
 1. Remove clothing
 2. Shower
- Wet decontamination can be problematic under certain circumstances
 - Compliance issues with disrobing
 - Re-aerosolization of contaminant
 - Cold weather
 - Water-reactive contaminant



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Dry decontamination with DryCon could be another tool

- No disrobing required in public or in inclement weather
- Easily re-aerosolized contaminant removed
- Temperature is of less concern
- No contaminated water for disposal following dry decontamination



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Dry decontamination is not a new idea

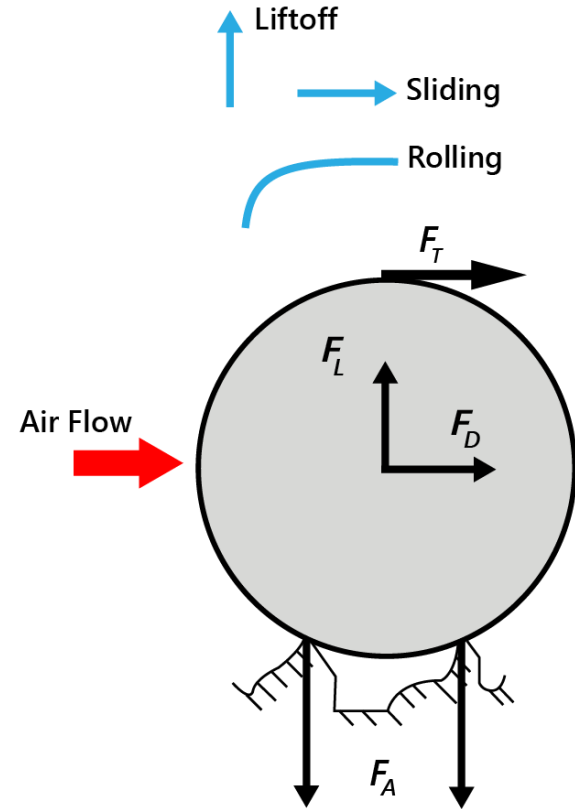
- NIOSH Clothes Cleaning System
 - Used in the mining industry
 - Air comes from a compressor
- Rapid Dry Firefighter Field Decontamination System
 - Handheld
 - No particle capture
- Air Showers
 - Used for cleanroom entry
 - Air nozzles are not aligned



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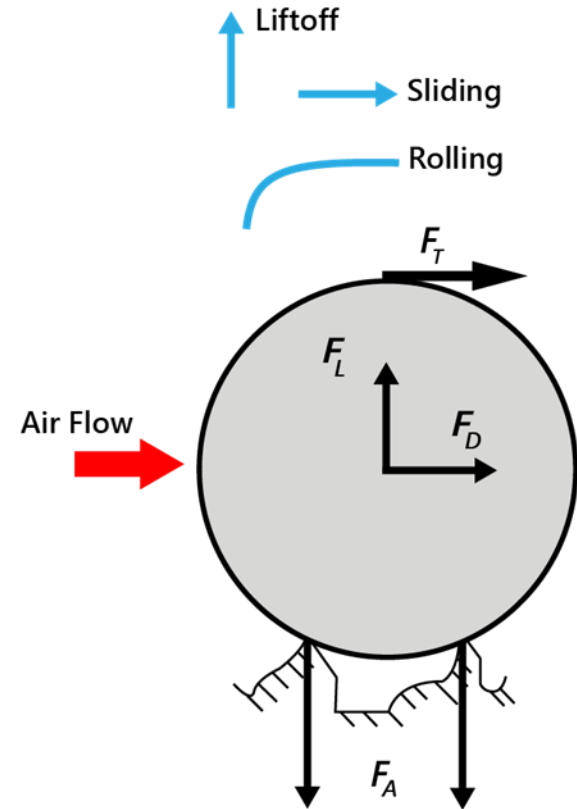
Forces of Particle Adhesion and Removal

- Forces of particle adhesion (F_A)
 - van der Waals
 - Chemical bonds
 - Capillary action of moisture
 - Electrostatic forces
- Forces of particle removal
 - Lift (F_L)
 - Drag (F_D)
 - Torque (F_T)



Factors Affecting Particle Removal

- Particle size
- Air speed
- Properties of the particle and the surface
- Relative humidity
- Residence time on the surface
- Stiffness of fabric



Components of DryCon

- Positive pressure blower
 - Delivers up to 600 cfm at 1 PSI pressure
 - Controlled by a programmable controller and variable frequency drive
- Enclosure
 - Doors on both sides
 - Vertical and horizontal rows of air nozzles
 - Controlled to slight negative pressure
- Exhaust blower
 - HEPA filter for particle capture
 - Rated up to 1600 cfm



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DryCon in Operation

- Video link: [EPA Decon video.mp4](#)

Test Method Developed

- Fluorescent powder used as surrogate
 - Applied with pesticide duster
 - Amount applied/removed measured with black light and light meter
- Three different types of fabric squares tested:
 - Polyester double knit
 - Cotton denim
 - Firefighter turnout fabric



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Fabric squares were attached to manikin on turntable

- Treatment time was 60 seconds
- Fluorescence was measured before and after
 - Two air flow rates were tested, 480 cfm (13,500 feet/min exiting the nozzle) and 540 cfm (15,000 feet/min exiting the nozzle)
 - Nozzle angles of 0° and 10° were tested



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Results of Laboratory Testing

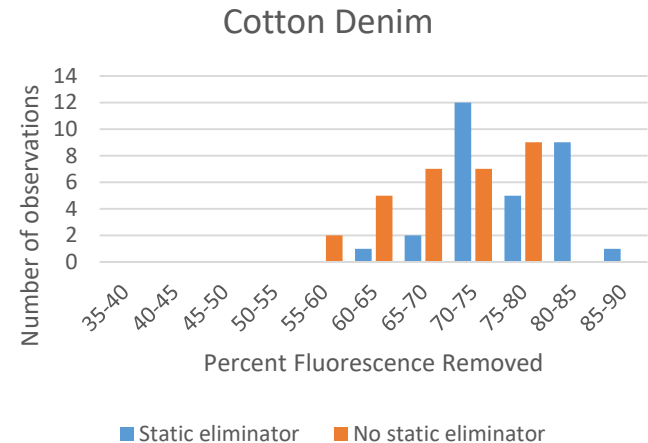
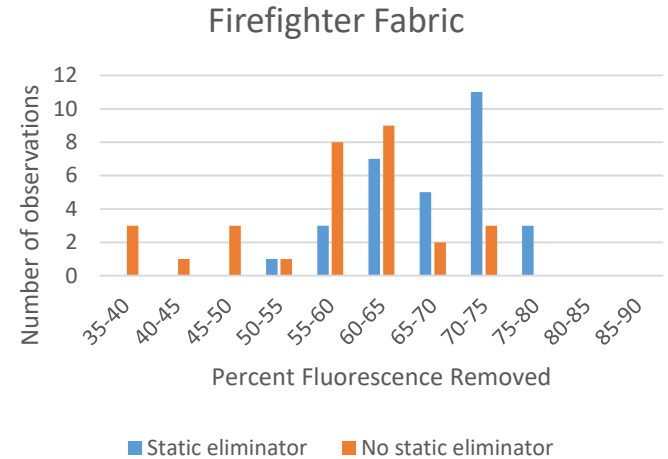
- Higher air flow rate was best overall
- Changing nozzle angle was insignificant
- Decontamination of double knit fabric was highest

Mean fluorescence removal efficiency by fabric and blower speed.

| Fabric | Mean fluorescence removal efficiency (%) | N | Air Flow Rate (cfm) |
|---------------------------|---|----------|----------------------------|
| Double Knit | 80.9 | 60 | 480 |
| | 80.7 | 58 | 540 |
| Cotton Denim | 64.5 | 60 | 480 |
| | 70.3 | 60 | 540 |
| Firefighter fabric | 53.4 | 70 | 480 |
| | 56.8 | 60 | 540 |

Improved results with Linear Ionizer to Eliminate Static Charge

- Firefighter fabric and cotton denim were tested
- Statistically significant improvements in contaminant removal were measured
 - Denim from 70.3% to 76.2%
 - Firefighter fabric from 56.8% to 68.0%



Modifications have made DryCon more adaptable

- Inflatable shelter sets up quicker
- Components modified to run on generator power
- Internal lighting



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Proof-of-concept study shows promise of DryCon technology

- Emergency decontamination for dusty substances
- Pre-decontamination before disrobing for wet decontamination
- Decontamination at the end of a work shift



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Questions?

For more information, contact CDC
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