ENGINEERING PHARMACEUTICAL INNOVATION

Application of the "Assessing the Particulate Containment Performance of Pharmaceutical Equipment" Good Practice Guide (aka SMEPAC)

George S. Petroka, CIH, CSP, RBP
Director BioPharma/ EHS Services
IES Engineers

Learning Objectives

- At the conclusion of this session, participants will understand:
  - APCPPE Guide
  - Containment Verification – Critical Issues
  - Sample Collection and Sampling Methodologies
  - Sampling Critical Issues
  - Documentation Issues
  - APCPPE Protocols

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APCPPE Guide

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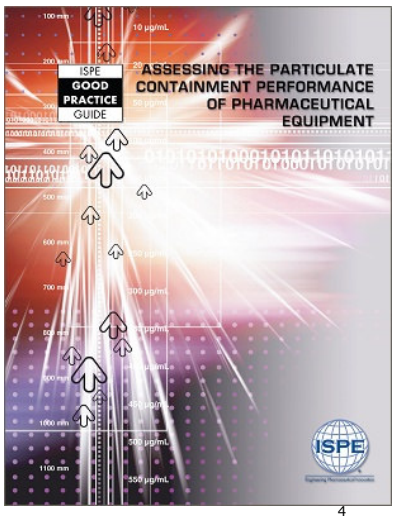
ISPE Guidance Document

- SMEPAC - APCPPE
- Adopted and published by ISPE in 2005
- "Good Practice Guide"
- FAT and SAT – intended to provide standard testing and comparison of relative performance and against common criteria
- Under review for document "update"



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Purpose and Scope

- Provide a standard methodology for use in testing the containment efficiency of solids handling systems
- Pharmaceutical industry
- Provide a basis for understanding the containment performance capabilities of equipment
- Powders only
- Airborne and Surface Contamination
- Test conditions and Test Materials only
- Simulated “typical operating conditions”

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Surrogate Testing

- Methodology
- Facility Design
- Test Material
- Measurement of Airborne Dust and Surface Contamination
- Analysis
- Report

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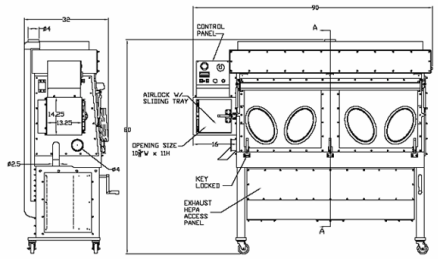
Containment Verification – Pre-Planning

Pre-Planning

1. Establish Containment Targets
2. Determine the Means to Simulate the Operation
3. Selection of Surrogate Material
4. Selection of Sampling Methods
5. Develop a Sampling Strategy



1. Establish Containment Targets

- Based on OEL or other health limits
- Driven by IH, toxicology, QA or engineering specification
- Consideration of PPE is incorporated if specified
- Incorporation of safety factors is common

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2. Determine Actions to Simulate the Operation

- Testing facility configuration – goal is to simulate “in-use process train” incorporating all critical steps in the process
- Multiple operators is preferred
- Do not rely on a single test – perform multiple runs

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Test Facility

- Containment must be performed in a test facility with low relative background contamination relative to the desired levels of detection
  - <10% of target containment level
- All room, materials, and equipment must be cleaned prior to testing
- Test enclosure may need to be constructed if baseline contamination is a problem

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Test Facility – Environmental Conditions

Temperature range:	20 ºC +/- 5 ºC
Relative Humidity (RH):	50 % +/- 10 %
Positive room pressure:	+ 10 Pa (minimum) relative to the adjacent space
Air change rate:	3-5/hr

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Test Personnel

- Only necessary, authorized personnel permitted in test facility
- Gowning and PPE must be used to minimize contamination
- Personnel must be trained
  - Purpose of test and methodology
  - Operational SOPs for processes and equipment

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3. Selection of Surrogate Material

- Surrogate considerations
  - Physical properties (flow characteristics, particle size, dustiness)
  - Safety – Health and physical hazard
  - Quality Issues (API vs. non-API)
  - Cost
  - Ease of procurement
  - LOD

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3. Selection of Surrogate Material

- Material Meets Requirements for the Manufacturing Process
  - Flowability (bulk powder movement)
  - Compactability and adhesion (tableting)
  - Solubility (emulsion vs. solution)

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3. Selection of Surrogate Material

- Test Material Availability and Cost
  - How much test material is needed?
  - Cost of bulk material
  - "Off the shelf" vs. Custom manufacture (micronization)

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Common Surrogates

Surrogate	API	Excipient	Solubility
Acetaminophen	x		Moderate
Lactose		x	High
Mannitol		x	High
Naproxen Sodium	x		High
Riboflavin	x		Sparingly
Sucrose		x	High

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Surrogate - Toxicity

Surrogate	OEL
Acetaminophen	3 mg/m^3
Lactose	10 mg/m^3
Mannitol	10 mg/m^3
Naproxen Sodium	2 mg/m^3
Riboflavin	5 mg/m^3
Sucrose	10 mg/m^3

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Surrogate - LOD

Surrogate	LOD
Acetaminophen	0.5 ng
Lactose	2.5 ng
Mannitol	1.0 ng
Naproxen Sodium	0.2 ng
Riboflavin	5.0 ng
Sucrose	5.0 ng

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3. Selection of Surrogate Material

- Lactose as a surrogate
  - LOD (Lactose) = 0.002 µg
  - Target Containment Level = 0.05 µg/m^3
- MAV to achieve target containment level?
- Minimum sampling time:
  - Personal sampling (2.0 liters/min)?
  - High-volume sampling pump (10 liters/min)?

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4. Selection of Sampling Methods

- Air Sampling
- Surface (Swab) Sampling
- Real-time Aerosol Monitoring
- Other – UV visualization

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Air Sampling

- A sampling train for aerosolized powder exposure monitoring consists of:
  - Air moving device (i.e., sampling pump)
  - Air conducting device (i.e., hose)
  - Filter adapter/holder
  - Sampling medium (i.e., filter)

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Air Sampling

- Personal Sampling Pumps
  - Flow rate of 1 to 4 lpm
  - High degree of employee mobility
  - Battery powered and intrinsically safe
  - Constant flow rate
  - Use 3 to 4-foot hose

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Air Sampling

- High Volume Sampling Pump
  - Flow rate of 5 to 10 lpm
  - Limited employee mobility
  - A/C powered (110 V) and not intrinsically safe
  - Variable flow rate
  - Use 10 to 20-foot hose

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Air Sampling

- Personal High Volume Sampling Pump
  - Flow rate of 5 to 15 lpm
  - High degree of employee mobility
  - Battery powered; up to 24 hour battery life
  - Constant flow rate
  - Not intrinsically safe
  - $$
  - Currently not readily available for rental

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Air Sampling

- Filters
  - Mechanical devices used to capture aerosolized powders
  - Contaminant capture is achieved by
    - Interception
    - Impaction
    - Electrostatic Attraction
    - Diffusion

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Air Sampling

- Filters
  - The type of filter needed to collect air samples for a given contaminant is dictated by the laboratory's sampling and analytical method
    - Polytetrafluoroethylene (PTFE)
    - Glass Fiber Filter (GFF)
    - Quartz Fiber Filter (QFF)
    - Polyvinyl Chloride (PVC)
    - Mixed Cellulose Ester (MCE)

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Air Sampling

- Filter Holders
  - IOM samplers targets inhalable dust fraction
    - Good repeatability
    - Requires flow at 2.0 lpm for proper size selectivity
    - Difficult to handle (cross contamination)
    - Many labs do not have enough filter holders to accommodate large numbers of samples

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Air Sampling

- Filter Holders
  - 2- and 3-piece sample cassettes collect sample of “total dust” concentrations
    - Not necessarily directly comparable with IOM
    - May have wider variability
    - Flow rates not as critical
    - Can enable higher flow rates

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Mathematics Review

- Remember:
  - Airborne contaminant concentrations are expressed in mg/m^3 or $\mu g/m^3$
  - Sampling pump flow rates are expressed as liters of air per minute (lpm)
- Important units:
  - 1 µg = 0.001 mg; 1,000 µg = 1 mg
  - 1 liter = 0.001 m^3; 1,000 liter = 1 m^3

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Important Concepts

- Target Containment Level (TCL) = Level of containment provided by containment equipment/system
- Limit of Detection (LOD) = The smallest amount of a material that the laboratory can detect using an analytical method
  - A measure of relative sensitivity of the analytical method
  - Expressed in µg/sample
  - Supplied by laboratory
- Minimum Air Volume (MAV) = The minimum volume of air that must be collected with a sampling pump to achieve detection at a target concentration

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Calculating - Minimum Air Volume (MAV)

$$\text{MAV (L)} = \frac{\text{LOD (µg)}}{\text{TCL(µg/m}^3\text{)}} \times 1{,}000 \text{ L/m}^3$$

- LOD supplied by laboratory
- TCL should be one-half the OEL or less
- Convert air volume in m^3 to liters

Example - Calculate the MAV:

- LOD = 0.0025 µg/sample
- Target Containment Level = 0.1 µg/m^3

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Calculating - Minimum Air Volume (MAV)

$$\text{MAV (L)} = \frac{0.0025\ \mu g}{0.1\ \mu g/m^3} \times 1{,}000\ L/m^3 = 25\ \text{Liters}$$

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Calculating - Minimum Sampling Time

Minimum Sampling Time = (MAV)/[Flow Rate (lpm)]

Example - Calculate the minimum sampling time:

- MAV = 25 liters
- Flow Rate (Personal Pump) = 2.0 lpm

Minimum Sampling Time = 25 liters/2 liters/min = 12.5 minutes

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Surface Sampling

- Media includes
  - Glass Fiber Filter (GFF)
  - Quartz Fiber Filter (QFF)
  - "Ghost Wipes"
  - Swabs

- The type of surface sampling medium for a given contaminant is dictated by
  - Laboratory's sampling and analytical method
  - Sampling application

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Surface Sampling

- A suitable wetting agent must be used
- For surface samples, sensitivity is a function of:
  - Analytical LOD
  - Area of surface swabbed
  - Concentration of dilution

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Surface Sampling

- Among other factors, accuracy is a function of recoverability of analyte from surfaces
  - Assumptions for recovery
    - Assume 100% recovery;
    - Utilize laboratory data; or
    - Perform recoverability studies

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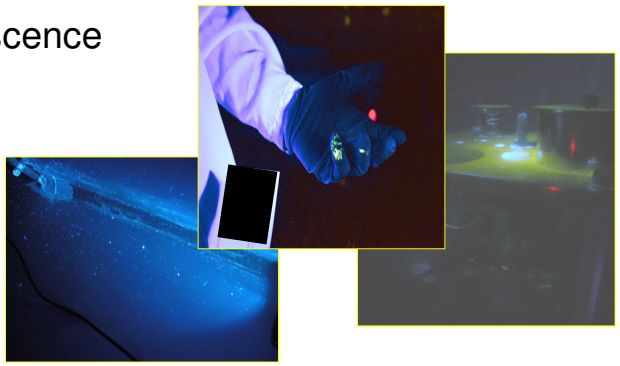
UV - Visualization

- Utilize material that fluoresces
  - Riboflavin
  - Fluorescence



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5. Develop a Sampling Strategy

- The sampling strategy will define:
  - Operations to be sampled
  - The types, numbers, and locations of the samples to be collected
  - Analyte(s) to be sampled
  - Length of time needed to sample
  - Equipment necessary for sampling

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5. Develop a Sampling Strategy

- Area sample at critical containment points
- Operator exposure sampling
- Task sampling – make sure task duration provides adequate sensitivity for meaningful results!
  - More sensitive methods (example: LC/MS/MS application vs. HPLC)
  - Higher flow rates
  - Longer sample times (multiple iterations for tasks)
- Consider surface sampling if it adds value

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5. Develop a Sampling Strategy

- Monitoring Locations
  - Static Sampler Locations
  - Personal Sampler Locations
  - Real-time Aerosol Monitor Location
  - Surface (Swab) Locations

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5. Develop a Sampling Strategy

- In general, will consist of:
  - Baseline Samples
  - Static Air Samples
  - Personal Air Samples
  - Surface (Swab) Samples
  - Field and Media Blanks
  - Real-time Aerosol Monitor

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5. Develop a Sampling Strategy

- Baseline Samples:
  - Identify existing contamination in area
  - High baseline results can confound air and wipe sampling results

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5. Develop a Sampling Strategy

- Static (Area) Air Samples:
  - Identify contaminant concentrations in specific areas
    - Identify exposure points
    - Evaluate contaminant migration
    - Evaluate ambient concentrations

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5. Develop a Sampling Strategy

- Personal Air Samples:
  - Evaluate airborne contaminant concentrations in the employee “breathing zone,” regardless of respirator use

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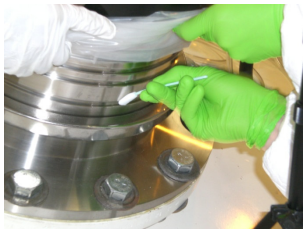
5. Develop a Sampling Strategy

- Surface (Swab) Samples:
  - Identify baseline contamination
  - Compare with established surface limits
  - Evaluate contaminant carryover on surfaces
  - Evaluate integrity of containment devices
  - Verify cleanliness



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5. Develop a Sampling Strategy

- Field and Media Blanks:
  - Unused sampling media handled in the same manner as the samples and submitted for analysis for QC purposes

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5. Develop a Sampling Strategy

- Real-time aerosol monitoring

  - Direct reading, light-scattering photometers capable of measuring total particulate in the atmosphere
  - Do not require laboratory analysis of dust samples - not compound specific.
  - Provide information on the pattern of exposure and identify the sources of dust emissions.
  - Used side-by-side with a area sampler for comparison purposes,
  - Can help identify when peak exposures occur
  - Useful information on dust levels during a short cycle of operations when other sampling methods may not be adequately sensitive
  - Data logging capabilities
  - Used to determine when a stable baseline level of airborne dust has been achieved in the test enclosure, prior to the start of testing

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5. Develop a Sampling Strategy

- Intended to identify equipment failure points
- Sampling strategy must include all applicable steps in process
  - Include both routine and supporting operations
- Air samples collected for duration of task plus 15 minutes
- Wipe samples collected:
  - Before each cycle/run
  - After each cycle/run
- Real-time Aerosol Monitor
  - Aerosol Concentration range

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5. Develop a Sampling Strategy

- Perform multiple iterations
  - Generally 3 iterations is recommended
  - Greater numbers of samples provide better statistical significance

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Costs $$$$

- One Iteration
  - Total Costs: $$
- Three Iterations
  - Total Costs: 1.75 x $$

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Sampling

Sampling – What Can Go Wrong May Go Wrong

- Surrogate
- Sampling equipment
- Sampling media
- Sampling strategy
- Sample analysis
- Baseline Samples
- Cleaning
- Process equipment
- Containment equipment
- Test facility
- Operators

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Documentation

- Document all activities and test conditions
  - Equipment and condition
  - Conditions in test area
  - Work activities performed
  - Sample locations
- Use pre-prepared sample data sheets
- Time-stamped photos and data
- Where possible, prepare photographic or video documentation

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Air Sampling

- Ensure that minimum air volume is obtained to achieve adequate sensitivity
- Avoid sampling errors through proper documentation and sample handling

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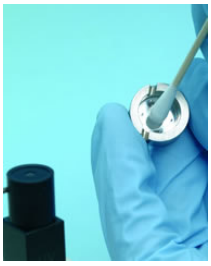
Surface Sampling

- Ensure that correct media and wetting agent are utilized
- Steps must be taken to minimize cross-contamination during sampling
  - Utilize clean gloved hands for each sample
  - Utilize clean templates for each sample
  - Be aware of contamination carryover during sample collection
- If necessary, protect yourself against contact with wetting agent



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Surface Sampling

- Collect samples over specified area to achieve desired level of detection
  - Where possible, use template
  - For irregular surfaces, estimate area of surface sampled

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Surface Sampling

- Samples typically collected over a 100 cm^2 or 1,000 cm^2 surface
  - Sensitivity can be increased by increasing the surface area sampled
    - Example:
      - LOD = 1 µg/sample
      - 1 µg/100 cm^2
      - 1 µg/1,000 cm^2 = 0.1 µg/100 cm^2
  - The type of sampling medium may limit the sampling area
  - Composite samples may be needed for large areas

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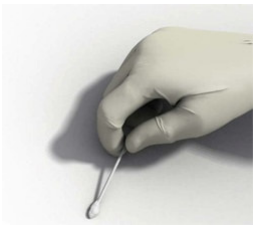
Sample Collection

- Minimization of cross contamination is of paramount concern
- Ensure that minimum air volume is obtained to achieve adequate sensitivity
- Avoid sampling errors through proper documentation and sample handling



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Real-time aerosol monitoring

- No recognized international standard for real-time aerosol monitors
- Verify particle size fractions
  - PM_1, $PM_{2.5}$, PM_{10}
- Verify aerosol concentration range
  - 0.001 to 150 mg/m^3
- Calibrate

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Documentation

Documentation

- Test report serves as historical record of equipment performance
- Maintain test report as part of data package for equipment

Documentation

- Test report should include:
  - Description of equipment and operations
  - Test conditions
  - Surrogate material
  - Sample locations
  - Sample equipment and calibration data
  - Data
    - Raw data
    - Analysis and interpretation of results
  - Photographic/video documentation

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Documentation

Sample Description	Run 01 (µg/m³)	Run 02 (µg/m³)	Run 03 (µg/m³)	Arithmetic Mean (µg/m³)
BASELINE				
Source Sample (SS) – Approximately 200 mm from the Hopper Outlet Valve and Dover Pac Continuous Liner (120309-A01)	0.08			
Area sample (AS) - Approximately 2 m from the Donaldson Hopper Outlet/Dover Pac (DHO/DP) set-up, at a height of approximately 1.5m. (120309-A02)	0.08			
EVENT #1 – POWDER CHARGE AND DISCHARGE				
Personal Sample Breathing Zone (PSBZ) – Operator #1 (Adam Sadkowski) during powder discharge (120309-A03; 123009-A15; 120309-A27)*	0.44	0.04	0.12	**0.20**
PSBZ – Operator #2 (Gary Handy) during powder discharge (120309-A04; 123009-A16; 120309-A28)*	<0.05	0.07	<0.04	**<0.05**
SS – Approximately 200 mm away from the right side of the transfer ring at the (DHO/DP) set-up (120309-A05; 123009-A17; 120309-A29)*	0.05	<0.03	<0.04	**<0.04**
SS – Approximately 200 mm away from the center of the (DHO/DP) set-up (120309-A06; 123009-A18; 120309-A30)*	0.08	0.14	<0.04	**<0.09**
SS – Approximately 200 mm away from the left side of the (DHO/DP) set-up (120309-A07; 123009-A19; 120309-A31)*	<0.05	0.25	<0.04	**<0.11**
AS-OBH – Approximately 2 m away from the (DHO/DP) set-up (120309-A08; 123009-A20; 120309-A32)*	<0.05	<0.03	<0.04	**<0.04**
PSBZ – Operator #1 (Adam Sadkowski) during removal of the continuous liner (120309-A09; 123009-A21; 120309-A33)*	0.17	0.72	0.13	**0.34**
PSBZ – Operator #2 (Gary Handy) during removal of the continuous liner (120309-A10; 123009-A22; 120309-A34)*	<0.04	0.08	0.30	**<0.14**
SS – Approximately 200 mm away from the right side of the transfer ring at the (DHO/DP) set-up (120309-A11; 123009-A23; 120309-A35)*	<0.04	0.04	0.18	**<0.09**
SS – Approximately 200 mm away from the center of the (DHO/DP) set-up (120309-A12; 123009-A24; 120309-A36)*	<0.04	0.05	0.54	**<0.21**
SS – Approximately 200 mm away from the left side of the (DHO/DP) set-up (120309-A13; 123009-A25; 120309-A37)*	0.13	0.54	0.41	**0.35**
AS-OBH – Approximately 2 m away from the (DHO/DP) set-up (120309-A14; 123009-A26; 120309-A38)*	0.04	0.04	0.06	**0.05**

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APCPPE Equipment Specific Protocols

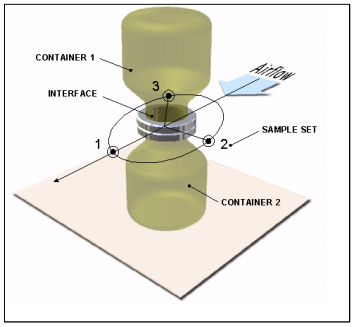
APCPPE Equipment Specific Protocols

1. Single Point Transfer System
2. Downflow Booth
3. Isolator or Glovebox
4. Drum Filling Within Extraction Booth

#1 - Single Point Transfer System

Static Sampler Locations

Sampler No.	Position with respect to the transfer device centerline
1	Distance D/2 + 200 mm, downstream
2	Distance D/2 + 200 mm, rotated by 120°
3	Distance D/2 + 200 mm, rotated by 240°
4	2,000 mm, 90° to airflow



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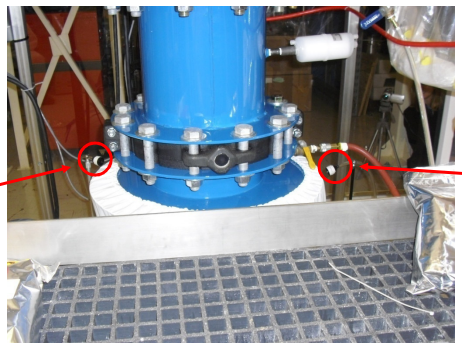
Static Sampler Locations - Example



Distance D/2 + 200 mm, downstream

Distance D/2 + 200 mm, rotated by 120°

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#1 - Single Point Transfer System

- Personal Sampler Locations
  - Each operator should wear a personal monitor
- Real-time Aerosol Monitor Location
  - Positioned adjacent to sampler 1 (where the highest exposure is expected)

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#1 - Single Point Transfer System

- Swab Locations
  - External surfaces of both parts of the single point transfer system before docking of the first cycle and after undocking of the last cycle of each run.
  - Area with the highest visible level of contamination or, where this is not obvious, from the mating faces.
  - Marked on drawings or shown on photographs that will be included in the report.

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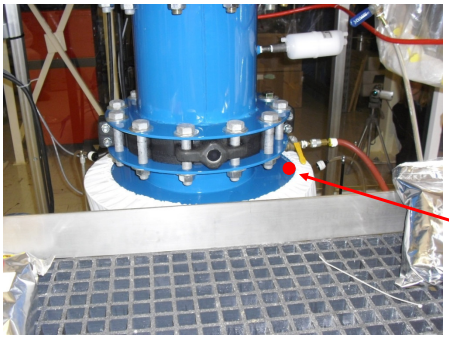
Swab Locations - Example



External surfaces of both parts of the single point transfer system before docking of the first cycle and after undocking of the last cycle of each run.

On the right side of the Hopper Valve housing lip, below the air line connection, after the discharge of powder

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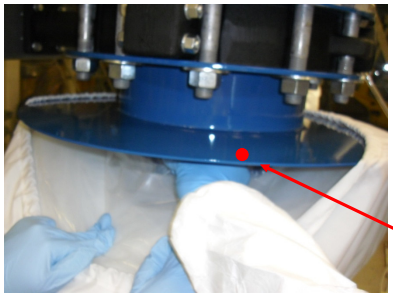
Swab Locations - Example



Area with the highest visible level of contamination or, where this is not obvious, from the mating faces

On left side of Hopper Valve at the continuous liner connection, after the discharge of powder and prior to the installation of a new continuous liner

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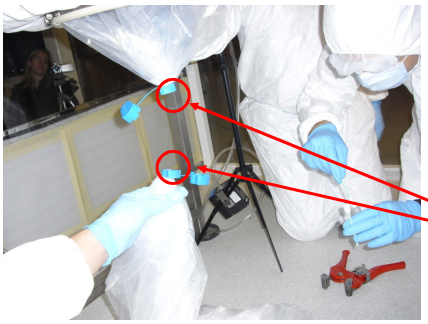
Swab Locations - Example



Area with the highest visible level of contamination or, where this is not obvious, from the mating faces

Exposed cut ends of continuous liner sleeve after crimping and cutting

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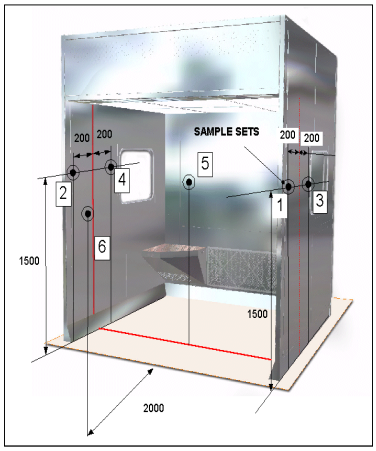
#2 - Downflow Booth

Static Sampler Locations

Sampler No.	Position with respect to the transfer device centerline
1	200 mm from the right wall of the booth approximately 200 mm outside the "safe line" of the booth at a height of 1.5 meters
2	200 mm from the left wall of the booth approximately 200 mm outside the "safe line" of the booth at a height of 1.5 meters
3	200 mm from the right wall of the booth approximately 200 mm inside the "safe line" of the booth at a height of 1.5 meters
4	200 mm from the left wall of the booth approximately 200 mm inside the "safe line" of the booth at a height of 1.5 meters
5	Center of the booth along the "safe line" at a height of 1.5 meters
6	2 m from the “safe line” of the downflow booth



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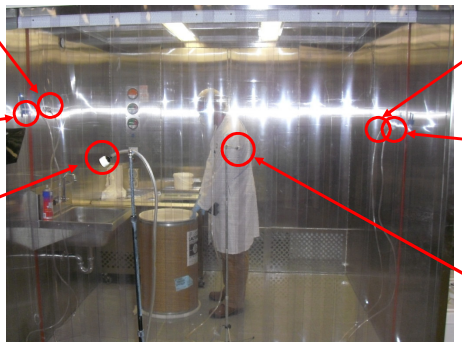
Static Sampler Locations - Example



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#2 - Downflow Booth

- Personal Sampler Locations
  - Each operator should wear a personal monitor
- Real-time Aerosol Monitor Location
  - Real-time aerosol monitors may not give accurate results when used in a downflow booth; therefore, no standardized recommendation for their use can be made

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#2 - Downflow Booth

- Swab Positions
  - External surfaces of the following:
    - Objects removed from the downflow booth
    - Downflow booth wall and floor surfaces 200 mm outside the safe working zone
  - Marked on drawings or shown on photographs that will be included in the report.

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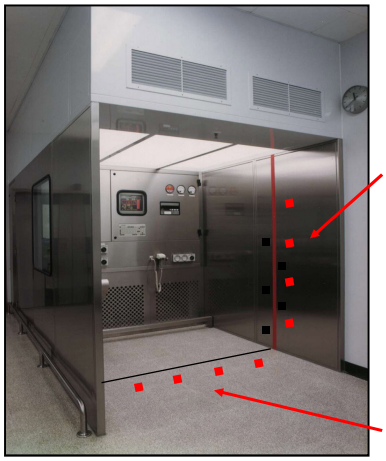
Swab Locations - Example



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#3 - Isolator or Glovebox

- Static Sampler Locations
  - Located adjacent to the potential points of emission
  - To maximize the capture of the airborne particles the samplers should be located downstream of the direction of the airflow as determined by smoke pattern
  - The number of samplers should reflect the number of potential emission points. A background sampler should also be placed at 2,000 mm from the isolator, perpendicular to the airflow, at a height of 1,500 mm from the floor level

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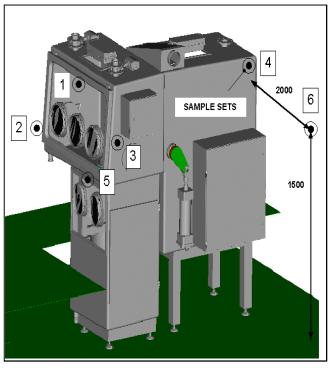
#3 - Isolator or Glovebox

Static Sampler Locations

Sampler No.	Position with respect to the transfer device centerline
1	At gloveports
2	200 mm from left side of the Isolator near the gloveports
3	200 mm from the pass-through door
4	200 mm from the exhaust outlet
5	200 mm from right side of the Isolator near the gloveports
6	2 m from the isolator at a height of approximately 1.5 m during typical powder handling activities within the isolator



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Static Sample Locations - Example

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Static Sample Locations - Example

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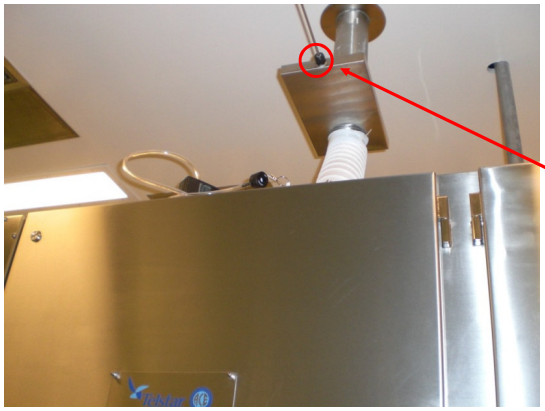
Static Sample Locations - Example



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#3 - Isolator or Glovebox

- Personal Sampler Locations
  - Each operator should wear a personal monitor
- Real-time Aerosol Monitor Location
  - Positioned where the highest exposure is expected

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#3 - Isolator or Glovebox

- Swab Positions
  - External surfaces of the following:
    - Objects removed from the isolator
    - Transfer port mating faces
    - Gloves
    - Bag out port bags
    - Isolator
  - Marked on drawings or shown on photographs that will be included in the report.

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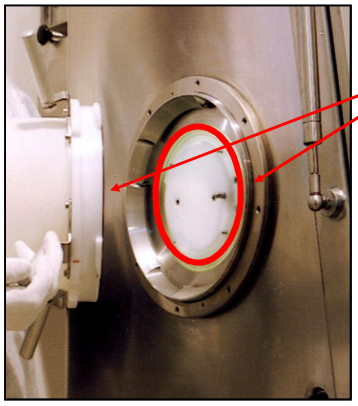
Swab Locations - Example



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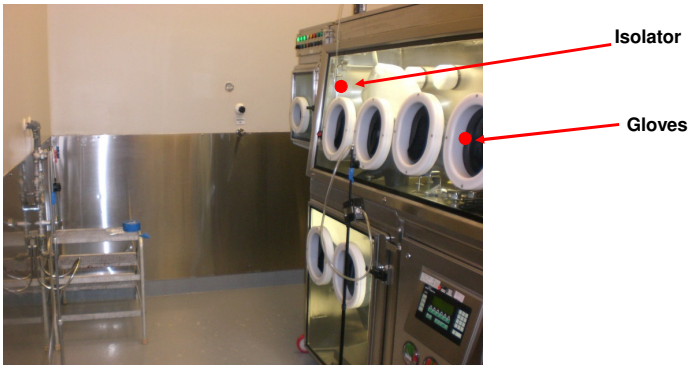
Swab Locations - Example



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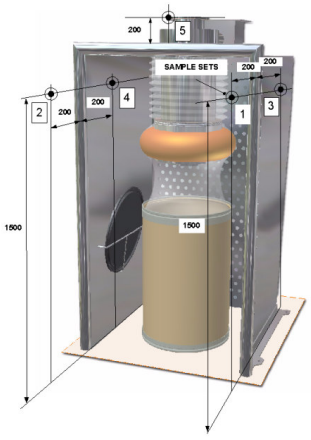
#4 - Drum Filling Within Extraction Booth

Static Sampler Locations

Sampler No.	Position with respect to the transfer device centerline
1	Outside the booth (right side) at a distance of 200 mm in front of the booth sidewalls level with the disconnection point
2	Outside the booth (left side) at a distance of 200 mm in front of the booth sidewalls level with the disconnection point
3	Inside the booth (right side) at a distance of 200 mm from the front face on the sidewalls level with the disconnection point
4	Inside the booth (left side) at a distance of 200 mm from the front face on the sidewalls level with the disconnection point
5	Centrally, 200 mm above the booth and level with the front face
Not shown	Where a container is positioned or removed via a door in the booth wall, a sampler should be centrally located, outside the booth, above the door on the booth wall
Not shown	If container lidding occurs outside the booth, a sampler should be located close to the activity, 1,500 mm from the floor level
Not shown	A background sampler should be located 2,000 mm from the booth, at a height of 1,500 mm from the floor level



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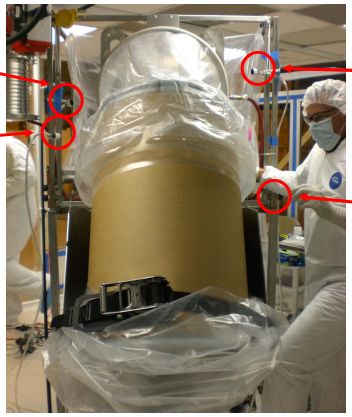
Static Sample Locations - Example



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#4 - Drum Filling Within Extraction Booth

- Personal Sampler Locations
  - Each operator should wear a personal monitor
- Real-time Aerosol Monitor Location
  - Positioned adjacent to sampler 1 (nearest the operators breathing zone)

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#4 - Drum Filling Within Extraction Booth

- Swab Positions
  - External surfaces of the following:
    - Objects removed from the booth (including the transfer container)
    - Drum lid - if it is handled in a manner that is different from the handling of the container and is potentially contaminated
    - Booth
  - Marked on drawings or shown on photographs that will be included in the report

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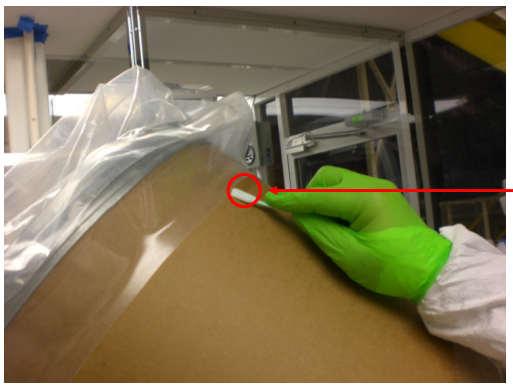
Swab Sample Locations - Example



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5. Develop a Sampling Strategy

Sampling Strategy Isolator

Sample Type	Sample Description	One Iteration Run 01
Baseline		
Baseline Air	Source sample approximately 200 mm from the isolator prior to the introduction of the surrogate material into the work area	1
Baseline Air	Area sample approximately 2 m from the isolator at a height of approximately 1.5 m prior to the introduction of the surrogate material into the work area	1
	Total Number of Samples during Baseline:	**2**
Procedure: Dispensing		
Task-Equivalent – Powder Handing in Isolator	Personal sample during typical powder handling activities within the isolator	2
Task-Equivalent – Powder Handing in Isolator	Area sample approximately 2 m from the isolator at a height of approximately 1.5 m during typical powder handling activities within the isolator	1
Task-Equivalent – Powder Handing in Isolator	Source sample approximately 200 mm from Isolator near the side RTP	2
Task-Equivalent – Powder Handing in Isolator	Source sample approximately 200 mm from Isolator near the gloveports	3
Task-Equivalent – Powder Handing in Isolator	Source sample approximately 200 mm from Isolator near the bottom RTP	2
Task-Equivalent – Powder Handing in Isolator	Source sample approximately 200 mm from Isolator near the exhaust outlet	1
	Total Number of TWA Task-Equivalent Samples during Powder Handling in Isolator	**11**

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Summary

- APCPPE Guide
  - 2005 edition and proposed changes
- Containment Verification – Critical Issues
  1. Establishing Containment Targets
  2. Determining the Means to Simulate the Operation
  3. Selection of Surrogate Material
  4. Selection of Sampling Methods
  5. Developing a Sampling Strategy

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Summary

- Sample Collection and Sampling Methodologies
- Sampling Critical Issues
- Documentation Issues
- APCPPE Equipment Specific Protocols

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Thank You!

George S. Petroka, CIH, CSP, RBP,
Director BioPharma/ EHS Services
IES Engineers
1720 Walton Road
Blue Bell, PA 19422
610-828-3078
gpetroka@iesengineers.com