# Decontamination Test Methodology: Context, Interpretation and Utilization

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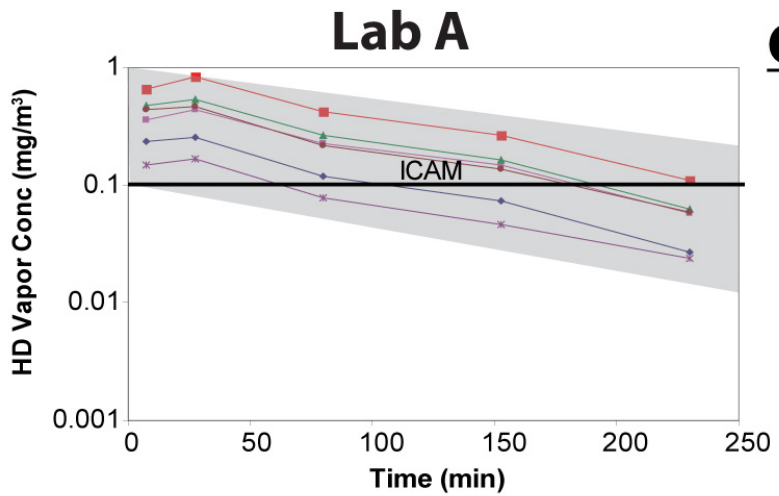
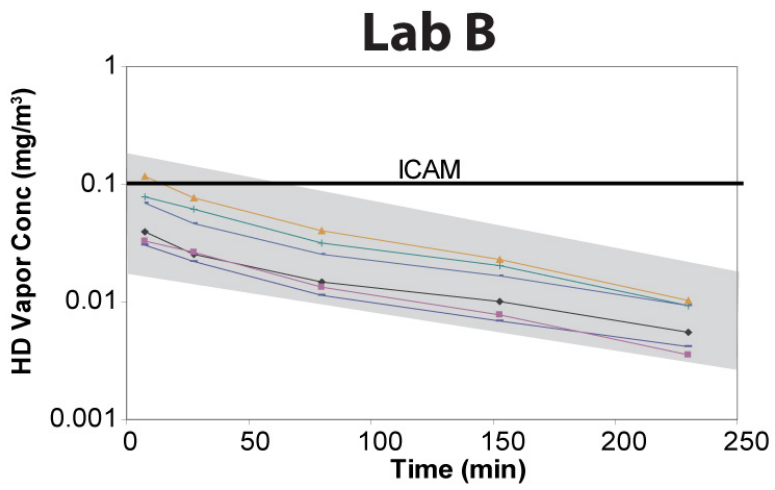
**Edgewood Chemical Biological Center**

**Joint Chemical Biological Decontamination & Protection Conference**

**October 2007**

# Fictional Scenario: Decon Evaluation Meeting to Assess if Decon Meets Vapor-Hazard ICAM Requirement




## Case Study Facts:

- Two labs perform the vapor-test evaluating Decon X on CARC.
- Both labs operated IAW TOP 8-2-061.
- Both laboratories report the results for testing 6 coupons.
- The performance criteria for this test is if the resulting vapor concentration is less than the ICAM detection limit.

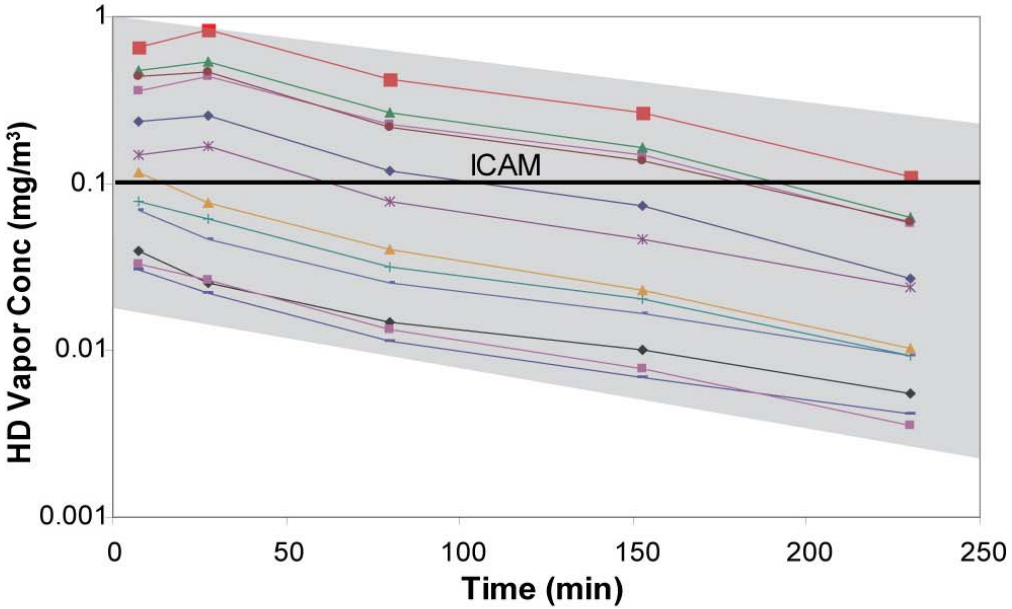
STOP

***Does this decontaminant meet the performance criteria?***

# Fictional Scenario was Real Set of Data Under "Ideal Test Setting"

These test results were actually obtained from one lab using:

- Same hood
- Same operator
- Same test tools
- Same instrumentation
- Same decon
- IAW TOP 8-2-061



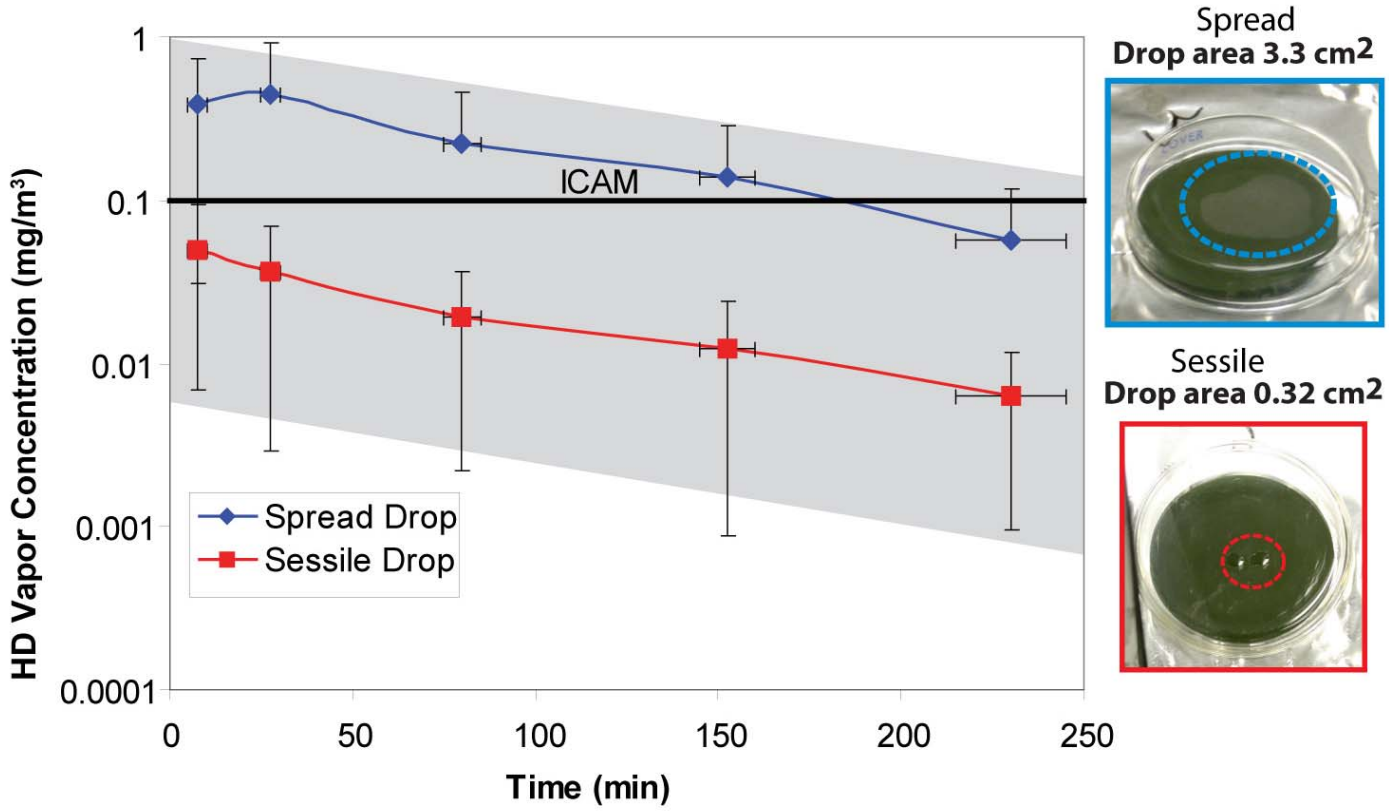

## Test Error

- The TOP 8-2-061 specifications for permisible error are 58-62%.

- This test demonstrated over two orders of magnitude of spread (105% relative error) is possible following the TOP.

# Vapor-Hazard Evaluation Significantly Affected by Degree of Agent Spread on Surface

**Missing Variable** - Degree of agent spread. TOP does not require quantifing or reporting this effect.

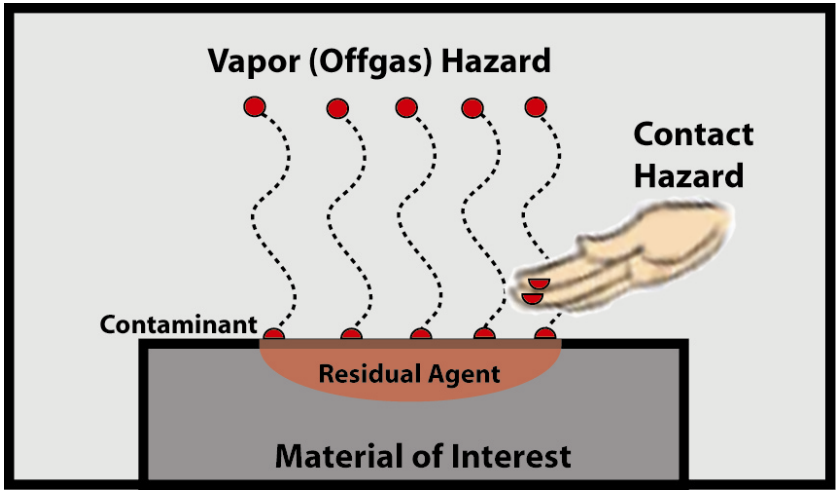



Accounting for area affect reduced relative error from 105% to 34%

# Key Terminology

**Contact-Hazard: The contact test measures the amount of contaminant available after decontamination that could pose a hazard to unprotected personnel touching the surface.**

**Vapor-Hazard: The vapor test measures the amount of contaminant available after decontamination that could pose a vapor (off-gassing) hazard to unprotected personnel.**




**Residual Agent: Amount of contaminant remaining in the material of interest that poses an unknown / potential hazard.**

**Requirements: Allowable contact- and vapor-hazard post-decontamination process. Based on acceptable risk for completing mission.**

**Contaminant – Decon – Material Interactions**

# Data Are Used to Make Mission Decisions


***All involved in making decisions from developing, evaluating, selecting and fielding the product.***

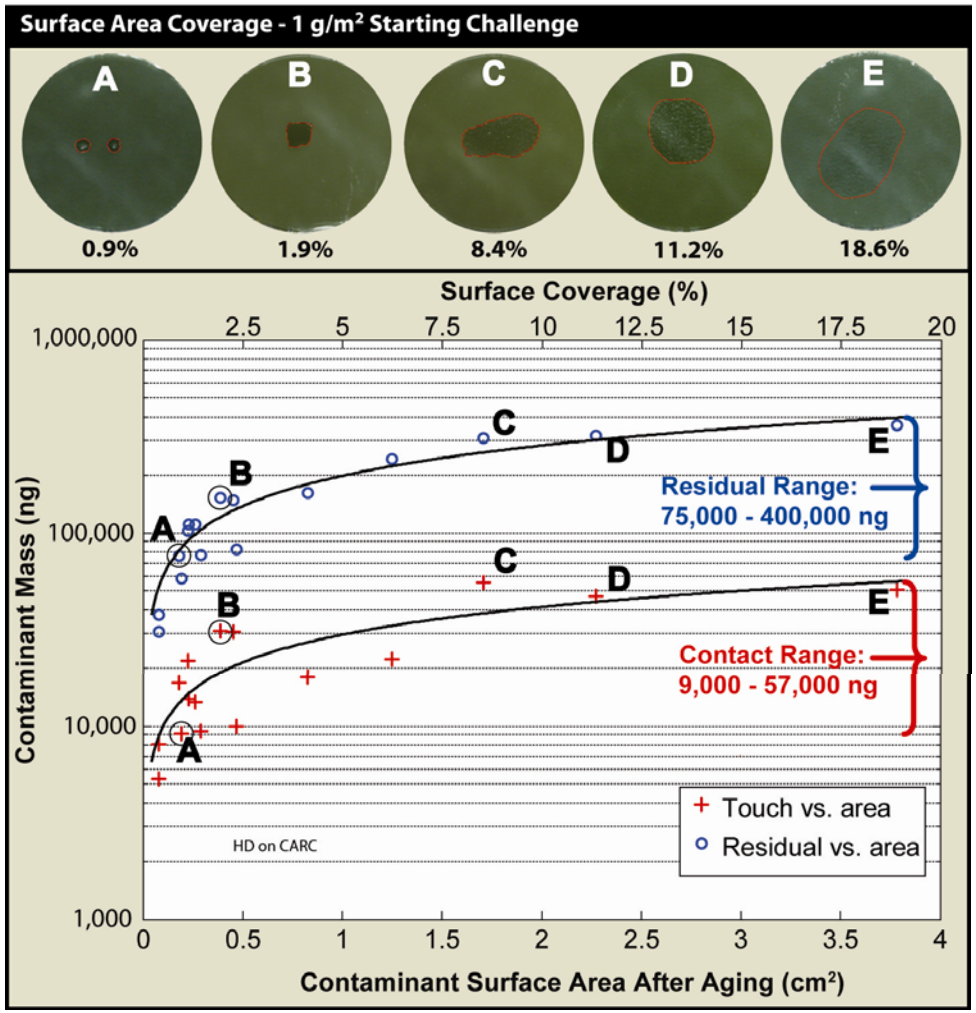
**Managers: Bottom line – balance assess acceptable risk and impact on mission. (Utilizers)**

**Evaluators: Evaluate data – "*is this better than what I have now?*" – "*does the decon performance meet the requirements?*" (Interpreters)**

**Testers: Generate and report defensible, accurate data to enable decisions. Need to be able to conduct the right tests. (Provide Context)**

**Developers & Vendors: Be able to provide the right product. Understand how their product will be tested.**

# Surface Area has Demonstrated Effect on Resulting Hazard




**Starting challenges are specified in terms of a contamination density ($g/m^2$).**

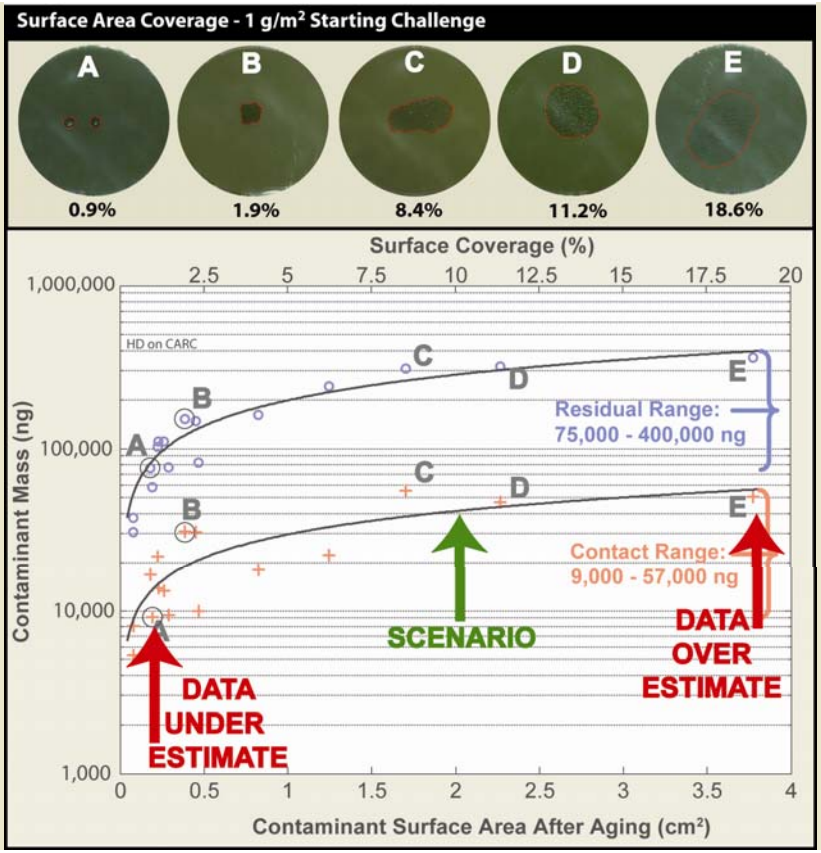
**Material-Agent interactions determine agent spreading (surface coverage) and rate of absorption in testing.**

**Surface area coverage key variable for data context. Knowing the field scenario is key for utilization.**

# Data Should be Used to Best Estimate Scenario Risk

**Under-Estimate Hazard**

- **Greater potential risk to personnel**

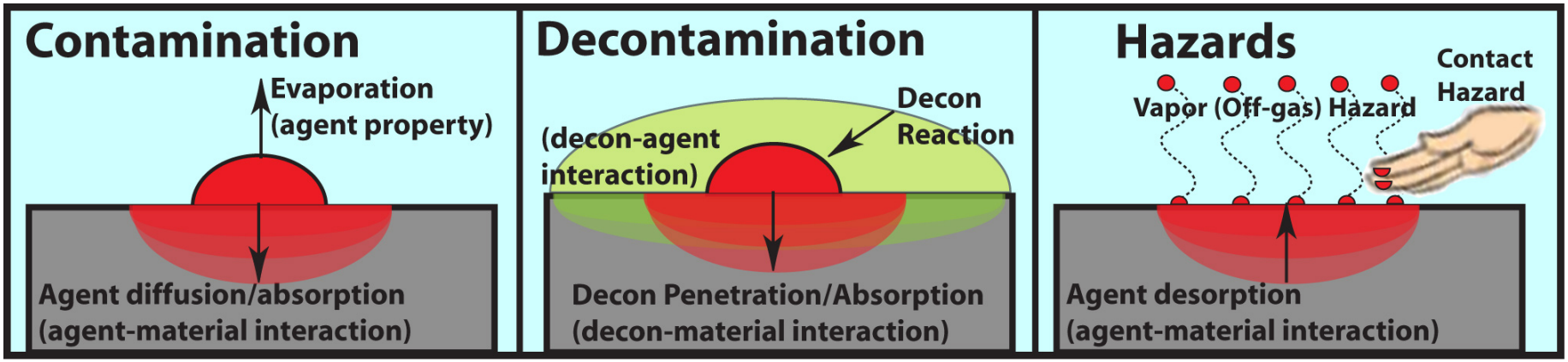



**Over-Estimate Hazard**

- **Additional burden on decon performance**
- **potential increase in time, and logistical demands**
- **potential increase time in gear requirements**

**Context – Interpretation – Utilization: Not realistic to test all conditions; however, need to use data in appropriate context to make best risk assessment.**

# Mass Transport Fundamental Decontamination Processes

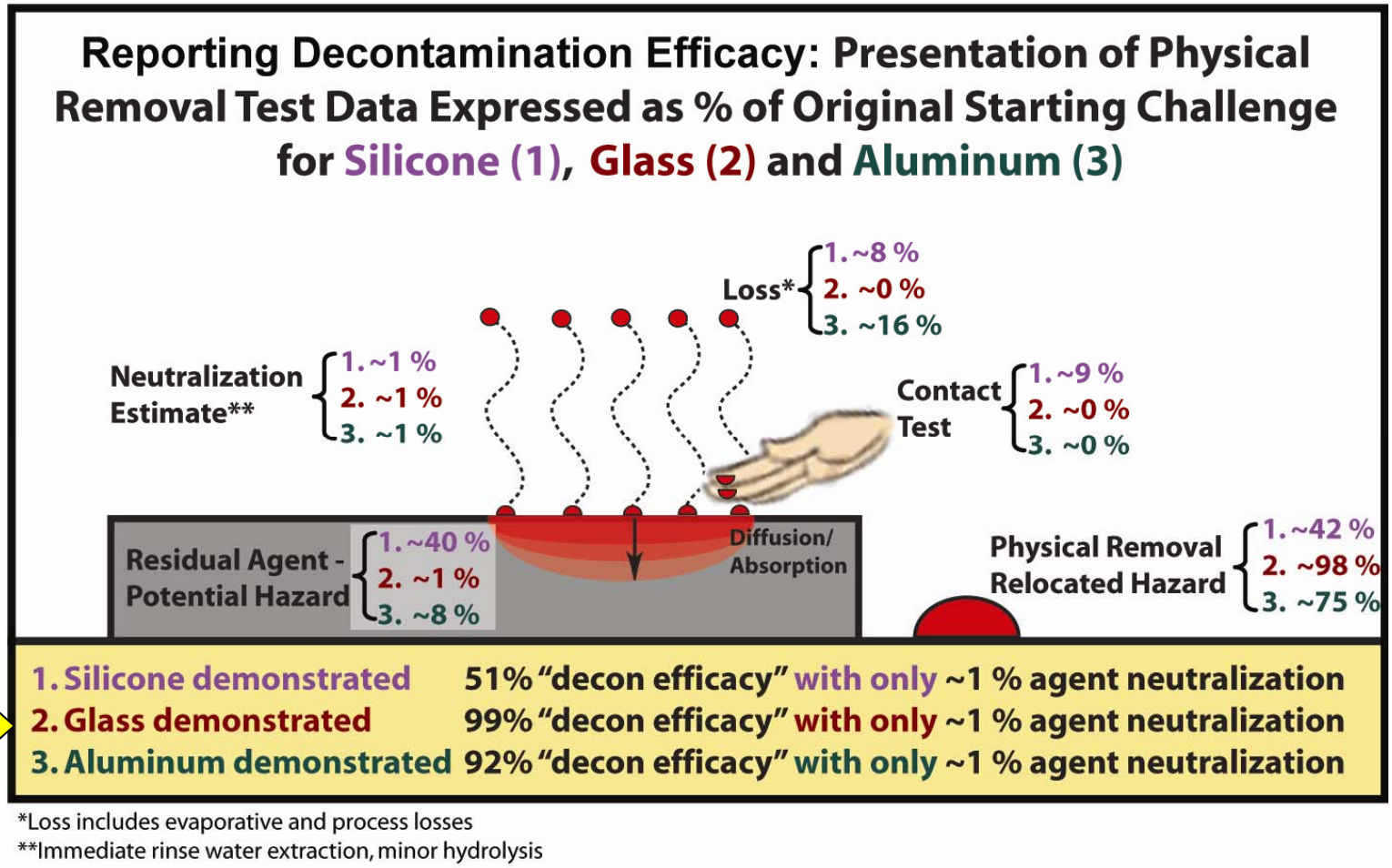



**Contaminant – Material – Decontaminant Interactions**

**Mass transport processes control how much contaminant (agent) is absorbed and how well the decon can neutralize the hazard.**

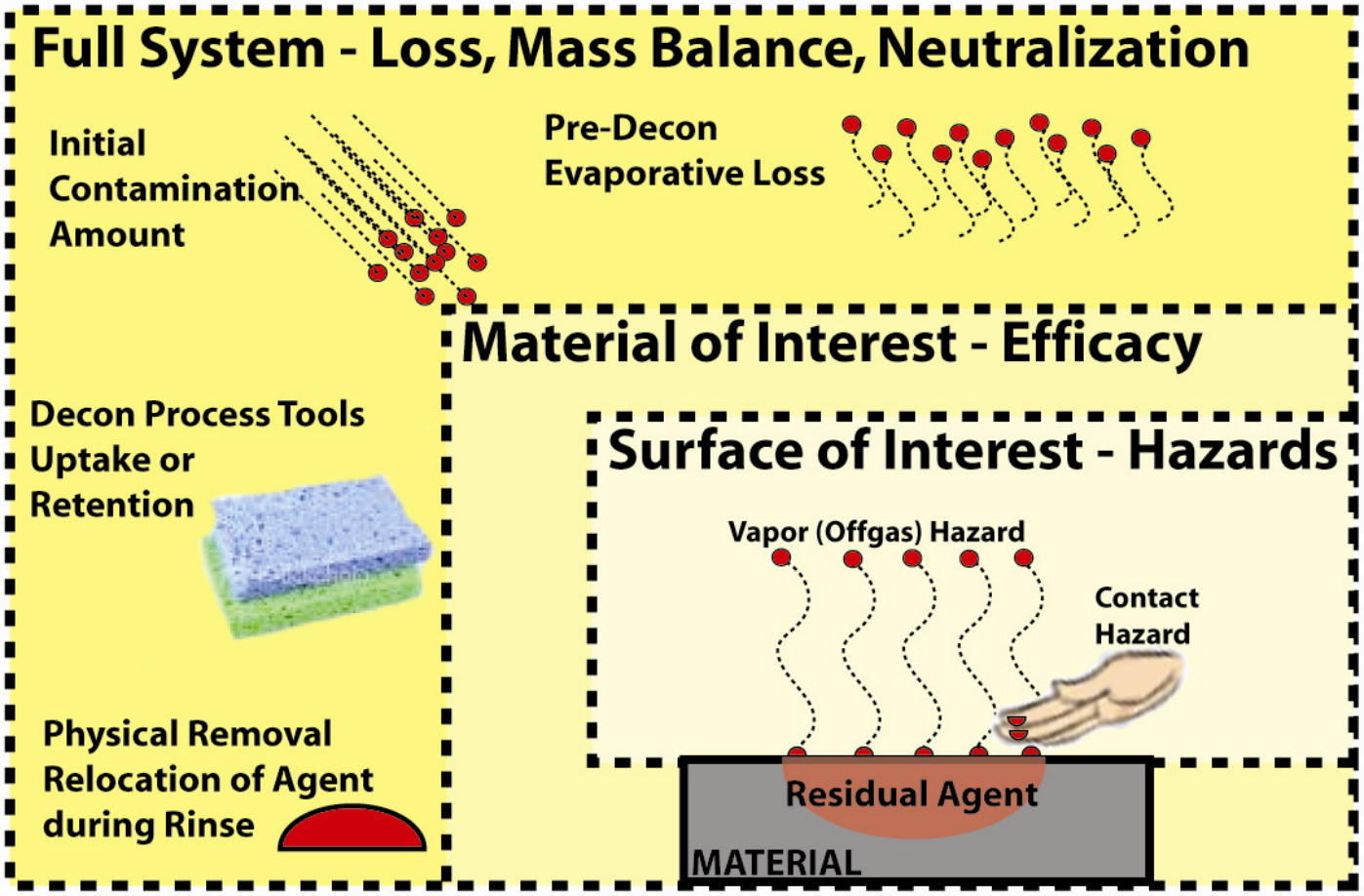
**Post decon hazards result from agent mass transport out of the material that was not removed or neutralized by the decon.**

# Context Important for Interpreting Decon Performance

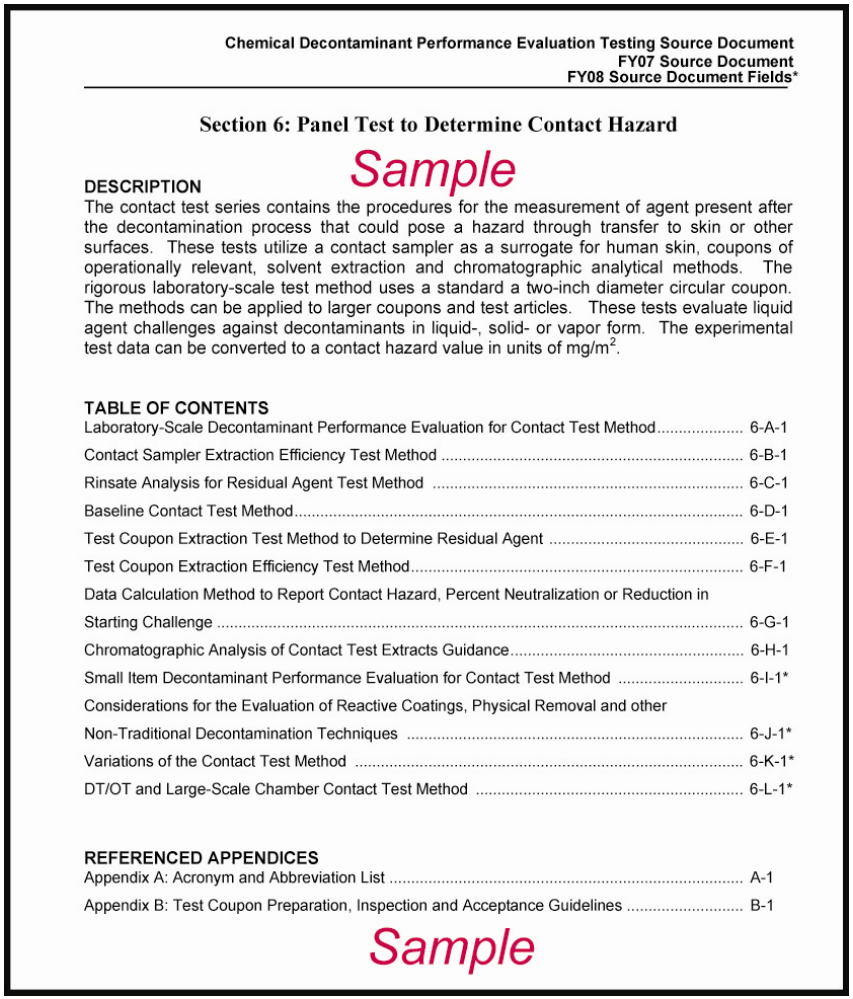



**Stated performance (efficacy) context typically for material of interest.**

# Question to be Answered Determines Necessary Measurements



# Future of Decon Methodology – Part 1: Capturing the Improvements



Chemical Decontaminant Performance Evaluation Testing Source Document
FY07 Source Document
FY08 Source Document Fields*

Section 6: Panel Test to Determine Contact Hazard

Sample

DESCRIPTION

The contact test series contains the procedures for the measurement of agent present after the decontamination process that could pose a hazard through transfer to skin or other surfaces. These tests utilize a contact sampler as a surrogate for human skin, coupons of operationally relevant, solvent extraction and chromatographic analytical methods. The rigorous laboratory-scale test method uses a standard a two-inch diameter circular coupon. The methods can be applied to larger coupons and test articles. These tests evaluate liquid agent challenges against decontaminants in liquid-, solid- or vapor form. The experimental test data can be converted to a contact hazard value in units of $mg/m^2$.

TABLE OF CONTENTS



REFERENCED APPENDICES



Sample

**<u>Structure</u>: The Source Document is organized by main test (chapter) containing the discreet procedures (sections) related to the main test that could be performed as part of a decontaminant evaluation.**

**The Source Document will be published as a DTIC report and made available to the community.**

# Providing Clear Context of the Information the Core Test Can Provide…

**Test Procedure 6-A: Laboratory-Scale Decontaminant Performance Evaluation for Contact Test Method**

**SUMMARY OF PROCEDURE**

The contact test is the measure of the contaminant present after the decontamination process that could pose a hazard through transfer to skin or other surfaces. A contact sampler is used in this test as a surrogate for human skin. The contact sampler is used to collect the agent remaining on the coupon surface that may either be **bioavailable** by touch or available for **contact transfer**. The contact sampler is extracted in solvent and analyzed. **The laboratory-scale Decontamination Performance Evaluation for contact-hazard measurement is a rigorous method for the execution of decontamination testing using a standard two-inch disk coupon**. The evaluation of other items is documented under a separate method (Procedure 6-K). **This test provides a mass of agent from the contact sampler in units of nanograms (ng)**.

This procedure provides the following information:

- The mass of agent in nanograms recovered from the contact sampler after the decontamination process.
- This test can be used for the performance evaluation of a decontaminant against liquid-phase challenges to include: chemical-warfare agents, chemical-warfare agent simulants, toxic-industrial-chemicals, toxic-industrial-materials and other chemicals.
- If analyzed accordingly, this test can also provide the mass of agent by-products in nanograms recovered from the contact sampler.

The following prerequisite tests are required for this test procedure:

- Procedure 6-B, "Contact Sampler Extraction Efficiency Test Method" is the method for determining the extraction efficiency of residual agent in or on the contact sampler using the solvent selected for testing.
- Procedure 6-H, "Chromatographic Analysis of Contact Test Extracts" is the guidance protocol for the analytical analysis of the extracts generated in this test.

**Summary: Each test method contains a summary of what the test measures, in what units.**

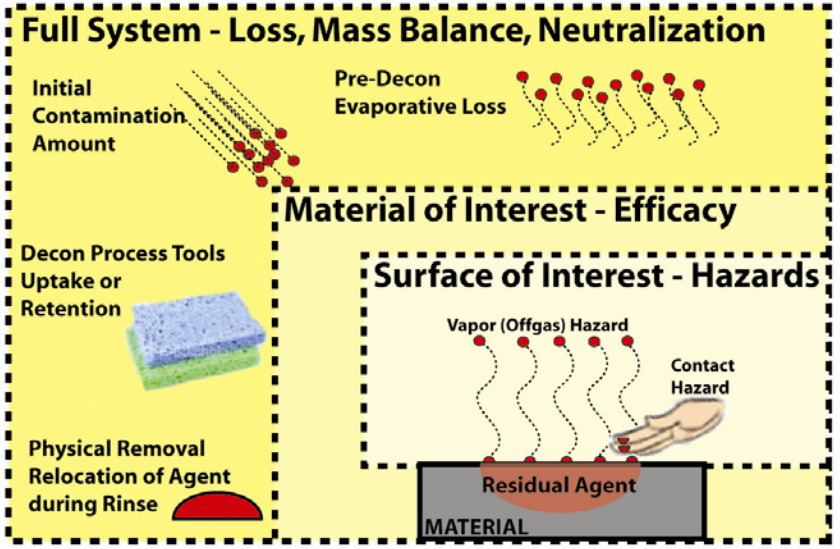
**Provides a listing of the other tests required to complete this test.**

# … and the Supplementary Tests to Enable Selection of the Correct Tests

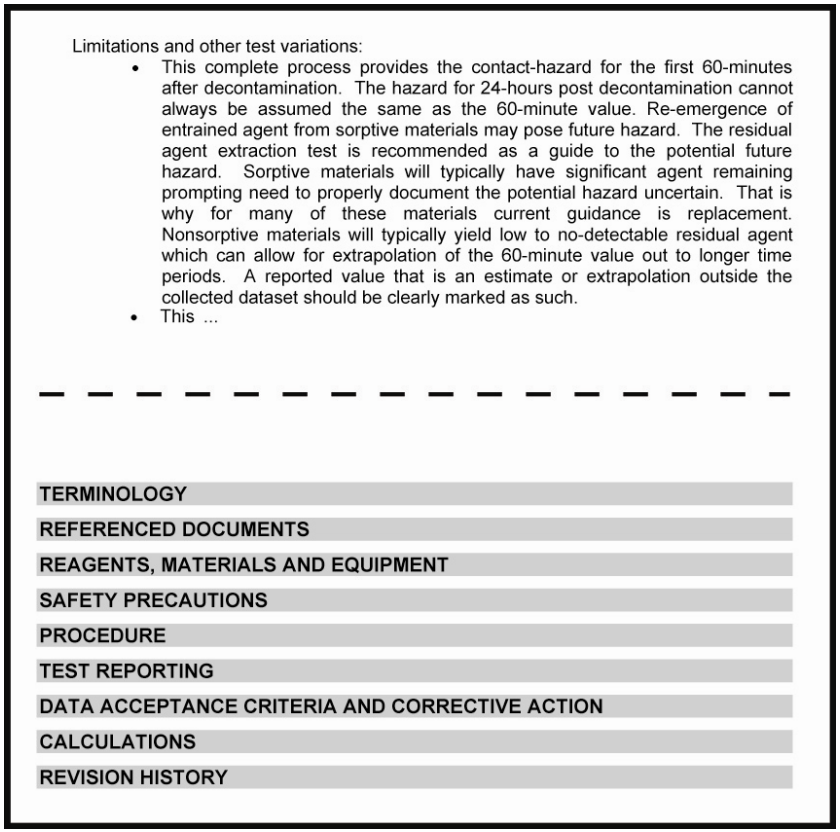
This procedure alone does not provide the complete assessment of the decontaminant's performance for reducing the agent contamination or reporting the hazard. The complete assessment of a decontaminant performance should also address:

- The amount of agent physically removed from the coupon during the decontamination process using either liquid decontaminants or post-decontamination rinsing step.
  - Procedure 6-C, "Rinsate Analysis for Residual Agent Test Method" is the measurement of the amount of agent physically removed from the coupon during the decontamination process.
- The amount of residual agent remaining in / on the coupon.
  - Procedure 6-E, "Test Coupon Extraction Test Method to Determine Residual Agent," is the extraction process for extracting, measuring and reporting the residual agent in or on the coupon.
  - Procedure 6-F, "Test Coupon Extraction Efficiency Test Method" is the method for determining the extraction efficiency of the selected solvent for the residual agent in or on the coupon.
- The amount of agent lost during the decontamination process to weathering / evaporation.
  - Procedure 6-D, "Baseline Contact Test Method," is the method for conducting the decontamination process without the use of decontaminant.
- The reporting of the contact hazard value in $mg/m^2$.
  - Procedure 6-G, "Data Calculation Method to Report Contact Hazard, Percent Neutralization or Reduction in Starting Challenge" is the process for converting the mass of agent recovered from the contact sampler to a reported hazard value.
- The reporting of the percent neutralization or reduction in starting challenge in $g/m^2$.
  - Procedure 6-G, "Data Calculation Method to Report Contact Hazard Percent Neutralization or Reduction in Starting Challenge" is the process for converting the mass of agent recovered from the contact sampler to a reported hazard value.

**<u>Supplementary Tests</u>: The tests for complete evaluation of decon performance are included with guidance for selecting the appropriate tests.**



# Clearing Documenting Limitations and Data Utilization Guidance



Limitations and other test variations:

- This complete process provides the contact-hazard for the first 60-minutes after decontamination. The hazard for 24-hours post decontamination cannot always be assumed the same as the 60-minute value. Re-emergence of entrained agent from sorptive materials may pose future hazard. The residual agent extraction test is recommended as a guide to the potential future hazard. Sorptive materials will typically have significant agent remaining prompting need to properly document the potential hazard uncertain. That is why for many of these materials current guidance is replacement. Nonsorptive materials will typically yield low to no-detectable residual agent which can allow for extrapolation of the 60-minute value out to longer time periods. A reported value that is an estimate or extrapolation outside the collected dataset should be clearly marked as such.
- This ...

TERMINOLOGY

REFERENCED DOCUMENTS

REAGENTS, MATERIALS AND EQUIPMENT

SAFETY PRECAUTIONS

PROCEDURE

TEST REPORTING

DATA ACCEPTANCE CRITERIA AND CORRECTIVE ACTION

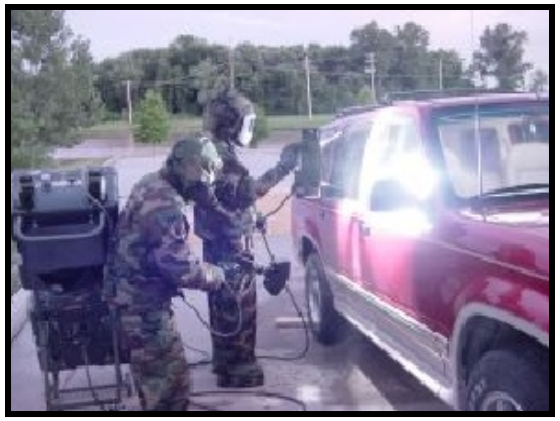
CALCULATIONS

REVISION HISTORY

**<u>Test Limitations</u>: Known limitations in the test measurement or utilization of the results are included.**

**<u>Standard Test Fields</u>: Aligned with ISO and ASTM standards that can be implemented directly into laboratory quality systems.**

# Future of Decon Methodology Part II: Robust Methods to Tackle Future Challenges



## New Decontamination Technologies

- **Reactive coatings and materials, energetic techniques just to name a few.**
- **Methodology needs to be able to measure contact, vapor and residual contamination to compare to standard techniques.**


## New Contaminants

- ***Anything in sufficient quantity can pose a hazard*.**
- **Methodology needs to be able to detect and quantify these materials including identifying interferences and other factors affecting detection.**

# Future of Decon Methodology Part II: Robust Methods to Tackle Future Challenges

**Chem Survivability**

- **NBC contamination survivability (NBCCS) the capability of a system (and its crew) to withstand a NBC-contaminated environment and relevant decontamination without losing the ability to accomplish the assigned mission. A NBC contamination-survivable system is hardened against NBC contamination and decontaminant; is decontaminable, and is compatible with individual protective equipment.**
- **Methodology needs to be able to evaluate new materials.**

# Complex Surfaces Pose Methodology Challenges

Complex Items
AN/PVS-7 Series Night Vision Device

## Complex Surfaces

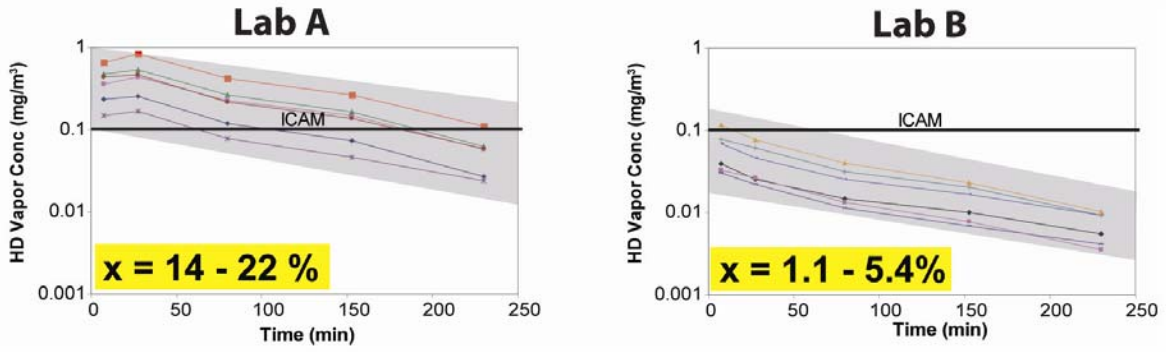
- **Complex surfaces can be sinks and stores for contaminant.**
  - **Groves, seamlines, etc.**
  - **Sorptive gasket materials**
- **Methodology must be able to accurately assess post-decontamination hazards.**
  - **Evaluating several materials**
  - **Reproducible sampling techniques**
  - **Residual measurement ability**

# Robust Methodology and Context

**The test methodology must be robust enough so that the decon, not the test methodology, is evaluated.**

**Revisiting the opening scenario:**

These data represent the vapor test results for a temperature of 20 °C and 50% RH where a CARC coupon was contaminated with HD at a contamination density of 1.2 g/m$^2$, applied as 2 × 1 µL drops with an initial surface coverage of 0.9% and after an aging time of 60 minutes had surface coverages ranging from ____x___; 1.000 mL of Decon X was applied via finger pump spray bottle; after 20 minutes rinsed with water and air dried for 15 minutes; the coupon was placed in a vapor cup with an air flow rate of 300 ml/min.




- **The testers provided the detailed evaluation report (context),**
- **the evaluator determined the 14-22% surface coverage best represented the scenario (interpretation),**
- **therefore this decon would not have met the requirement (utilization).**

# Acknowledgements


**DTRA Support, Fred Crowson, Dr. Charles Bass, Dr. John Weimaster and Mark Mueller**

**JPEO-CBD JPM Decon Support, Mike Diederen**

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**Zach Zander, Morgan Hall, Matt Shue, Pam Humphreys**

**Bill Davis**

# Decontamination Test Methodology: Context, Interpretation and Utilization

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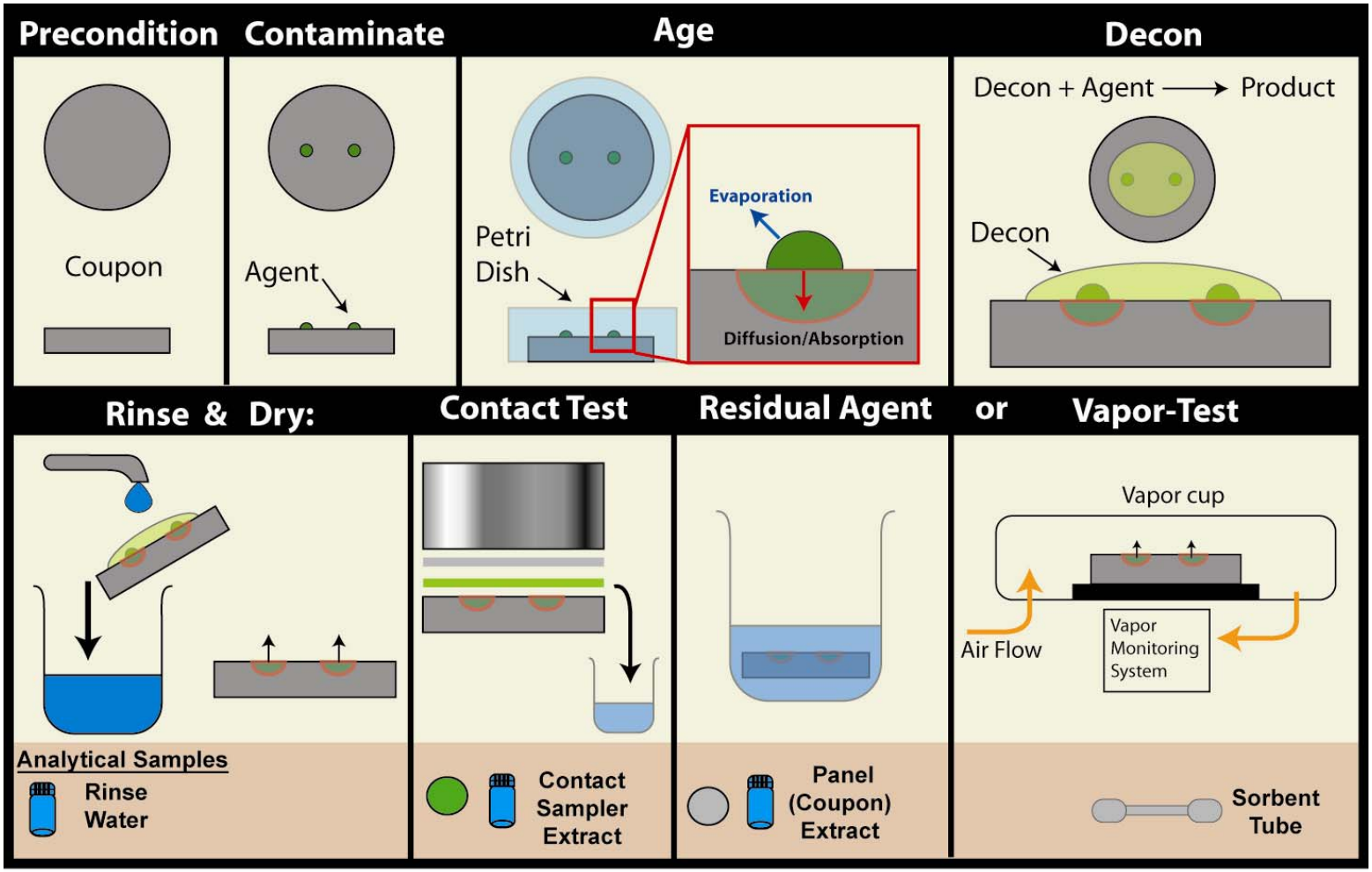
**October 2007**

# Laboratory Scale Panel (Coupon) Contact and Vapor Test




*Sketch: Mantooth-Lalain '07*