Test Methodology Development for Individual Respiratory Protection Against VX

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Joint Service Aircrew Masks (JSAM)

Provide aircrews with protection against chemical and biological warfare agents

MPU-6

MPU-5

Rotary Wing

Fixed Wing

Need for VX Test Methodology

- TEMPs for current mask programs include testing protection capability against VX vapor.
- Previous material testing has provided mixed test results. Lead Operational Test Agency (OTA) requires SMARTMAN to increase confidence in VX permeation results.
- JPM IP has developed a strategy to investigate several hypotheses regarding the reaction/deposition fate of VX during testing and to determine a relative mass balance of the agent.
- Goal is to determine if current test methods are adequate to reliably test VX SMARTMAN.

Need for greater confidence that VX testing accurately reflects the performance capabilities of the system.

Experimental Concept

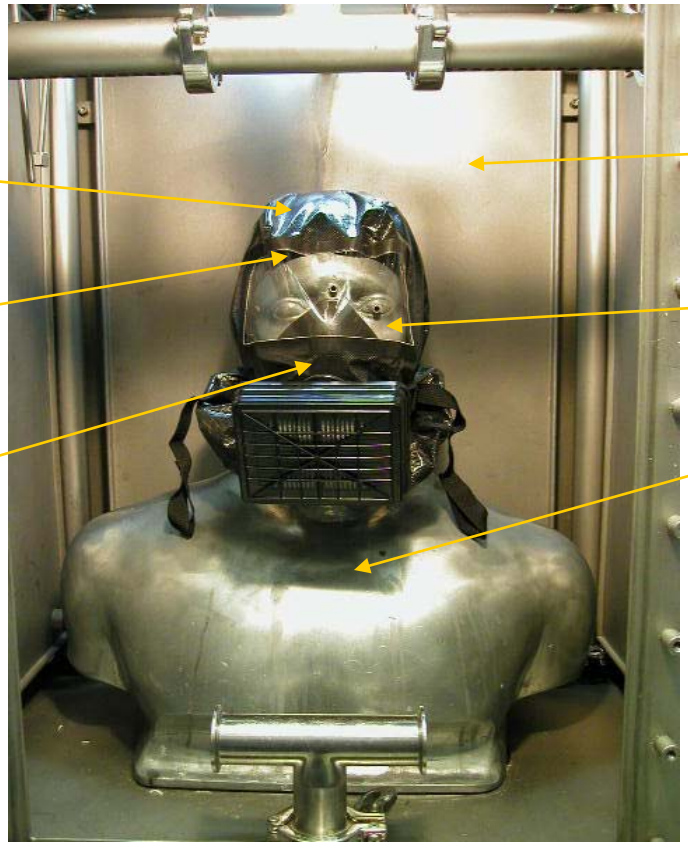
Do we understand what happens to VX at the material level?

- Leverage existing test methods to quantitatively measure VX within the test fixture
  - Extract agent from swatch
  - Measure agent (liquid and vapor) in Aerosol-Liquid-Vapor Assessment Group (AVLAG) fixture and SMARTMAN
- Develop a VX mass balance—CB community has some data from G series and HD, but not available for VX
  - Vapor pressure of VX is so low, that the majority of the agent is likely in liquid form, which is presently unaccounted for in permeation tests
  - Begin to address concerns that a lack of homogeneity in the rubber formulation accounts for differences seen between laboratories
- Collaboration between Joint Program Manager for Individual Protection, Dugway Proving Grounds and Edgewood Chemical and Biological Center

Enhancements to Current Test Methods

- Potential improvements to material test procedures (AVLAG)
  - Accounting for potential areas of VX deposition in the test fixture
  - Make improvements to enhance accuracy and repeatability of the existing test method
- Confirmation of SMARTMAN test procedure to be used towards verification and validation
  - Chamber characterization and chemical sampling methods
  - Application of mass balance information
  - Positive and negative controls identified

VX Mass Balance on the SMARTMAN Test Fixture

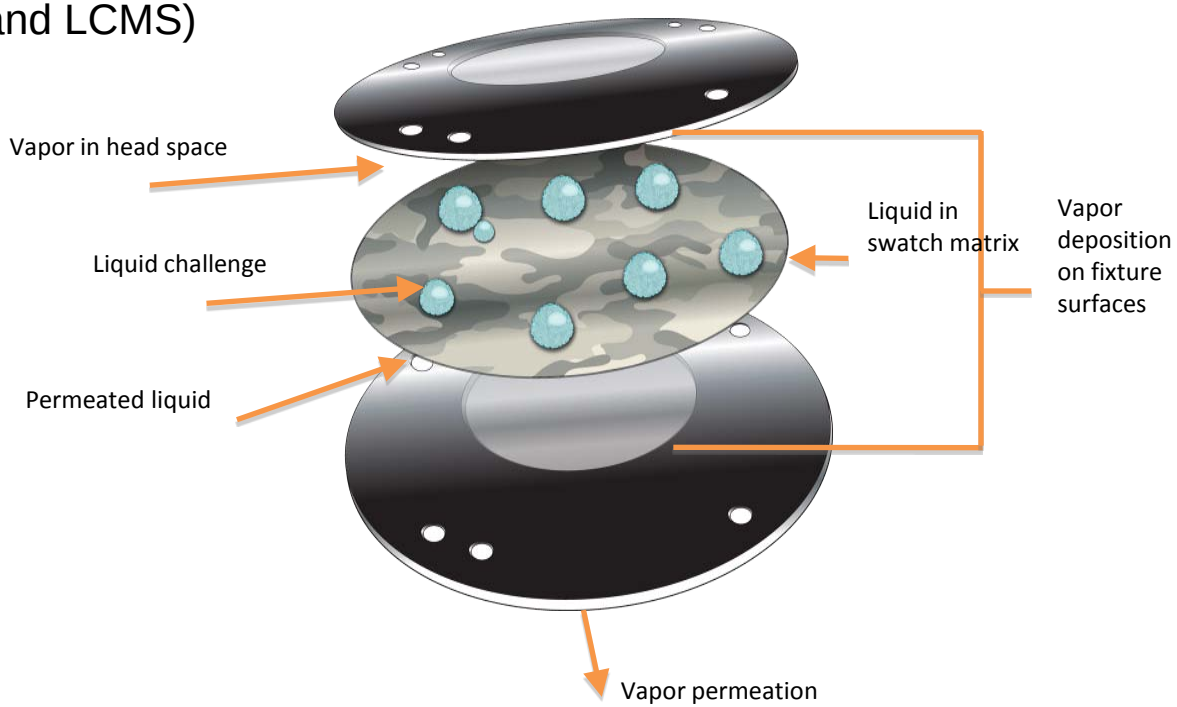


Apply data gathered in the permeation and extraction AVLAG tests for development of a VX mass balance for use in SMARTMAN

Note: JSCESM is pictured in the SMARTMAN chamber for illustrative purposes only. Liquid protection is not a program requirement.

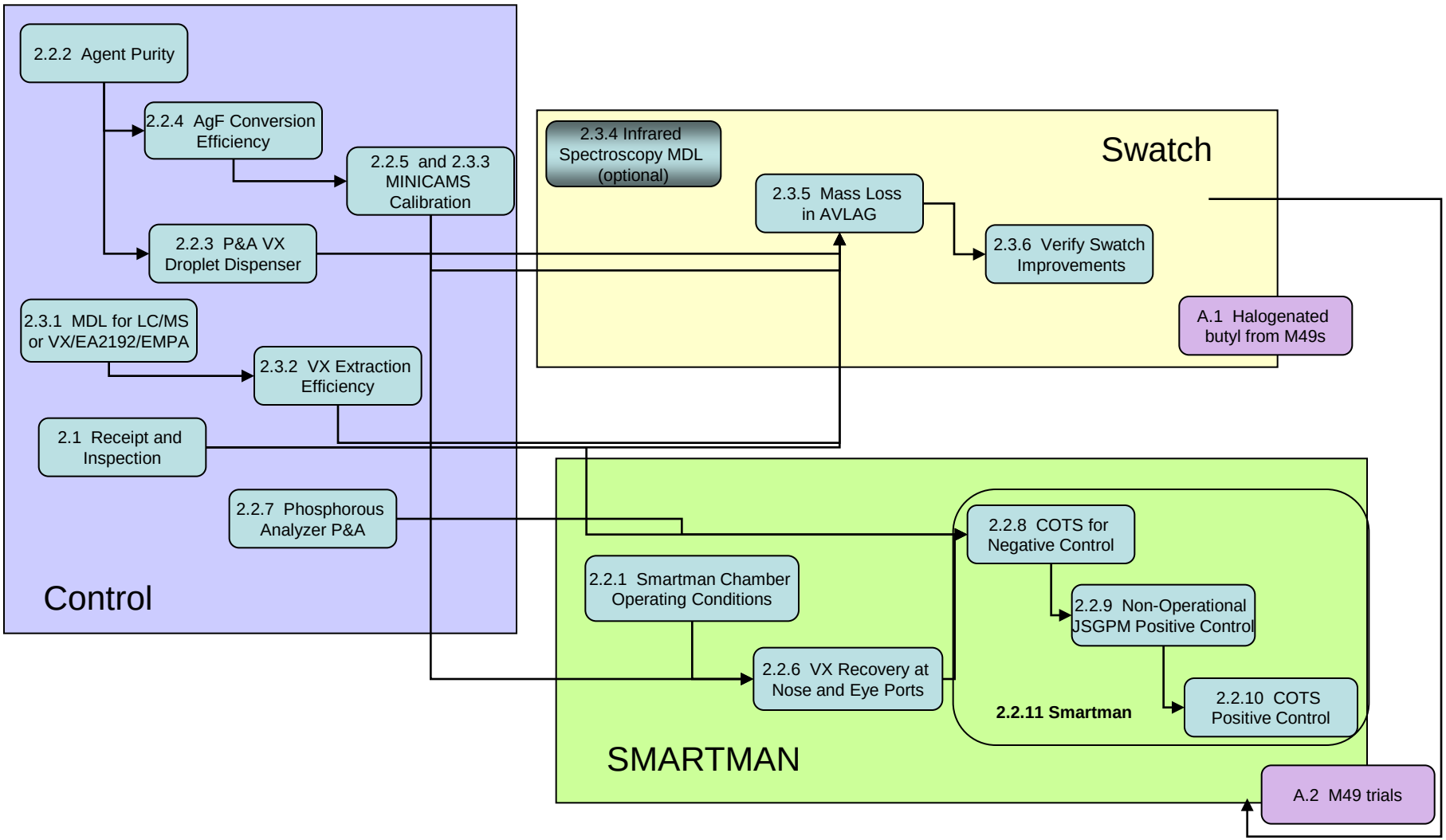
VX Mass Balance Using the AVLAG Test Fixture

- Testing with the SMARTMAN fixture to determine the location of VX in/on/around the mask system not feasible
- AVLAG test method modified to include extraction of swatch, sample lines and test fixture surfaces; effluent concentration measured via multiple analysis methods (Minicams, GC and LCMS)



Permeation and extraction testing using the AVLAG cell will enable the development of a VX mass balance for use in SMARTMAN

VX Methodology Detailed Test Plan Flow Chart of Subtests and Data



Preliminary Results

- Positive and negative control COTS masks identified for VX SMARTMAN testing.
- High relative humidity results in significant VX hydrolysis products. Humidity appears to reduce the amount of VX vapor from evaporating in the SMARTMAN chamber. Ambient relative humidly test showed better recovery of VX.
- Approximately 1/3 of permeated VX vapor captured by sorbent tubes is detected by Minicams (potential silver-fluoride pad conversion issue).

Data analysis still on-going. Testing of butyl rubber swatch and SMARTMAN yet to be completed.

Conclusion

- Current course of action designed to support need for JSAM SMARTMAN testing.
- Collaborative effort between DPG, JPM IP and ECBC to answer questions and verify assumptions regarding the testing of VX.
- Modification of existing test methods to investigate potential test improvements.
- Potential outcomes from current methodology initiative:
  - Confirms what we have predicted about VX, allowing us to develop a mass balance and confidence that a VX SMARTMAN test can be adequately executed.
  - Uncover new information which indicates additional methodology development is necessary to understand the behavior of VX before a reliable SMARTMAN test can be executed.
- Anticipate V&V testing required of VX test methodology.