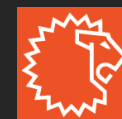




LION MT94 NFPA 1994 Class 2/1992



Starfield™
ready for action

Today's Agenda

- Basis and need for NFPA certified gear
- PPE Concepts
- NFPA Classes
- Gore Class 2 ChemPak
- Testing protocols and results
- MT advantages vs. Level A

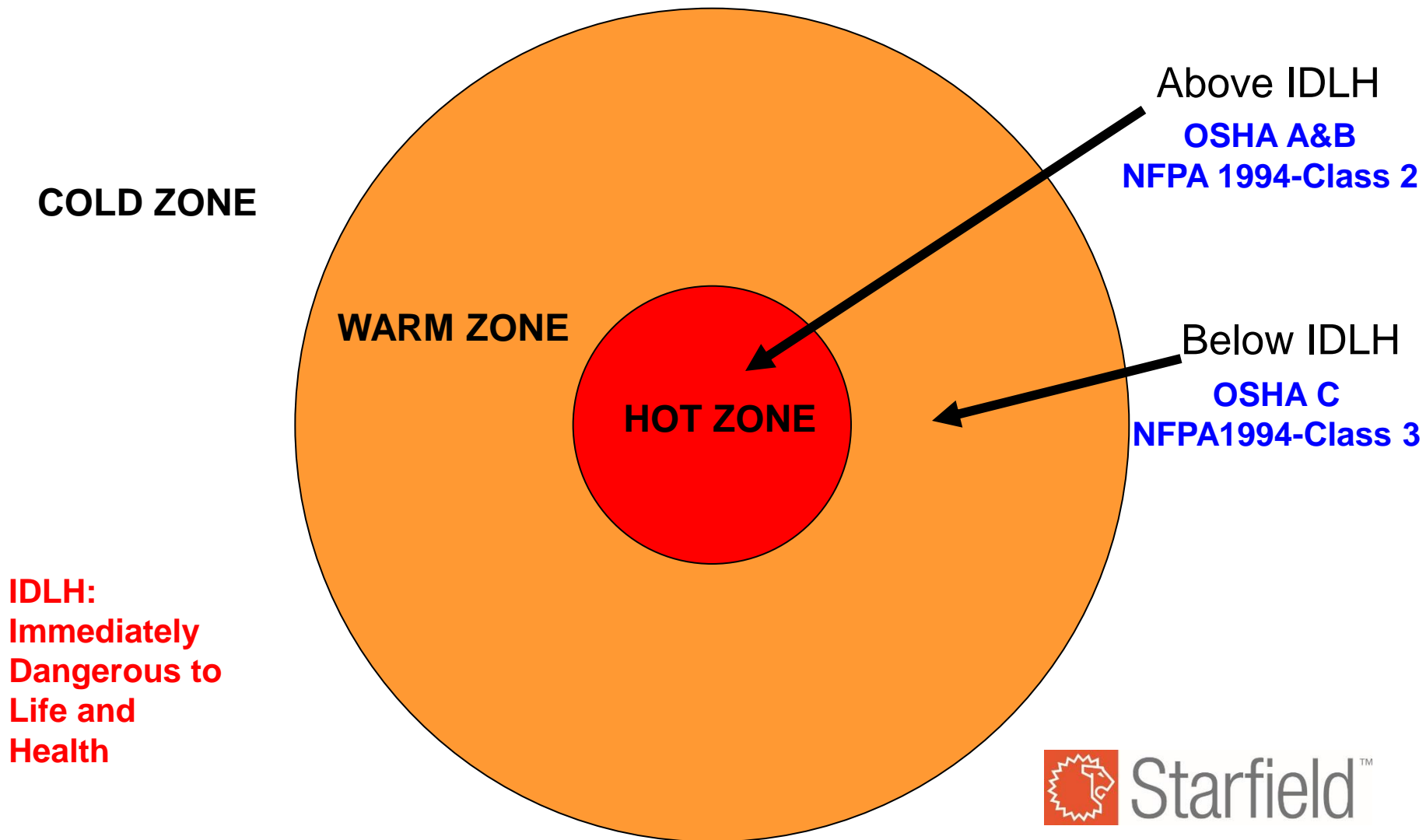
Enhanced Functionality in Chemical and Biological Environments

- **Military applications**
- **Domestic preparedness**
- **Fire service mission specific**
- **Clandestine lab mitigation**

- technical or tactically demanding operations
- performance driven
- unmet user needs



PPE Concepts – CBRN Incident



NFPA 1994 - Protection Classes (2012 ed.)

Class 2 Ensemble – LION MT94 series :

- involving **high or unknown chemical vapor** or liquid chemical hazards
- concentrations are **at/above IDLH**
- require the use of SCBA

Class 3 Ensemble – LION ERSPC:

- involving low levels of chemical vapor or liquid hazards
- concentrations are below IDLH
- use of APR or PAPR is appropriate

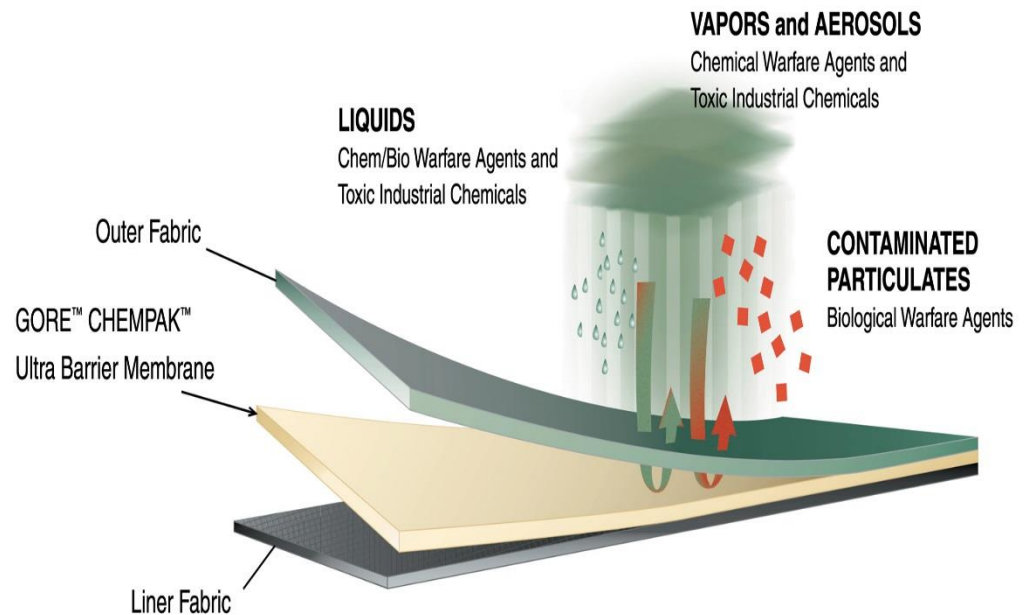
Class 4 Ensemble – LION ERS4C :

- biological or radiological particulate hazards
- concentrations are below IDLH
- use of APR or PAPR is appropriate

GORE® CHEMPAK®

Ultra Barrier Fabric

- FR Textiles Nomex woven -
PTFE – Nomex knit -
Trilaminate
- Lightweight – 9.4 osy
- Flexible
- Reduced heat stress by
wetting down exterior for
conductive heat loss
- Protection against wide
range of CWAs, TICs, TIMs
 - No PPE can completely protect
against everything



GORE® CHEMPAK® Ultra Barrier Fabric

NFPA 1994, Garment Element Requirement, 2012 Edition

MATERIAL PERFORMANCE		Requirement	MULTI-THREAT Typical Results
Burst Strength		> 35 lbf	> 310 lbf
Puncture, Propagation, and Tear Resistance		7 lbf	> 12 lbf
Cold Temperature Bending Moment, @ -25°C and 60 degree angle		< 0.057 N-m	< 0.007N-m
Seam Break Strength		15 lbf/2 in	> 190 lbf/2 in
VIRAL PENETRATION	Requirement	Minimum Required Time	MULTI-THREAT
Phi-X-174 Resistance	No Penetration	60 min	PASS



GORE® CHEMPAK® Ultra Barrier Fabric - *Chemical Permeation Performance*

NFPA 1994, Garment Element Requirement, 2012 Edition

CHEMICAL PERMEATION	Max Level	Minimum Required Time	MULTI-THREAT
Mustard (HD)	< 4 µg/cm ²	60 min	> 720 min
Soman (GD)	< 1.25 µg/cm ²	60 min	> 720 min
Dimethyl Sulfate (DMS)	< 6 µg/cm ²	60 min	> 480 min
Acrolein	< 6 µg/cm ²	60 min	> 480 min
Acrylonitrile	< 6 µg/cm ²	60 min	> 480 min
Ammonia (NH)	< 6 µg/cm ²	60 min	> 480 min*
Chlorine (Cl)	< 6 µg/cm ²	60 min	> 480 min*

*** Test stopped due to equipment limitation**

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CHEMICAL PERMEATION GUIDE

This information is intended to provide guidance to those with technical ability to evaluate the applicability of this data to the specific hazards for their end-use application. The user has the responsibility to determine the proper protective equipment needed for their actual conditions of use.

All data are based on *ASTM F 739 Standard Test Method for Permeation of Liquids and Gases through Protective Clothing Materials under Conditions of Continuous Contact* (chemical challenge 100% concentration and 0.1 µg/cm²/min breakthrough end point) except where modification is footnoted.

CHEMICAL	Time to Breakthrough (minutes)	Footnote
Acetone	>480	
Acrolein	>480	(1)
Acrylonitrile	>480	(1)
Ammonia	>480	
Benzyl Chloride	>480	
Carbonyl Chloride (CG)	>390	(2,6)
Chlorine	>480	(2)
Chloroform	>480	
Cyanogen Chloride (CK)	>450	(2,6)
Dimethyl Sulfate (DMS)	>480	(3)
Ethyl Ether	>480	
Hexane	>480	
Hydrogen Fluoride, HF (Gas)	43	
Hydrofluoric Acid (48%)	>480	
Hydrochloric Acid (37%)	>480	

CHEMICAL	Time to Breakthrough (minutes)	Footnote
Hydrogen Chloride (Gas)	>480	
Hydrogen Cyanide (HCN)	>480	(2)
Hydrogen Peroxide (50%)	>480	
Hydroiodic Acid (55%)	>480	
Lewisite (L)	>720	(4)
Methanol	>480	
Mustard (HD)	>720	(4)
Nitric Acid (70%)	>480	
Sarin (GB)	>720	(5)
Sodium Hydroxide (50%)	>480	
Soman (GD)	>720	(5)
Sulfuric Acid (98%)	>480	
Thionyl Chloride	>480	
Toluene	>480	
V-Agent (VX)	>720	(5)

Footnotes:

Industrial chemicals and chemical warfare agents are tested per method outlined in NFPA 1994 Standard on Protective Ensembles for First Responders to CBRN Terrorism Incidents, Class 2, Edition 2001 or 2007.

- (1) Chemical challenge concentration 350 ppm and 6 µg/cm² breakthrough end point.
- (2) Chemical challenge concentration 1000 ppm and 0.1 µg/cm²/min breakthrough end point.
- (3) Chemical challenge concentration 10 g/m² and 0.1 µg/cm²/min breakthrough end point.
- (4) Chemical challenge concentration 10 g/m² and 4 µg/cm² breakthrough end point.
- (5) Chemical challenge concentration 10 g/m² and 1.25 µg/cm² breakthrough end point.
- (6) Test stopped due to equipment limitation.

All permeation data presented are believed to be reliable. They are generated using swatches of fabric under controlled laboratory conditions by independent and accredited third party laboratories.

The data in this guide are subject to revision as additional information and knowledge become available.

GORE® CHEMPAK® Ultra Barrier Fabric: Liquid Chemical Penetration Performance

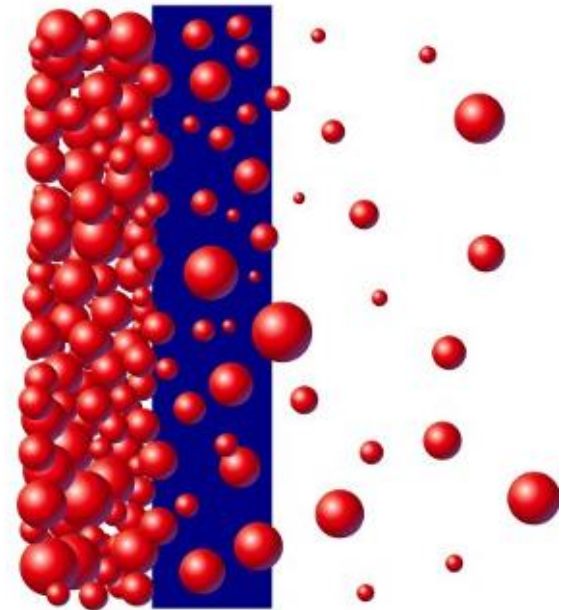
NFPA 1992, Garment Element Requirement, 2012 Edition

CHEMICAL PENETRATION	Chemical	Requirement	Minimum Required Time	Typical Results
MATERIAL	Acetone	No Visible Penetration	60 min.	PASS
	Dimethylformamide			PASS
	Ethyl Acetate			PASS
	Nitrobenzene			PASS
	Sodium Hydroxide			PASS
	Sulfuric Acid			PASS
	Tetrahydrofuran			PASS
SEAMS	Isopropyl Alcohol	No Visible Penetration	60 min.	PASS
	Sulfuric Acid			PASS

Permeation

Factors Affecting Permeation Rate

- Chemical and material interactions
- Occluded vs. open surface
- Concentration
- Temperature
- Humidity
- Amount on surface



Permeation testing process

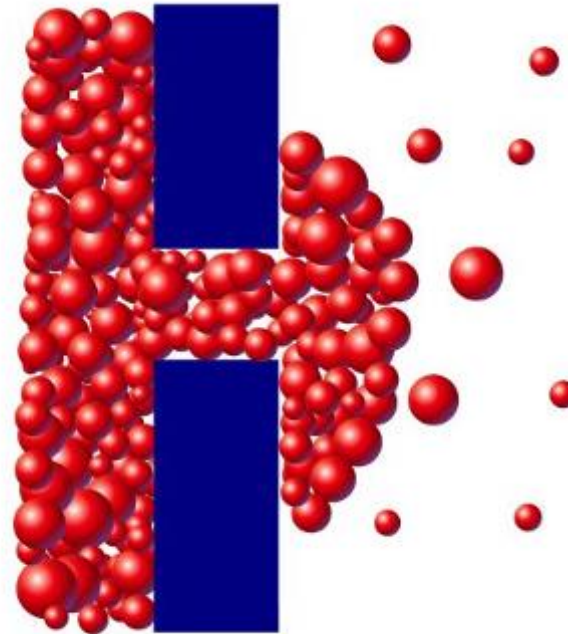
- 10 grams (droplets) of contaminate per meter
 - Mustard/liquid = blister agent
 - Soman/liquid = nerve agent
 - DMS/liquid = liquid TIC
 - Others listed are gasses = 350 parts per million
- Droplets placed on a closed top cell on the outer fabric
 - Laboratory setting – cm² is square centimeter=test area about 1” across
 - ug = micro gram which is 1 millionth of one gram
 - Standard allows for not more than 4 ug/1.25ug/6ug per hour permeation permitted
- Clean air is circulated on the reverse side (inner fabric)
- Air is collected for 1 hour and the permeation is measured
 - Air is not under pressure
 - Chart shows that at 12 hours (720 mins) and 8 hours (480 mins) still less than 4 ug permeated through Ultra Barrier



Penetration

Factors Affecting Penetration Rate

- Chemical/material solubility
- Viscosity
- Surface Tension
- Pressure
- Temperature
- Pathway size



Man-in-Simulant Test (MIST)

- Provides information on PPE design and integrity
 - How airtight is the suit?
- Required protection factors (PF) are based on anticipated exposure levels
 - Varies with class of suit – Class 2 or Class 3

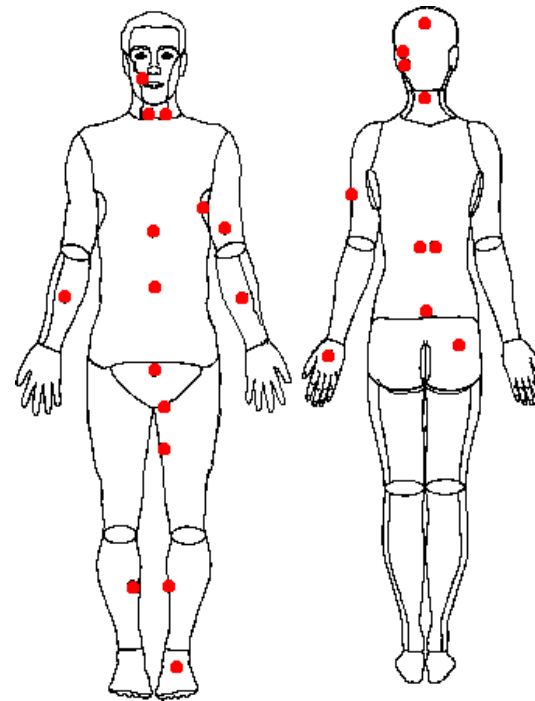
$$\text{PPDF}^* = \frac{\text{Concentration Outside Suit}}{\text{Concentration Inside Suit}}$$

- Movement mimics natural body movements to stress the closure points of suits

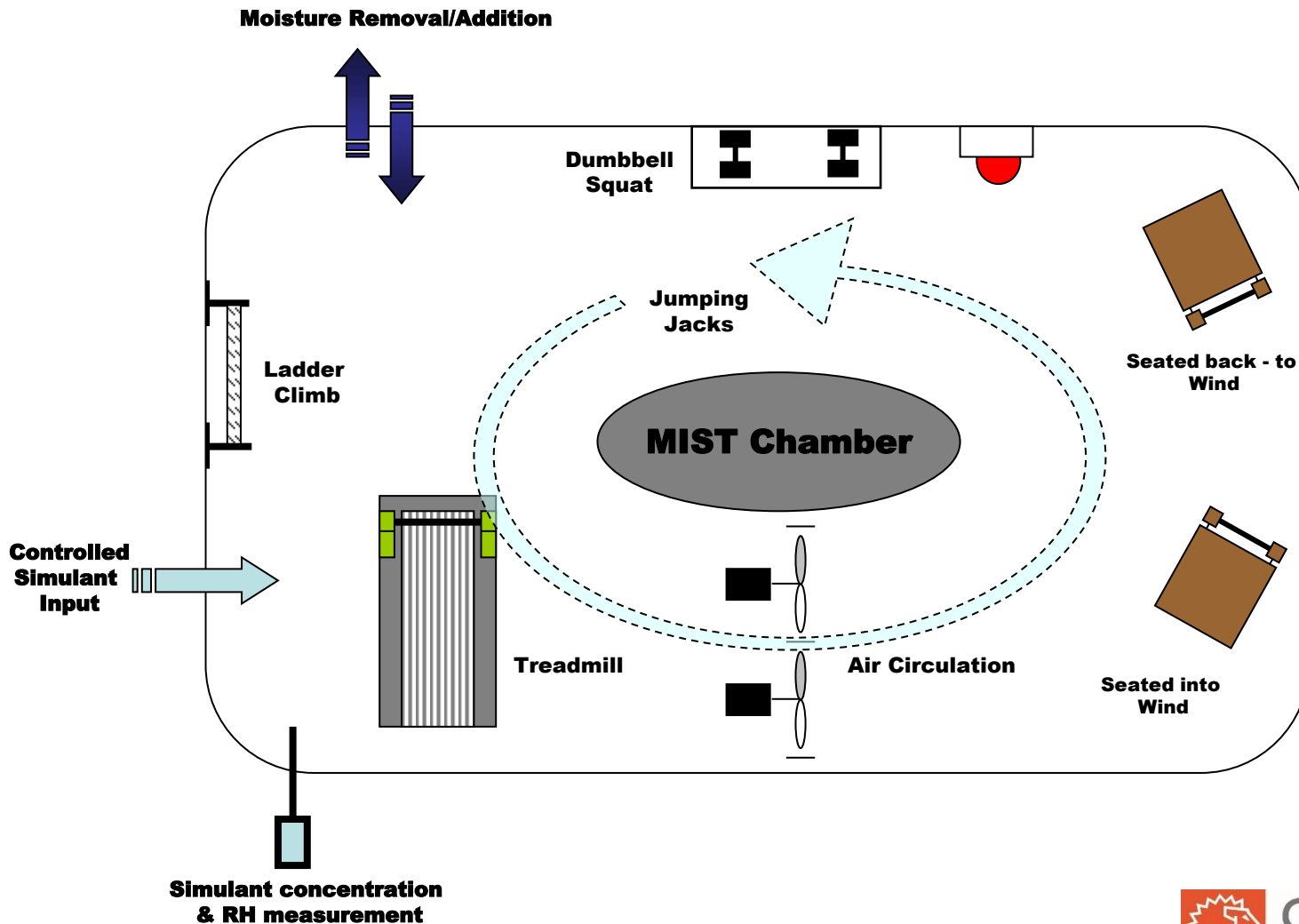
*PPDF – Physiological Protective Dosage Factor

Man-in-Simulant Test (MIST)

- Evaluates 30 interface/sensitive locations
- Closures, interfaces, etc
- Sensitive to small openings
- Performance is based on toxicity limits and anticipated exposure threat
- Results are reported for local regions and systemic
- PPDF is determined by calculating the amount of the contaminant that found its way into the suit vs. the amount of contaminate in the chamber



MIST – Test Chamber Layout



MT94 Multi Threat Ensemble

GORE® CHEMPAK® Ultra Barrier fabric

- MIST (PPDFsys) = +1400 avg (Standard req. 361)
- NFPA 1994 Class 2 and NFPA 1992
- Flame Resistance & Anti-static properties
- High abrasion and tear resistance – can be used in trench rescue and on a rock pile
- 5 wear/wash durability (wear trial)
- Form fitting and quiet (Velcro® cinch points)
- Storage pockets
- Conformable booties (will fit station boots)
- Simple and quick donning/doffing (1 extra person)
- Tested and certified to variety of the most prevalent SCBAs
- Low absorption rate of IDLH
- Air bottles on outside of suit for easy replacement
- Wet decon

USES

- Mitigation
- Rescue
- Decontamination
- Air Monitoring
- Identification of hazardous materials
- Technical rescue in a contaminated environment
- Reconassance



MT94 Multi Threat Ensemble

GORE® CHEMPAK® Ultra Barrier fabric

Benefits over Level A design

•Protection factor equal or higher PPDF

- Reduced donning/doffing time
 - <4 minutes
- Reduced physical load (10-13 pounds lighter)
- Improved vision
 - No visor fogging
- Superior glove dexterity and protection (FR knit Nomex and goat hide)
- **Reduced heat stress** – wet down before entry
- Force multiplier – **longer performance** on scene
 - More removals per person (2X of Level A)
- Available in Navy or Tan, with/without reflective
- Field or factory replaceable gloves





Copies of this presentation can be forwarded electronically
Thank you.

