



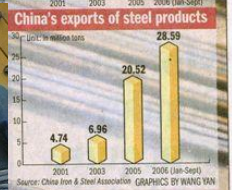
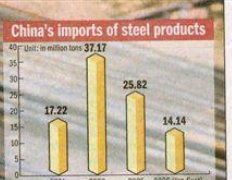
Federal Office  
of Civil Protection and  
Disaster Assistance

# Personal Protective Equipment (PPE)



# Personal Protective Equipment

## Different PPE and its usage!



FILE PHOTO

Pictures by Fun-E@mail-Arbeitsschutz

# Personal Protective Equipment



**Different areas of application**

# Personal Protective Equipment

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## COUNCIL DIRECTIVE

of 30 November 1989

**concerning the minimum safety and health requirements for the workplace (first individual directive within the meaning of Article 16 (1) of Directive 89/391/EEC)**

(89/654/EEC)

### Section II employer`s obligations

#### Article 5

1. The employer shall have a duty to ensure the safety and health of workers in every aspect related to the work (risk assessment)

## EPA/OSHA Levels of Protection

Level	Types of PPE	When Used
A	Totally encapsulating suit Self-contained breathing apparatus Chemical resistant gloves/boots	Unknown situations; highest level of dermal, respiratory protection
B	Chemically resistant splash suit Self-contained breathing apparatus Chemical resistant gloves/boots	High respirator hazards, low skin hazards
C	Chemically resistant splash suit Air-purifying respirator Chemical resistant gloves/boots	Low respirator, skin hazards
D	Coveralls, hardhat, safety glasses Optional gloves/footwear	No contaminants expected

[http://www.gryphonscientific.com/course/pdf/3\\_PPE\\_Levels\\_OSHA\\_EPA.pdf](http://www.gryphonscientific.com/course/pdf/3_PPE_Levels_OSHA_EPA.pdf)

# Personal Protective Equipment

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## NFPA-Standards

- NFPA® Standard 1991 „Standard on Vapor Protective Ensembles for Hazardous Materials Emergencies“
- NFPA® Standard 1992 „Standard on Liquid Splash-Protective Ensembles and Clothing for Hazardous Materials Emergencies“
- NFPA® Standard 1994 „Standard on Protective Ensembles for First Responders to CBRN Terrorism Incidents“

## NFPA/ EPA Level Match

Performance Based Standard	EPA Level
NFPA 1991 (2005 Ed.) worn with NIOSH CBRN SCBA	A
NFPA 1994 (2012 Ed.) Class 2 worn with NIOSH CBRN SCBA	B
NFPA 1971 (2007 Ed.) with CBRN option worn with Niosh CBRN SCBA	B
NFPA 1994 (2012 Ed.) Class 3 worn with Niosh CBRN APR/PAPR	C
NFPA 1994 (2012 Ed.) Class 4 worn with Niosh CBRN APR/PAPR	C
NFPA 1951 (2007 Ed.) CBRN technical rescue ensemble worn with NIOSH CBRN APR/PAPR	C

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## German Regulations

Fire Code 500

CBRN Incidents

Vfdb guideline 0800

Vfdb guideline 0810

Vfdb guideline 0830

Vfdb guideline 0840



# Personal Protective Equipment

BG/GUV-I 8675

4.21 PSA für C-Einsatz (ABC)  
(nach FwDV 500 geeignet  
für den A-, B- und C-Einsatz)

PSA 57

**Einsatzaufgabe:** ABC-Einsatz im Gefahrenbereich ab Gefahrengruppe II

**Ausrüstung:** siehe unten



# Personal Protective Equipment

## European Standard EN 340

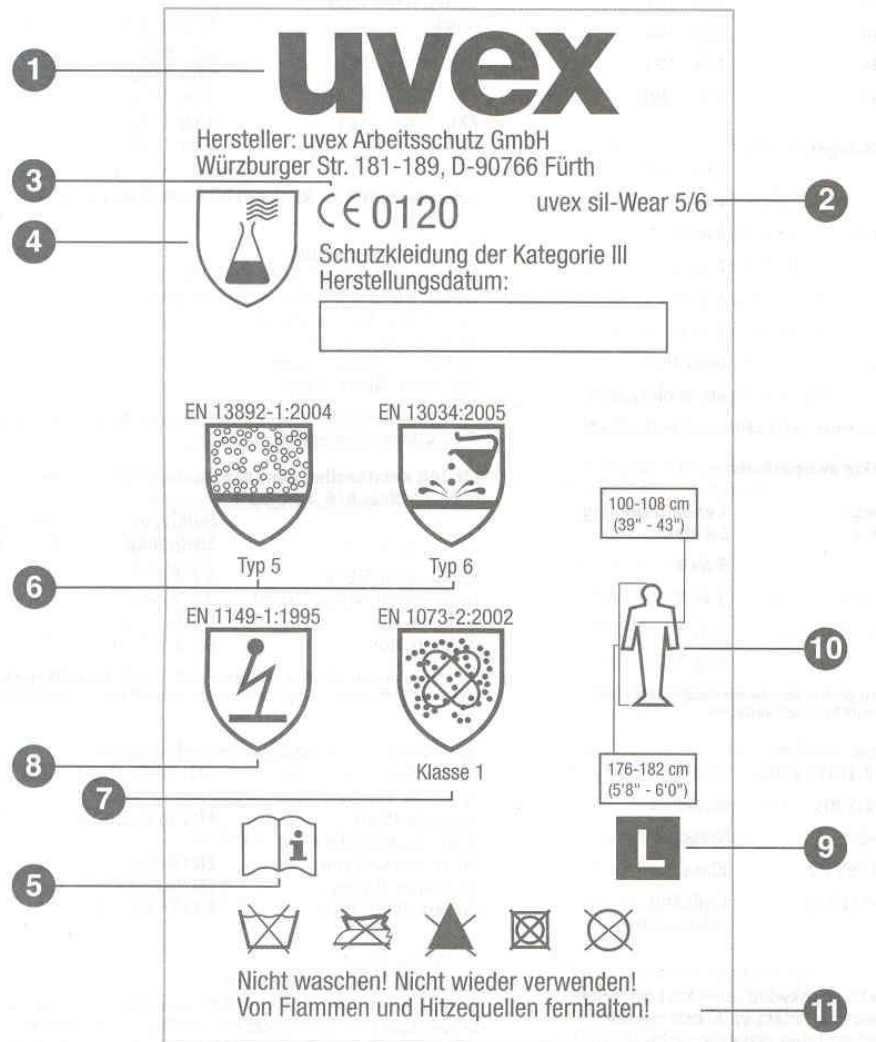
- The standard specifies general performance requirements for ergonomics, innocuousness, size designation, ageing, compatibility and marking of protective clothing and the information to be supplied by the manufacturer with the protective clothing.
- EN 340 is a reference standard, used only in combination with specific protective clothing standards such as EN 342 etc.

# Personal Protective Equipment



# Personal Protective Equipment

## Labelling of Protective Suits



# Personal Protective Equipment

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## Category III PPE (Complex PPE)

- "Complex PPE" or "Category 3 PPE" is defined as PPE of complex design intended to protect against mortal danger, or against dangers that may seriously and irreversibly harm health, the immediate effects of which the designer assumes that the user cannot identify in sufficient time. The products must be tested and certified by a Notified Body.

# Personal Protective Equipment

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## Chemicals

Typ 1  
Typ 2  
Typ 3  
Typ 4  
Typ 5  
Typ 6

## Radioactive Particles

non-ventilated  
ventilated

## Biological Agents

Typ 3B  
Typ 4B  
Typ 5B  
Typ 6B

# Personal Protective Equipment

Gaseous  
chemicals  
Vapours  
Type 1

**EN 943-1**



Liquids  
Type 3

EN 14605



Spray  
Type 4

EN 14605



Solid  
particulates,  
fibres Type 5

EN ISO  
13982-1







Light spray,  
low volume  
splashes  
Type 6

EN 13034



# Personal Protective Equipment

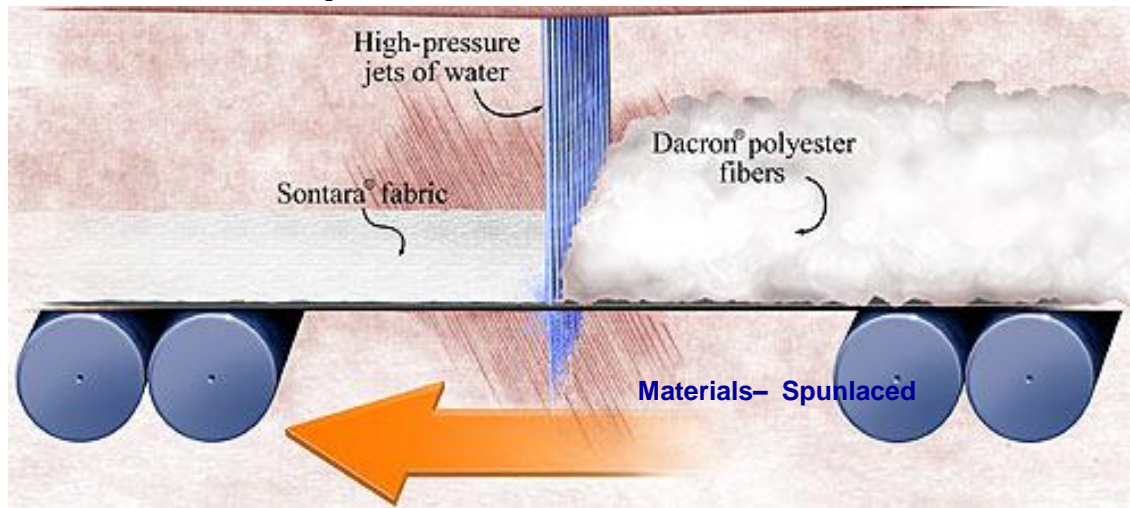
## Other important European Standards

EN	Title	EN - Symbols
<b>EN 1073-2</b>	<b>Protective clothing against radioactive contamination</b>	
<b>EN 14126</b>	<b>Protective Clothing Protection against infectious agents</b>	
<b>EN 1149-1</b>	<b>Protective clothing Electrostatic properties. Surface resistivity</b>	
<b>EN 533</b>	<b>Protective clothing Protection against heat and flame</b>	

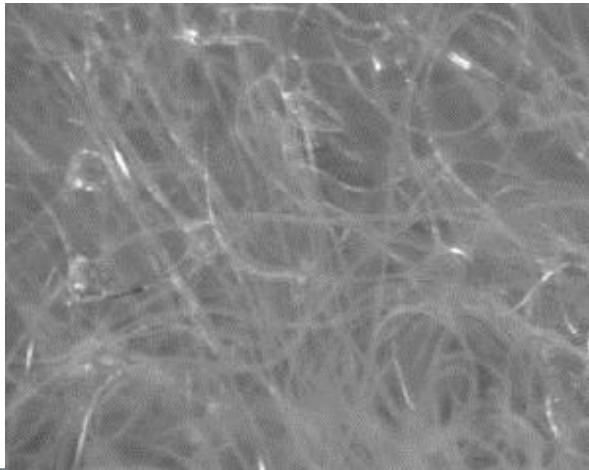


# Personal Protective Equipment

## Materials - Spunlaced



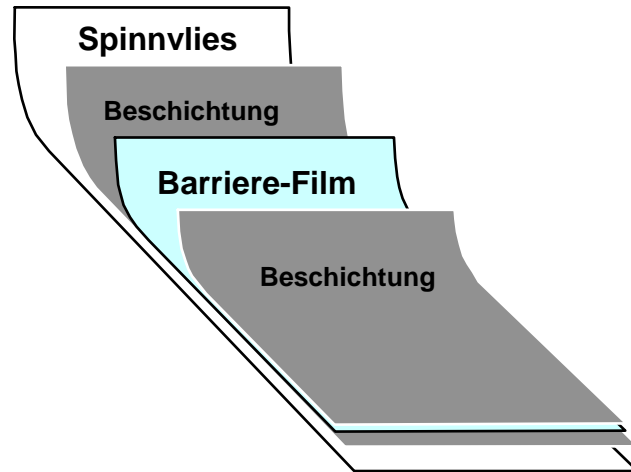
**Use of many different fiber types and different layers**



- high comfort for the user
- low mechanical stability
- acceptable particle denseness
- high fluid permeability

# Personal Protective Equipment

## Laminated materials




**Air tight structure, very good barrier possible (depending on the used material)**

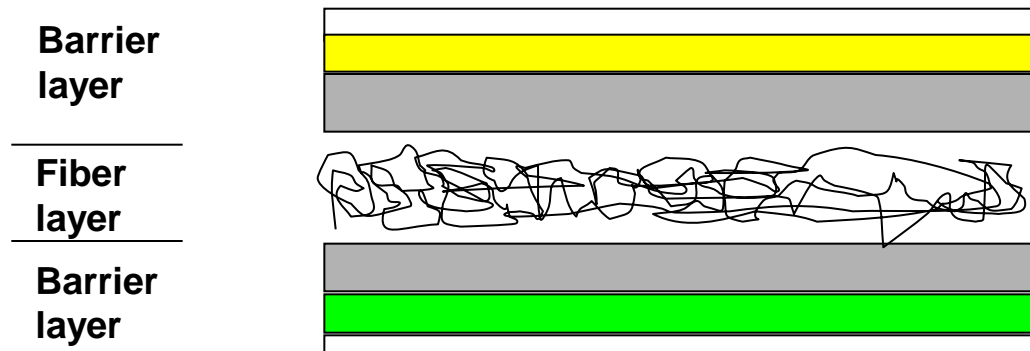
- good comfort for the user
- good to very good mechanical resistance
- total particle denseness
- very good fluid denseness
- air tight
- many different colours possible

# Personal Protective Equipment

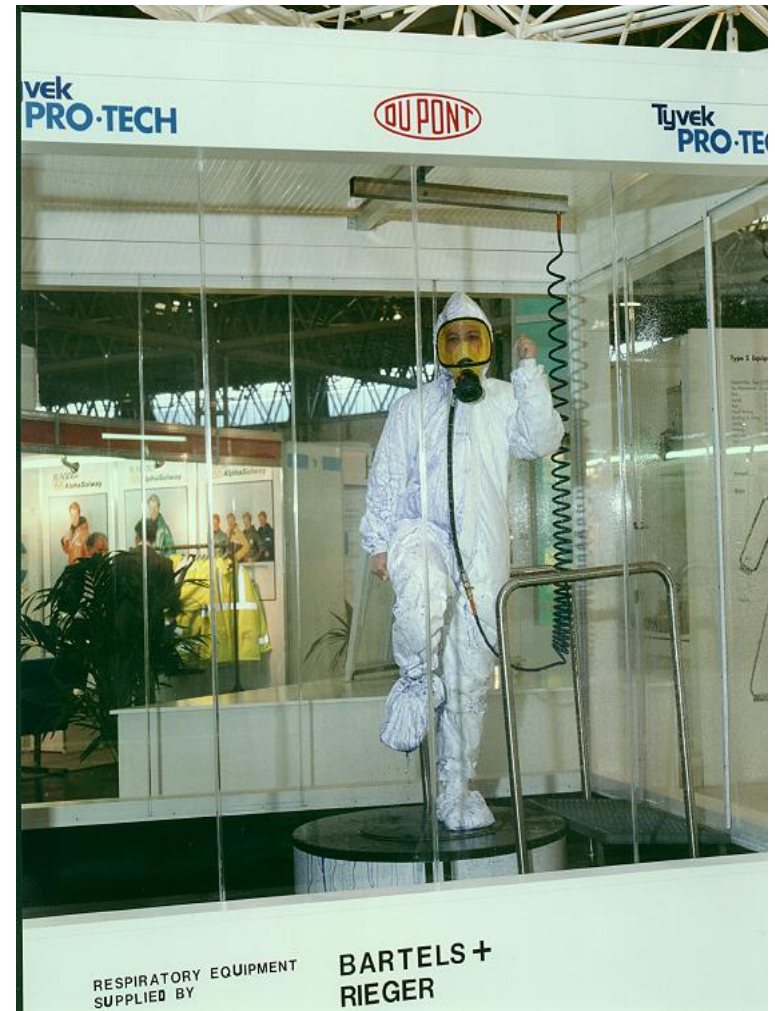
**Be aware!**

**Protective suits should have a chemical resistant layer at the outside and the inside of the used material!** 

**Better safety for the user if the surface of the material is destroyed**



# Personal Protective Equipment



# Personal Protective Equipment



## Gloves

### Problems:

- Tightness at the sleeves
- Fixation of the sleeves and gloves

# Personal Protective Equipment



## Footwear

### Problem:

- Socks
- Size

# Personal Protective Equipment

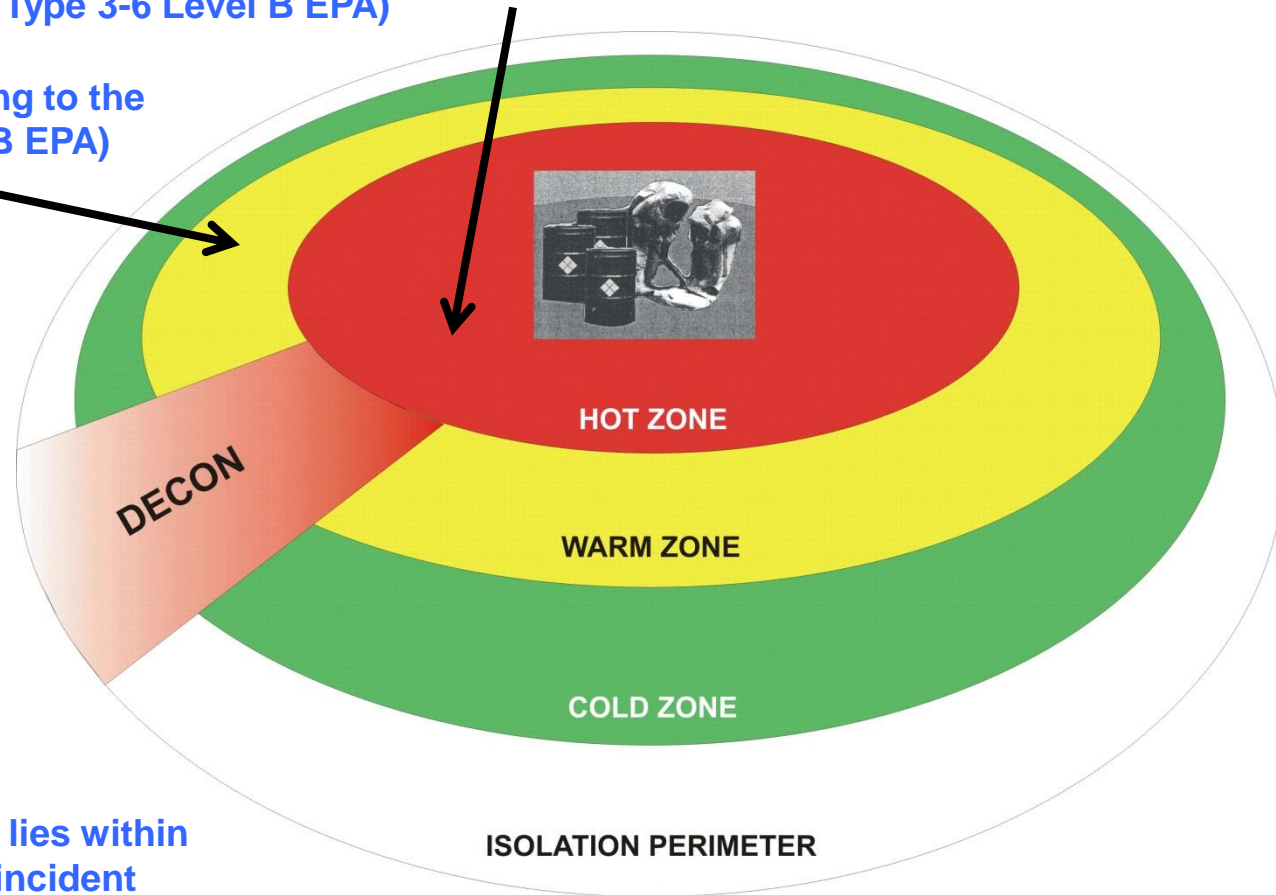
Unknown hazard : Type 1 suit ( EN 943,Level A EPA)

Known hazard: Type 1 suit (EN 943 Level A EPA) or suit according/adapted to the identified hazard ( Type 3-6 Level B EPA)

Type 3 – Type 6 according to the identified hazard (Level B EPA)

Decontamination:  
The same PPE as the primary entry team is used (less common) or PPE one level below the PPE of the primary entry team is used (more common)  
PPE is reduced with proceeding decontamination

Note:  
The selection of the PPE lies within the responsibility of the incident commander or the teamleader !



# Personal Protective Equipment

## Putting on of a Protective Suite





# Personal Protective Equipment

..and the result !



# Personal Protective Equipment



# Personal Protective Equipment



# Personal Protective Equipment



# Respiratory Protection



# Personal Protective Equipment

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## **Respiratory Protection (classification)**

- **air purifying systems**

**(FFP, Full Face or Half Face Mask with filter, Purified – Air-Powered -Respirators)**

- **self contained breathing systems**

**( Self Contained Breathing Apparatus, Closed Circuit Apparatus, Supplied –Air Respirator SAR (airline respirator))**

# Personal Protective Equipment

## Limitations for the use of Air Purifying Respirators (APR)

- Existing oxygen concentration must be  $>$  than 17 %
- Existing harmful substances must be known (concentration and composition of substances, characteristics  $\longrightarrow$  constant monitoring necessary ) !
- Gas Filters may only be used in the presence of gases, not of particles !
- Particle Filters may only be used in the presence of particles, not in the presence of gases !
- Usual filters do not protect against Carbonmonoxide !
- The highest permissible concentration of the harmful substances for the filter class must be noted !
- **Caution: APR's should only be used if the hazardous material has a taste or a smell !!!!**

## Respiratory Protection

### 1. Single use masks

Masks with and without exhalation valve.

**Pros:**

**FFP masks (Face Filtering Particle)**

**very comfortable to wear, light, very hygienic, very low medical requirements**

**Contras:**

**high leakage, only for particles not for gases, eye protection must be provided, single use**





## Respiratory Protection

### 2. Half Mask Respiratory (Half Facepiece)

**Consists of mask body and filter. An additional eye protection must be used.**

#### **Pros:**

**can protect against particles and gases, not as heavy as a Full Facepiece**

#### **Contras:**

**Cleaning and disinfection necessary, heavier than a FFP single use mask, eye protection must be provided**

# Personal Protective Equipment

## Respiratory Protection



Scott Profile 2 Halbmaske



Dräger X-plore 3300



3 M Halbmaske 6300

# Personal Protective Equipment



Draeger filter 680 ST P3



ABEK 2 Hg P3 filter



Draeger Partikelfilter P3



Scott Tornado combined filter



# Personal Protective Equipment

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## Respiratory Protection

### 3. Full Face Mask:

**Distinction between low pressure versions and high pressure versions.**

#### **Pros:**

**Best protection for the face, better tightness than a half mask respiratory, very safe, chemical and temperature resistant**

#### **Contras:**

**Less comfortable, high strain for the user, limited field of vision, high medical requirements, weight of units, limited communication, reduced mobility.**

**Note: High pressure facepieces can cause problems when used with filters!**

# Personal Protective Equipment

## Respiratory Protection



MSA Auer 3 S (Überdruck)

Scott vision 3

## Full Face Masks



Draeger Panorama Nova B



# Personal Protective Equipment

## Respiratory Protection

### 4. Powered Air Purifying Respirators (PAPR)

**Consists of a headtop and a separate respirator (venting system). Headtop and respirator are connected by a hose. The respirator purifies the air and sends it via hose into the hood. There the purified air spreads and can be breathed.**

#### **Pros:**

**High comfort for the wearer, positive pressure (no breathing resistance, big faceshield, cooling airflow, nearly no contact with the skin, slight overpressure inside the suit, no special medical requirements**

#### **Contras:**

**High Costs, special filters, incompatibility between different systems of different manufacturers**

# Personal Protective Equipment



Scott Tornado T 25

## Purified- air-powered-Respirators (PAPRs) and Headtops



Scott Proflow 3



3 M Jupiter -Hoods



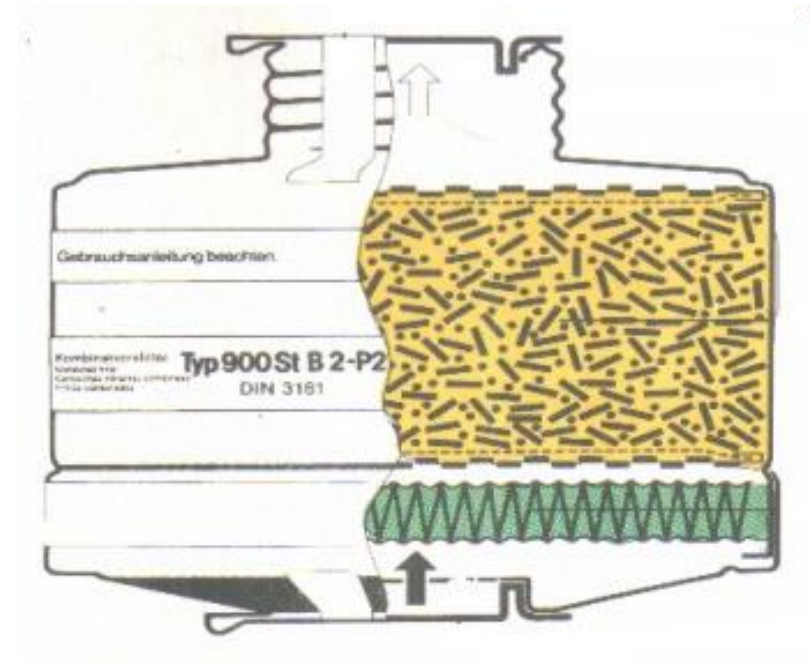
3 M Jupiter Respirator Unit



3 M HT 152







# Personal Protective Equipment

## Combination Filter





# Personal Protective Equipment

Colour mark	Type	Application	Class	Max. allowed gas concentration	Standard					
	A	Organic gases and vapours [boiling point > 65 °C]	1	1000 ml/m <sup>3</sup> [0.1 Vol.-%]	EN 14387					
			2	5000 ml/m <sup>3</sup> [0.5 Vol.-%]						
			3	10000 ml/m <sup>3</sup> [1.0 Vol.-%]						
	B	Inorganic gases and vapours [not CO], e.g. chlorine, H <sub>2</sub> S, HCN...	1	1000 ml/m <sup>3</sup> [0.1 Vol.-%]	EN 14387					
			2	5000 ml/m <sup>3</sup> [0.5 Vol.-%]						
			3	10000 ml/m <sup>3</sup> [1.0 Vol.-%]						
	E	Sulfur dioxide and acidic gases and vapours	1	1000 ml/m <sup>3</sup> [0.1 Vol.-%]	EN 14387					
			2	5000 ml/m <sup>3</sup> [0.5 Vol.-%]						
			3	10000 ml/m <sup>3</sup> [1.0 Vol.-%]						
	K	Ammonia and organic ammonia derivatives	1	1000 ml/m <sup>3</sup> [0.1 Vol.-%]	EN 14387					
			2	5000 ml/m <sup>3</sup> [0.5 Vol.-%]						
			3	10000 ml/m <sup>3</sup> [1.0 Vol.-%]						
	AX	Organic gases and vapours [boiling point < 65 °C] of low boiling substance groups 1 and 2	–	Gr. 1 [100 ml/m <sup>3</sup> max. 40 min.] Gr. 1 [500 ml/m <sup>3</sup> max. 20 min.] Gr. 2 [1000 ml/m <sup>3</sup> max. 60 min.] Gr. 2 [5000 ml/m <sup>3</sup> max. 20 min.]	EN 371 or EN 14387					
			NO-P3	Nitrogen oxides e.g. NO, NO <sub>2</sub> , NO <sub>x</sub> and particles	–	Maximum allowed time of use 20 minutes	EN 14387			
					Hg-P3	Mercury vapours and particles		–	Maximum allowed time of use 50 hours	EN 14387
								CO*	Carbon monoxide	
	Reactor P3*	Radioactive iodine and particles	–	Local guidelines	DIN 3181*					
			P	Particles	1	Efficiency [low]	EN 143			
2	Efficiency [medium]	EN 14387								
3	Efficiency [high]									

\*only colour mark and type standardized

# Personal Protective Equipment

<b>Particle filter class</b>	<b>Efficiency</b>
<b>P1</b>	<b>low</b>
<b>P2</b>	<b>medium</b>
<b>P3</b>	<b>high</b>

<b>Gas filter class</b>	<b>Maximum allowed gas concentration</b>
<b>1</b>	<b>low (1000ml/m<sup>3</sup>, 0,1 Vol%)</b>
<b>2</b>	<b>medium (5000ml/m<sup>3</sup>, 0,5 Vol%)</b>
<b>3</b>	<b>high (10000ml/m<sup>3</sup>, 1 Vol%)</b>

# Personal Protective Equipment

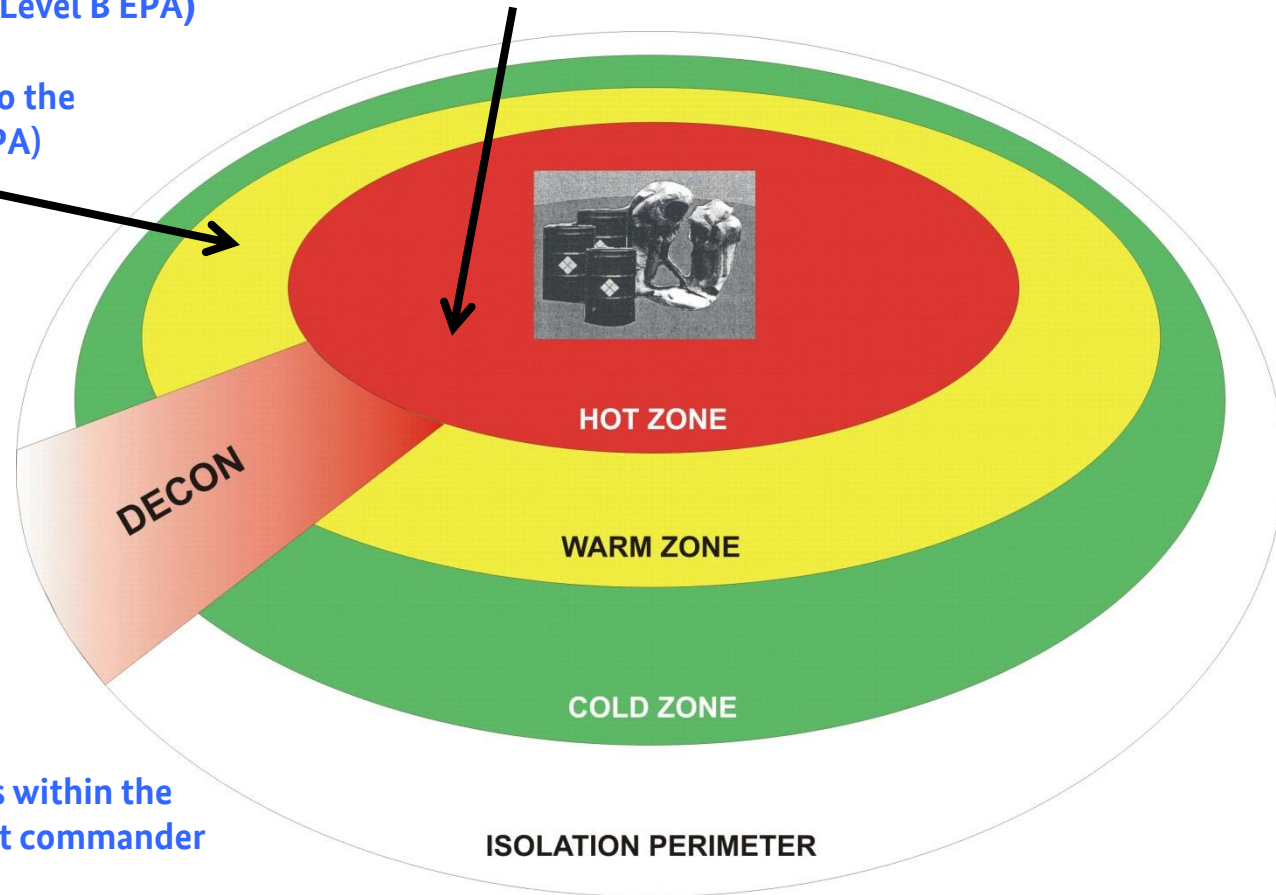
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**Note:**  
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Incident site and PPE



DEPARTMENT OF HEALTH AND HUMAN SERVICES  
Centers for Disease Control and Prevention  
National Institute for Occupational Safety and Health



**NIOSH**

## Estimating the Permeation Resistance of Nonporous Barrier Polymers to Sulfur Mustard (HD) and Sarin (GB) Chemical Warfare Agents Using Liquid Simulants

Donald Rivin, Ph.D.  
Wendel J. Shuely  
Frank Palya, Jr.  
Robert S. Lindsay  
Axel Rodriguez  
Philip W. Bartram

DEPARTMENT OF HEALTH AND HUMAN SERVICES  
Centers for Disease Control and Prevention  
National Institute for Occupational Safety and Health

## Risk Assessment of Using Firefighter Protective Ensemble with Self-Contained Breathing Apparatus for Rescue Operations During a Terrorist Chemical Agent Incident



Prepared by:  
U.S. Army Soldier and Biological  
Chemical Command  
Homeland Defense Business Unit  
Improved Response Program

August 2003



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Brown University  
**Office of Environmental Health & Safety**

## Selection and Usage of Chemically-Resistant Gloves

Permeation/Degradation Resistance Guide for Protective Gloves

**Permeation:**

A process by which a chemical can pass through a protective film without going through pinholes, pores, or other visible openings. Individual molecules of the chemical enter the film and "squirm" through by passing between the molecules of the glove material may appear unchanged to the human eye.

Chemical permeation can be described in simple terms by comparing it to what happens to the air in a balloon after several hours. Although there are no holes or defects, and the balloon is tightly sealed, the air gradually passes through (permeates) its walls and escapes. This simple example uses gas permeation, but the principle is the same with liquids or chemicals.

Permeation data are presented in two values: **Breakthrough time** and **Rate**.

**Breakthrough time:**

Breakthrough times (min.) are the times observed from the start of the test to first detection of the chemical on the other side of the sample (for test methodology, see the outside back cover of this guide). These times represent how long a glove can be expected to provide effective permeation resistance when totally immersed in the test chemical.

**Rate:**

Permeation rates are the highest flow rates recorded for the permeating chemicals through the glove samples during a six-hour test. These qualitative ratings are comparisons of permeation rates to each other.

**Degradation:**

Degradation is a reduction in one or more physical properties of a glove material due to contact with a chemical. Certain glove materials may become hard, stiff, or brittle, or they may grow softer, weaker, and swell to several times their original size. If a chemical has a significant impact on the physical properties of a glove material, its permeation resistance is quickly impaired. For this reason, glove/chemical combinations rated "Poor" or "Not Recommended" in degradation testing were not tested for permeation resistance. Please note, however that permeation and degradation do not always correlate (6th Edition, Ansell Protective Protective Products Chemical Resistance Guide- Permeation & Degradation Data)

Guidelines  
Definitions  
Companies  
• Ansell  
• Best  
• Mapa  
• North  
Lab Safety

http://www.brown.edu/Administration/EHS/gloves/def.html

**NATIONAL FIRE PROTECTION ASSOCIATION**  
The leading information and knowledge resource on fire, electrical and related hazards

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**CODES & STANDARDS** SAFETY INFORMATION TRAINING RESEARCH MEMBER ACCESS

Home > Codes and Standards > List of NFPA codes & standards > NFPA 1991

### NFPA 1991: STANDARD ON VAPOR-PROTECTIVE ENSEMBLES FOR HAZARDOUS MATERIALS EMERGENCIES

Free access to the 2016 edition of NFPA 1991 Alerts: [Receive e-mail updates on this document](#)

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**BUY THIS EDITION**

**NFPA 1991: Standard on Vapor-Protective Ensembles for Hazardous Materials Emergencies, 2016 Edition**  
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**What is NFPA 1991?**  
This standard provides requirements for protection for emergency responders against adverse vapor environments during hazardous materials incidents, and from specified chemical, biological, or radiological terrorism agents during chemical and biological terrorism incidents. [Official document scope](#)

**What does NFPA 1991 address?**  
Provisions cover design, performance, labeling, testing, documentation, and certification requirements for new vapor-protective ensembles and ensemble elements. Additional optional criteria for escape protection only from chemical flash fires encountered during hazardous materials incidents are also provided.

**Articles and Reports**  
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**News about NFPA codes and standards**

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- [Call for members on new Technical Committee on Low Pressure Dispensing Containers \(LPDC\)](#)
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Federal Office  
of Civil Protection and  
Disaster Assistance

# Thank you for your kind attention!

## Kontakt

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**BBK.** Working together. Living in safety.

G.Uelpenich, Department IV.4 Science, Technology and Health