



## ENVIRONMENTAL COMPANY OF SAO PAULO STATE – CETESB

### REGIONAL CENTRE OF STOCKHOLM CONVENTION ON POPs FOR LATIN AMERICA AND THE CARIBBEAN REGION

#### V INTERNATIONAL TRAINING PROGRAM ON ENVIRONMENTAL SOUND MANAGEMENT ON CHEMICALS AND WASTES, ESPECIALLY ON PERSISTENT ORGANIC POLLUTANTS (POPs) AND MERCURY (Hg)

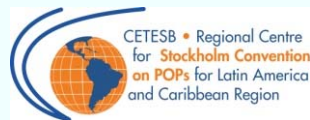
*Personal Protective Equipment  
Environmental Technician Luciano de Oliveira Baptista*

2016

Sao Paulo – SP – Brazil



JBPP  
PROGRAMA DE PARCERIA BRASIL-JAPÃO



# PPE

## Introduction

- Exposition to chemicals - risk;
- Need to ensure workers' health through reduction of the degree of exposure;





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# Adequation

PPE must be compatible with the substances involved and the circumstances;

- Skin protection - consider the degradation of materials and the rate of permeation of the substance in the tissue;
- Respiratory protection - consider the adequacy of the filters and the amount of oxygen in the atmosphere.

# PPE´s Certification



PPE's should be certified:

- USA: National Institute for Occupational Safety and Health (NIOSH)

-Europe: PPE Council Directive (89/686/EEC).

Category I PPE: manufacturer can self certify e.g. simple gardening glove, sunglasses

Category II PPE: PPE subject to an EC-type examination (Article 10 of Directive 89/686/EEC) by a Notified Body e.g. safety and sports helmet, safety footwear, high visibility clothing

Category III PPE: PPE subject to EC-type examination and a factory audit for Quality Assurance e.g. respiratory equipment, fall arrest equipment and chemical protective clothing

- Brazil: - Companies should be authorized by Ministry of Labor to manufacture PPE, they receive a Manufacturer Registration Card (CRF) and PPE should have the manufacturer's name and number engraved in its material.

# RESISTANCE OF FABRICS

- Cloth capacity to be resistant to chemical contact;
- This is the most important characteristic to be considered in the selection of PPE;
- No fabric is fully resistant to all products.



# Penetration Degradation



## Chemical family with absorption time through the glove from 300 to 480 minutes for sundry materials

Chemical family tested	Glove material
Aliphatic hydrocarbons, ketones, halogenated carbons and ethers	PVA
Amine salts, salts, isocyanates and hydrocarbons epoxidated	Latex
Aromatic aliphatic hydrocarbons, aromatic halogenated hydrocarbons, amines, nitriles, halogenated carbons and alcohols	Viton
Aliphatic amines, hydrocarbons and halogenated carbons	Nitrile
Aliphatic ketones, aldehydes, alcohols, nitriles, amines and acids	Butyl Rubber
Aliphatic alcohols and amine salts	Neoprene



# **CUTANEOUS PROTECTION CHARACTERISTICS**

Taking into account the different types of work and risk, the user must select the suit considering the following aspects:

- Degree of protection (isolation / confinement);
- Ease of cleaning and decontamination;
- Chemical resistance;
- Malleability.

# CUTANEOUS PROTECTION

- Disposable clothing;
- Anti-fire Clothes;
- Coats;
- Pant, jacket and hood;
- Total encapsulation coveralls;
- Gloves, boots, leggings, etc.

# Chemical Resistant Clothing



# Chemical-Resistant Gloves



# Outer Chemical-Resistant Boots



MATERIAL	GOOD FOR	BAD FOR
BUTYL RUBBER	BASES	ALIPHATICS, HALOCARBONS AND AROMATICS HYDROCARBONS, GASOLINE
POLYVINYL CHLORIDE (PVC)	ACIDS, BASES , AMINES	MOST OF THE ORGANIC COMPOUNDS
NITRILE RUBBER	PHENOLS, OILS, ALCOHOLS, COMBUSTIBLES, AMINES, BASES, PEROXIDES	HALOCARBONS AND AROMATIC HYDROCARBONS , AMIDES, ACETONES
TYVEK® (POLYETHYLENE FIBERS)	PARTICULATES MATTER	CHEMICAL RESISTANCE AND DURABILITY
TYCHEM® (PAD OVERLAID WITH TYVEK)	ACIDS, BASES, ALCOHOLS, PHENOLS, ALDEHYDES	ALIPHATICS, HALOCARBONS, AND AROMATICS HYDROCARBONS
SARANEX®	ACIDS, BASES, AMINES, POLYCHLORINATED BIPHENYL	HALOCARBONS AND AROMATICS HYDROCARBONS
VITON	ALIPHATICS, HALOCARBONS AND AROMATIC HYDROCARBONS, ACIDS	ALDEHYDES, KETONES, ESTERS, AMINES

# Respiratory Protection



# Respiratory Protection

Breathing air under normal conditions should:

- Contain at least 19.5% oxygen;
- Be free of foreign matter;
- Be with pressure and temperature that will not lead to injuries to the human organism.



# Respiratory Protection

**Aspects to be observed in the selection of protective equipment:**

**Regarding the risks:**

- oxygen level in atmosphere ;
- existence of contaminants;
- toxicological class;
- concentration of the contaminant.

**Regarding the environment:**

- confinement of the environment (wells, silos, basements);
- distance and accessibility between the hot zone and the cold zone;
- scenario and mobility limitation.

# Respiratory Protection

**Aspects to be observed in the selection of protective equipment:**

**Regarding activities:**

- operation characteristics (mobility x frequency);
- respiratory rate of the technician (physical activity).

**Intended use of the protection:**

- continuous – needed during permanence;
- intermittent – use just in the operation;
- in emergencies.

# **Respiratory Protection**

**Types**

**Dependents and Independents**

# Respiratory Protection

## Dependents

Half or Full-Facial Masks that work with filtering elements, removing from the contaminated environment the breathable air .

### Restrictions:

- They are not effective in atmospheres below 19,5% concentration of O<sub>2</sub>;
- In high concentration of contaminants they saturate fast;
- Less durable in contaminants and humidity saturated atmospheres.
- Never to be used in unknown conditions.

# Half-Face Mask

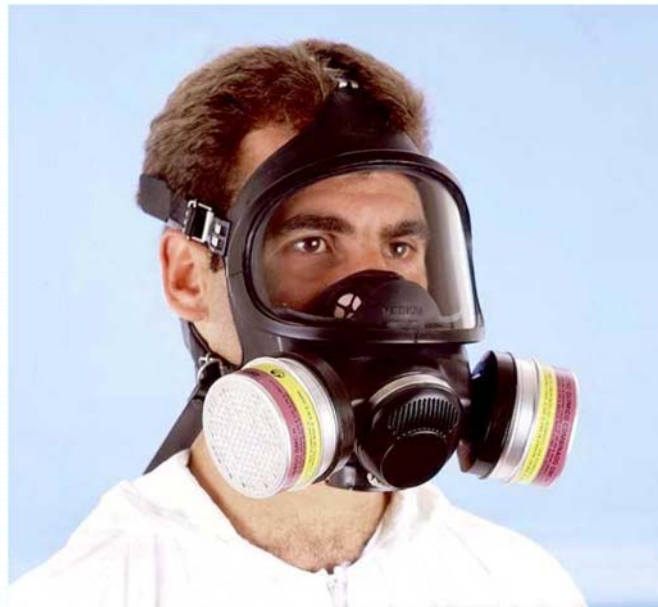
Concentration of up to 1000 ppm



# Full-Face Mask

**With combination filter**

**Concentration of up to  
1.000 ppm**










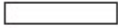


**With combination filter**

**Concentration of up to  
5.000 ppm**



**Table 2: Colour-Coding for Filters**

Colour code	Filter type	Contaminants present
	AX <sup>3)</sup>	Gases and vapours of organic compounds with boiling point ≤ 65 °C
	A	Gases and vapours of organic compounds with boiling point > 65 °C
	B	Inorganic gases and vapours, e.g. chlorine, hydrogen sulphide, hydrogen cyanide
	E	Sulphur dioxide, hydrogen chloride
	K	Ammonia and organic Ammonia derivatives
	CO <sup>4)</sup>	Carbon monoxide
	Hg <sup>5)</sup>	Mercury vapour
	NO <sup>6)</sup>	Nitrous gases including nitrogen monoxide
	Reactor <sup>7)</sup>	Radioactive iodine including radioactive methyl iodide
	P	Particles

<sup>3)</sup> AX filters may only be used as supplied from factory. Reuse and use against gascompounds is absolutely impermissible.

<sup>4)</sup> CO filters for one time use only. Must be disposed after use. Special guidelines according to local regulations apply.

<sup>5)</sup> Hg Filters can only be used for a maximum of 50 hours according to EN 14387.

<sup>6)</sup> NO filters for one time use only. Must be disposed after use.

<sup>7)</sup> Reactor filters: special guidelines according to local regulations apply.



# Respiratory Protection

## Independent

Normally they are Self-Contained Breathing Apparatus (SCBA) or Continuous flow compressed air line breathing apparatus, that supply air to the worker independently of the contaminant and environment conditions.

They really isolate the respiratory tract from the contaminated atmosphere.

### **Restrictions:**

Time to develop the work and air supply are limited.



# Self-Contained Breathing Apparatus (SCBA) with positive pressure







## CYLINDERS

### MATERIAL X WEIGHT

CARBON FIBER OR (COMPOSITE) X  
~3,6 Kg

STEEL X ~ 8,5 Kg

### LIFESPAN

CARBON FIBER = 15 YEARS

STEEL = INDEFINITE

### HYDROSTATIC TEST

CARBON FIBER = 03 – 05 YEARS

STEEL = 05 YEARS

# Levels of Protection

EPA (US Environmental Protection Agency) defined four levels of personal protective equipment for chemical protection.

The selection of each level should take into account the extent of exposure regarding cutaneous and respiratory protection.

There is, also, the European standard for personal protective equipment with a different terminology, but following the same reasoning.

# Level “A”

Composed of:

- Fully encapsulating suits;
- Self-Contained Breathing Apparatus (SCBA) , with positive pressure;
- Inner gloves, outer gloves and chemical resistant boots;
- Helmet and radio.





# When to use?

- Identified substance requires the highest level of protection to breathing tract, skin and eyes;
- There is a suspicion of the presence of products with high potential for damage to the skin;
- Works conducted in confined and badly ventilated spaces;
- Detection equipments readings indicate dangerous gases/vapours concentrations of in atmosphere (values above the IDLH).



# Training with Level A Suit





# TIGHTNESS TEST





	Praça Louveira, 83 - Tatuapé			
	CEP 03080-010 - São Paulo - SP			
	cruz.fabio@protcap.com.br / www.protcap.com.br			
	Fone: (11) 2090-3300 Fax: (11) 2090-3320			
Processo:	Página:		10.02.2012	
<b>Dados do Cliente</b>				
Razão Social:	CETESB - Cia Ambiental do Estado de São Paulo			
Endereço:	Avenida Professor Frederico Hermann Jr, N° 345			
CGC / IE:	43.776.491/0001-70			
Contato / E-mail:	Luciano de Oliveira / luciano@cetesbnet.sp.gov.br			
Telefone / Fax:	(11) 3133-3797 / 3133-3986			
<b>Dados do Equipamento</b>				
Equipamento / Modelo:	NIVEL A / TKRB			
Código:	TKRB			
Data da Compra / NF:				
Numero de Série:	KC10881372NOYL2/MM852NOYL2NOYL2			
Lote:	M852NOYL2			
Acessórios:				
Defeito:				
Data de entrada:	INSPEÇÃO "IN COMPANY"			
Data da Inspeção:	10.02.2012			
Observações:				
<b>Inspeção Visual</b>				
Visor	OK			
Ziper	OK			
Velcro	OK			
Valvula 01	OK			
Valvula 02	OK			
Melas	OK			
Luvax	OK			
Costuras	OK			
Serviços a executar / Valor: TESTE DE PRESSÃO / CORTESIA				
Teste 01		Teste 02		DIAGNÓSTICO
Tempo seg.	in/H2O	Tempo seg.	in/H2O	
0'	6,00	240'	4,10	APROVADO
<b>Dados para Retorno</b>				
Nota Fiscal Cliente / Data:				
Data da Aprovação:				
Prazo de Entrega:		Frete:		
Data da Devolução:				
Responsável pela Inspeção / Manutenção		Felipe Vieira		
Diretor de Operações e Qualidade		Eng. Cláudio N. Castello - CREA 124659		

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	Fone: (11) 2090-3300 Fax: (11) 2090-3320			
Processo:	Página:		10.02.2012	
<b>Dados do Cliente</b>				
Razão Social:	CETESB - Cia Ambiental do Estado de São Paulo			
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Contato / E-mail:	Luciano de Oliveira / luciano@cetesbnet.sp.gov.br			
Telefone / Fax:	(11) 3133-3797 / 3133-3986			
<b>Dados do Equipamento</b>				
Equipamento / Modelo:	NIVEL A / TKRB			
Código:	TKRB			
Data da Compra / NF:				
Numero de Série:	KC10881372NOYKY/MM852NOYKY			
Lote:	MM852NOYKY			
Acessórios:				
Defeito:				
Data de entrada:	INSPEÇÃO "IN COMPANY"			
Data da Inspeção:	10.02.2012			
Observações:	SINAIS DE IMPACTO NA PARTE TRASEIRA DA VESTIMENTA (EAR)			
<b>Inspeção Visual</b>				
Visor	OK			
Ziper	OK			
Velcro	OK			
Valvula 01	OK			
Valvula 02	OK			
Melas	OK			
Luvax	FURO NA BOTA DO LADO ESQUERDO			
Costuras	OK			
Serviços a executar / Valor: TESTE DE PRESSÃO / CORTESIA				
Teste 01		Teste 02		DIAGNÓSTICO
Tempo seg.	in/H2O	Tempo seg.	in/H2O	
0'	6,00	240'	2,70	REPROVADO
<b>Dados para Retorno</b>				
Nota Fiscal Cliente / Data:				
Data da Aprovação:				
Prazo de Entrega:		Frete:		
Data da Devolução:				
Responsável pela Inspeção / Manutenção		Felipe Vieira		
Diretor de Operações e Qualidade		Eng. Cláudio N. Castello - CREA 124659		

# Level “B”

Composed of:

- Self-Contained Breathing Apparatus (SCBA) worn on the outside of the garment ;
- Chemical splash suit (1 or 2 pieces);
- Inner gloves, outer gloves and chemical resistant boots;
- Helmet and radio.



# When to use?

- The identified product and its concentration require a high level of breathing protection without requiring the same level of protection for the skin;
- Oxygen content in the atmosphere is lower than 19.5% in volumen;
- Low possibility of formation of gases/vapours in harmful concentration to the skin.





# Level “C”

Composed of:

- Chemical splash suit;
- Differs from Level B by replacing the SCBA for an air-purifying respirators or mask with chemical filter;
- Inner and outer gloves, and chemical-resistant boots.



# When to use?

- The atmosphere contains at least 19,5% oxygen;
- The product has been identified and its concentration can be limited to a value lower than its tolerance limit, with the use of filtering masks;
- The concentration of the product does not exceed the IDLH level.
- The work to be performed does not require the use of an autonomous respiratory mask.











# Level “D”

Composed of:

- Coveralls, uniforms or professional clothing;
- Chemical-resistant leather or rubber boots or shoes;
- Safety glasses or goggles.
- Helmet
  
- Optional: Escape mask



# When?

- Does not protect from chemical exposure.
- It can only be used in situations where there is no possibility of contact with chemicals.



# Thermal protection clothes

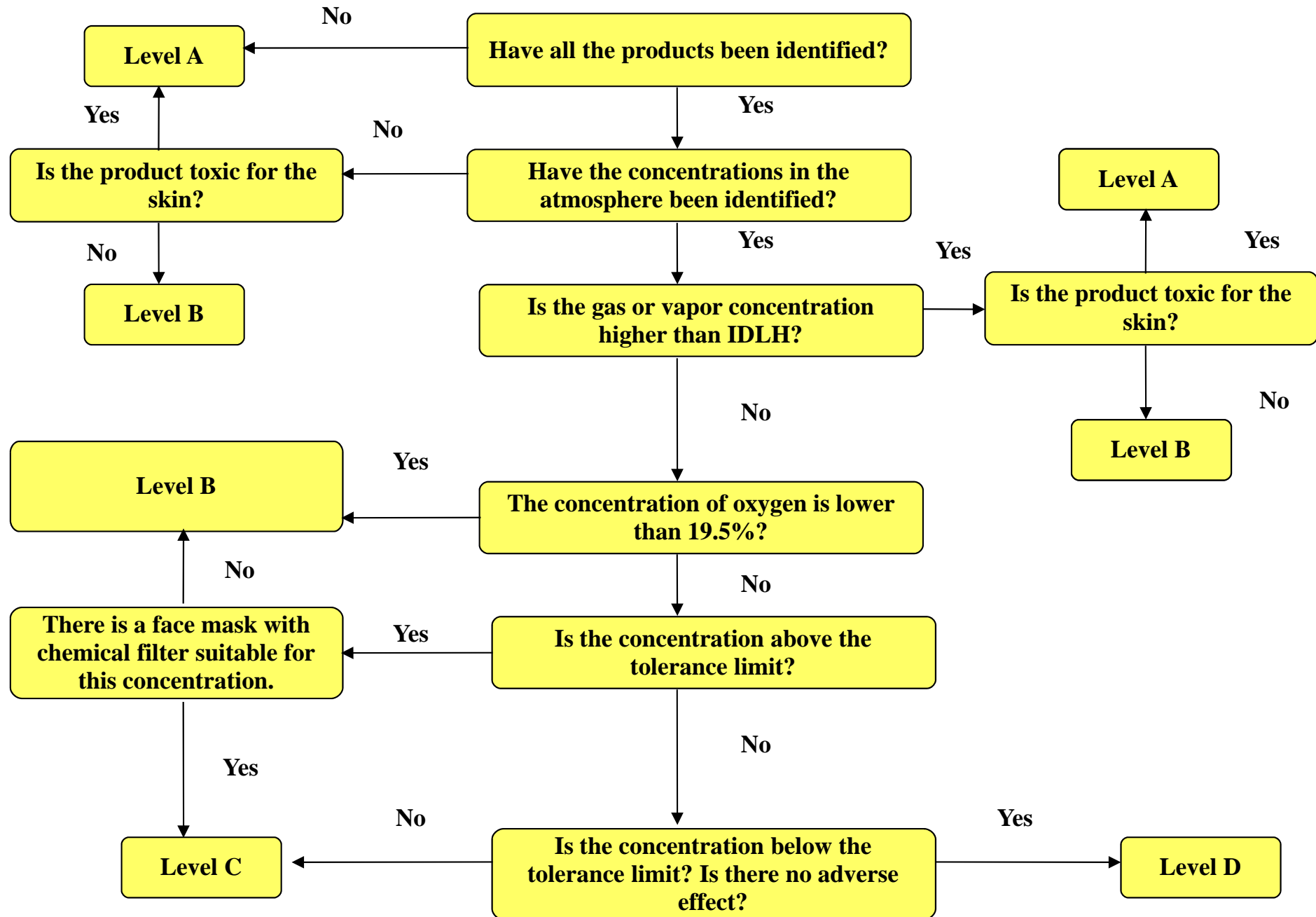


For operations involving flammable chemicals.

# Advantages and disadvantages of each protection Level

PROTECTION LEVEL	ADVANTAGES	DISADVANTAGES
A	<ul style="list-style-type: none"> <li>• HIGHEST CHEMICAL PROTECTION LEVEL</li> </ul>	<ul style="list-style-type: none"> <li>• UNCOMFORTABLE</li> <li>• LIMITED TIME FOR USE</li> <li>• HIGH COST</li> <li>• CONSTATNE TRAINING ROUTINE NEEDED</li> </ul>
B	<ul style="list-style-type: none"> <li>• LOW COST AND WEIGHT</li> <li>• GOOD FOR ATMOSPHERES ABOVE THE IDLH VALUES, AS LONG AS THE PRODUCT IS NOT TOXIC TO THE SKIN.</li> </ul>	<ul style="list-style-type: none"> <li>• NOT COMPLETE SKIN PROTECTION</li> <li>• NEEDS SOME TRAINING FOR USE</li> </ul>
C	<ul style="list-style-type: none"> <li>• EASY TO USE</li> <li>• LOW COST AND WEIGHT</li> </ul>	<ul style="list-style-type: none"> <li>• SHOULD BE ADOPTED JUST IN ATMOSPHERES ABOVE O<sub>2</sub> CONCENTRATION OF 19,5 %</li> <li>• PRODUCTS SHOULD BE DETERMINATED, AS WELL AS ITS CONCENTRATION</li> </ul>

# Selection of Protection Level





# PERSONAL PROTECTIVE EQUIPMENT

In case of doubt or unawareness of the exposure and/or level the worker will be exposed to, maximum protection equipment should always be used.

After evaluation of the situation, the use of PF be adjusted to real situations.









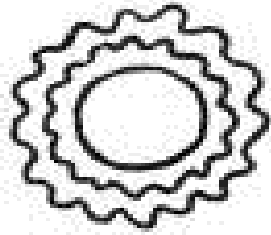
## Non-recommended work practices



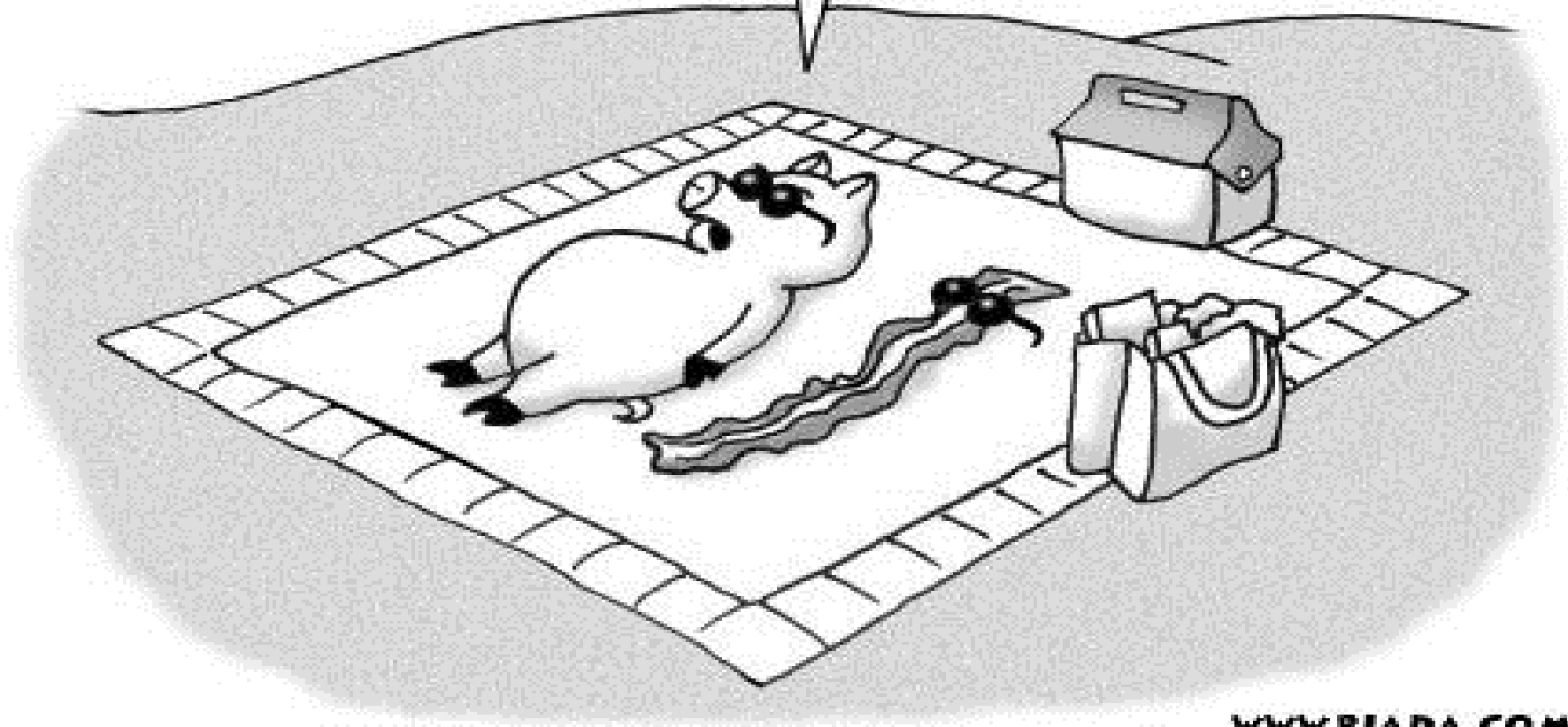
No one is Superman . . .

. . . Not even the expert.





Next time , it ´ s better for you  
to use some solar protection



**THANK YOU VERY MUCH**

**ENVIRONMENTAL TECHNICIAN LUCIANO DE OLIVEIRA  
BAPTISTA**