# Chemical Safety (I)
## Chemical Hazards and Controls

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# Important Reminder

Safety training courses provided by HSE only cover BASIC safety principles. Your supervisor is responsible for your job-specific safety training, including operational safety procedures, departmental safety policies, etc.

# Outline Of Presentation

- Evaluation of Chemical Hazards
- Control Approaches
- Description and Control of Different Types of Chemical Hazards
- Local Exhaust Ventilation

# Evaluation of Chemical Hazards

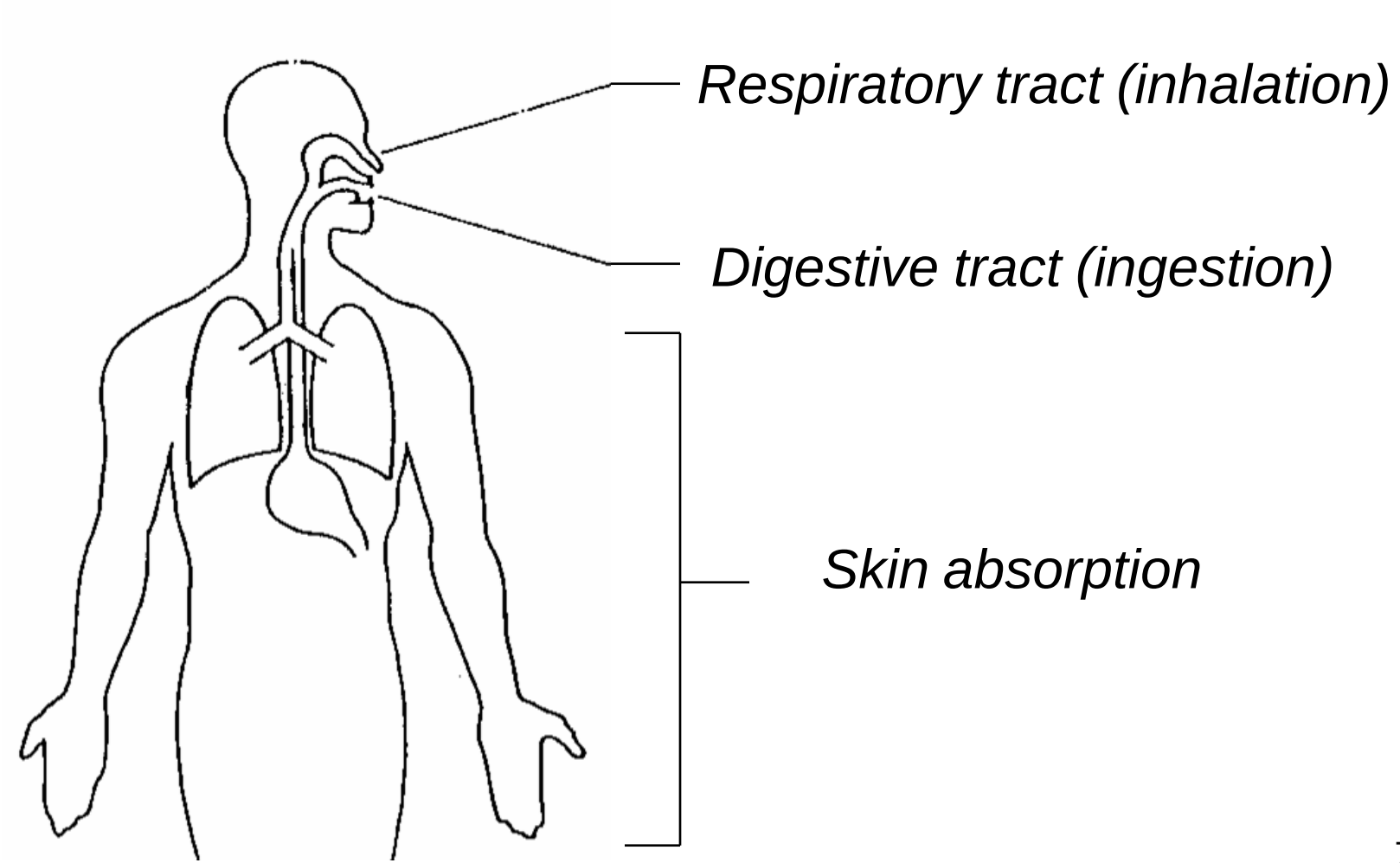
# Evaluation of Chemical Hazard

- Toxicity
  - Type of material
  - Physical state
  - Route of entry
- Quantity
  - Nature of operation
  - Duration of operation

# Toxicity Depends on Routes of Entry

- Toxicologists refer to "portals of entry"
- Inhalation - Most important industrially
  - Direct access to blood, limited metabolism
  - Potentially serious consequences
- Skin - Most common
  - Dermatitis the most common occupational disease
- Ingestion - Associated with poor personal hygiene or housekeeping

# How Chemicals Enter Our Body: Routes of Entry



# A Toxicity Reference Scheme

| Class | Oral Dose ($LD_{50}$) | For an Average Person |
|---|---|---|
| Practically Nontoxic | > 15 g/kg | > 1L |
| Slightly Toxic | 5 - 15 g/kg | 0.5 - 1L |
| Moderately Toxic | 0.5 - 5 g/kg | 30 - 500mL |
| Very Toxic | 50 - 500 mg/kg | 5 - 30mL |
| Extremely Toxic | 5 - 50 mg/kg | 7 drops - 5mL |
| Supertoxic | < 5 mg/kg | A taste (< 7 drops) |

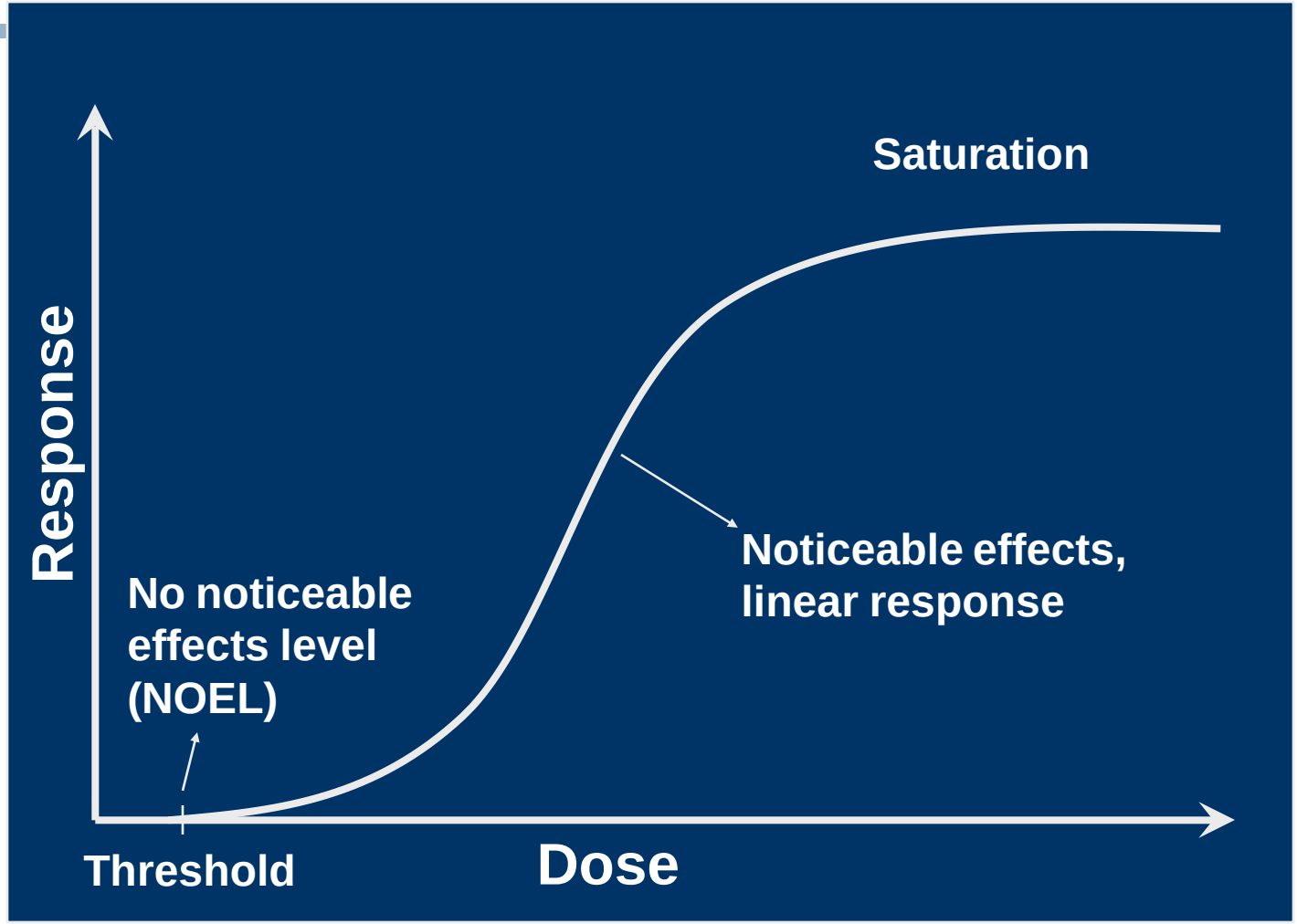
# Magnitude of the Hazard Depends on the Dose

- No good or bad chemicals
- All are toxic at some dose
- "The dose makes the poison"

*All substances are poisons; there is none which is not a poison. The right dose differentiates a poison and a remedy.*

Paracelsus
(1493-1541)

# More Dose Means More Risk



# Lethal Doses Vary

| *Material* | *rat oral $LD_{50}$ (mg/kg)* |
|---|---|
| Sucrose | 29,700 |
| Vitamin C | 11,900 |
| Ethyl alcohol | 7,060 |
| Table salt | 3,000 |
| Paracetamol | 1,944 |
| Metallic arsenic | 763 |
| Caffeine | 192 |

# Lethal Doses Vary (Continued)

| *Material* | *rat oral $LD_{50}$(mg/kg)* |
|---|---|
| Nicotine | 50 |
| Mercury (II) choride | 1 |
| Beryllium oxide | 0.5 |
| Dioxin (TCDD) | 0.02 |
| Botulinum toxin (human) | 0.000001 |

That's a range of 10,000,000,000=$10^{10}$!

# Toxics can be grouped by how quickly they act

- Acute toxicity - Fast (seconds - days)

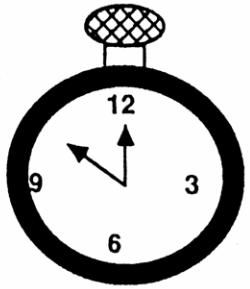
  "You'll know right away!"

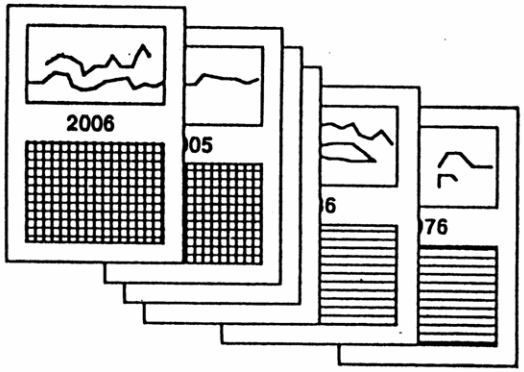
  Examples: ammonia, cyanides

- Chronic toxicity - Slow (months - decades)

  "Could catch up with you!"

  Examples: lead, asbestos, cadmium



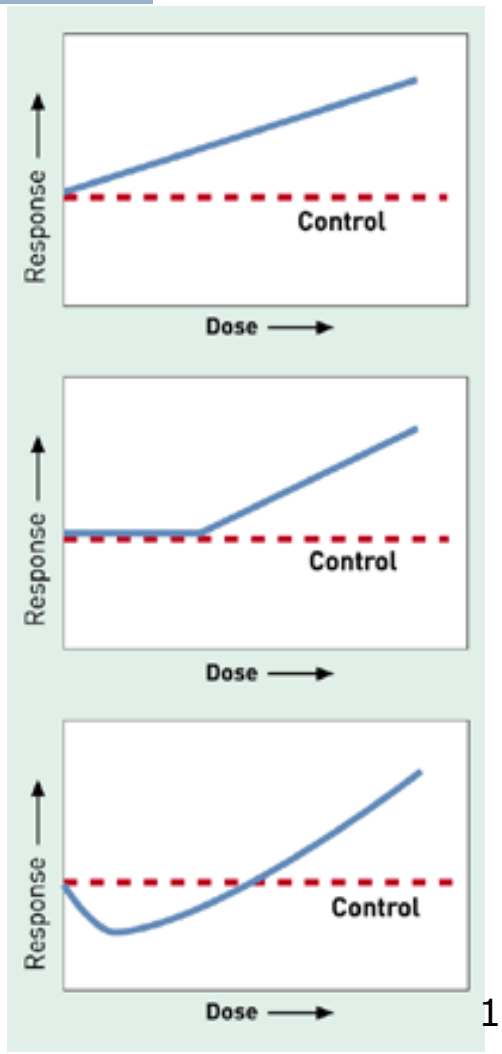



# Carcinogens

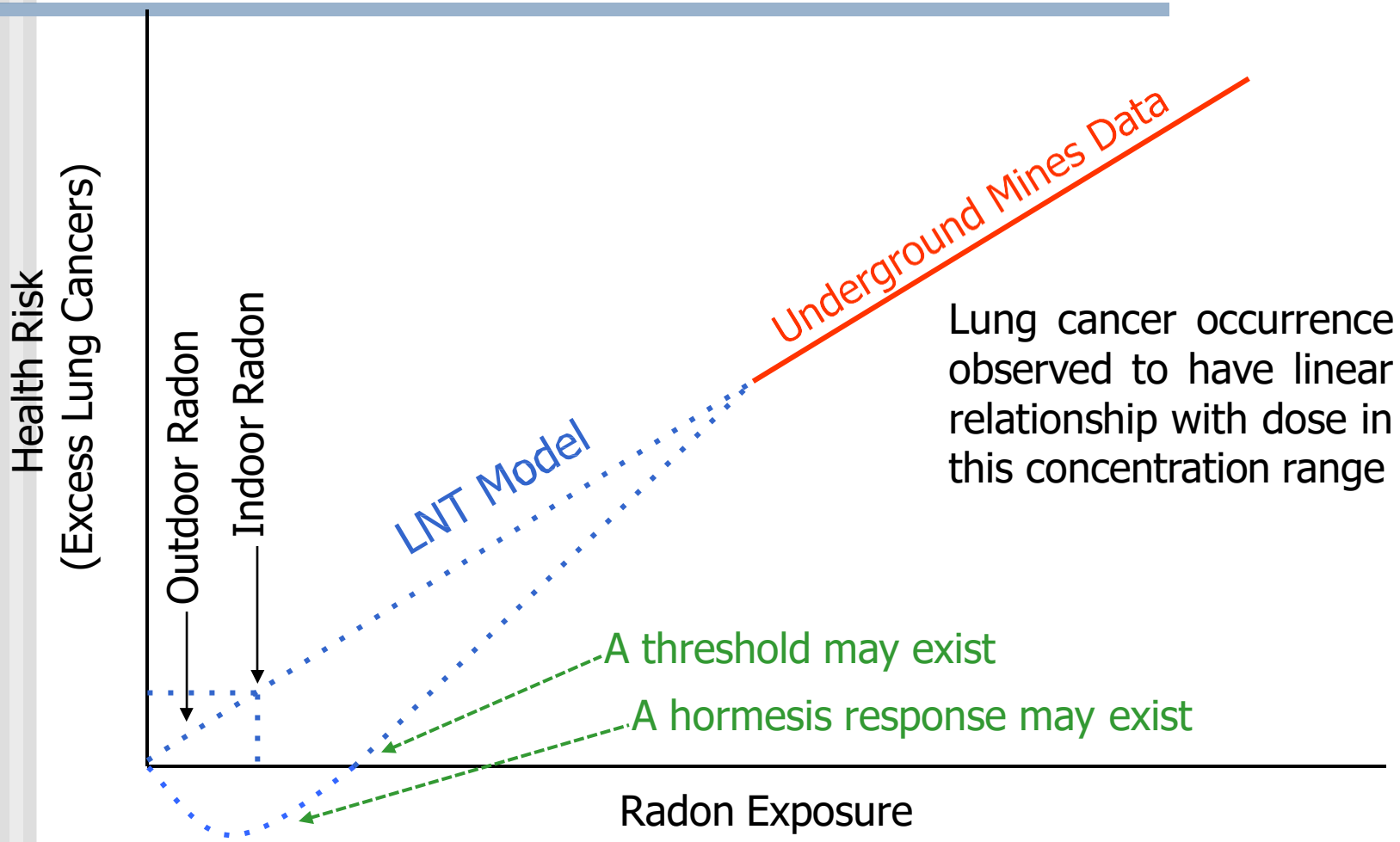
- Carcinogenesis not completely understood
- A multistage process that takes years to occur
- Conservative approach: assume “linear no threshold” dose response
- No “safe level”, only “acceptable risk”

# The Problem of Low Dose

- Linear (no threshold)
- Threshold ("safe level")
- Hormesis (stimulatory effect)



# Radon Exposure and Lung Cancer Risk

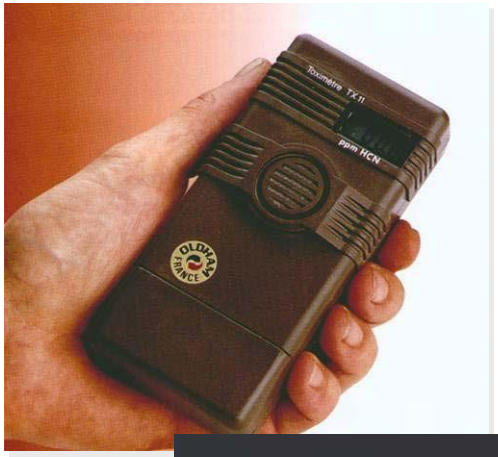


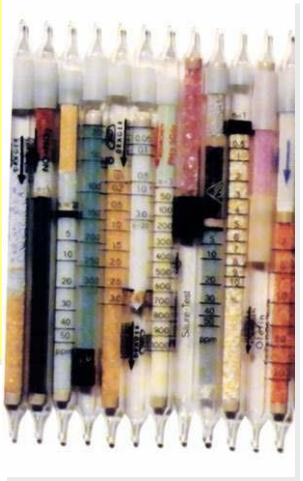
# Quantifying Chemical Hazard

- Exposure monitoring
- Airborne chemical concentration
  - Direct measurement
  - Air sampling and laboratory analysis
- Surface chemical sampling
- Bulk sampling and analysis

# Monitoring of Airborne Chemical Concentration (1)

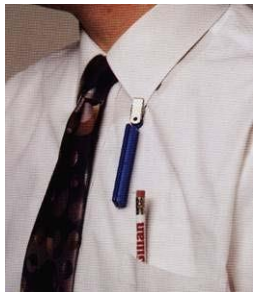
- Direct Measurement
  - On site, real time
  - Electronic instruments, fixed or portable
  - Colorimetric indicator (detector) tubes



# Monitoring of Airborne Chemical Concentration (2)

- Sampling and Laboratory Analysis
  - Sampling pumps and various media
  - Air sampling in field
  - Analysis in laboratory



# Occupational Exposure Limit - OEL

- Time-Weighted Average (TWA)
  - "the time-weighted average concentration for a conventional 8-hour workday and a 40-hour workweek, to which it is believed that nearly all workers may be repeatedly exposed, day after day, without adverse effect."

*American Conference of Governmental Industrial Hygienist* (ACGIH) Definition of Threshold Limit Value—Time Weighter Average (TLV-TWA)

# Example of TWA Calculation

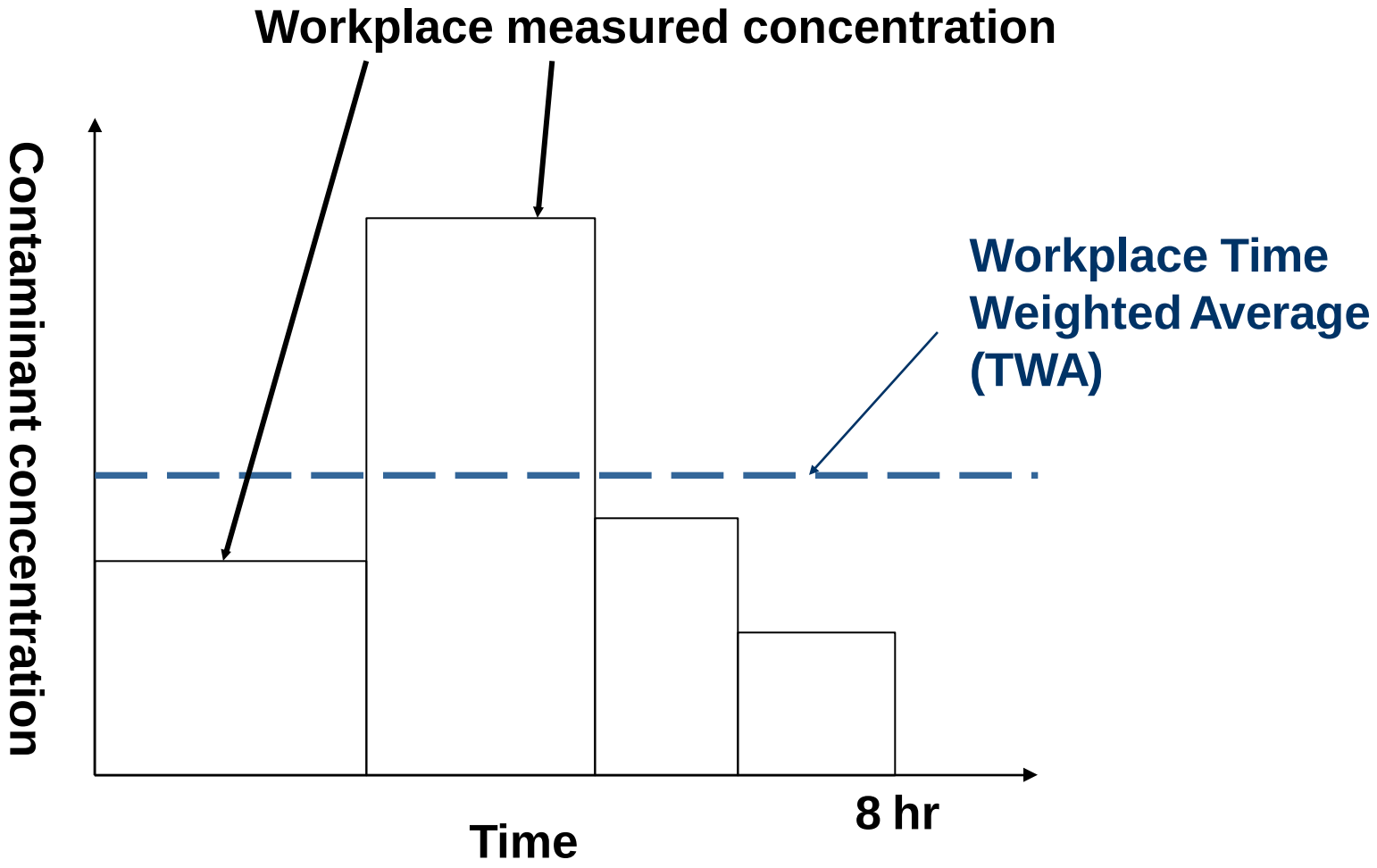
If a worker is exposed to Substance X under the following situation

- 10 units for 1 hour
- 20 units for 1 hour
- 5 units for 6 hours

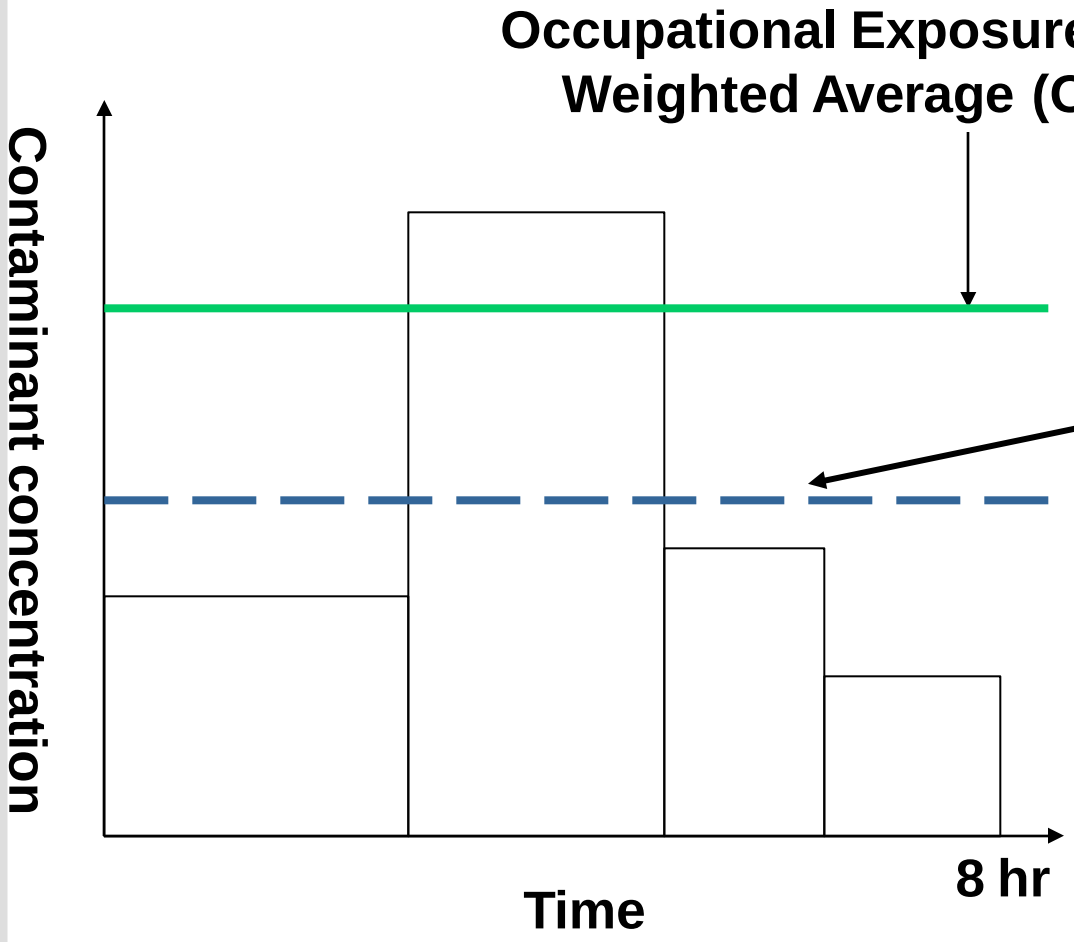
The correct calculation of the TWA is

[(10 x 1)+(20 x 1)+(5 x 6)] / 8 = 7.5 units

# Workplace Time Weighted Average



# Occupational Exposure Limit – Time Weighted Average (OEL-TWA)



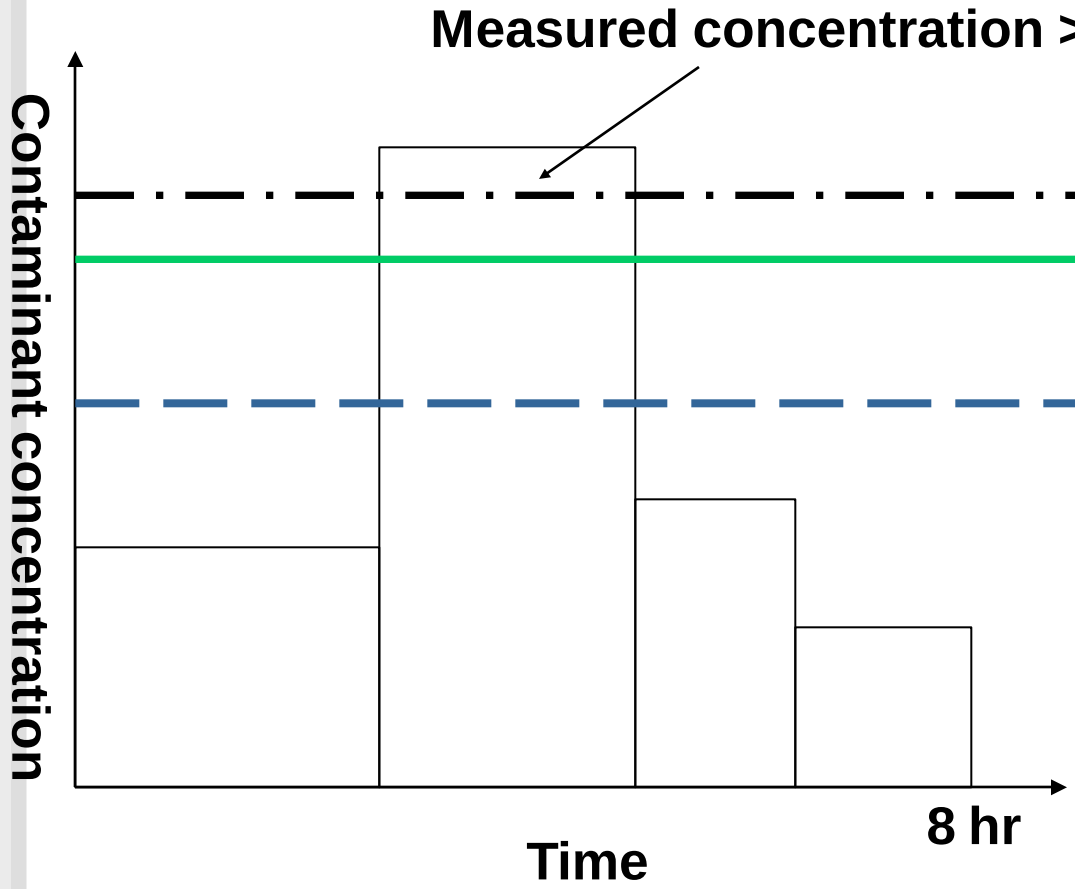

**Conclusion:**

**The workplace TWA is less than OEL – TWA. Therefore, the exposure is acceptable**

# Occupational Exposure Limit - OEL

- Short Term Exposure Limit (STEL)
  - An STEL is defined as a 15-minute TWA exposure which should not be exceeded at any time during a workday even if the 8-hour TWA is within the TLV-TWA.
  - Exposures above the TLV-TWA up to the STEL should not be longer than 15 minutes and should not occur more than four times per day. There should be at least 60 minutes between successive exposures in this range.

# Occupational Exposure Limit – Short Term Exposure Limit (OEL – STEL)

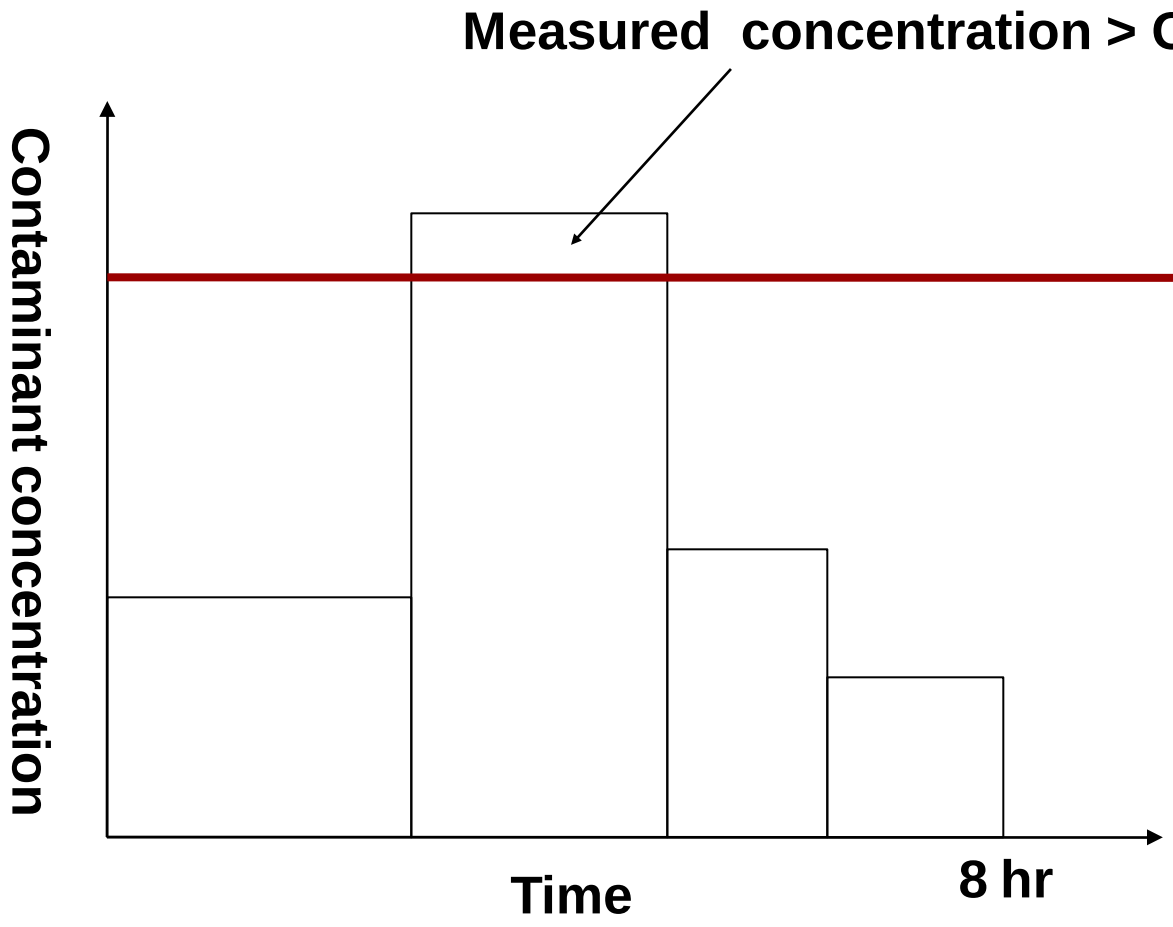



**Conclusion:**
**The workplace TWA is less than OEL-TWA but the measured concentration for one period is greater than OEL-STEL. Therefore, the exposure is not acceptable.**

# Occupational Exposure Limit - OEL

- Ceiling (C)
  - the concentration that should not be exceeded during any part of the working exposure.

# Occupational Exposure Limit – Ceiling (OEL – C)




**Conclusion:**

**The measured concentration is greater than OEL – C. Therefore, the exposure is not acceptable.**

# Example of Occupational Exposure Limits

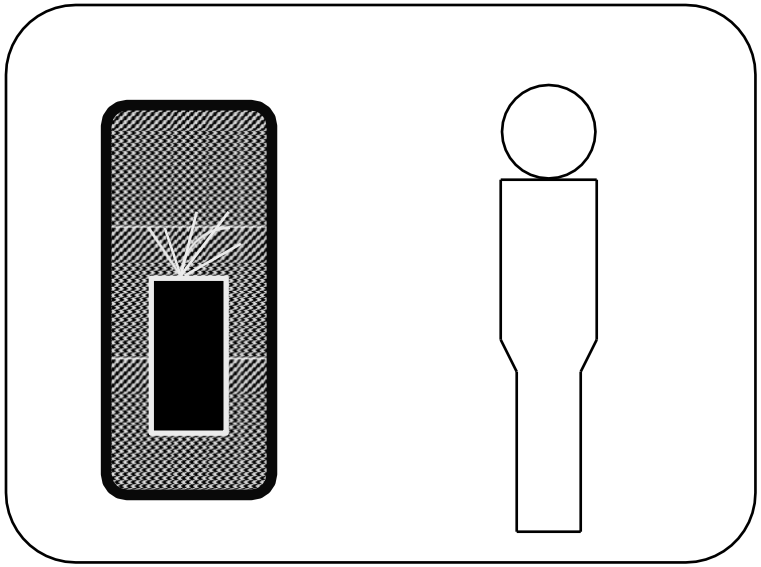
| | *TWA* | *STEL* | *CEILING* |
|---|---|---|---|
| Acetone | 500 | 750 | |
| Benzene | 0.5 | 2.5 | |
| Ethanol | 1000 | | |
| Hydrogen Cyanide | | | 4.7 |
| Hydrogen Sulfide | 10 | 15 | |
| Nitric Acid | 2 | 4 | |
| Toluene diisocyanate | 0.005 | 0.02 | |

Units: Parts Per Million volume by volume (ppmv)

# Control Approaches for Chemical Hazards

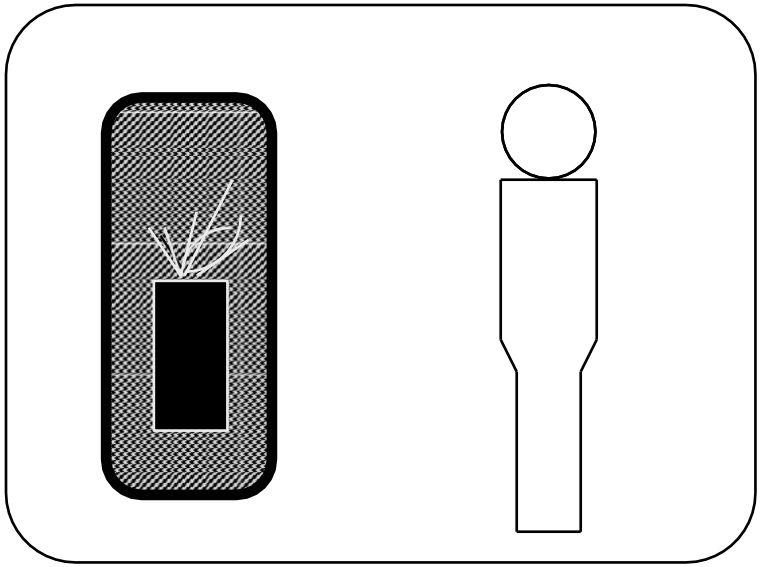
# Engineering Controls (I)

- Ventilation
- Isolation / enclosure
- Remote control
- Using less hazardous material
- Interlock
- Built-in safety features



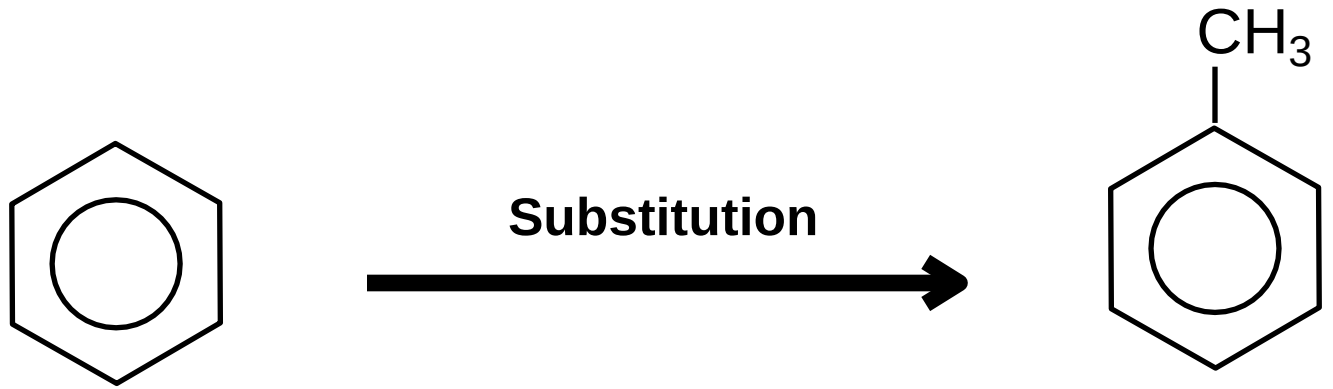
# Engineering Controls (II)

- Engineering controls are <u>preferred</u>:
  - "Fool-proof"
  - Easiest to use
  - Best chance of successfully protecting people!



# Examples of Engineering Control

Using less hazardous materials




**Benzene**

**Human Carcinogen**

**Toluene**

**Harmful**

# Examples of Engineering Control

**Glove Box: Isolation of air and water sensitive chemical**


**Explosion-proof Refrigerator: Storage of hazardous chemical**

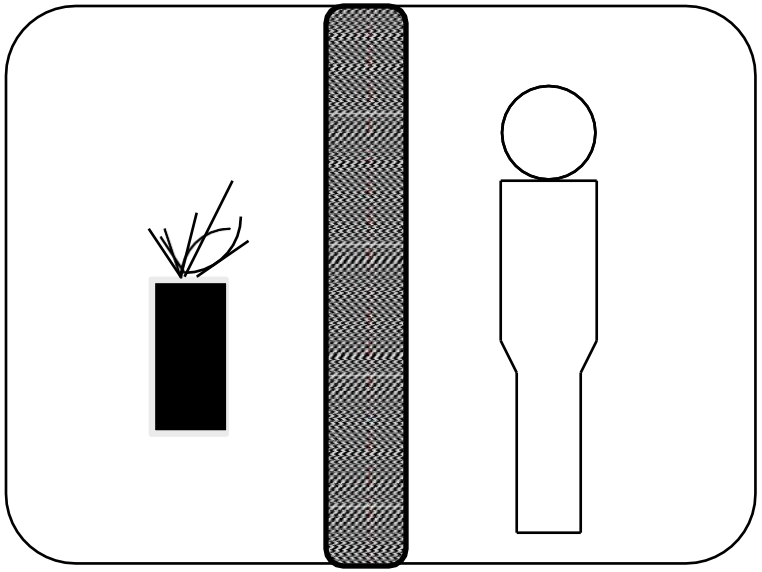
# Examples of Engineering Control

**Local Exhaust Ventilation**

**Total Enclosure – Ventilated Cabinet for a fluorine gas cylinder**

# Administrative Controls

- Work Procedures
- Work shift
- Training
- Warning devices
- Depends on the "human element"
- Less reliable than engineering control



# Examples of Administrative Control



**Warning Notices**

# Examples of Administrative Control

**Chemical Hazard Labels GHS Classification System**

Danger
Unstable, Explosive

Danger/Warning
Flammable

Danger/Warning
Oxidising

Warning
Compressed gas

Danger/Warning
Corrosive

Danger
Toxic

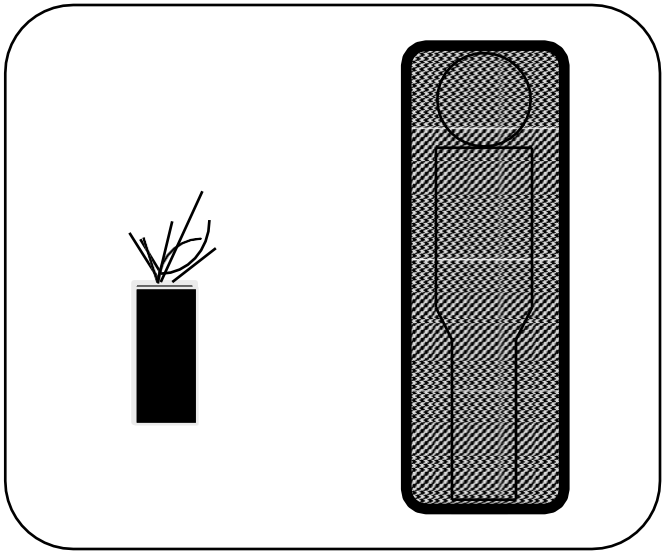
Warning
Toxic, Irritant, Lower systemic health hazards

Danger/Warning
Systemic health hazards

Warning
Environment

# Personal Protective Equipment (PPE)

- Last line of defense
- Lowest initial cost
- Depends on "human element"
- Strong demands on supervision
- Need to match PPE & hazards



# Examples of PPE

# Important Reminder: A Tragedy of PPE Mismatch

- Karen E. Wetterhahn was a professor of chemistry at Dartmouth College
- She became ill and died in 1997, at the age of 48
- A few drops of dimethyl-mercury was accidentally spilled onto her hands protected only by latex glove
- Delayed neurotoxic effects caused her to be hospitalized after 5 months, and she died 10 months after the accident.

# Chemical Compatibility of Glove Materials

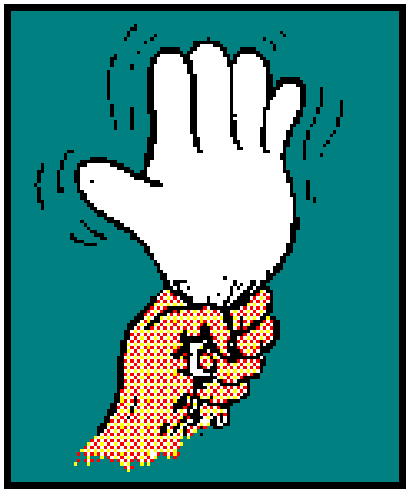
| Material | Generally Recommended | Not Recommended |
|---|---|---|
| Natural rubber (NR) | alcohols, caustics, ketones, many acids | aromatics, hydrocarbons, many solvents (especially chlorinated or aromatic solvents) |
| Nitrile Buna Rubber(NBR) | many acids, alcohols, caustics, hydrocarbons | ketones, chlorinated hydrocarbons, strong acids |
| Neoprene | organic acid, caustics, alcohols, petroleum solvents, ketones | aromatic and chlorinated solvents |

# Chemical Compatibility of Glove Materials (Continued)

| Material | Generally Recommended | Not Recommended |
|---|---|---|
| Polyvinyl chloride (PVC) | alcohols, caustics, hydrocarbons | aromatic and chlorinated solvents aldehydes |
| Butyl rubber | acids, ketones, esters, bases, alcohols, aldehydes | hydrocarbons, halogenated or aromatic hydrocarbons |
| Viton | chlorinated solvents, aromatics | ketones, ethers, amines, aldehydes |
| Polyvinyl alcohol (PVA) | solvents, including aromatic, chlorinated & petroleumsolvents | inorganics acids, alcohols, caustics |

# Reminders for Using Chemical-Resistant Gloves

- Check glove material compatibility with chemicals to be handled, but do not rely on colors
- Check for leak before use
- Dispose worn-out gloves, remember gloves are consumable items, they need to be changed regularly



# PPE May Save The Day

# Remember the Order of Preference

- Engineering Control
- Administrative Control
- Personal Protective Equipment

# Description and Control of Different Types of Chemical Hazards

# What Kinds of Chemicals Are We Concerned With? (1)

- Flammables
- Oxidizers
- Peroxidizables
- Shock sensitives
- Pyrophorics
- Water reactives
- Light sensitives

# What Kinds of Chemicals Are We Concerned With? (2)

- Corrosives
  - Acids
  - Alkalines
- Toxics
- Asphyxiants
- Cryogens

# Precautions Against Highly Reactive Chemicals (I)

- Recognize hazard
- Minimize quantities
- No extraneous materials in area of experiment
- Adequate ventilation for process
- Store properly:
  - Separate from incompatible chemicals
  - Use compatible containers
  - Use spill trays

# On-Line Info on Chemical Compatibility

- http://www.ab.ust.hk/sepo/Waste/incomp2.htm
- http://www.ab.ust.hk/sepo/Waste/incomp1.htm
- http://www.ab.ust.hk/sepo/Waste/hwcompe.htm
- http://www.ab.ust.hk/sepo/Waste/hwcompch.htm

# Precautions Against Highly Reactive Chemicals (II)

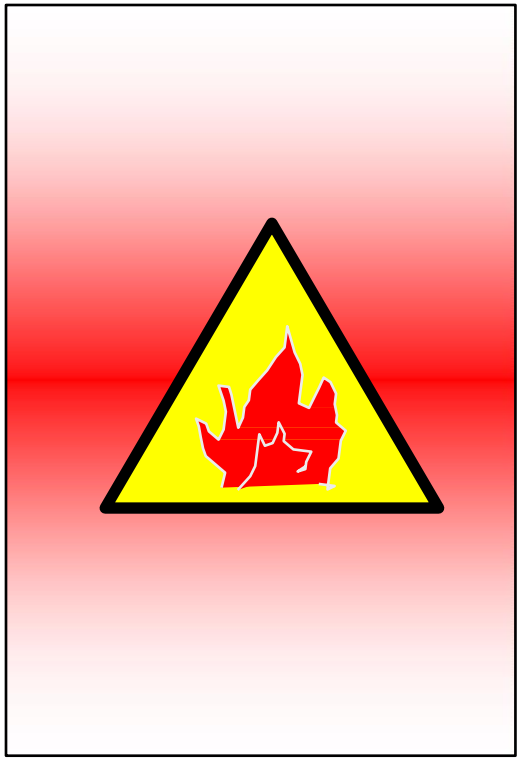
- Put up appropriate barriers if necessary
- Use Personal Protective Equipment:
  - Eye protection (mandatory)
  - Gloves (check compatibility)
  - Clothing (depends on work nature)
  - Respirator (type and cartridge depend on material being handled)
- Proper waste disposal

# Flammable Mixtures Only Burn in a Certain Range...

*100% vapor:0% air*

*Too rich*

*Upper explosive limit*



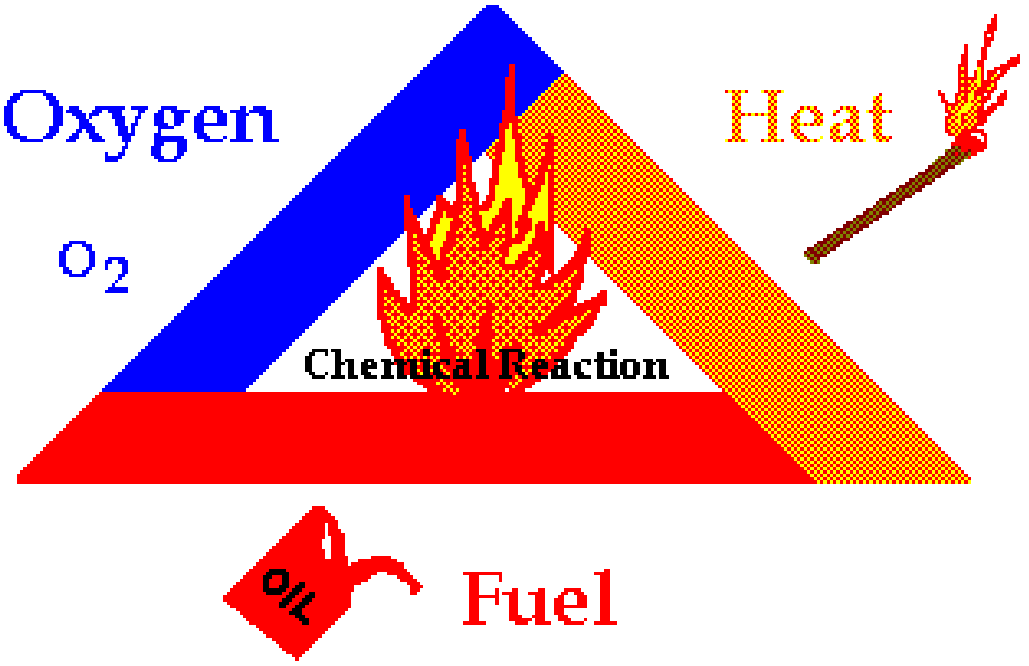
*Flammable range*

*Lower explosive limit*

*Too lean*

*0% vapor:100% air*

# Fire Triangle



# The Three Elements of Fire

To start a fire, there must be

- Fuel
- Oxygen
- Ignition Source

Therefore, to prevent a fire one needs to prevent the concurrent existence of the three elements

# Examples of Common Oxidizers

| ***Gases*** | ***Liquids*** |
|---|---|
| *Oxygen* | *Nitric acid* |
| *Ozone* | *Sulfuric acid* |
| *Halogens (chlorine, fluorine, etc.)* | *Bromine* |
| | *Sodium hypochlorite* |

***Solids***

| | |
|---|---|
| *Chromates* | *Perchlorates* |
| *Bromates* | *Nitrates and nitrites* |
| *Chlorates* | *Potassium permanganate* |

# Special Precautions for Oxidizers

- Beware of unexpected reactions
- Store separately from
  - bases
  - reducing agents
  - organic/flammable materials
- Use Corrosion resistant containers

# Some Chemicals Can Form Dangerous Peroxides

- Diethyl ether
- Tetrahydrofuran
- Di-isopropyl ether
- Potassium
- Acetaldehyde
- p-Dioxane

表2 有机过氧化物 GHS标签要素

| | 信号词 | 危险说明 | 防范说明 | 象形图 |
|---|---|---|---|---|
| A 型 | 危险 | H240：加热可能爆炸 | 预防：<br>P210；P220；<br>P234；P280；<br><br>应急：<br>无；<br><br>贮存：<br>P411+P235；<br>P410；P420；<br><br>处置：<br>P501 |  |
| B 型 | 危险 | H241：加热可能起火或爆炸 | |  <br>  |
| C 型 | 危险 | H242：加热可能起火 | |  |
| D 型 | 危险 | H242：加热可能起火 | | |
| E 型 | 警告 | H242：加热可能起火 | | |
| F 型 | 警告 | H242：加热可能起火 | | |
| G 型 | 无 | 无 | 无 | 无 |

《全球化学品统一分类和标签制度》(GHS制度) (2015年修订版)
《化学品分类和标签规范 第15部分: 氧化性固体》（GB30000.15-2013）

# Peroxidizable Iso-propanol

# Special Precautions for Peroxidizable Materials

- Dating product
  - At time of receipt at Lab
  - At time product is opened
- Test for peroxide every 3 months after opening
- Do not open containers with liquid layers or crystal on cap
- Store properly

# A Peroxide Warning Label

**WARNING : MAY FORM EXPLOSIVE PEROXIDES**

Store in tightly closed original container. Avoid exposure to light, air, and heat. If crystals, discoloration, or layering are visible, contact SEPO immediately. Check for peroxides before distilling or concentrating.

**THIS CHEMICAL HAS A LIMITED SHELF LIFE**

Received on_____Opened on _____

**PEROXIDE TEST RECORD**

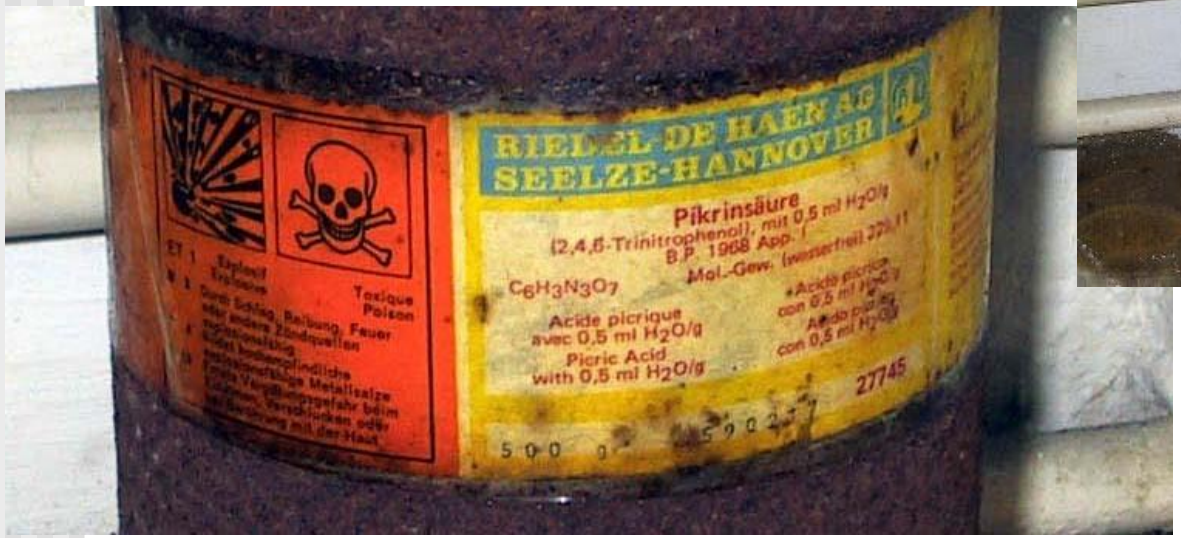
Test Date:_____ Peroxide:Y/N By: _____

Retest Date:_____ Peroxide:Y/N By:_____

# Some Chemicals are Shock Sensitive

- Peroxides
- Picric acid
- Azides
- Perchlorates

# Anhydrous Picric Acid




**Anhydrous Picric Acid is classified as explosive chemical**

# Protection From Shock Sensitive Chemicals

- Use protective measures against blasting
  - barriers
  - face shields
- Use special procedures
  - perchlorates
  - picric acid

# Some Chemicals are Pyrophoric

- Pyrophoric materials are those that are capable of spontaneous combustion in the presence of air
- Common Pyrophoric Compounds
  - Finely divided metals such as Ca
  - Alkali metals such as Na, K
  - White Phosphorous
  - Grignard reagents

# Precautions for Pyrophoric Chemicals

- Stored in tightly closed containers under an inert atmosphere ($N_2$) or liquid (Kerosene)
- Store and handle pyrophoric chemical in a glove box under nitrogen atmosphere

# Glove Box Suitable for Handling Pyrophorics

# On-Line Info on Explosive or Unstable Chemicals

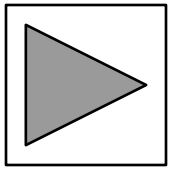
- Shock Sensitive Chemicals
- Peroxide Chemicals
- Peroxide Tests
- Prolonged Storage of Hazardous Chemicals
- MSDS

# Some Chemicals are Water Reactive

| **Solids** | **Liquids** |
| --- | --- |
| Alkali metals | Acetyl chloride |
| Calcium carbide | Chlorosulfonic acid |
| Magnesium | Silicon tetrachloride |
| Maleic anhydride | Stannic chloride |
| Anhydrous aluminum chloride | Sulfur chloride |
| Phosphorous pentachloride | Sulfuryl chloride |
| Phosphorous pentasulfide | Thionyl chloride |

# Special Precautions for Water Reactives

- Minimize scrap production
- Clean scraps up quickly and put in proper containers
- Eliminate ignition sources
- Work in an inert atmosphere
- Proper storage, some may require storage under oil



# Corrosives

- Chemicals that attack and damage biological tissues
- Acids
  - inorganic: sulfuric, nitric, hydrochloric
  - organic: formic, acetic
  - hydrofluoric
- Alkalines
  - hydroxides: potassium, sodium, ammonium

# Special Precautions for Corrosives

- Avoid contact with skin
- Use proper PPE
  - safety glasses/goggles, face shield
  - corrosive resistant gloves, apron, boots
  - respirator
- Storage in compatible containers
  - formic acid decomposes to $CO_2$, must use cap with relief device

# Toxics

- Include acutely and chronically toxic compounds, mutagens/carcinogens, teratogens
- Focus on chemical hygiene
- Use in fume hood to minimize intake through inhalation
- Follow safety procedures and use suitable PPE to prevent ingestion and skin absorption

# Simple Asphyxiants Are Very Common

- Argon, nitrogen, neon, helium, xenon, sulfur hexafluoride carbon dioxide, freons
- Exclude oxygen essential for life
- All could be hazards in confined spaces
  - Small rooms
  - Pits or basements
  - Tanks and Vessels

# What Are the Effects of Acute Oxygen Deficiency?

- Shortness of breath
- Headache
- Nausea
- Disoriented/confused
- Muscular weakness
- Uncoordinated
- Distorted vision/hearing
- Unconsciousness/coma/death

# How Much Oxygen Do We Need?

| Oxygen Conc. | Effects |
|---|---|
| 16% | Feeling dizzy |
| 15% | Lose muscle control |
| 12% | Permanent brain damage |
| 10% | Paralysis can occur |
| 7% | Unconsciousness |
| 6% | Death in 6-8 minutes |

# Important Note

- These symptoms may not occur.
- A person can slowly, quietly pass out without knowing anything is wrong!!

# Protection from Simple Asphyxiants

- Recognize the hazard
- Practice extreme caution in and around CONFINED SPACES:
  - evaluate the workplace
  - use calibrated oxygen monitors
  - be prepared for evacuation
- Proper pressure design/installation
- Handle cylinders and regulators carefully

# Chemical Asphyxiant Carbon Monoxide

- It keeps the blood's haemoglobin from carrying oxygen (victims have bright red skin color)
- An odorless, colorless, tasteless gas
  - Occupational Exposure limit 8-hr TWA 25 ppm
  - $LC_{lo}$ (human) 4,000 ppm
  - $TC_{lo}$ (human) 800 ppm
- Also flammable, LEL= 12.5%

# Chemical Asphyxiant Hydrogen Cyanide

- It inhibits transfer of oxygen from blood to tissue cells (combines with cell enzymes)
- A slight odor of almond
  - OEL Ceiling 5.7 ppm
  - 270 ppm in air is usually FATAL to humans
- LEL and UEL 6-41%

# Precautions for Chemical Asphyxiants (I)

- Avoid accidental formation of gas
  - Beware of incomplete combustion
  - NEVER add acid to cyanide solutions
- Properly design/install gas lines
- Ensure adequate ventilation and exhaust:
  - Laboratory hoods
  - Gas storage cabinets
  - Vented sheds for inactive cylinders

# Precautions for Chemical Asphyxiants (II)

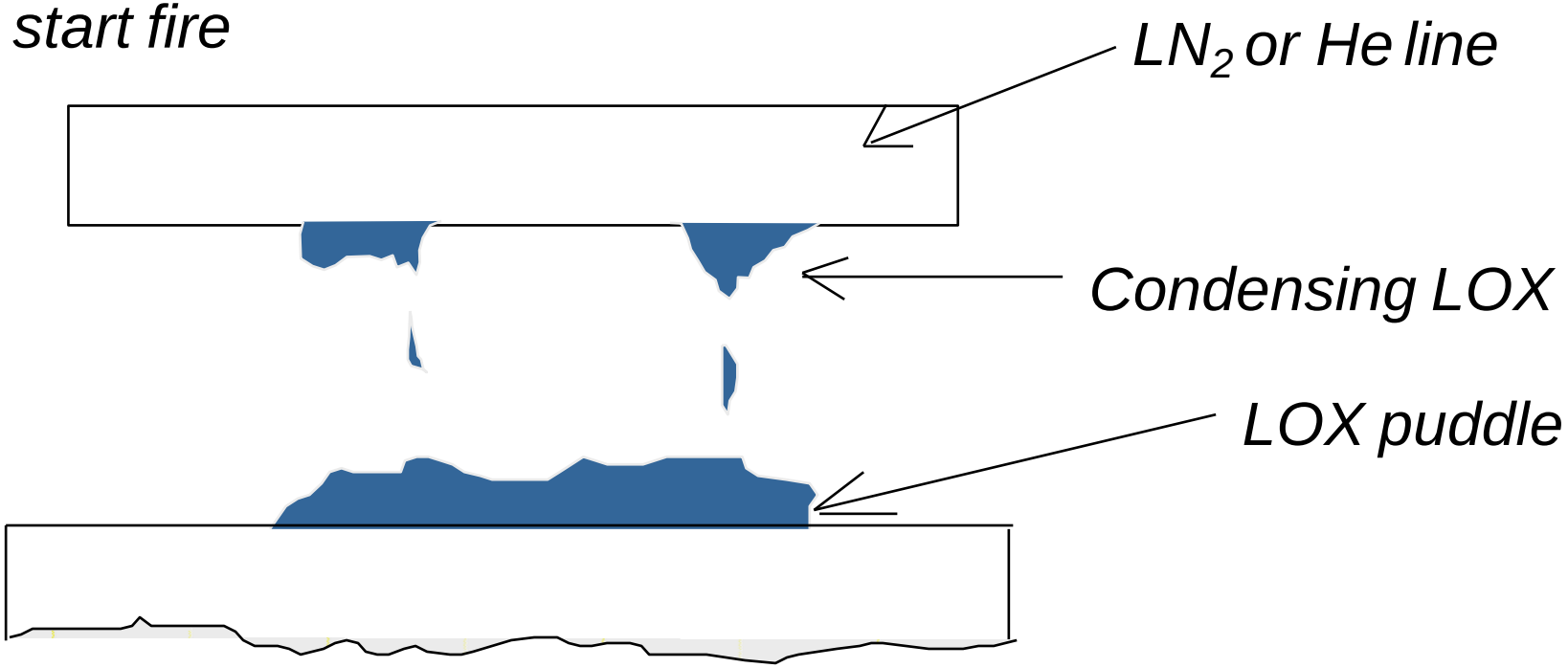
- Keep flames, sparks & hot objects away from where gas is in use
- For first aid - speed is essential
  - remove victim from exposure
  - seek immediate medical attention

# Cryogenic Liquids Can Cause Hazards

- Pressure
- Embrittlement
- Asphyxiation
- Skin burns
- Fire


# Watch Out for LOX formation!

- *$LN_2$/LHe are so cold they can condense oxygen out of air*
- *LOX dripping on asphalt, oils and flammables can start fire*



# How Do You Protect Yourself From Cryogens?

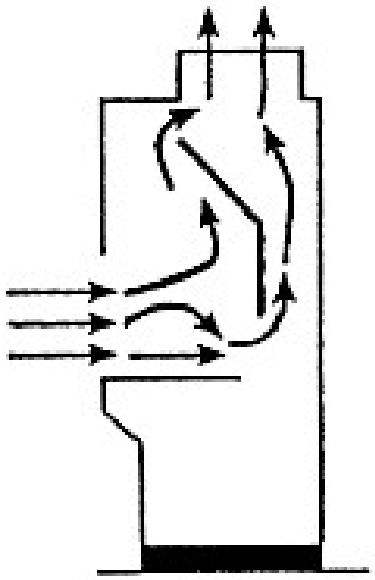
- Clean containers & equipment
- Control the making of mixtures to prevent explosions
- Personal protective equipment:
  - use full face protection
  - wear a lab coat or apron
  - cuffless trousers & high topped shoes
  - gloves which are impervious & large

# How Do You Protect Yourself From Cryogens?

- Remove watches and rings
- Use Pressure relief devices
- Work in a well-ventilated area

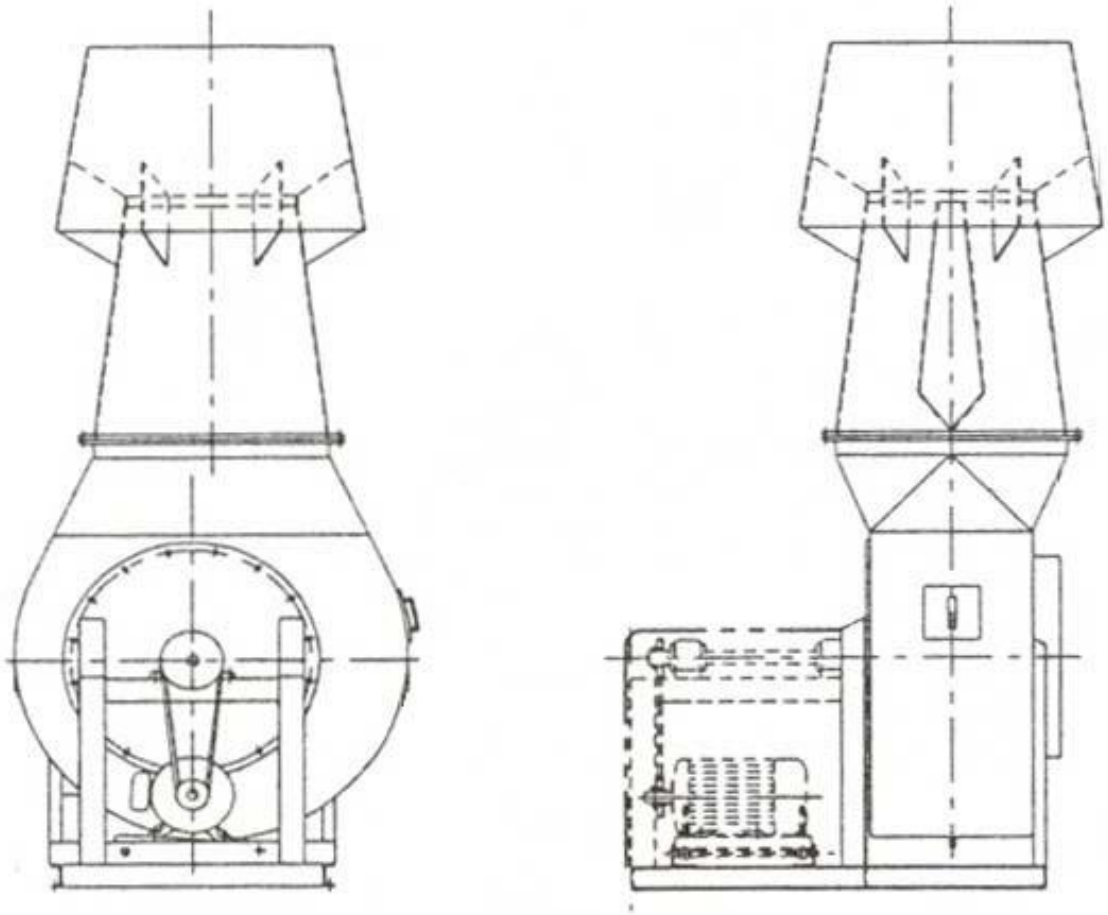
# Local Exhaust Ventilation

# Chemical Fume Hood



Chemical
Fume Hood


CAUTION



Virtual Stack Fans

# Reminder for Fumehood Usage

- Ensure fumehood is running properly, and is regularly maintained
- Always lower sash as much as possible
- Leave at least 15 cm in front and 3 cm at the back of fumehood work area
- If bulky equipment is put inside a fumehood, elevate it to allow air movement
- Maintain good housekeeping, do not use fumehood for storage


NORMAL OPERATING
HEIGHT 500mm
AIR FAIL
AIR SAFE
ALARM
MUTE

# What should you do when the low flow alarm is on?

- Stop working in fumehood at once
- Lower sash and wait for alarm to stop
- May mute audible alarm while waiting
- If low flow alarm does not go away after 15 minutes, call Labor Service at 88339099
- If low flow causes a hazardous situation, call Security Control Centre at 88330110


What's wrong with this fumehood?
CAUTION
HIGH TEMPERATURE
memmert
CAUTION
HOT
SURFACES

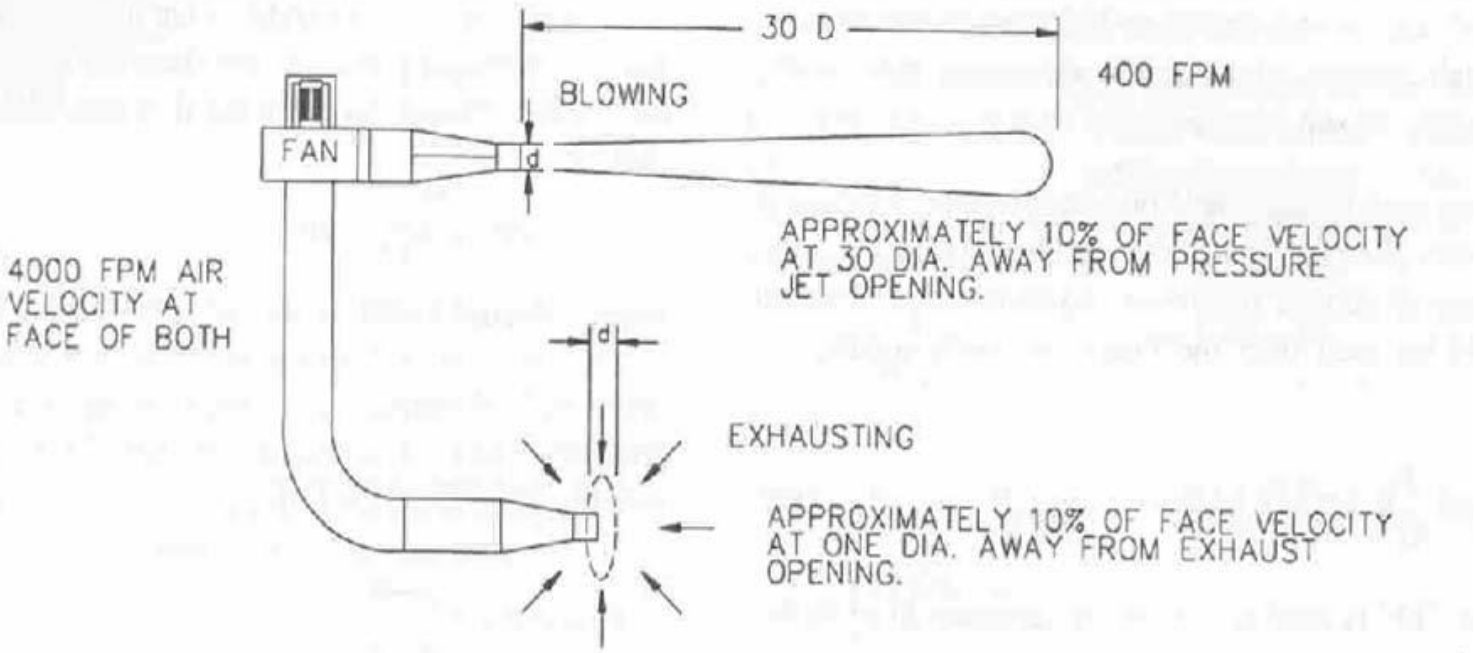
# Reminder for Ductless Fumehood Usage

- Ductless fumehoods re-circulate air and rely on filters/treatment systems to remove contaminants, user must ensure filter/system match chemicals to be used
- Check sash position and flow indicator, ensure face velocity is 0.4-0.5 m/s
- Look out for saturation alarm or counter reading to check for filter breakthrough
- Never use ductless fumehood for chemical storage

# Things to Remember About Local Exhaust Points

- Must have adequate air flow to capture air contaminants
  - Look for label with designed air flow
  - Look for label of field verification of air flow
- The closer the better

# Blowing vs Exhausting



# HKUST(GZ) Guidelines for the safety management of hazardous chemicals in laboratories

# Controlled chemicals

| 管理分级 | 一级管理 | | |
|---|---|---|---|
| 分类 | 剧毒化学品 | 麻醉药品及第一类精神药品 | 第一类易制毒化学品 |
| 具体品名 | 剧毒化学品目录（2015年版） | 麻醉药品品种目录（2013年版）及精神药品目录（2013年版）第一类精神药品 | 第一类易制毒化学品目录（2018年版） |
| 管理方式 | 二级单位集中储存管理 | | |
| 管理要求 | 双人收发及运输至少有一位是在岗教职工；双人记账、双人双锁、双人领取、双人监督使用 | 双人收发、双人记账、双人双锁、双人领取、双人使用 | 双人领取及登记、双人双锁 |
| 规范要求 | 剧毒化学品，应当在专用仓库内单独存放，并实行双人收发、双人保管制度 | 药品入库双人验收并签字，出库双人复核，做到账物相符，实行专人（双人）负责、专库（柜）双锁保存。 | 双人双锁，双人领取 |
| 储存场所要求 | 1.二级单位储存场所建设符合（GA 1002-2012）剧毒化学品、放射源存放场所治安防范要求并通过保卫处的认定验收。2.设有专用储存用保险柜。 | 1.场所建设通过保卫处的资格认定，达到相应治安防范要求。<br>2.专用保险柜储存。 | |
| 使用要求 | 1.实验室向所在单位申请领用；<br>2.实验室设双人双锁的临时储存保险柜，用于存放当天领用的化学品，且监控必须覆盖整个实验区域及实验室出入口。<br>3.不得在实验室过夜，当天使用完毕离开实验室前，必须将该剩余化学品交回所在单位保管人；<br>4.二级单位做好库房管理台帐、实验室做好使用台账；<br>5.二级单位定期检查实验室的使用管理情况。 | | |
| 处置要求 | 废弃物需单独存放在符合相应安全条件的专用柜，并张贴有明显相应警示标识。 | 按香港科技大学（广州）<br>危险废物管理规定执行 | |

# Controlled chemicals

| 管理分级 | 二级管理 | | |
|---|---|---|---|
| 分类 | 第二类精神药品 | 毒性药品 | 易制爆化学品 |
| 具体品名 | 精神药品目录（2013年版）第二类精神药品 | 《医疗用毒性药品管理办法》所附的《毒性药品管理品种》（1988年版） | 易制爆危险化学品名录（2017年版） |
| 管理方式 | 可由实验室储存管理所在单位负责日常监管 | | |
| 管理要求 | 专人保管，保管人必须是在岗教职工 | “双人验收入库、双人领取使用、 双人归还、双人保管记账、双人双锁保管”的五双制度。保管“双人”必须是在岗教职工。 | 双人领取及登记、双人双锁， |
| 规范要求 | 专库或者专柜储存第二类精神药品，并建立专用账册，实行专人管理 | 使用毒性药品的单位必须建立健全保管、验收、领发、核对等制度，严防收假、发错，严禁与其他药品混杂，做到划定仓间或仓位，专柜加锁并由专人保管。 | 构成重大危险源的易制爆危险化学品，应当在专用仓库内单独存放，并实行双人收发、双人保管制度 |
| 储存场所要求 | 1.场所建设通过保卫处的资格认定，达到相应治安防范要求。<br>2.专用保险柜储存。 | 1.场所建设通过保卫处的认定，达到相应治安防范要求。<br>2.专用保险柜储存。 | 1.场所建设应符合（GA 1511-2018）易制爆危险化学品储存场所治安防范要求<br>并通过保卫处的资质认定。<br>2.专用储存柜储存，按安全特性分类存放 |
| 使用要求 | 1.当天使用完毕离开实验室前必须归还实验室保管人；<br>2.实验室台账管理；<br>3.二级单位定期检查实验室使用台账建设、安全规范储存、使用和处置情况并做好检查记录。 | | |
| 处置要求 | 按香港科技大学（广州）危险废物管理规定执行 | 废弃物应单独存放在符合相应安全条件的专用柜，并张贴有明显相应警示标识。 | 按香港科技大学（广州）危险废物管理规定执行 |

# Controlled chemicals

| | |
|---|---|
| **管理分级** | **三级管理** |
| **分类** | 第二、第三类易制毒化学品 |
| **具体品名** | 易制毒化学品目录（2018年版）第二、第三类易制毒化学品 |
| **管理方式** | 可由实验室储存管理所在单位负责日常监管 |
| **管理要求** | 专人保管，保管人必须是在岗教职工 |
| **规范要求** | 严格执行易制毒化学品存储和出入库制度，做到出入库记录完整、记录台账清晰，做到票据、账面记录与实物相符 |
| **储存场所要求** | 存放在上锁的符合安全要求的实验柜中，按安全特性分类存放。 |
| **使用要求** | 1.实验室台账登记；<br>2.二级单位定期检查实验室使用台账建设、安全规范储存、使用和处置情况并做好检查记录。 |
| **处置要求** | 按香港科技大学（广州）<br>危险废物管理规定执行 |

# Uncontrolled chemicals

| | |
|---|---|
| **管理分级** | **四级管理** |
| **分类** | 气瓶及实验室常用危险化学品 |
| **具体品名** | 危险化学品目录（2015 版） |
| **管理方式** | 可由实验室储存管理所在单位负责日常监管 |
| **管理要求** | 指定实验室专人领取及收发登记 |
| **规范要求** | 严格执行学校危险化学品管理暂行规定要求 |
| **储存场所要求** | 所在单位负责对实验室的储存条件进行审核认定。 |
| **使用要求** | 实验室按包装规格一次性登记，使用完毕及时销账。定期更新实验室的相关台账，做到物账相符，按安全特性分类存放。 |
| **处置要求** | 按香港科技大学（广州）<br>危险废物管理规定执行 |

# Reference


- 《危险化学品登记管理办法》(2012年修订版)
- 《危险化学品安全管理条例》(2013年修订版)
- 《全球化学品统一分类和标签制度》(GHS制度) (2015年修订版)
- 《化学品安全标签编写规定》(GB 15258-2009)
- 《化学品分类和标签规范 第15部分: 氧化性固体》(GB30000.15-2013)
- 《易制毒化学品名录》(2021年版)
- 《剧毒化学品、放射源存放场所治安防范要求》(GA 1002-2012)
- 《易制毒化学品管理条例》(2018年修订版)
- 《易制毒化学品购销和运输管理办法》(2006年版)
- 《剧毒化学品购买和公路运输许可证件管理办法》(2005年版)
- 《药品类易制毒化学品管理办法》(2010年版)
- 《麻醉药品和精神药品管理条例》(2016修订版)
- 《易制爆危险化学品名录》(2017年版)
- 《易燃易爆性商品储存养护技术条件》(GB 17914-2013)
- 《易制爆危险化学品储存场所治安防范要求》(GA 1511-2018)
- 《易制爆危险化学品治安管理办法》(2019年版)

# ~End of Part I~

To be Continued:

Chemical Safety (II)

Nanosafety, Waste Management & Emergency Response