



# ASSESSING ASBESTOS IN SOILS, RISK ASSESSMENT AND DETERMINING ACTIONS - AN OCCUPATIONAL HYGIENIST'S PERSPECTIVE



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# Presenter

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# Session Contents

- **Asbestos and Occupational Hygiene**
- **Sources of Asbestos Contamination**
- **Terminology**
- **Sampling and Results**
- **Risk Assessment**
- **Legislation**
- **Management of Asbestos Impacted Soil**

# Occupational Hygiene

In the words of the text books

- **Anticipation**
- **Identification**
- **Evaluation**  
(measurement & interpretation)
- **Control**

of Workplace Health Hazards

# Asbestos Types

- Many different types
- Only 3 types mined commercially
  - Chrysotile (White Asbestos)
  - Amosite (Brown Asbestos)
  - Crocidolite (Blue Asbestos)
- World production - >90% chrysotile.



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# Two Categories of Products

- **Friable Materials**
  - Easily Disturbed
  - If disturbed - potential for elevated airborne fibres
  - Typically 70-100% asbestos
- **Bonded Materials**
  - Asbestos bonded into matrix
  - Requires significant disturbance to liberate airborne fibres
  - AC Sheeting assumed to be 15% asbestos

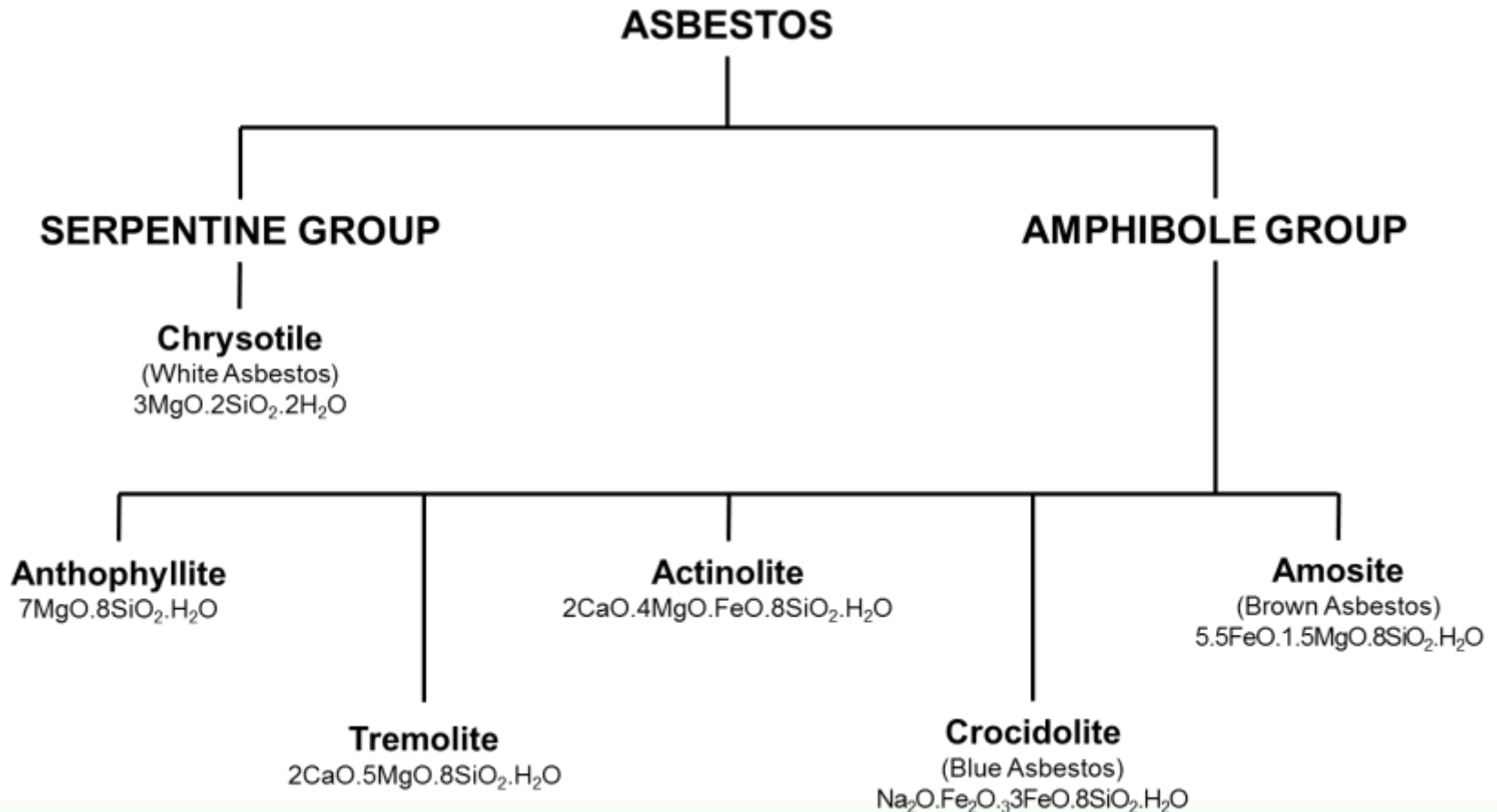
# Friable



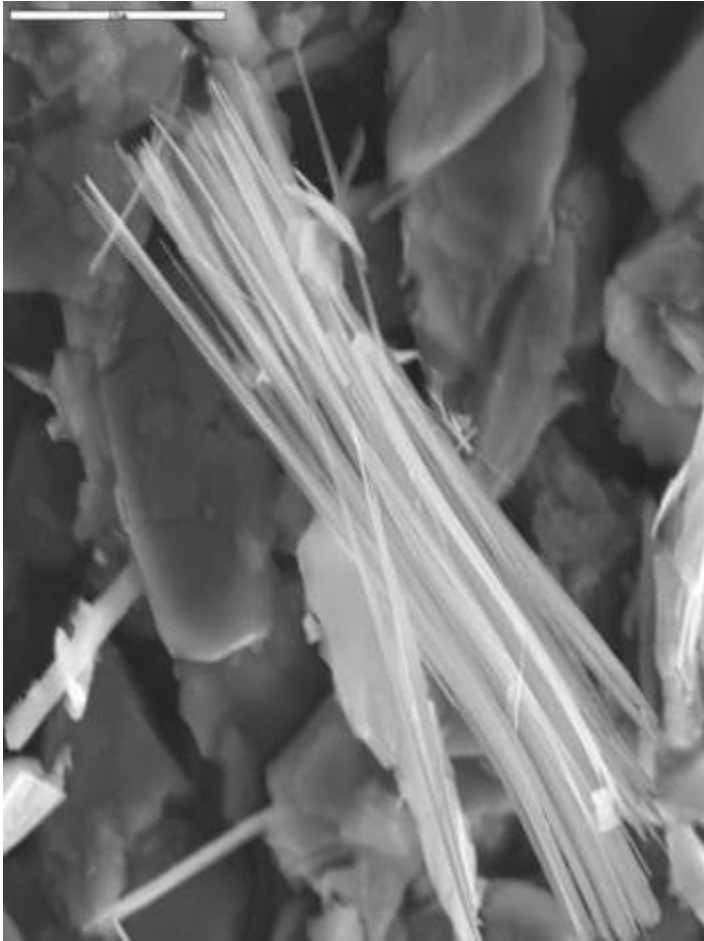
# Bonded



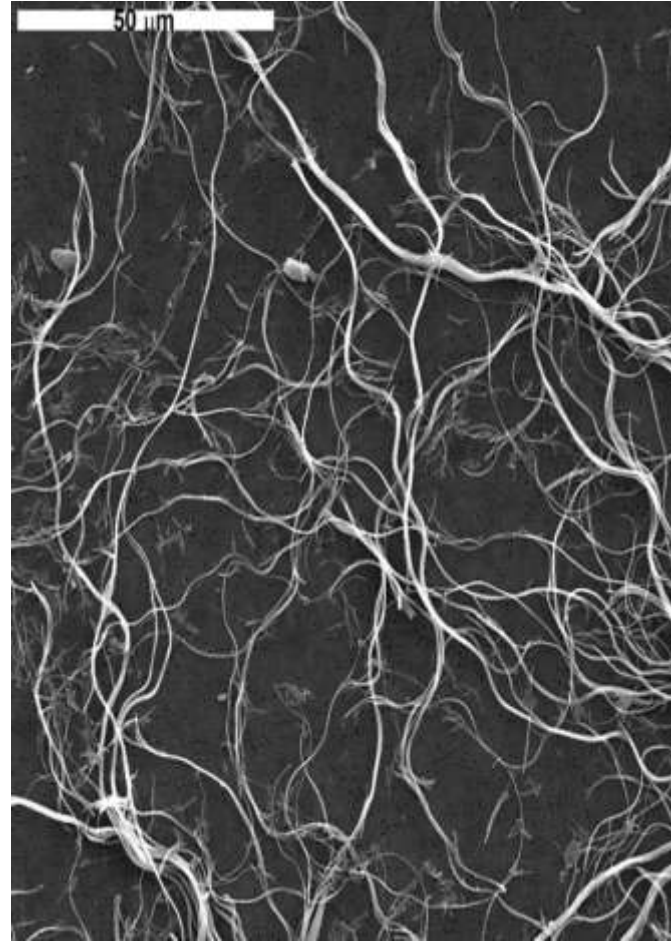
# What is Asbestos?



# Morphology



**Amphibole Fibre**



**Serpentine Fibre**



# Rupture of Fibres



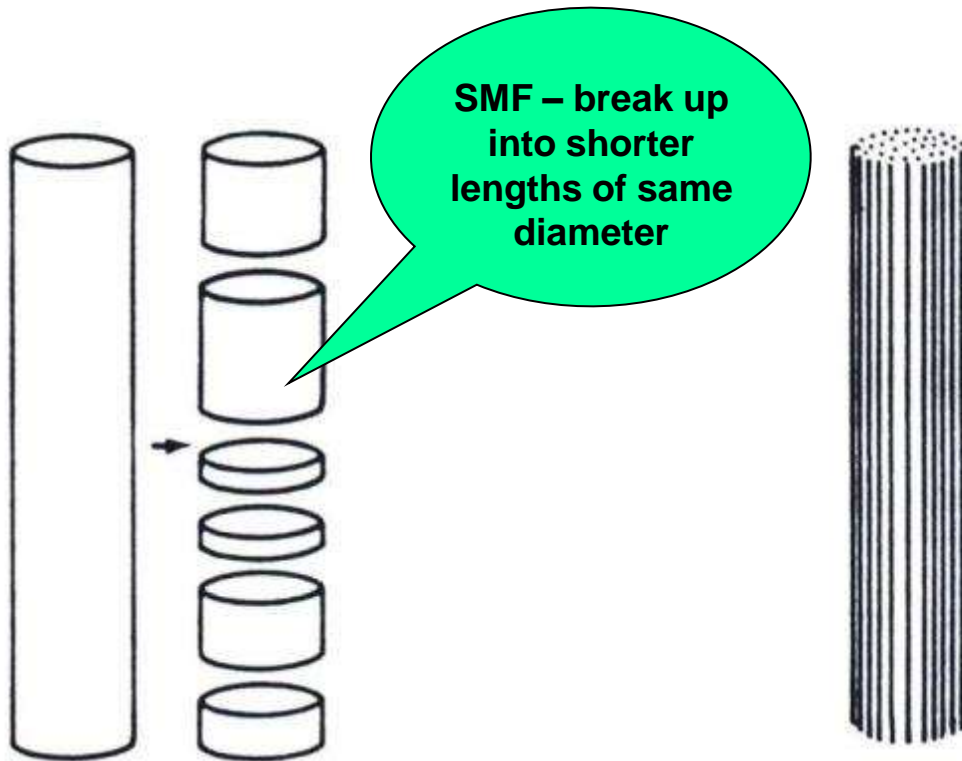
Man-made fibres



Asbestos fibres



# Rupture of Fibres



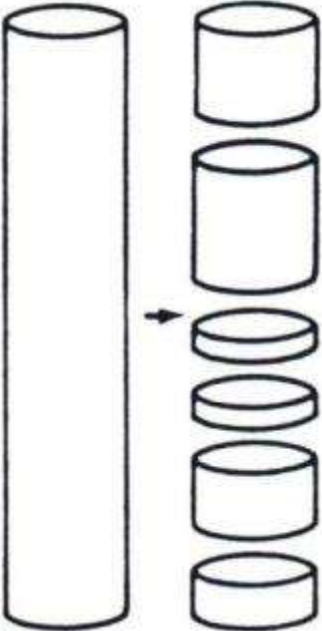
Man-made fibres

Asbestos fibres





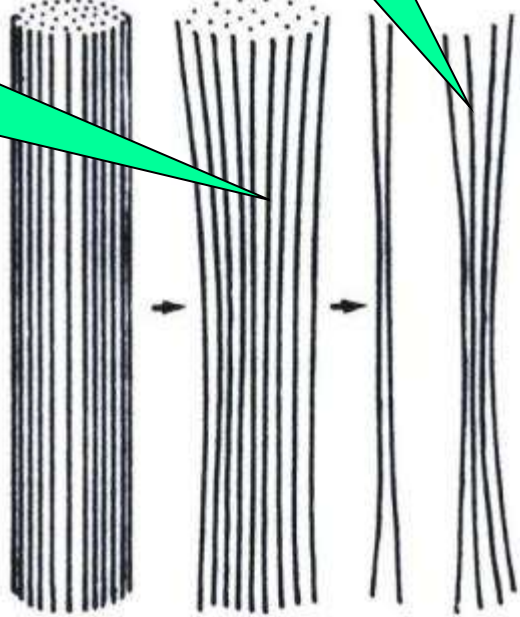
# Rupture of Fibres



Man-made fibres  
Asbestos fibres

Asbestos fibres –  
comprised of  
bundles of  
microscopic fibrils.

Asbestos fibres –  
when ruptured  
releases fibres of  
smaller diameter.



# Respirable Fibres

- Asbestos Exposure is measured by the Inhalation of Respirable Fibres
- Not all airborne asbestos fibres are respirable.
- Respirable size range
  - Length > 5 microns
  - Width < 3microns
  - Aspect ratio > 3:1
- Respirable Fibres
  - aerodynamic characteristics to penetrate into the lungs – Serpentine or Amphibole???



# Sources of Asbestos Contamination



# Sources of Soil Contamination

- Degradation of structures
- Stormwater runoff
- Inappropriate demolition
- Illegal dumping or inappropriate historical disposal
- Contaminated landfill material
- Fire damage
- Storm damage
- Underground services
- Mining tailings
- Proximity to Naturally Occurring Asbestos



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# Characteristics of Soil Contamination

- **Typically non homogeneous**
- **Source is typically non friable asbestos material – bonded ACM**
- **Typically not mobile – bonded**
- **Not leachable**
- **Most significant on surface**
- **Only impacts humans**
- **Emotive!!!**





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# Terminology

## Hygiene

Friable

Non-Friable (Bonded)

Asbestos Contaminated Dusts  
and Debris (ACDD)

## Environmental

- Non-Friable (Bonded ACM)
- Asbestos Fines (AF) (NEPM: Friable)
- Fibrous Asbestos (FA) (NEPM: Friable)

# Friable



# Fibrous Asbestos



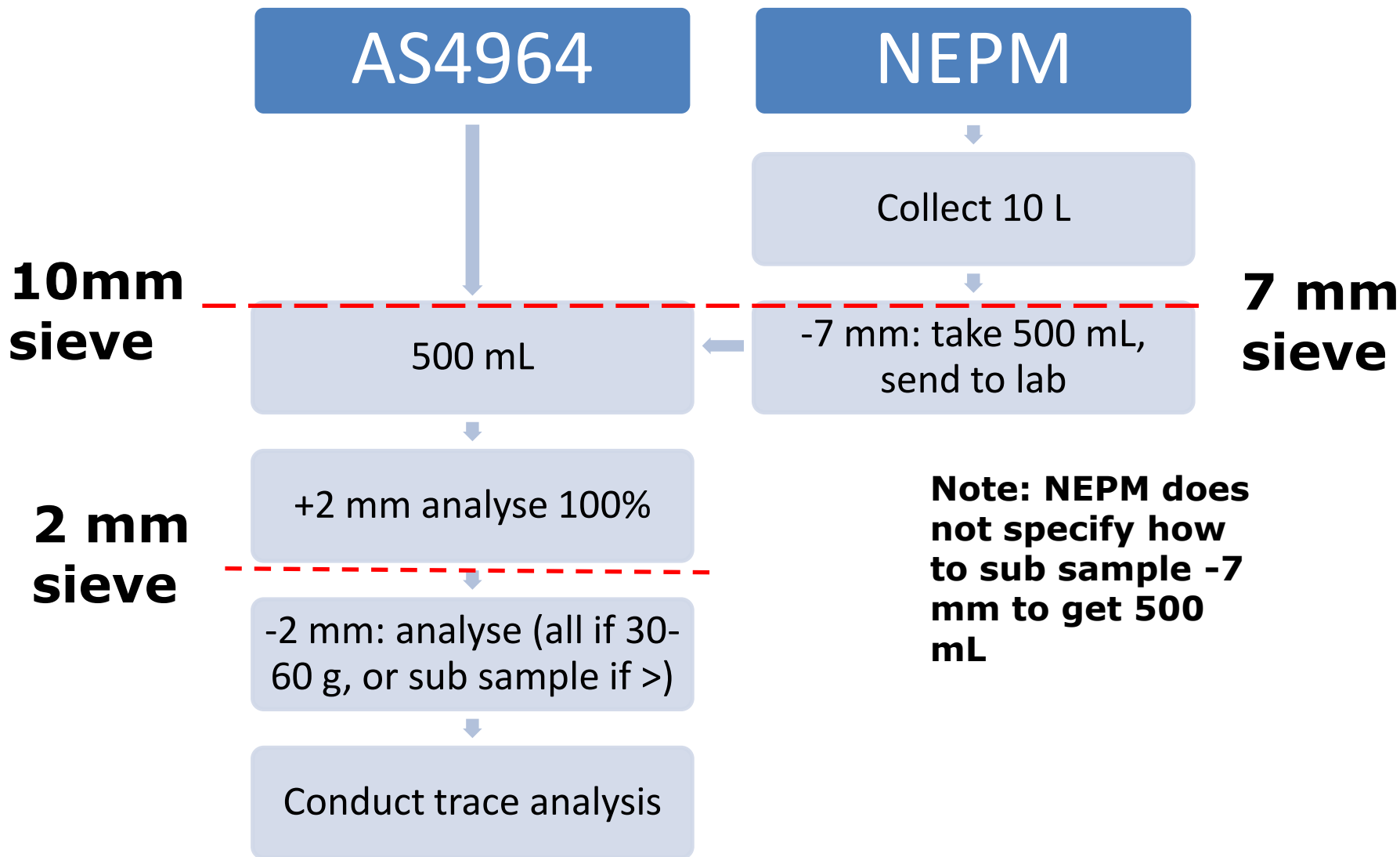
# “Friable”

- The term **FRIABLE** in relation to soil is confusing
- Friable asbestos is a material that is capable of releasing measurable airborne respirable fibres
- Classification of ‘friable’ ACM defines:-
  - Risk profile and the class of removal contractor required to remove it, and
  - Level of controls for removal
  - WHS Regulations and CoP

# Sampling and Results

- Purpose – Hygiene
- Purpose – Environmental
- Analytical Methods – AS4964
- Sampling Methods – NEPM
- Reporting of Results
- Interpretation of Results

**Note: AS4964 does not specify how much soil is to be collected**





# Trace Analysis

- Trace analysis:-
  - Linked to the detection limit of the method.
  - Determines presence of 'free' and 'respirable' size fibres distributed throughout the sample.
- AS4964: **TRACE ANALYSIS MUST** be done on all soil samples, even if asbestos found or not.
- Lengthy text description and flow chart in AS4964.

# Reporting NATA

- Reporting ACM found as 'friable' or 'non friable' is inappropriate
- NATA and AS4964 – no reporting concentration (%)
- Can weigh AC frags, very difficult to accurately weigh bundles
- Report reader must understand this limitation and issues around determining % asbestos
- If % reported, it must be **VERY CLEARLY** annotated as it is beyond the scope of the NATA report and AS4964



# RISK ASSESSMENT

# What is the Risk?

- Asbestos Exposure is the Inhalation of **Respirable Fibres**
- Not all asbestos fibres are respirable.
- Respirable size range
  - Length > 5 microns
  - Width < 3microns
  - Aspect ratio > 3:1
- Respirable Fibres
  - aerodynamic characteristics to penetrate into the lungs





# What is the Risk?

- Exaggerated perception of risk in the general community about asbestos!
- 1 fibre theory - background fibre levels
- Historical occupational exposures → increased risk
  - Concentration of airborne respirable fibres
  - Duration of exposure to airborne respirable fibres
- **Asbestos materials in a stable condition and left undisturbed 'Do Not' release fibres and 'Do Not' pose a measurable risk to workers, occupiers or tenants**





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# What is the Risk?

- **Type of asbestos:**
  - Friable,
  - Non-Friable,
  - AF or FA –
  - Respirable Fibres?
- **Concentration** – How much is there?
- **Exposure** – How long?
- **Dose** = Concentration (f/mL) x Exposure (mins)

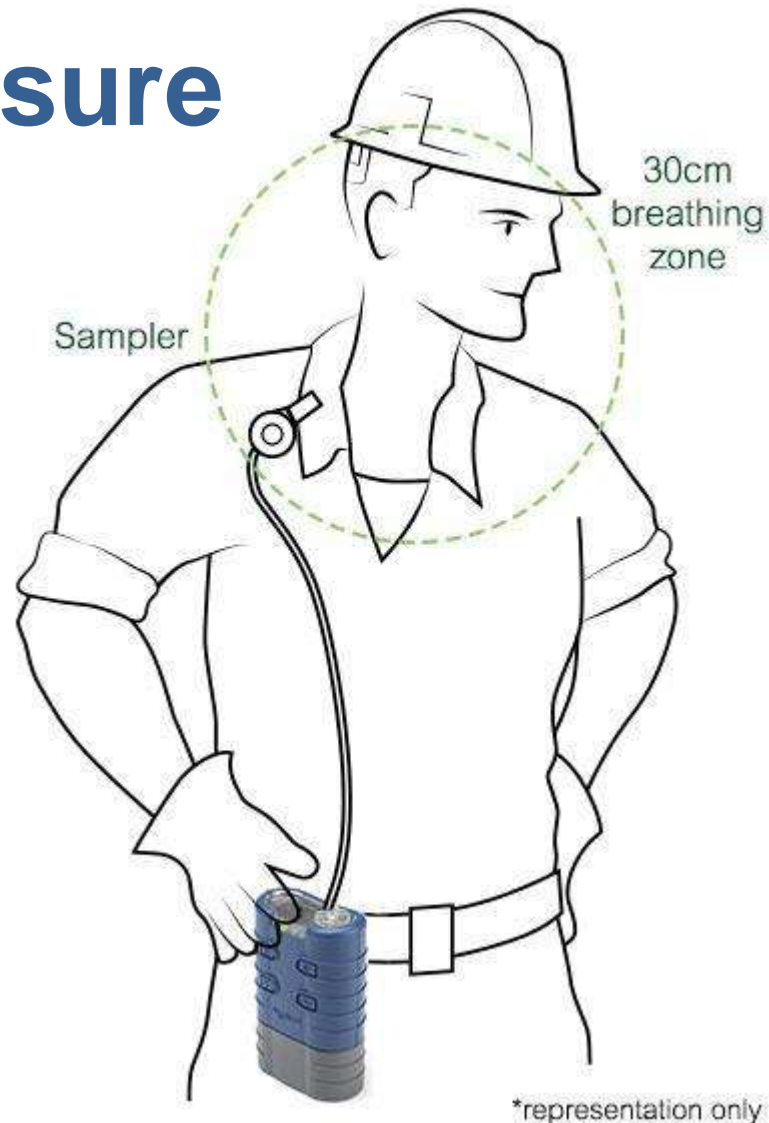


# What is the Risk - Other Factors

- Depth in soils?
  - Soil surface
  - At depth
- Potential for disturbance?
- How do Occupational Hygienist quantify the risk of asbestos exposure?

# Personal Exposure Monitoring

- Breathing Zone
- 30cm hemisphere drawn from the centre of the nose
- Results compared to SafeWork Australia Exposure Standards
- NOHSC:3003(2005) – Membrane Filter Method



# Exposure Standards

## UK – Control Limit

- 0.1 fibres/ml 4hr TWA
- Peak exposure limit of 0.6 fibres/ml over 10 minutes

## USA – ACGIH Threshold Limit Value (TLV)

- 0.1 fibres/ml 8hr TWA

## Australia – National Exposure Standard:

- 0.1 fibres/ml 8hr TWA





# Swartjes and Tromp (2008)

- Conducted field and simulation tests using both friable and non-friable asbestos in a soil medium.
- Showed that a percentage of 0.01% 'friable' asbestos should keep airborne asbestos fibres below 0.001fibres/mL (estimated around 0.0001fibres/mL).

**Remember – Australian Exposure Standard for Asbestos is 0.1fibres/mL.**



# Typical Airborne Levels II

## Asbestos Operations

- **Changing Brakes** <0.05 f/ml
- **Removing VAT** <0.01 f/ml
- **Hand cutting gaskets** <0.01 f/ml
- **Removing AC cont. soil** <0.01 f/ml
- **Drilling 1 hole in AC sheet** <0.01 f/ml
- **Light sanding AC sheet** <0.01 f/ml



# Typical Airborne Levels III

## Disturbed / Asbestos Removal

- Removal of sprayed asbestos 1 – 100+ f/ml
- Removal of weathered AC roof 0.1 - 1 f/ml

# Legislation



# Legislation

## Workplace Health and Safety (WHS)

- WHS Regulation 2011
- WHS Codes of Practice (2016) – limited information on soils
- NSW Government – Managing Asbestos In or On Soils (2014)
- State WHS Regulator Guidelines
  - *NSW - Managing asbestos in or on soil (March 2014)*
  - *WA - Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia. (May 2009)*



# Legislation

## Environmental

- National Environment Protection (Assessment of Site Contamination) Measure 1999 (Amended 2013)
- Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia – May 2009
- enHealth Management of asbestos in the non-occupational environment – 2005
- AS 4482.1—2005 Guide to the investigation and sampling of sites with potentially contaminated soil Part 1: Non-volatile and semi-volatile compounds
- State Environmental Regulations and Guidelines



# Conclusions of Legislative Review

- WHS Regulations include asbestos in soil but provide very few specific requirements. There are some limited additional guidelines.
- The National Environment Protection (Assessment of Site Contamination) Measure 1999 (Amended 2013) is the main source of requirements for the assessment of soil contamination.
- The above is based on Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia (May 2009) which contains additional details on remediation and management.





# Remediation Vs Management

- Preferred Objectives – Risk based approach
- On site Management – Can we manage it on site?
- On Site Remediation – How effective? End Result?
- Complete Removal – Cost/Landfill/Risk

# On Site Controls

- Occupational Hygiene – Anticipate, Identify, Evaluate and Control.
- Planning – PSI/DSI
- Asbestos Awareness Training
- Asbestos Management Plan
- Unexpected Finds Protocol



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# AIOH Position Paper

- The presence of asbestos may constitute a health hazard, however the degree of risk to health is based on the likelihood that 'respirable' fibres are released and inhaled, and then deposited in the lung.
- There is no scientific or epidemiological evidence to suggest that small or single exposures to asbestos will cause asbestos related diseases. All humans have continuous very low level background environmental exposure to asbestos fibres.

# AIOH Position Paper

- Potential for human exposure as a result of asbestos contamination in soil is typically limited.
- During contaminated soil disturbance and / or removal work, exposures should be maintained in accordance with the ALARP principle. In addition, it is a community expectation that no measureable airborne asbestos fibres are generated during soil remediation work.
- AS 4964 must be used whenever soil testing is required. As part of the analysis procedure, trace analysis must be undertaken to determine presence of free (or respirable) asbestos.



# Take Home Message

**Differentiative between bonded asbestos, friable asbestos, asbestos fines and fibrous asbestos.**

**Asbestos Stable → No Respirable Fibres → No Measurable Risk**

**Develop and Adopt a RISK BASED APPROACH**

