Workplace Airborne Hazards and Air Sampling - Construction Industry

Midland Construction Safety Association

8th August 2017

Jeremy Evans - Sales Development Manager

Topics

- Construction - Importance of Airborne Health Hazards
- Why Measure Them?
- Ways to Measure
  - Dust
  - Vapours
- Air Sampling Options

Size of the Problem?

1 mg/m³

one teaspoon of flour spread over a rugby/football field,

to a height of one metre

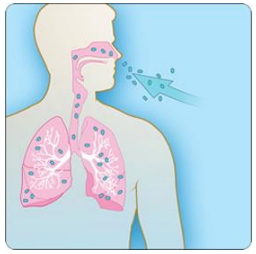
1 ppm

contents of a party balloon in the volume of **50** three bedroom houses

Airborne Hazards

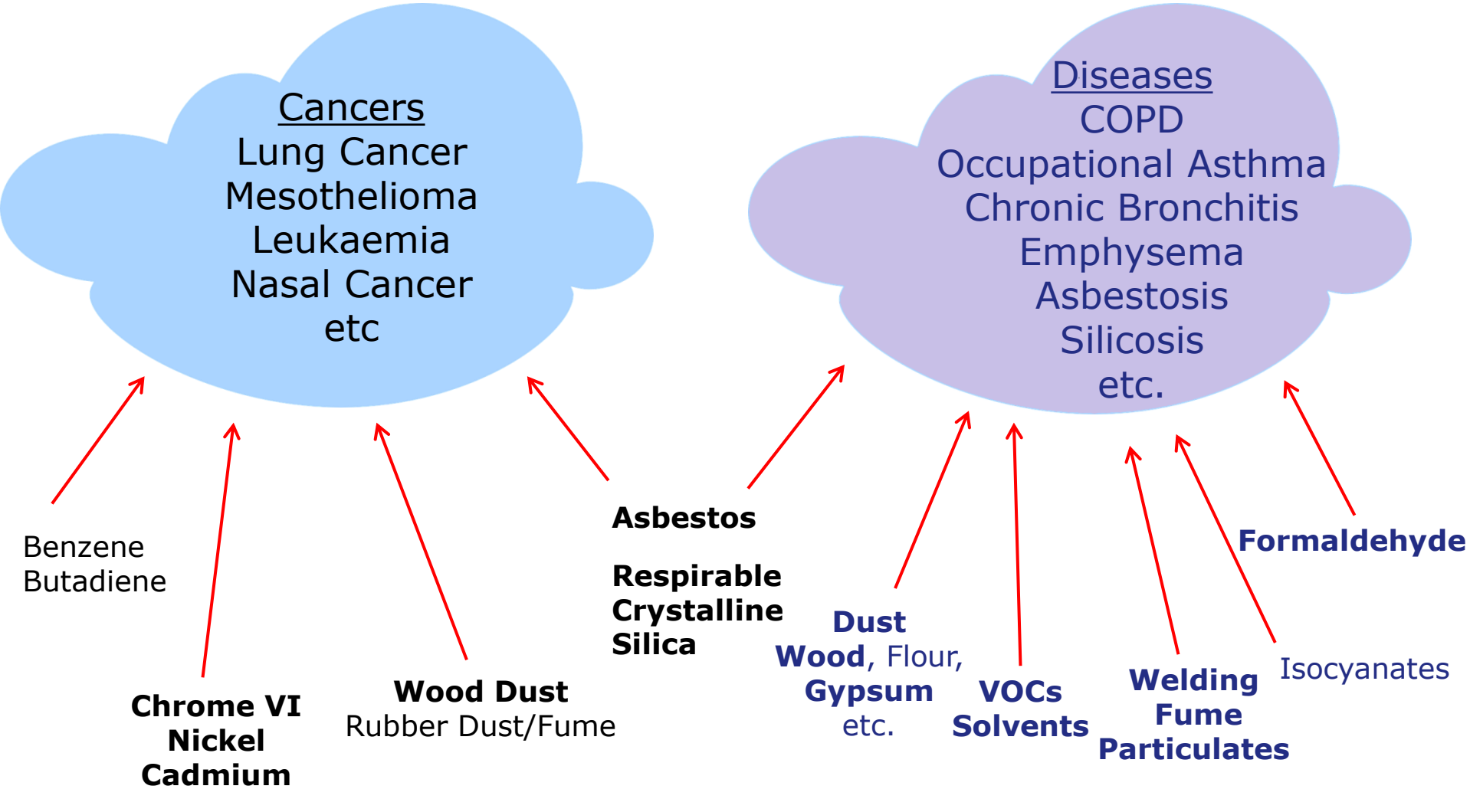
- Injuries (SAFETY)
  - Fatal Injuries Total: 137 PER ANNUM
  - 12 per month
  - Fatal Injuries Construction: 30 PER ANNUM
  - 3 per month

- Occupational Lung Disease & Cancer (HEALTH)
  - Deaths Total: 12,000-13,000
  - 1000+ per month (34 PER DAY)
  - Construction Industry alone: 40% of all Reported Occupational Cancers



OR

Airborne Hazards (Health)



Other Industries (Health)

- Welding, Soldering, Metal Work
  - 1 in 10 of 30,000 reported breathing/lung problems caused/made worse by work

- Bakers
  - 80 times more likely to develop occupational asthma

Long Latency Period

- Welding Fumes - 18 Years to develop Asthma

H&S Headlines

- Scaffold fall
- Ceiling collapse injures worker
- Fall from roof
- Severe electrical burns
- Crush death
- Hit by steel girder

Health Hazards - Headlines?

- Asbestos ✓
- Others ✗

Construction Airborne Hazards

- DUST
  - Asbestos
  - Respirable Crystalline Silica
  - Wood Dust
  - General Dust e.g. Gypsum
  - Metals
- CONTROLS ✓
  - Dust Suppression
  - Containment
  - RPE

- STAFF EXPOSURE MEASUREMENT ✗

Despite:
- HSE Workplace Exposure Limits
- Defined, simple sampling methods
- Many benefits

WHY MEASURE EXPOSURE?

Questions

- How can I be sure my staff are not overexposed to Airborne Hazards?
- What Evidence/Records do I have of their actual exposure?
- How do I decide the Need for & Level of Controls required?
- How can I measure their Effectiveness**?**

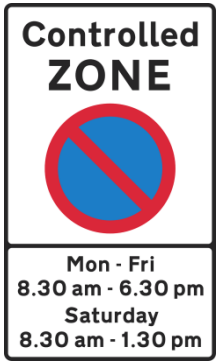
EXPOSURE MEASUREMENT - BENEFITS

- Records - *Evidence*
- Informed Decisions based on Facts - *not Assumptions*
- Potential Cost Savings
- Protection of Staff and Company

Reasons for Workplace Air Sampling

- Health Protection
- Compliance with Government Legislation
  - COSHH: Control of Substances Hazardous to Health
  - EH40: HSE Workplace Exposure Limits
  - CLAW: Control of Lead at Work Regulations
  - CAR: Control of Asbestos Regulations

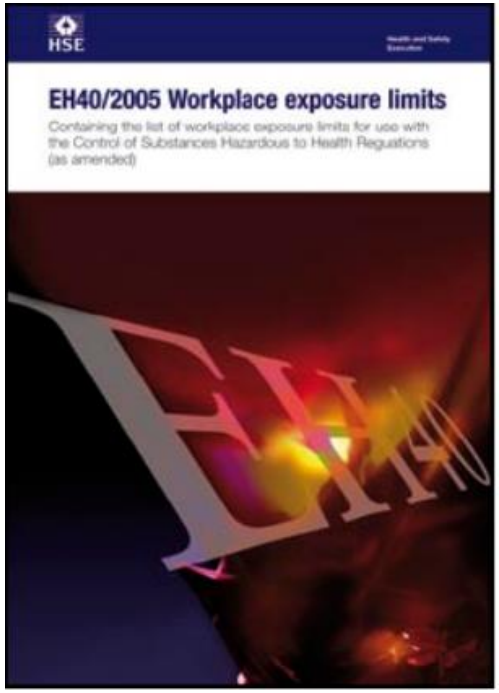
- Protection from Compensation Claims
- Process Control Measures



Exposure Limits in the Workplace

- EH40:2005
  - WEL (Workplace Exposure Limit)
  - 8 Hour (Time Weighted Average)
  - 15 Minute (Short Term Exposure Limit) *Vapours*

- Includes
  - Dust
  - Wood Dust (*hard & soft wood)*
  - Respirable Crystalline Silica
  - Metals
  - VOCs / Solvents (various)



What is Air Sampling?

- Air is passed through a filter, tube or other collecting media
- Hazard Presence/Level detected by
  - Direct Reading
    (Dust)

    or

  - Colour Change of Media
    (Vapours)

    or

  - Laboratory Analysis
    (Dust, Silica, Metals, Vapours)

Passive Sampling

- Dust and Vapours
- Diffusion
- Semi-quantitative
- Indicator e.g. surveys
- Immediate results
  (Dust Monitors, Gastec/Dräger Tubes)

Grab Sampling

- Vapours only
- Small sample volume
- Semi-quantitative
- Not time-based exposure
- Indicator e.g. surveys
- Immediate results *(Gastec/Dräger Tubes)*

Active Sampling

- Dust and Vapours
- Sampling Pump + Sampling Head
- Quantitative - *Known Flow Rate + Time*
- Most Accurate / Meaningful

Immediate Results
Dust Monitors

Samples to Laboratory
HSE Methods

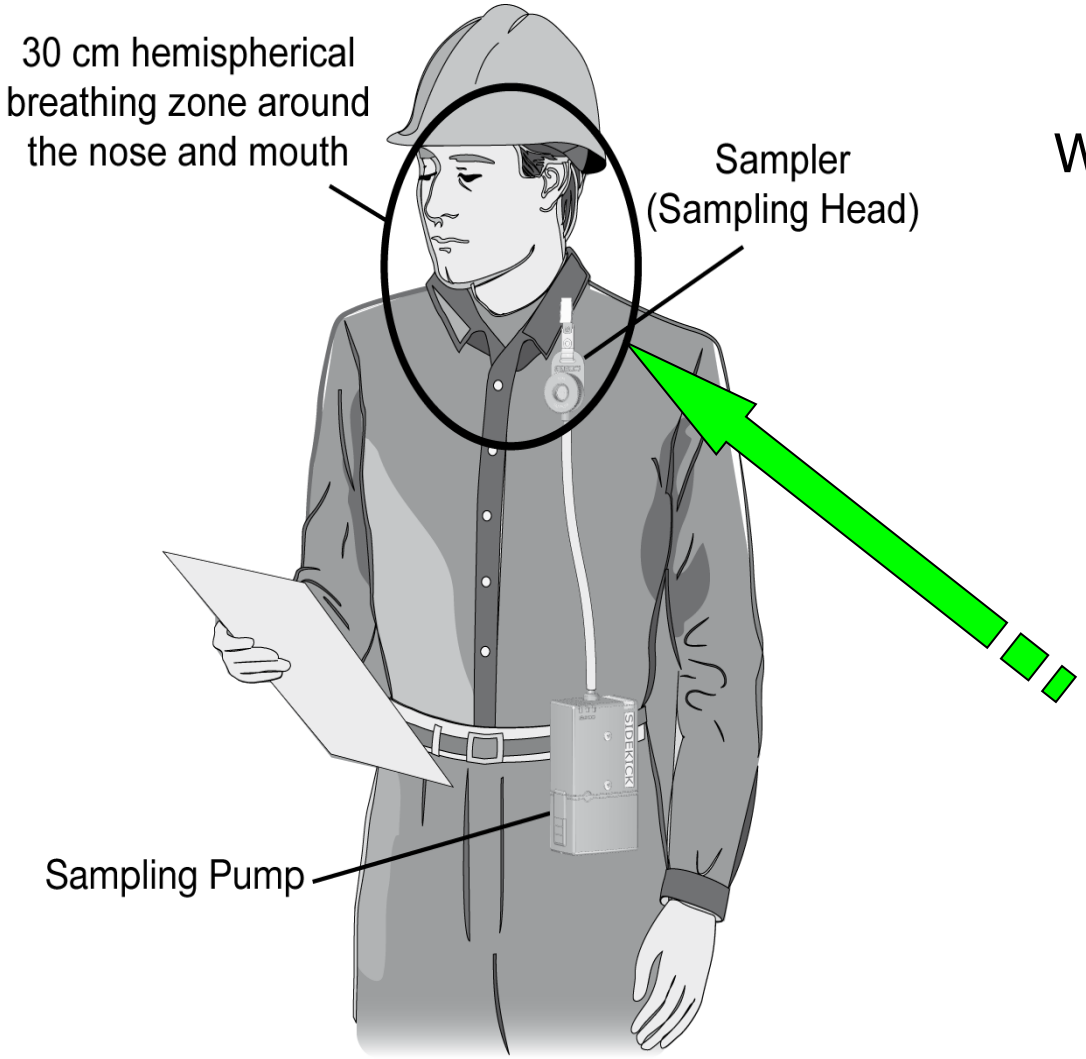
Sampling Train

- Pump
- Connecting tube
- Sampler

Active Sampling

- Setup Sampling Train
- Calibrate Flow Rate - *Before* Sampling
- Fit Sample Train to Operator
- Check Flow Rate - *After* Sampling
- *Send Sample to Laboratory*
- Review Results
  - *Actual Exposure vs 8 hr WEL*
    15 min STEL

Personal vs Static Sampling



Workplace Exposure Limits (WELS) based on PERSONAL SAMPLES

MUST be taken in the BREATHING ZONE

Particulates (Construction)

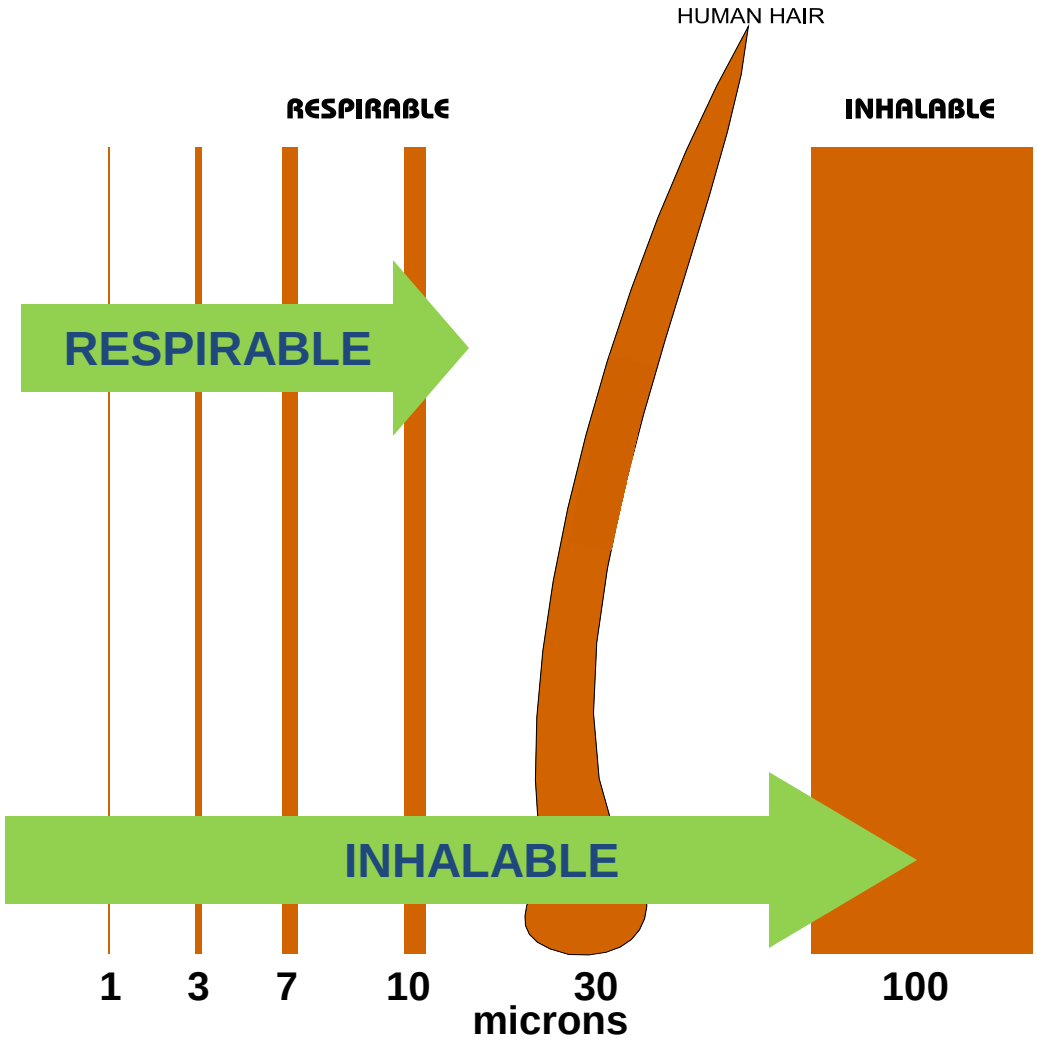
- Dust - *Respirable Crystalline Silica*
- Dust - *General* e.g *Gypsum*
- Fibres - *Asbestos*
- Wood Dust
- Fumes - *Welding (metals/metal oxides)*
- Metals - *Grinding, Blasting, etc.*
- Diesel Particulates - *Engines*







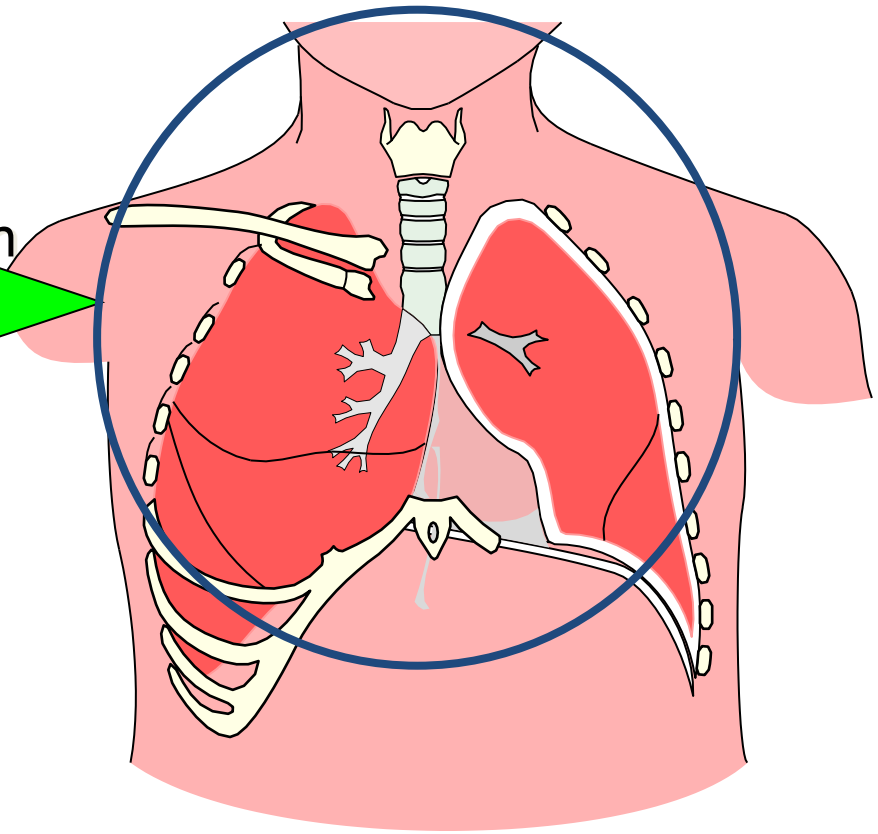

Relative Size of Particles



- Respirable dust to 12 micron
- Inhalable dust to 100 micron

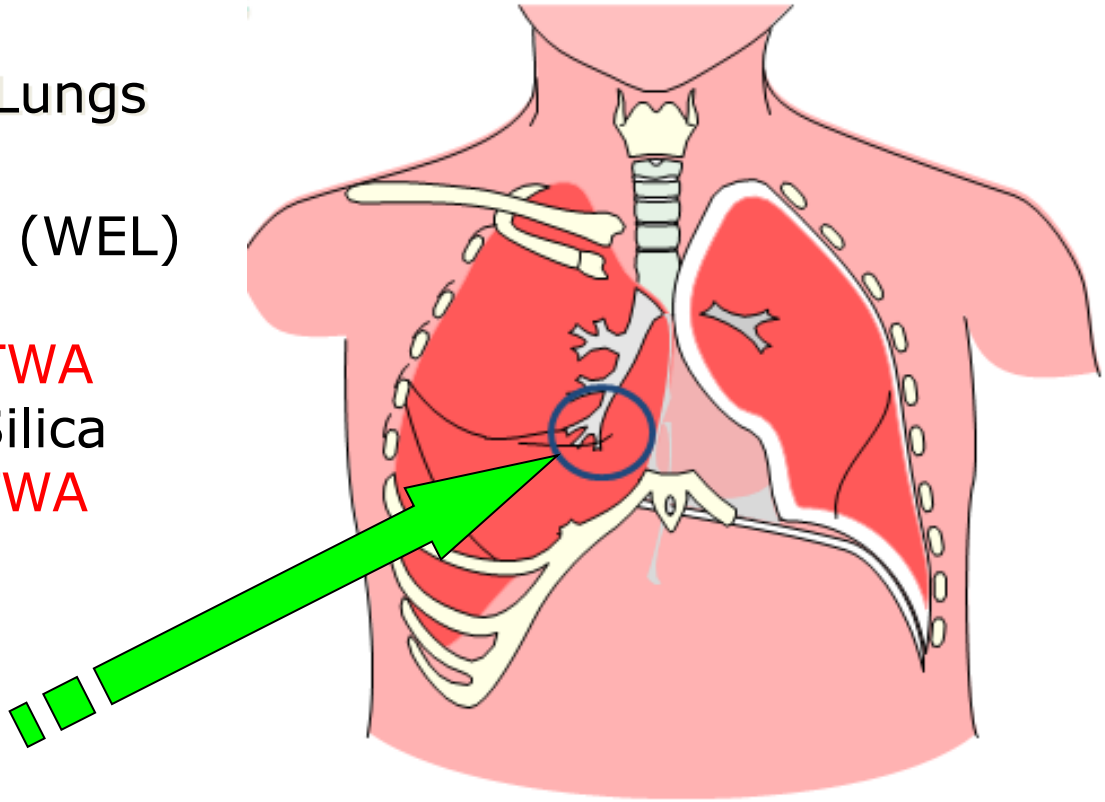
Inhalable Dust

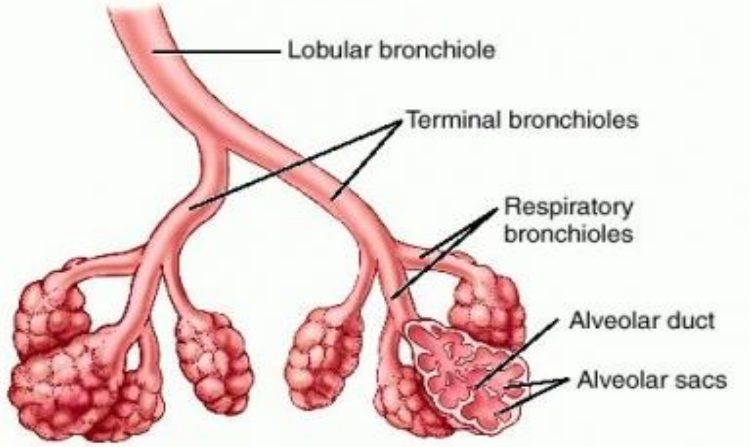
- Size Distribution BS EN 481:1993
- Up to 100 micron AED
- Affects ALL the respiratory system
- Partially visible
- Workplace Exposure Limit (WEL)
  - Dust
    10 mg/m^3 8 Hour TWA
  - Hard Wood & Soft Wood Dust
    5 mg/m^3 8 Hour TWA



Respirable Dust

- Size Distribution BS EN 481:1993
- Up to 12 micron AED
- Penetrates Deep into the Lungs
- Invisible
- Workplace Exposure Limit (WEL)
  - Dust
    4 mg/m^3 8 Hour TWA
  - Respirable Crystalline Silica
    0.1 mg/m^3 8 Hour TWA

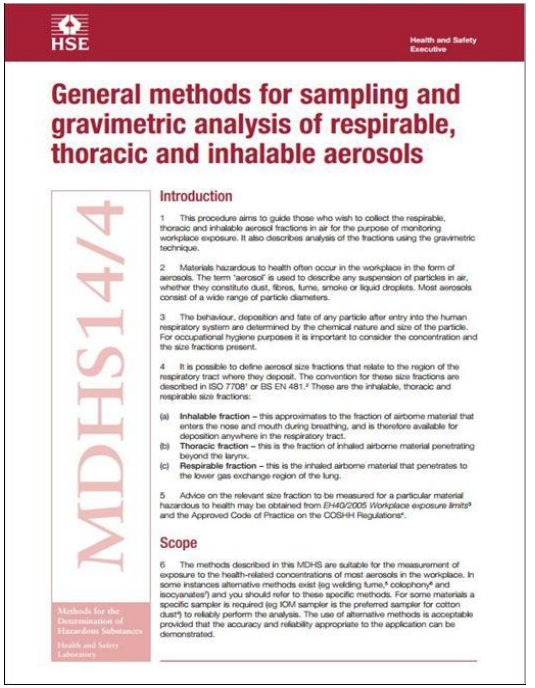




Methods – Active Sampling

HSE Methods

- MDHS - Method for the Determination of Hazardous Substances
  - MDHS 14/4 - *Inhalable & Respirable Dust*
  - MDHS 101/2 - *Respirable Crystalline Silica*


HSE

Health and Safety Executive

General methods for sampling and gravimetric analysis of respirable, thoracic and inhalable aerosols

MDHS14/4

Introduction

1 This procedure aims to guide those who wish to collect the respirable, thoracic and inhalable aerosol fractions in air for the purpose of monitoring workplace exposure. It also describes analysis of the fractions using the gravimetric technique.

2 Materials hazardous to health often occur in the workplace in the form of aerosols. The term "aerosol" is used to describe any suspension of particles in air, whether they constitute dust, fibres, fume, smoke or liquid droplets. Most aerosols consist of a wide range of particle diameters.

3 The behaviour, deposition and fate of any particle after entry into the human respiratory system are determined by the chemical nature and size of the particle. For occupational hygiene purposes it is important to consider the concentration and the size fractions present.

4 It is possible to define aerosol size fractions that relate to the region of the respiratory tract where they deposit. The convention for these size fractions are described in ISO 7708[1] or BS EN 481.[2] These are the inhalable, thoracic and respirable size fractions:

(a) **Inhalable fraction** – this approximates to the fraction of airborne material that enters the nose and mouth during breathing, and is therefore available for deposition anywhere in the respiratory tract.
(b) **Thoracic fraction** – this is the fraction of inhaled airborne material penetrating beyond the larynx.
(c) **Respirable fraction** – this is the inhaled airborne material that penetrates to the lower gas exchange region of the lung.

5 Advice on the relevant size fraction to be measured for a particular material hazardous to health may be obtained from *EH40/2005 Workplace exposure limits*[3] and the Approved Code of Practice on the COSHH Regulations[4].

Scope

6 The methods described in this MDHS are suitable for the measurement of exposure to the health-related concentrations of most aerosols in the workplace. In some instances alternative methods exist (eg welding fume,[5] colophony[6] and isocyanates[7]) and you should refer to these specific methods. For some materials a specific sampler is required (eg IOM sampler is the preferred sampler for cotton dust[8]) to reliably perform the analysis. The use of alternative methods is acceptable provided that the accuracy and reliability appropriate to the application can be demonstrated.

Methods for the Determination of Hazardous Substances

Health and Safety Laboratory

Survey Methods

- Direct Reading - *Particulate Monitors*
  - Inhalable / Respirable Dust
  - Passive / Active
  - Personal or Static

Survey Methods – Particulates

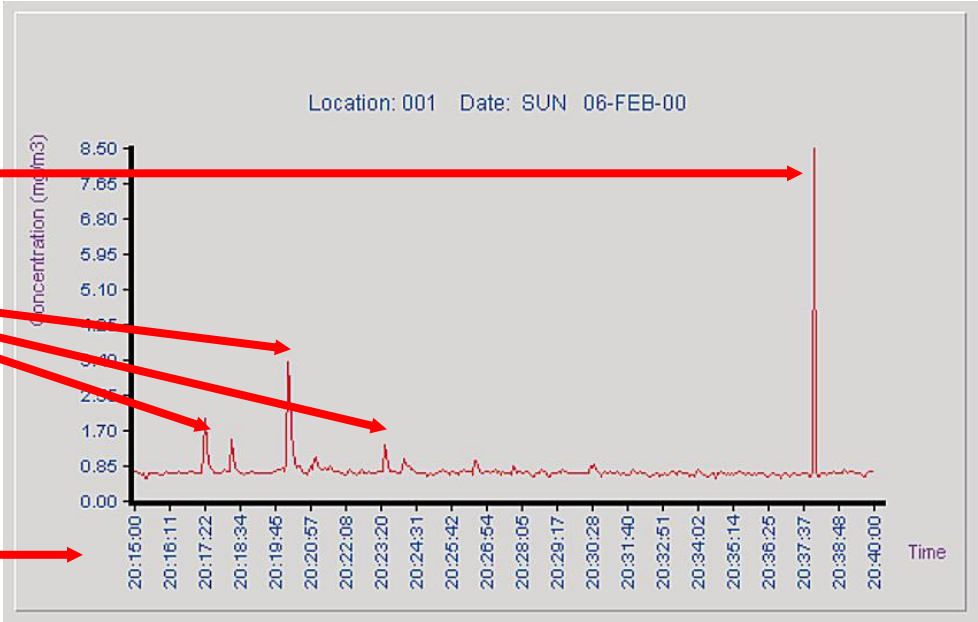
Direct reading - time-based picture of the situation

- Area Mapping
  - Hotspots
  - When
  - Who

Cleaning

Construction Processes

TIMES!



Air Sampling – Particulates

Sampling Heads (containing a Filter)

IOM
Inhalable Dust
Metals

Cyclone
Respirable Dust
Silica

Cowled
Fibres
Asbestos

Mini Sampler
Welding Fume
Components
(Metals)

Vapours (Construction)

- Organic Chemicals - *VOCs (Solvents), etc.*
- In Commercial Products

  Cleaning, Glues, MDF, Paints, Paint Strippers, insulation, etc.

  e.g. Formaldehyde (MDF)

  Dichoromethane (paint strippers)

  Xylene, 1-Butanol, etc.

  (paints/glues, etc)

- Isocyanates
  - Two pack Polyurethane Paints
  - Coatings, Foams, Flooring

Vapours – Exposure Limits (WELs)

- Parts per Million (ppm)
- Wide Range
  - Vapours
  - Limits

Examples	*8 Hour TWA*	*15 Minute STEL*
– Formaldehyde	2 ppm	2 ppm
– Xylene	50 ppm	100 ppm
– Dichloromethane	100 ppm	300 ppm

Passive/Grab Sampling - Vapours

Passive Sampling Badges

Colour Change Tubes

Active Sampling - Vapours

Sorbent Tube with Holder & Cover

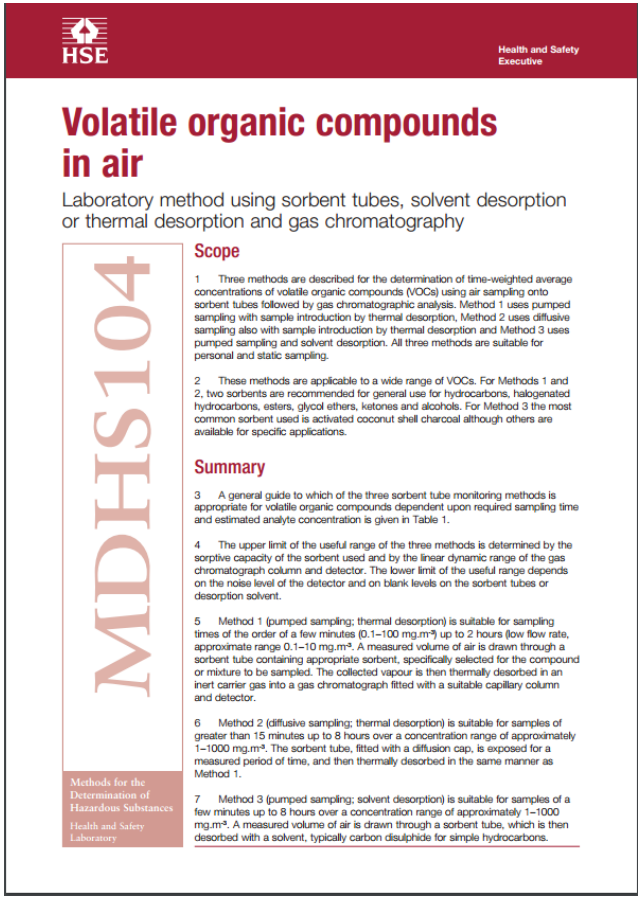
Cassette & Holder
(containing treated filter)

HSE Methods - Vapours

MDHS - Method for the Determination of Hazardous Substances

Generic (VOCs)

- MDHS 88 - *Passive Sampling*
- MDHS 104 - *Active Sampling*



HSE

Health and Safety Executive

Volatile organic compounds in air

Laboratory method using sorbent tubes, solvent desorption or thermal desorption and gas chromatography

MDHS104

Methods for the Determination of Hazardous Substances

Health and Safety Laboratory

Scope

1 Three methods are described for the determination of time-weighted average concentrations of volatile organic compounds (VOCs) using air sampling onto sorbent tubes followed by gas chromatographic analysis. Method 1 uses pumped sampling with sample introduction by thermal desorption, Method 2 uses diffusive sampling also with sample introduction by thermal desorption and Method 3 uses pumped sampling and solvent desorption. All three methods are suitable for personal and static sampling.

2 These methods are applicable to a wide range of VOCs. For Methods 1 and 2, two sorbents are recommended for general use for hydrocarbons, halogenated hydrocarbons, esters, glycol ethers, ketones and alcohols. For Method 3 the most common sorbent used is activated coconut shell charcoal although others are available for specific applications.

Summary

3 A general guide to which of the three sorbent tube monitoring methods is appropriate for volatile organic compounds dependent upon required sampling time and estimated analyte concentration is given in Table 1.

4 The upper limit of the useful range of the three methods is determined by the sorptive capacity of the sorbent used and by the linear dynamic range of the gas chromatograph column and detector. The lower limit of the useful range depends on the noise level of the detector and on blank levels on the sorbent tubes or desorption solvent.

5 Method 1 (pumped sampling; thermal desorption) is suitable for sampling times of the order of a few minutes (0.1–100 mg.m^{-3}) up to 2 hours (low flow rate, approximate range 0.1–10 mg.m^{-3}. A measured volume of air is drawn through a sorbent tube containing appropriate sorbent, specifically selected for the compound or mixture to be sampled. The collected vapour is then thermally desorbed in an inert carrier gas into a gas chromatograph fitted with a suitable capillary column and detector.

6 Method 2 (diffusive sampling; thermal desorption) is suitable for samples of greater than 15 minutes up to 8 hours over a concentration range of approximately 1–1000 mg.m^{-3}. The sorbent tube, fitted with a diffusion cap, is exposed for a measured period of time, and then thermally desorbed in the same manner as Method 1.

7 Method 3 (pumped sampling; solvent desorption) is suitable for samples of a few minutes up to 8 hours over a concentration range of approximately 1–1000 mg.m^{-3}. A measured volume of air is drawn through a sorbent tube, which is then desorbed with a solvent, typically carbon disulphide for simple hydrocarbons.

Workplace Air Sampling - Options

- Consultant
- DIY
- Both

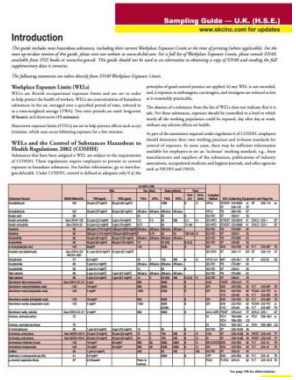
DIY Benefits

- Cost Savings
- Flexibility
- Involvement / Ownership
- Additional Skills / Experience

Measurement Requirements

- Equipment, Accessories

- Guidance/Support
  - Equipment Supplier
  - Laboratory
  - HSE, etc.



- Competence (Training)

Summary – Construction Industry

- Importance of Airborne Health Hazards
- Why, What and How to Measure
- Sampling Options - DIY Benefits

Summary – Construction Industry

Don’t Just Rely on Controls / Assumptions

Airborne Hazards Exposure Measurement is a Key to:

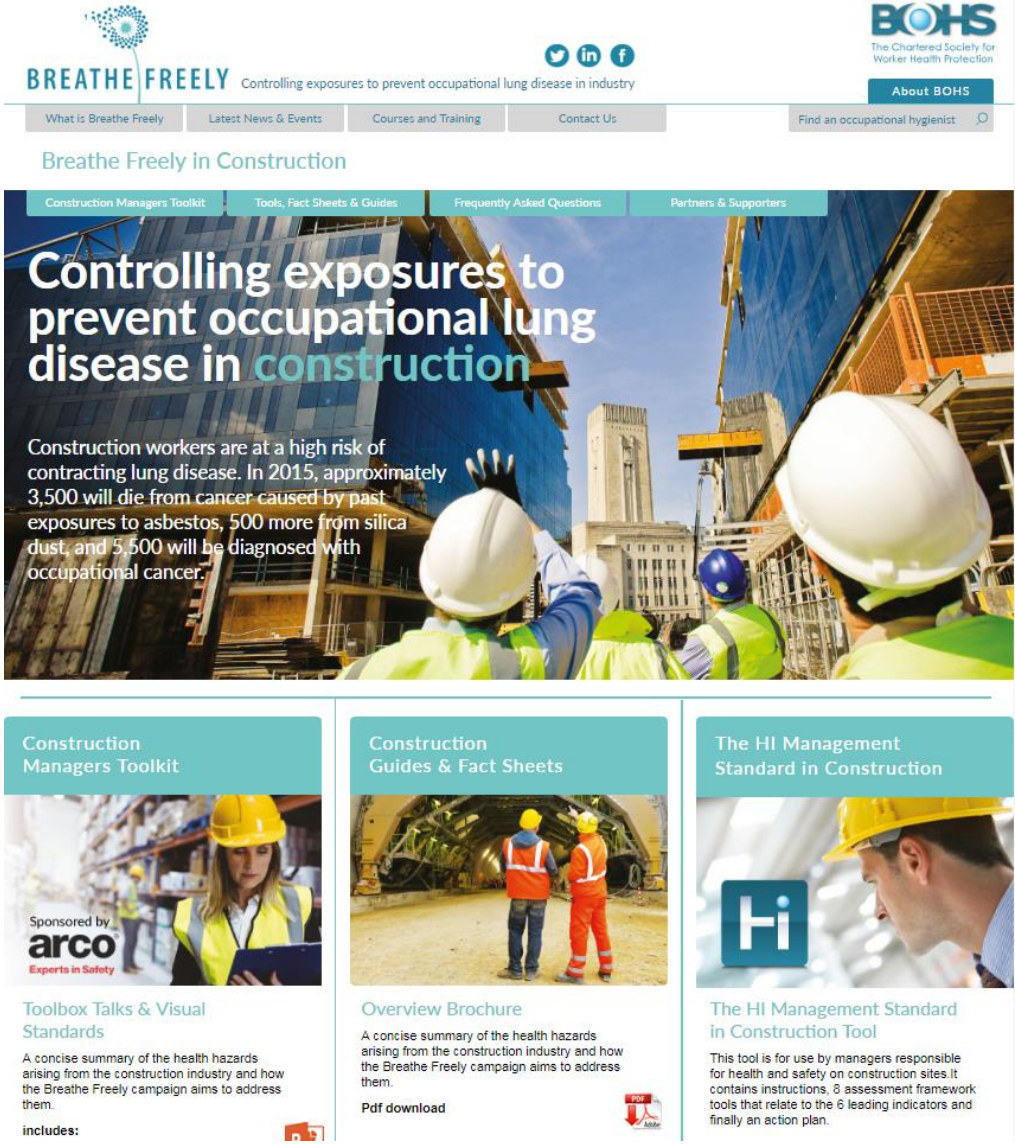
- Staff – *Health & Success*
- Company – *Health & Success*

Defuse the Exposure Time Bombs

Redress the Balance

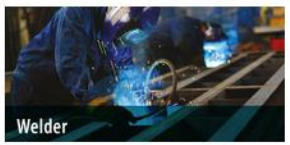
http://www.breathefreely.org.uk/breathefreelyconstruction.html

Launched April 2015



Trade Fact Sheets

These fact sheets highlight the main hazards, highest risks and preferred control options for all the key construction trades. Just click on the images below to download the pdf of the fact sheets that are of interest to you.



BREATHE FREELY

Controlling Exposures to prevent occupational lung disease in the construction industry

Carpenter/Joiner

HAZARDS AND RISKS

The biggest respiratory ill health risk to woodworkers comes from inhaling wood dust. Carpentry, joinery and shop fitting work typically involves cutting, shaping and fixing timber and wood pieces using saws, planes, chisels and other power and hand tools, all of which generate wood dust, as do tasks such as sweeping and cleaning. These workers can also be at risk through inhaling solvents and isocyanates from adhesives, paints, stains and varnishes that are used to fix and treat wood products.

Wood dust

Wood can be in many forms such as softwood and hardwood, and wood-based products such as MDF and chipboard. Exposure to all types of wood dust can lead to the development of asthma which is a serious, debilitating, and sometimes life-limiting condition, and can also trigger asthma attacks in existing asthma sufferers. Hardwood dusts are listed in Schedule 1 of COSHH as carcinogenic and can cause a rare form of nasal cancer. More rarely, there is an increased risk of developing extrinsic allergic alveolitis (a disease which can cause progressive lung damage) when working with some specific woods (eg. western red cedar or iroko). Exposure to any type of wood dust can also cause irritation, allergic rhinitis (runny nose) and impaired lung function.

Solvents & isocyanates

Inhaling solvents can lead to irritation, dizziness and drowsiness. Exposure to isocyanates can cause allergic rhinitis and asthma.

CONTROL OPTIONS

Elimination/prevention

- Use pre-cut materials, to eliminate the need to cut wood on site, wherever possible.
- Use less toxic materials/substances, eg: avoid high risk woods (such as Western Red Cedar); use solvent-free products, etc.

Engineering controls

- Use powered hand tools that feature integrated dust extraction (or "on tool" dust extraction).
- Use local exhaust ventilation (LEV) for bench or semi-permanent machines; stand-alone dust collectors can be considered for occasional use.
- Use dustless cleaning methods eg: H or M class vacuum cleaner (HEPA filter) with antistatic hoses.

Safe working methods

- Ensure good general ventilation to the work area; work outdoors if feasible.
- Set up dedicated work areas with restricted access to other workers.
- Clean up regularly and ensure vacuuming or wet cleaning; avoid dry sweeping or use of compressed air to remove dust from clothing.
- Minimise dust release eg. through damping down of work areas.
- Use roller/brush application of coatings rather than spraying if feasible.

PPE

- Respiratory protective equipment (RPE) may be required to supplement the control measures described above. RPE must be worn if, for example, LEV cannot be used when operating power saws or machines, or hand sawing is carried out in enclosed or poorly ventilated areas. As a minimum, a re-usable half mask with a P2 rated filter, or disposable RPE (rated at least FFP2 and APF10; APF20 for hardwoods and/or high dust

MANAGING THE RISK

Training & communication, supervision, maintenance & testing of controls and **air monitoring*** are all vital aspects of managing the risk, in addition to health surveillance which can be a requirement in certain circumstances.

See our introductory *Respiratory Health Hazards in Construction Fact Sheet Series:* **Overview** for more information about what things to consider and implement.

Air monitoring*

Air monitoring is a specialist activity. It may be needed as part of a COSHH assessment, as a periodic check on control effectiveness and to assess compliance with relevant WELs, or where there has been a failure in a control (for example if a worker reports respiratory symptoms). A qualified Occupational Hygienist can ensure it is carried out in a way that provides meaningful and helpful results.

Also, see HSE leaflet G409, Exposure measurement: Air sampling.
www.hse.gov.uk/pubns/guidance/g409.pdf

Carpenter/Joiner

WORKPLACE EXPOSURE LIMITS (WELs) & EXPOSURE LEVELS

Agent or substance	Control/Exposure Limit	Exposure Levels
Wood dust:	5 mg/m³ (8 hour TWA)	Applies to both hardwood and softwood. Exposure levels are affected by the frequency and duration of the work being undertaken and are likely to be higher in poorly ventilated spaces/areas.
Other substances		Adhesives, paints and paint strippers, varnishes and wood preservatives may all contain substances which have WELs; refer to Material Safety Data Sheets (MSDSs) for the substances present and to HSE's guidance note Workplace Exposure Limits EH40/2005: *www.hse.gov.uk/pubns/priced/eh40.pdf*

Midland Construction Safety Association

8th August 2017