

**The British Occupational Hygiene Society  
Faculty of Occupational Hygiene**

**MODULE SYLLABUS**

**S301 - ASBESTOS AND OTHER FIBRES**

**AIM:** This module enhances the student's knowledge of occupational hygiene practice in relation to fibrous dusts. The module concentrates on asbestos, but other fibres, eg. MMMF, Aramids, etc., which are increasingly finding uses in industry are also covered.

On successful completion of this module there will be benefit to those working in asbestos consultancy as well as main stream occupational hygiene, giving an understanding of the health risks associated with asbestos and other fibres as well as the means of evaluation and control.

On successful completion of this module the student should be able to:

- describe the composition, nature and properties of asbestos and other man made mineral fibres.(MMMF)
- describe the health effects and apply appropriate exposure limits.
- advise on the implications of asbestos and MMMF in workplace activities as well as in situ in buildings.
- sample and identify asbestos fibres.
- conduct air sampling to determine airborne concentrations of asbestos fibres in accordance with HSE approved procedures including the four stage clearance procedure.
- advise on containment, removal, disposal and management of asbestos in buildings in accordance with current legislation.

**CONTENT:**

TOPIC	TIME ALLOCATION
1. ASBESTOS and OTHER FIBRES	5%
2. HEALTH HAZARDS AND EXPOSURE LIMITS	5%
3. LEGISLATION	10%
4. ASBESTOS IN BUILDINGS AND SURVEYS	20%
5. ASBESTOS REMOVAL AND CERTIFICATE THE OF REOCCUPATION	20%
6. AIR SAMPLING	20%
7. ANALYSIS OF BULK SAMPLES	10%
8. FIBRE COUNTING	10%

**Note:** Reference is made in this syllabus to HSE guidance or other documentation. This may not be the most up-to-date relevant publications from HSE/other sources and is intended as guidance for candidates only.

## 1. ASBESTOS AND OTHER FIBRES (5%)

### 1.1 Asbestos

Describe the six regulated forms of asbestos in relation to the serpentine and amphibole groups of minerals. Discuss their characteristic properties, such as flexibility, tensile strength, combustibility, thermal conductivity and resistance to chemical attack. Describe the effects of thermal and other forms degradation on asbestos minerals.

### 1.2 Uses of Asbestos

Explain the physical and chemical properties of asbestos which have determined the use to which it has been put by industry. Discuss the three types of asbestos which have found significant commercial use (amosite, chrysotile and crocidolite) and the types of materials they were added to. Describe the use and occurrence of the other types of asbestos particularly as possible contaminants in other minerals.

### 1.3 MMMF

The physical and chemical properties of other fibres such as mineral wools, ceramic fibres, special purpose fibres and continuous filament fibres.

### Educational Objectives

The student should know the types and forms of asbestos fibres and their historical industrial uses.

## 2. HEALTH HAZARDS AND EXPOSURE LIMITS (5%)

### 2.1 Health Effects of Asbestos

Describe the full range of health effects ranging from the benign (pleural plaques) to the terminal (mesothelioma) in the light of results from epidemiological studies carried out on asbestos workers. Pay particular attention to the report by Doll and Peto, 'Effects on Health of Exposure to Asbestos', (1985) and that by Hodgson and Dauntton 'The Quantitative Risks of Mesothelioma and Lung Cancer in Relation to Asbestos Exposure' (2000). Review subsequent influential publications. Cover dose response relationships, the effects of smoking whilst working with asbestos and the risks to health from low level exposure.

### 2.2 Inhalation Studies

Review research studies of the effects of natural and synthetic fibres on laboratory animals, with particular attention being given to inhalation studies. Draw attention to the differences and similarities between the results of inhalation studies on laboratory animals subjected to various types of fibre. Compare the animal experimental evidence and that derived from known human experience.

### 2.3 Control Limits etc for Asbestos

Review control limits, and the clearance indicator threshold for asbestos together with the philosophy behind setting them.

### 2.4 MMMF

Describe the health effects of MMMF's such as skin, eye and upper respiratory tract irritation as well as carcinogenic effects. Explain the Department of Health Committee on Carcinogenicity, Review and the IARC 2B classification (3).

### 2.5 Typical Exposures to MMMF

Give examples of typical exposures while working with MMMF in fibres/ml and explain what can be achieved under good working conditions. Operations discussed should include the whole range of possible exposure levels. Comment on the relationship between mass standards and number standards.

## Educational Objectives

The student should be able to describe the health effects of asbestos and other fibres and relate these to typical exposures and the exposure limits for different fibres.

### 3. LEGISLATION (10%)

#### 3.1 Health and Safety at Work etc Act 1974

Discuss the basic concepts of this enabling legislation with particular reference to employer's responsibilities for asbestos.

#### 3.2 Asbestos Regulations

Review all the relevant current Regulations on asbestos:

- Control of Asbestos Regulations (CAR) 2006
- Management of Health and Safety at Work Regulations (1999)
- Hazardous Waste Regulations 2005
- Construction (Design and Management) Regulations 1994
- Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1995
- Maintenance and testing of enclosures and the need for control other than RPE. Consider the management of asbestos removal projects, particular attention being paid to legal duties imposed by the Health and Safety at Work Act, the CAR and the various Codes of Practice which apply (1) (4) (8).

#### 3.3 Approved Codes of Practice

Discuss the provisions of the Approved Codes of Practice for the CAR and the status of the ACOP (1) (5).

## Educational Objectives

The student should have a clear understanding of the legislation relating to asbestos.

### 4. ASBESTOS IN BUILDINGS AND SURVEYS (20%)

#### 4.1 Types and Uses of Asbestos in Buildings

Use the HSE (6) and/or DETR (7) as a primary source of information on products and their locations in buildings. Explain the physical and chemical properties of asbestos which have determined the use to which it has been put by industry. Discuss the three types of asbestos which have found significant commercial use (amosite, chrysotile and crocidolite) in relation to sprayed and thermal insulation, insulating boards, coatings, cement products and other reinforced products (eg. vinyl tiles, roofing felts) commonly used in building construction.

Discuss the uses and composition of other asbestos products likely to be used or found inside buildings on plant, machinery or domestic appliances (eg. textiles, friction materials, seals, gaskets etc). Describe the use and occurrence of the other types of asbestos particularly as possible contaminants in other minerals.

#### 4.2 Surveys of asbestos containing materials in buildings

Discuss the types of survey which can be carried out following relevant HSE guidance. How to plan, organise and conduct surveys. What parameters need to be assessed and recorded during the survey. Typical errors and how to present results and record the location of asbestos containing materials (6).

#### 4.3 Bulk Sampling

The reasons for bulk sampling ranging from the collection of one sample through to a complete asbestos audit of a building to compile an asbestos register. The techniques used and precautions required when collecting bulk samples (2) (6).

#### 4.4 Risk assessment of asbestos containing materials in buildings

Examine strategies for risk assessment of asbestos containing materials in buildings and the compilation of asbestos registers. Outline the types and sources of information required and discuss the uses to which this information is put (2) (5) (6) (9).

#### 4.5 Management of asbestos containing materials in buildings

Examine strategies for management of asbestos containing materials in buildings and the use of asbestos registers and permit to work systems. Outline the types and sources of information required and discuss the uses to which this information is put. Describe the decision making protocols for prioritising management actions (5) (8) (9) (10).

### Educational Objectives

The student should be able to describe the uses of asbestos in buildings and the public health risk these might pose. The student should understand the principles of and requirements for: asbestos surveys, risk assessment and risk management strategies and their role in reducing health risks.

## 5. ASBESTOS REMOVAL AND CERTIFICATE OF REOCCUPATION (20%)

### 5.1 Preparation

Discuss the steps required in a job specification, preparation of a plan of work by the contractor, tender evaluation and the various roles required under the CDM Regulations for management of the site. Other health and safety aspects including emergency procedures should be included (4) (8).

### 5.2 Enclosures

With reference to HSE Guidance Note (8) and Approved Code of Practice, (1) describe with practical examples the following:

- Correct principles of an enclosure for asbestos removal.
- Methods of enclosure examination and the documentation associated with the enclosure.
- correct procedures for entry, exit and decontamination.
- the use of negative pressure monitors.
- use of secondary enclosures.

### 5.3 Removal procedures

Describe the various control measures available to a removal company to ensure that asbestos dust levels are kept as low as is reasonably practicable inside the enclosure (8) (11).

### 5.4 Waste Removal

Describe the requirements for removal, storage and disposal of waste from an enclosure (1) (8) (11).

### 5.5 Role of Analyst

Describe the role of the analyst as a competent person/ consultant. (2) Understand the requirements for quality management systems in accordance with ISO17025 (12) and accreditation by UKAS.

### 5.6 Air monitoring and other techniques

Identify the various stages where air monitoring should be employed. Discuss what other inspection techniques such as the dust lamp, smoke tubes, negative pressure monitors are also useful for checking of the effectiveness of the work and the control measures (1) (2).

### 5.7 Certification of Reoccupation

Demonstrate the essential requirements of four stage clearance procedure for asbestos removal work and the decontamination unit including visual inspections and final certification for reoccupation (1) (2).

### **Educational objectives**

The student should be thoroughly familiar with current good practice in enclosures for asbestos removal and should understand the principles of clearance testing including the four stage clearance procedure. (3).

## **6. AIR SAMPLING (20%)**

### **6.1 Types of air sampling**

Detail the types of air sampling that can be carried out by HSG248 (2)]. Examine the sampling requirements and their relevance for identification of sources of contamination, assessment of personal exposure and the checking of efficiency and effectiveness of control measures.

### **6.2 Air Sampling equipment and procedures**

Discuss the requirements of the WHO, HSG248 (2)], MDHS 59 and WHO method in relation to sampling of airborne asbestos and MMMF. Demonstrate the equipment required and the adjustment, measurement and calibration of sampling rate. Discuss the requirements for recording calibration and site sampling information to ISO17025 standards (12) (13).

### **6.3 Clearance Sampling**

Discuss when and how clearance sampling is carried out, what should be looked for and the types and frequency of disturbance which must take place. (2)

### **Educational Objectives**

The student should have a detailed knowledge of the approved methods for sampling of airborne asbestos and MMMF.

## **7. ANALYSIS OF BULK SAMPLES (10%)**

### **7.1 Macroscopic examination**

Using HSG248 as a basis, demonstrate examination by low power stereo microscope, including the recognition of the basic physical properties of the main asbestos types ie. colour, lustre, elasticity, tenacity, morphology and behaviour in water (2) .

### **7.2 Sample Preparation**

Explain and demonstrate the options for sample preparation to segregate the asbestos for analysis. Using HSG248 as a basis, demonstrate sample preparation methods to remove matrix materials before PLM identification, including acid washing, solvent extraction and combustion (2).

### **7.3 Polarised Light Microscopy**

Examine using polarised light microscopy characteristics such as morphology, colour, pleochroism, birefringence (interference colours), sign of elongation and extinction of different asbestos types. (2)

### **7.4 Dispersion Staining**

Describe and demonstrate dispersion stain microscopy using R.I. liquids together with a McCrone dispersion staining objective or phase contrast microscopy with polariser in relation to the assessment of refractive indices of asbestos and other fibres. (2)

### **7.5 Health and Safety Precautions During Identification**

Discuss the precautions required when working with asbestos and other fibres eg. the use of glove boxes and ventilated cabinets as well as the required precautions when using acids during sample preparation and when handling R.I. liquids.

## 7.6 Quality Control

Discuss Quality Control procedures, likely detection limits, problems of cross contamination during sampling and analysis, together with the handling of homogeneous and heterogeneous samples. External proficiency schemes such as AIMS.

## 7.7 Interfering fibres and products

Describe other types of fibres and other products which may interfere with asbestos identification eg. leather swarf, skin cells, polyethylene.  
Problems with products such as floor tiles. The effects of heat on asbestos fibres.

### Educational Objectives

The student should be able to describe the approved methods for analysis of bulk fibre samples and have an understanding of the exposure controls and quality controls required during this activity.

## 8. FIBRE COUNTING (10%)

### 8.1 Setting Up Microscopes

Use of light microscopy, setting up of Koehler illumination, calibration of stage micrometer, test slides.

Describe the theory of phase contrast microscopy, with particular attention being paid to the microscope specifications outlined in guidance material. Demonstrate and allow students to practice the use of the Walton Beckett graticule, stage micrometer and NPL test slide. Students should be given the opportunity to set up various makes of microscope used in this work as well as to count slides of known quality such as those used in the RICE scheme.

### 8.2 Filter Preparation

Make students familiar with the preparation of filters and counting of fibres in accordance with the recognised counting rules, using HSG248 (2)]. WHO method as a basis. Discuss the limitations of the methods together with examination of accuracy, precision and systematic differences (2).

### 8.3 Calculation of Results and Quality Control

Examine the reliability of results in relation to quality control schemes such as UKAS, RICE and ISO and European Standards for GLP.

### 8.4 Electron Microscopy

An outline of the basic principles of SEM and TEM.  
The discrimination between asbestos types and other fibres using SEM and TEM together with Energy Dispersive X-Ray analysis (EDXA).

## REFERENCES

- (1) HSE ACOP (L143) (2006) Work with Materials containing Asbestos.
- (2) HSE Guidance HSG 248 [2005] Asbestos: The analyst's guide for sampling, analysis and clearance procedures.
- (3) HSE Guidance Note EH46 (1990) Man Made Mineral Fibres.
- (4) HSE ACOP and Guidance HSG 224 (2001) Managing Health and Safety in Construction. Construction (Design and Management) Regulations 1994
- (5) HSE ACOP (L127) (2006) Management of Asbestos in Non-Domestic Premises
- (6) HSE Guidance Note MDHS 100 (2001) Surveying, Sampling and Assessment of Asbestos – Containing Materials.
- (7) Asbestos and Man Made Fibres in Buildings, Practical Guidance. Thomas Telford DETR (1999)
- (8) HSE Guidance HSG 247 (2006) Asbestos: The licensed contractor's Guide
- (9) HSE Guidance Note HSG 227 (2002). Comprehensive Guide to Managing Asbestos in Premises.
- (10) HSE Guidance INDG 223 (2001) Managing Asbestos in Workplace Premises
- (11) HSE Guidance Note HSG 213 (2001) Introduction to Asbestos Essentials.
- (12) ISO 17025 (2000) General Requirements for the Competence of Testing and Calibration Laboratories.
- (13) HSE Guidance MDHS 59 (1988). Man Made Mineral Fibre Airborne Number Concentration by Phase Contrast Light Microscopy.