

INTERNATIONAL MODULE SYLLABUS

W505 - CONTROL OF HAZARDOUS SUBSTANCES

Aim: To describe the ways in which exposure to hazardous substances arises in the workplace, and to introduce the methodologies and technologies available to control exposures and thereby reduce risks to health.

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

- Outcomes:**
- describe how airborne contaminants are generated by industrial processes, how this impacts on the control strategy, and how control solutions can thereby be optimised
 - recognise the range of approaches to risk reduction embodied in the hierarchy of control and select appropriate strategies for implementation;
 - describe the meaning of “adequate control”, particularly in relation to personal exposures ;
 - discuss the importance of design considerations in terms of the workplace, process, and plant, as a means of reducing occupational exposures;
 - describe the principal elements of a local exhaust ventilation system, give examples of typical installations and know how to carry out the necessary measurements to assess whether a local exhaust ventilation system is effective and operating to the design specification;
 - recognise the limitations of local exhaust hoods and enclosures and the means to optimise their effectiveness
 - describe how personal protective equipment programmes may be used in an effective manner.
 - recognise the impact that control measures may have on other workplace hazards and understand the need to take a holistic approach to the design of control solutions.

Content:	Topic	Time Allocation
	1 Hazardous Substances use and processes	15%
	2 Workplace Control Principles	15%
	3 Process Design and Principles	15%
	4 Ventilation Systems and performance assessment	35%
	5 Personal Protective Equipment	15%
	6 Administrative Elements	5%

Note: Reference is made to standards and good practice documentation. This may not be the most up-to-date relevant publications and is intended as guidance for candidates only.

1 Hazardous Substances Uses and Processes (15%)

Consider the range of properties of airborne contaminants [dusts—aerosols—vapours—gases] and the potential hazards they may present.

Using a series of short case studies, provide an overview of the health hazards and risks, and the sources and factors affecting emission of airborne contaminants, in order to develop an understanding of the approach to controlling exposure problems and how to select appropriate control strategies.

These should include such processes as in the use of rotary tools [eg circular saws, rotary sanders] other directional processes [eg paint spraying], and fume yielding processes [eg welding and soldering]

The principles of containment and control techniques for common process such as weighing and dispensing solids and liquids from containers to process equipment should be considered for a range of materials from low to high hazard.

[NOTE: The nature of specific toxic substances is not included in this module.]

2 Workplace Control Principles (15%)

2.1 Hierarchy of Control

Principles of identifying hazards and risks in the workplace.

Hierarchy of control and its underlying principles.

- work procedures, process engineering control, ventilation and PPE.

[Practicable programmes may involve a combination of measures]

2.2 Achieving Effective Control

The meaning of adequate control including the use of occupational exposure limits, other published and in-house standards (including those for carcinogens, asthmagens and biological agents).

The role of assessment (by all routes):

- to identify exposures, confirm compliance, and achieve adequate control.
- to identify risks at the design stage and in existing facilities.
- to identify risks from normal operations and during non-routine or maintenance activities.

The practical application of the hierarchy of control eg. use of a combination of measures, stepwise approach.

Identifying effective control strategies, adopting the principles of reasonable practicability (including COSHH Essentials / ILO toolbox).

3 Process Design and Principles (15%)

3.1 Design of Equipment and Workplace

General design of equipment and workplace layout and how this influences exposure.

The effects of automation and robotics.

3.2 Prevention, Elimination, Substitution

Prevention of exposure by good process design, including containment, elimination or substitution of hazardous substances and activities.

Examples of industrial processes where hazards may be minimised by changes to substance or form (eg reduction of volatile constituents, granulation of dusty powders) or changes to the process (eg replacement of paint spraying by brush application) and workplace layout.

4 Ventilation Systems (35%)

4.1 Types of System

General ventilation systems, Local exhaust ventilation [LEV]

4.2 Principles

Basic principles of system design- fans, ducts, air cleaners and discharges.

Fan types and their typical applications.

Duct sizing, configuration and duct materials.

Principles of system balancing.

Facilities for thorough examination, maintenance, examination and testing.

Air cleaners -types (gravity and centrifugal collectors, dry fabric, electrostatic, wet methods, absorption types) and their performance.

4.3 General Ventilation Systems

Use as a means of controlling airborne exposures.

Principles of natural ventilation and infiltration.

Mechanical ventilation, dilution or displacement, including methods of delivery and distribution.

Determination and calculation of ventilation requirements.

Application and limitations of general ventilation.

4.4 *Local Exhaust Ventilation [LEV]*

Design Features

LEV hoods; enclosing hoods, receiving hoods and capturing hoods.

Capture velocities, face velocity, transport velocities

Fletcher and Garrison methods of predicting air flows, velocity contours and effects of flanges.

Application of hoods of all types and use of partial and total enclosures in industrial situations.

Limitations of LEV

Supply air, [importance of location and direction] Use of treated recycled air.

Safe discharge arrangements. [Treatment before discharge and location of discharge]

4.5 *Measurement and Testing of LEV Systems.*

Measurement of performance and relation to attainment of control of exposure.

Calculations for volume flows from pressure and velocity measurements.

Maintenance examination and test; periodic checks and inspections, thorough examinations, and testing.

Continued satisfactory performance indication

5 **Personal Protective Equipment (15%)**

5.1 *General*

Types of Personal Protective Equipment (PPE) including Respiratory Protective Equipment (RPE) protective gloves and chemical protective clothing.

Limitations of use.

Definition of suitability.

Importance of selection, training, maintenance, and proper use in the development of a PPE programme.

5.2 *Respiratory Protective Equipment*

Types of RPE and their limitations eg. Dust respirators; high efficiency, powered, ventilated visors, disposables, ori-nasal, breathing apparatus.

Respirators for organic vapours and inorganic gases.

Selection, use and maintenance of RPE. Face fit testing.

5.3 *Chemical Protective Clothing (CPC)*

Types of CPC

Performance criteria

Testing effectiveness

Application, limitations.

Storage arrangements, laundering arrangements, role in prevention of spread of contamination.

Suitability for use and integrity

5.4 *Gloves and Dermal care*

Basic dermal exposure assessment techniques and principles of dermal exposure risk management.

Types of gloves and their performance data

Permeation and breakthrough

Glove selection, maintenance and training in use.

6 **Administrative Elements (5%)**

Reducing periods of exposure.

Exclusion of non-essential personnel, personal hygiene arrangements.

Co-ordinated approach to control, training, supervision.

Control of access to hazardous areas.

The role of assessment, measurement, monitoring, and health surveillance in initiating control measures.

Role of written operating procedures, permits to work etc.

Role of occupational hygiene programmes in continuing control.

Overall Assessment Method

The overall assessment for this module consists of an "open book" written examination and satisfactory results from the formative practical assessment.

Written Examination

40 short answer questions to be answered in 120 minutes. The questions require candidates to write short answers which will require no more than the box provided but may include multiple answers. Some questions may require calculations.

Formative Practical Assessment

All candidates must participate in the practical studies and demonstrate the required skills.

The studies should be designed by the course tutor(s) to test the basic skill and knowledge of each of the candidates in the techniques in making measurements of conditions that are required to assess the performance of control measures.

The exercises must, therefore, involve:

- Visualisation of air flows as a means to test control (smoke tubes, smoke generators and dust lamps) on at least two typical ventilation systems
- Measurements in relation to a selection of extract points (e.g. face velocity or capture velocity) using thermal and vane anemometers and show a basic understanding of requirements for a selection of tasks.

Full details of the practical requirements and the individual candidate reporting forms etc. are available in document JE.2.

References

- (1) HSE(UK) LEV Homepage <http://www.hse.gov.uk/lev/processes/index.htm> Series of visualized process control case studies.
- (2) ILO Control Banding Guidance http://www.ilo.org/public/english/safework/ctrl_banding/index.htm

Relevant Documentation

- i WHO Guidelines on the prevention of toxic exposures
- ii ACGIH Industrial Ventilation A Manual of Recommended Practice 26th edition
- iii ACGIH Guidelines on Selection of Chemical Protective Clothing
- iv Controlling airborne contaminants at work HSE books HSG258
- v Respiratory Protection at Work HSE Books HSG53
- vi ISO 16900 series standards on Respiratory Protective Devices
- vii ISO 16602 Protective Clothing for Protection against Chemicals – Classification, labelling and performance requirements
- viii NIOSH guide to industrial respiratory protection
- ix NIOSH A guide for assessing the performance of protective clothing
- x Controlling Skin Exposure to Chemicals and Wet-Work' by Rajadurai Sithamparanadarajah, ISBN 978-1-906674-00-7

NOTE: This list is indicative only. Students should be encouraged to read as widely as possible on relevant topics.