British Occupational Hygiene Society

The Chartered Society for Worker Health Protection

P602 Proficiency Qualification:

# Basic Design Principles of Local Exhaust Ventilation Systems

Qualification Specification

www.bohs.org

Issue 2 | July 2021

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# Section 1

## About BOHS

### BOHS - the Chartered Society for Worker Health Protection

BOHS is the Chartered Society for Worker Health Protection. Our vision is to create a healthy working environment for everyone by preventing exposure to hazardous substances in the workplace.

Founded in 1953, we have developed over the last 64 years into a highly respected and influential body on workplace health issues, working closely with organisations in the UK and overseas to promote our vision. We are a registered charity, professional society and a member of the International Occupational Hygiene Association which is recognised as a non-government organisation by the International Labour Organisation (ILO) and the World Health Organization (WHO).

We were awarded a Royal Charter in 2013 in recognition of our pre-eminent role in protecting worker health.

BOHS is a membership organisation, open to anyone who has an interest in workplace health issues, and we have over 1700 members in 60 countries.

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### BOHS qualifications – the quality choice

We are the leading awarding body in our field. Our UK courses and qualifications are recognised and respected by independent agencies such as the Health and Safety Executive (HSE) and the United Kingdom Accreditation Service (UKAS) and further afield by industry and employers worldwide. Over 50,000 people have taken one of our qualifications through our network of training providers which offer engaging, challenging and practical courses.

Our courses and qualifications are overseen by a team of highly experienced professionals who are dedicated to developing the competence and career opportunities for the many thousands of people who play a key role in protecting worker health, in diverse fields such as asbestos, legionella and control technologies.

Information about all our qualifications is available from our website:
[www.bohs.org/qualifications-training/bohs-qualifications/](http://www.bohs.org/qualifications-training/bohs-qualifications/)

# Section 2

## P602 at a glance

### What is the objective?

To provide candidates with the theoretical and practical knowledge for designing and evaluating the performance of local exhaust ventilation systems, to ensure that they effectively control airborne contaminants.

### Who is it for?

Anyone that is responsible for designing the components for an LEV system, and evaluating its performance. This could include LEV engineers (e.g. designers, specifiers, commissioning engineers), maintenance personnel and health and safety practitioners.

### What are the entry requirements?

It is *desirable* for candidates to:

- Have successfully completed *P601 – Thorough Examination and Testing of Local Exhaust Ventilation Systems,* or be able to demonstrate an equivalent level of learning.
- Have a good understanding of *HSG258: Controlling Airborne Contaminants at Work.*

### What are the main subject areas?

- Workplace control principles.
- Design of LEV systems.
- Evaluation of the performance of LEV systems.

### How long does it take?

Normally four days.

### What level is it?

Level 4 in the BOHS qualifications framework.

### How do candidates pass it?

Candidates must pass two parts within 12 months:

- Written Theory examination.
- Two case study submissions.

# Section 3

## Background to the qualification

BOHS aims to protect worker health through promoting the science and practice of occupational hygiene. By identifying and controlling health risks in the workplace, we can reduce the levels of occupational ill health.

Inhalable hazardous substances (e.g. wood dusts) are a big cause of ill health in the workplace, and if not controlled can lead to potentially fatal illnesses such as lung cancer. LEV systems are an effective method of drawing harmful contaminants out of the air, making it safer to breathe in and potentially saving many lives.

However, in order to work effectively an LEV system must be functioning properly. It is therefore important that an experienced professional carries out regular maintenance of LEV system equipment to ensure that it is working to its full potential.

BOHS' LEV qualifications ensure that candidates have the skills and knowledge required to design, test, commission and maintain LEV systems. *P602 - Basic Design Principles of Local Exhaust Ventilation Systems* gives candidates a practical and theoretical understanding of best control practice for hazardous substances, the role of local exhaust ventilation (LEV) in this regard, and how to design LEV systems and evaluate their performance to ensure that they are functioning properly in order to protect worker health.

# Section 4

## Key features of the qualification

### Objective

To provide candidates with the theoretical and practical knowledge for designing and evaluating local exhaust ventilation systems, to a standard which reduces occupational ill health.

### Target audience

This qualification is suitable for anyone who is responsible for designing LEV system components, and evaluating their performance. This could include:

- LEV designers/specifiers.
- Engineering personnel involved with the maintenance of LEV systems.
- Assigned lead LEV engineers within a company.
- LEV TExT, inspection and commissioning engineers.
- Occupational hygienists.
- Health and safety practitioners and managers.

It may also be suitable for those who wish to progress into these job roles.

### Entry requirements

Before taking P602, it is *desirable* for candidates to have successfully completed *P601 – Thorough Examination and Testing of Local Exhaust Ventilation Systems* (or demonstrate equivalent level of learning). They should also have a good understanding of *HSG258: Controlling Airborne Contaminants at Work*.

### Level

The level of a qualification indicates the relative complexity and depth of knowledge and skills required to attain the qualification.

This qualification is set at level 4 in the BOHS qualifications framework.

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### Fees

The examination fee for each candidate is published on the BOHS website: [www.bohs.org/qualifications-training/examination-fees/](www.bohs.org/qualifications-training/examination-fees/)

# Section 5

## Delivering the qualification

### Teaching and learning time

The P602 course is normally conducted over four days, which comprises a minimum of 24 hours of learning time. This includes 18 hours teaching time and 6 hours independent study (in the candidate's own time).

The course can be delivered more flexibly, such as one day per week, but should still include 18 hours of teaching time.

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### Tutors

The course should be taught by tutors who are experienced and qualified/certified LEV system engineers or occupational hygienists. As a guide, tutors will typically have:

- At least three years' current experience in testing and examining LEV systems;
- A recognised LEV qualification or a professional occupational hygiene qualification/certification such as:
  - BOHS Certificate of Competence (Control).
  - BOHS Certificate of Operational Competence (CertOH).
  - BOHS Diploma of Professional Competence (DipOH).

This list is not necessarily exhaustive or definitive.

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### Teaching resources

Training providers must have the following facilities and equipment:

- Measurement data, drawings and photographs for LEV system design studies for the control of hazardous material (e.g. safety checklists for the facilities).
- Fully detailed case studies with drawings, measurement data and photographs for practical learning during the course.

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### Support for teaching and learning

BOHS provides:

- Examination guidance for tutors, which includes sample examination questions.
- Sample case study assignments.

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### Language

The examinations are provided in English only.

# Section 6

## Syllabus

The qualification is structured into four sections, each with an indicative time allocation:

| Section | Syllabus section | Time allocation |
|---|---|---|
| 1 | Workplace control principles | 10% |
| 2 | Design of LEV systems | 55% |
| 3 | Evaluation of the performance of LEV systems | 20% |
| 4 | Practical | 15% |

**Educational objectives**

The student should understand:

- The complex nature of employee exposure to health hazards in the workplace. The hierarchy of Control measures, and the overall approach that is required for successful implementation of a control programme.
- The consequences of ineffective exposure control measures.

***1.1 Principles of good control practice***

1.1.1 The importance of recognising all potential sources of exposure, and how each of these sources can be controlled.

1.1.2 The Hierarchy of Control options, including work procedures, process engineering controls, ventilation and PPE.

1.1.3 Practical application of control measures, including testing for the adequacy of the control measure and evaluation of its ongoing performance.

1.1.4 The control of emissions in relation to exposure control, and the consequences of inadequate control (i.e. in terms of health and finance).

1.1.5 The need for proper development and management of exposure control measures, and their implication for COSHH assessments.

***1.2 Achieving control***

1.2.1 The overall exposure control measure for a procedure comprises of a mixture of process design, extraction systems and working practices. All of these parameters (hardware and software) must be properly considered in the overall design to achieve a proper level of sustainable control.

***1.3 Assessment of exposure and risk assessments***

1.3.1 Use of process and procedure risk assessments to evaluate the potential over-exposures that control measures need to overcome, in order to achieve adequate control at the design stage for a process.

## 2 Design of LEV systems (55%)

**Educational objectives**
The student should:

- Understand in detail the best design factors of local exhaust ventilation systems.
- Be able to identify the most common design errors which make local exhaust ventilation systems ineffective.
- Have an informed awareness of the use of prototype systems to assess potential level of control.
- Have a good understanding of the measurement methods used in the evaluation of LEV systems.

### *2.1 Types of system*

2.1.1 The range of ventilation systems in use: general ventilation, local exhaust ventilation, enclosures, down flow systems etc.

### *2.2 Principles of LEV systems and their components*

Design principles of the system itself and of its components, including:

2.2.1 Hood designs (e.g. captor, receptor, enclosure, vena contracta etc.) Include details of the Fletcher and Garrison methods of predicting air flows, velocity contours and effects of flanges on inlets.

2.2.2 Ducts: duct size, configuration and materials, design of bends and junctions etc. This includes balancing systems by design or use of dampers etc.

2.2.3 Fans: different fan types and their application and effects of direction of rotation. This includes detail on fan performance curves and their utilisation.

2.2.4 Air cleaners: types and their performance (e.g. gravity and centrifugal collectors, dry fabric, electrostatic, wet methods, absorption).

2.2.5 Facilities for maintenance, examination, testing and conditioning.

2.2.6 Balancing air flows, both within ventilation systems and the immediate environment.

2.2.7 The nature of flammable dusts and vapours, and of explosion prevention and explosion relief in relation to LEV.

2.2.8 Discharge systems: their risks and deficiencies.

2.2.9 The provision of replacement air (if the workroom is either relatively small or relatively well sealed). Emphasise the importance of the distribution of the replacement air in a workroom, so that it assists with the control.

### *2.3 Design considerations of LEV systems*

2.3.1 Identification of the sources of release.

2.3.2 The requirement to enclose each source (as far as reasonably practicable).

2.3.3 Design considerations for captor and receptor hoods, enclosures, booths, other types of extract hood (e.g. partial enclosure, which is not necessarily the same as a booth). Additional special types should also be known about, such as push-pull systems, High Velocity Low Volume (HVLV) systems etc.

2.3.4 Application of hoods, slots and enclosures to industrial situations.

2.3.5 Specifying relevant measurable performance criteria for an LEV system.

2.3.6 Capture velocities, face velocity and transport velocities.

2.3.7 Calculating the air flow that is required in each branch of an LEV system.

2.3.8 Pressure loss calculations for a multiple-branch LEV system.

2.3.9 Calculating the fan duty that is required (i.e. air flow and pressure drop).

2.3.10 Balancing the air flows in an LEV system: use of duct design or dampers and use of flow control valve(s).

2.3.11 The importance of air distribution across the face of a large extract hood.

2.3.12 Description of how hot plumes behave.

2.3.13 Discharge arrangements and the risk of re-circulation of contaminated air (including where the discharge is, and whether it can be drawn back into the building).

2.3.14 Treatment systems and filtration standards, including their maintenance standards.

2.3.15 Limitations of LEV and evaluating the practicability of the system for use.

2.3.16 The filtration standard that is needed if air that contains particulates is to be re-circulated into the workroom (i.e. HEPA to a minimum of EU13).

**Educational objectives**
The student should understand the basic techniques for measurements associated with the evaluation of LEV systems, and be able to use them as part of system commissioning.

***3.1 Measurement considerations***

3. .1 The visualisation of air flows and the effective capture of thecontaminant(s) into the ventilation system, including the use of a dust lamp.

3. .2 The use of common measurement types for LEV systems.

3. .3 Full understanding of all calculations for volume flows from pressure and velocity measurements, and their importance during commissioning or re-commissioning of systems.

3. .4 The specification of suitable measurable performance criteria for anLEV system, and how to report this.

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**Educational objectives**
The student should understand the principles behind the operation of ventilation systems. They should be able to design a system to meet relevant criteria, and then carry out measurements to check the effectiveness of the system.

***4.1 Practical knowledge***

The student should have experience of carrying out the following tasks:

- Design of an LEV system to control a process.
- Use of an appropriate technique to visualise air flows as a means to test control.
- Using common pressure and velocity measuring instruments to undertake the measurements in relation to LEV systems (e.g. face velocity or capture velocity).
- Where and how to undertake duct measurements to get meaningful results.

# Section 7

## References and further reading


| | |
|---|---|
| 1 | ACGIH (2007), Industrial Ventilation: A Manual of Recommended Practice for Operation and Maintenance |
| 2 | ACGIH (2016), Industrial Ventilation: A Manual of Recommended Practice for Design (29th Edition) |
| 3 | HSE COSHH Essentials e-tool: http://www.hse.gov.uk/coshh/essentials/ |
| 4 | HSG258 (2017), Controlling airborne contaminants at work: A guide to local exhaust ventilation (LEV) 3rd Edition, HSE |
| 8 | L5 (2013), The Control of Substances Hazardous to Health Regulations 2002. Approved Code of Practice and guidance, HSE |
| 9 | WIS23 (2012), Wood dust: Controlling the risks, HSE |

# Section 8

## Achieving the qualification

Candidates are required to pass two mandatory components to be awarded the P602 qualification:

- Written Theory examination.
- Two case study submissions.

## Written Theory examination

The written theory examination enables candidates to demonstrate that they have attained the breadth and depth of knowledge about inhalable health hazards, the role of LEV systems in controlling these hazards, and designing and evaluating the performance of LEV systems to determine if they are functioning effectively.

The examination comprises 35 short-answer questions to be answered in 1 hour 45 minutes. Short-answer questions require candidates to give brief answers, sometimes as bullet points or calculations. All questions are worth 4 marks and candidates may be awarded between 0 and 4 marks per question. Candidates should attempt all questions as no marks are deducted for incorrect answers.

The pass mark is 50%. The examination covers sections 1 to 3 of the syllabus in proportion to the time allocation given for each section. This gives a question allocation as follows:

| Section | | Number of questions |
|---|---|---|
| 1 | Workplace control principles | 4 |
| 2 | Design of LEV systems | 23 |
| 3 | Evaluation of the performance of LEV systems | 8 |

The sections are clearly marked in the examination paper.

The written theory examination is a closed-book examination, which means that candidates are not permitted to have access to any external materials or textbooks.

**Invigilation**

The written theory examination is carried out in controlled conditions, to help ensure that all candidates demonstrate their true level of attainment. BOHS will appoint an independent invigilator to oversee the examination.

**Marking and results**
All examination papers are marked by BOHS.

Candidates receive their results in writing from BOHS. The results are reported as pass or fail plus a percentage. Borderline fail results are automatically re-marked by a second marker.

Training providers are sent a list of results for all candidates on a course.

**Feedback**

Candidates receive feedback on their examination performance. For example, the feedback for a written theory examination in which a candidate scored 53% would be shown as follows:

| | Syllabus area | Result | |
|---|---|---|---|
| 1 | Workplace control principles | 12/16 | (75%) |
| 2 | Design of LEV systems | 46/92 | (50%) |
| 3 | Evaluation of the performance of LEV systems | 16/32 | (50%) |
| **Total** | | **74/140** | **(53%)** |

Training providers receive feedback on the overall performance of all candidates. For example, the feedback for a course with six candidates would be as follows:

| **Written exam performance against syllabus** | | **Number of candidates in each scoring band** | | |
|---|---|---|---|---|
| | | 0-49% | 50-75% | 76-100% |
| Written Theory | 1. Workplace control principles | 1 | 4 | 1 |
| Written Theory | 2. Design of LEV systems | 0 | 3 | 3 |
| Written Theory | 3. Evaluation of the performance of LEV systems | 2 | 4 | 0 |

**Resits**

Candidates may re-sit the written theory examination, provided that they pass within 12 months of the original sitting.

## Case study submissions

Upon successful completion of the course and the written theory examination, candidates will be assigned two case studies to complete, to submit their proposals and findings on an individual basis. This is to test that they can apply their learning to real-life LEV system design and performance evaluation situations.

**Content of case studies**
One case study will focus on how an LEV system has been designed to control a hazardous substance, and the other case study will look at identification of system faults and the rectification required for an existing LEV system.

**Case Study 1: Design of LEV systems**
The design case study scenario will be presented by means of a text document with drawings and photographs. The candidate will be required to respond to the prompts given in the case study and submit their conclusions, with appropriate drawings and explanations.

The design case study will test candidates on:

- Specification of LEV hood types for the effective capture and control of airborne hazardous substances from one or more processes. The protocol for hood selection will follow the procedure in Appendix 2 of HSG258 Controlling airborne contaminants at work (latest edition).
- Use of data provided and calculation of system parameters to specify appropriate ducting, collector, fan and discharge for a multi-branched LEV system.

**Case Study 2: Identification of system faults**
The second case study is about identifying faults in existing LEV systems. Candidates are asked to evaluate a system based on the data provided, and recommend appropriate corrective measures for each fault.

This involves evaluation of a poor LEV system design, using photographs and prompt questions. The candidate will be required to respond and submit their conclusions with appropriate drawings and explanations.

**Submission process**
BOHS will email the case studies to the candidate for completion. The case studies will require several hours of self-study and research work to complete.

The case studies are set up so that candidates read the scenarios and answer a number of questions within the same document. Spaces are indicated where candidates should write their answers or insert drawings.

Candidates are required to complete Part 1: Certificate of Authorship for each case study, to certify that it is the candidate's own work. Candidates will then write their answers in Part 3 of each case study document.

Candidates must complete and submit both case studies within **three months** of sitting the written theory examination. Case study documents should be submitted electronically to **qualifications@bohs.org** .

Candidates must pass both case studies within 12 months of the Written Theory examination date. If candidates fail to submit either case study within 12 months, they will be required to re-take the Written Theory examination.

**Marking and results**

Candidates will receive their result in writing from BOHS. The result is given as a pass or fail. If a case study has not passed, the case study document will be returned to the candidate with Part 4: Results and feedback completed by the case study marker, with details of amendments required by the candidate.

The candidate should amend the case study accordingly, and add their comments under Part 4: Results and feedback to advise which questions they have amended in the case study. They should then re-submit their amended case study to BOHS for re-marking.

# Section 9

## Quality assurance

### Internal quality assurance

Training providers must operate an internal quality assurance system which evaluates and improves the delivery of the qualification.

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### External quality assurance

BOHS undertakes desk-based reviews of documents, including teaching materials, and conducts surveys of candidates. We also may inspect training providers.

# Section 10

## Offering the qualification

### Approved training providers

Please complete and return the 'Application to Offer Additional Qualifications' form to qualifications@bohs.org. The form is available on the BOHS website.

# Section 11

## Other courses and qualifications

Candidates who successfully complete this qualification may wish to take:

### P603 - Control of Hazardous Substances - Personal Protective Equipment

**Objective**
To teach candidates about the different options available for controlling health hazards in the workplace, and how to develop, organise and implement a successful personal protective equipment programme to reduce worker exposure to these hazards.

**Target audience**
Anyone who is responsible for managing health risks in the workplace or maintaining local exhaust ventilation systems. This could include LEV engineers, health and safety practitioners and occupational hygienists.

### P604 - Performance Evaluation, Commissioning and Management of Local Exhaust Ventilation Systems

**Objective**
To provide candidates with the knowledge and skills to commission new and existing LEV systems, to ensure that they are designed, installed and maintained to a standard where they effectively control airborne contaminants in the workplace.

**Target audience**
Anyone that is responsible for managing, commissioning and evaluating the performance of LEV systems. This could include commissioning engineers, maintenance managers and occupational hygienists.