This Safety Guideline is intended to provide users of LEV systems with practical advice on how to ensure their system is effective as a control measure for preventing exposure of persons and on how to release the extracted air to the atmosphere.

**DOCUMENTATION**

**Reference documents:**

1. General Safety Instruction, GSI-C-1, Prevention and Protection Measures (EDMS No. 1113405).
5. Opérations de soudage à l’arc et de coupage, ED 668, INRS, juillet 2010.
8. Arrêté du 2 février 1998 relatif aux prélèvements et à la consommation d’eau ainsi qu’aux émissions de toute nature des installations classées pour la protection de l'environnement soumises à autorisation.

**Further Reading:**

**TRACEABILITY**

**Reference No.:** Safety Guideline SG-C-1-0-3

**EDMS No.:** 1113398 v.5

**Prepared by:** J. Gulley; A. Henriques; S. Kleiner; HSE/SEE

**Date:** 17/01/2017

**Verified by:** C. Laverrière, F. Angerand, HSE/SEE

**Date:** 05/07/2017

**Approved by:** E. Cennini, HSE/SEE

**Date:** 05/07/2017

**Distribution:** Public document published on the Safety Rules web site.

<table>
<thead>
<tr>
<th>Rev. No.</th>
<th>Date</th>
<th>Description of Changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>18.12.2012</td>
<td>Standard XP X 15-203 obsolete and replaced by EN 14175</td>
</tr>
<tr>
<td>2</td>
<td>20.03.2014</td>
<td>Requirements for the release of extracted air to the atmosphere were included in section 5.1.3.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>References [6], [7], [8] and [9] were added in the document.</td>
</tr>
<tr>
<td>3</td>
<td>04.11.2015</td>
<td>Image changed in 7.1 Labelling hoods + minor modifications of Annex II</td>
</tr>
<tr>
<td>5</td>
<td>05.07.2017</td>
<td>Replaced EN 14175-5 with new reference ‘Technical Specification CEN/TS 14175-5’. In Chapter 5.1.2.2, Removed the following text ‘For fume cupboards the minimum capture velocity should be 0.4 m/s’. In Chapters 4 and 7.2, replaced GS/SE with SMB-SE.</td>
</tr>
</tbody>
</table>
1 INTRODUCTION

Local Exhaust Ventilation (LEV) is an engineering control measure to reduce exposure at the workplace by removing airborne contaminants such as dust, mist, fume, vapour or gas, at or near to the source of release. The common elements of a simple LEV system are shown below:

**Hood**: where the contaminant enters the LEV.

**Ducting**: conducts air and the contaminant from the hood to the discharge point.

**Air cleaner or arrestor**: filters or cleans the extracted air (e.g. fabric filter or activated carbon filter, cyclone, electrostatic precipitator, wet scrubber).

**Air mover**: powers the extraction system, usually a fan.

**Discharge**: releases the extracted air to a safe place.

An LEV hood may be very small (e.g. fitted to a hand-held tool) or it may be large enough to walk into. There are three basic types of LEV hood:

1. **Enclosing Hood** (e.g. glove box, walk-in booth, fume cupboard)

Figure 1.1 – Glove box

Figure 1.2 – Walk-in booth

Figure 1.3 – Fume cupboard
If possible always try to enclose the process as this will increase the effectiveness of the LEV and reduce the potential for exposure.

For moveable capturing hoods, ensure the hood is placed as close as possible to the source of release, normally less than one hood diameter away.

It is a legal requirement to ensure that control measures are maintained in an efficient state, in efficient working order, in good repair and in a clean condition.

2 DEFINITIONS

**Particles**: includes dusts, fumes, mists and fibres.

**Inhalable particles**: ‘that fraction of airborne material that enters the nose and mouth and is therefore available for deposition in the respiratory tract’, [Ref. 3] (particles that are small enough to be breathed in, size range 0.01 µm up to 100 µm).

**Respirable particles**: ‘that fraction of airborne material that penetrates to the gaseous exchange region of the lung’, [Ref. 3] (particles that are small enough to penetrate deep into the lungs, upper size limit of about 10 µm)

**Capture velocity**: the air velocity (m/s) required around a source to capture the contaminant and draw it into the hood.

**Capture zone or capture bubble**: a three dimensional envelope in front of a capturing hood, in which the capture velocity is adequate.

**Face velocity**: the average velocity of air at the open front face of a hood or booth (m/s).
3 SOME PROPERTIES OF AIRBORNE CONTAMINANTS

3.1 Particles

3.1.1 Visibility
A contaminant cloud that contains mainly respirable particles is practically invisible to the naked eye; a cloud containing inhalable particles is partially visible.

3.1.2 Movement
The size of a particle rather than the density determines how particles move in the air. Larger particles (100 µm or larger) fall out of the air easily. Smaller particles, even of high-density material such as lead, can float away from the release point and remain suspended in the air, moving with the air currents.

3.2 Gases and vapours
The difference in density between gas or vapour clouds and air is generally small, and will become smaller as they dilute in air after being released. For this reason dense gases or vapours will move with the surrounding air, rather than tending to sink. LEV should therefore be placed as close to the source as possible.

4 SELECTION AND PURCHASE
The hood design selected for a particular activity or process must be effective and reliable in controlling exposure to the airborne contaminant generated. You should seek competent advice from the HSE Unit, SMB/SE Group etc. before purchasing LEV and for help in preparing a clear and adequate technical specification.

For some activities it’s important that the LEV system is fitted with an airflow indicator or pressure gauge to give a clear indication to the operator that the hood is still effective in controlling exposure. Such devices can be retrospectively fitted for existing LEV hoods.

4.1 Fume Cupboards
All newly purchased fume cupboards should be in accordance with the relevant European Standard (Ref. 4) and be fitted with a pressure switch to activate an alarm if the flow rate falls below the required level (see Ref. 4, EN 14175-2).

For existing fume cupboards, it is recommended that for activities where the risk of exposure is high (e.g. handling chemicals of high toxicity):
A fume cupboard in accordance with EN-14175 [Ref. 4] should be purchased; or
As a minimum, the existing fume cupboard should be retro-fitted with a suitable warning device. This could be a simple device such as a manometer used to measure the static pressure in the hood duct or a complex device such as a pressure switch.
Recirculating fume cupboards fitted with adsorption filters for removing gases or vapours are not recommended due to the difficulties in ensuring that the operator is aware that the filters continue to remain effective and that exposure is controlled.
4.2 Soldering work

It is recommended that for effective control of the fume emitted during soldering work:

- Tip extraction is used; or
- The work-station is enclosed as much as possible (e.g. see photo below).

Both of these methods are proven to be more effective than the use of moveable capturing hoods.

The problems with moveable hoods (as shown) are that:

- correct positioning of the device is vital. The tendency is for operators to position the hood too far away from the source in order to not obstruct and interfere with their work;
- the capture zone can be easily disrupted by draughts at the workplace, further reducing the ability of the hood to capture the fume. In conclusion, this type of device is usually ineffective at controlling exposure.

4.3 Welding activities

An efficient method to remove welding fume in order to control exposure should be used. The use of one of the following systems is recommended:

- Fume extraction torch:

Ref. [5]
• Fume extraction table:

Ref. [5]

For the reasons already mentioned in § 4.2, moveable capturing hoods are not the most efficient system for controlling exposure to welding fume. The capture velocity for the extraction table should be 0.5 m/s at the point of welding and the minimum air flow for the extraction torch should be 100 m³/h (Ref. [5]).

5 INSTALLATION AND COMMISSIONING

5.1 Installation

The LEV hood should be installed in accordance with the design specification. This should be verified by suitable qualitative and quantitative checks, as described below.

5.1.1 Qualitative tests

A dust-lamp can be used to illuminate dust that would normally be invisible (see photo below). This can be used to check the effectiveness of the LEV in capturing dust or mist and should be done whilst the process is running.

Similarly, smoke tubes or an artificial smoke generator can be used to determine the degree of control for the LEV system (e.g. determine the degree of confinement by checking for smoke leakage, creation of eddies), again whilst the process is running.

5.1.2 Quantitative tests

5.1.2.1 Full enclosures (e.g. glove box)

The static pressure inside the enclosure must be lower than the static pressure in the workroom. To confirm that containment is achieved tracer gases can be injected into the enclosure and suitable detectors used to check for leakage.
5.1.2.2 Partial enclosures (e.g. booths, fume cupboards)

The face velocity must be sufficient to contain the contaminant cloud and prevent exposure.

5.1.2.3 Receiving hoods

The volume flow rate must empty the hood at least as fast as it fills, to contain and remove the worst-case contaminant clouds.

5.1.2.4 Capturing hoods

The ‘capture velocity’ required will depend on the type of process and the energy of the release, as shown in the table below:

<table>
<thead>
<tr>
<th>Contaminant cloud release</th>
<th>Example of process</th>
<th>Capture velocity range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Into still air with little or no energy</td>
<td>Evaporation (e.g. mist from electroplating baths)</td>
<td>0.25 to 0.5 m/s</td>
</tr>
<tr>
<td>Into fairly still air with low energy</td>
<td>Welding, soldering, liquid transfer</td>
<td>0.5 to 1.0 m/s</td>
</tr>
<tr>
<td>Into moving air with moderate energy</td>
<td>Crushing, spraying</td>
<td>1.0 to 2.5 m/s</td>
</tr>
<tr>
<td>Into turbulent air with high energy</td>
<td>Cutting, abrasive blasting, grinding</td>
<td>2.5 to &gt; 10 m/s</td>
</tr>
</tbody>
</table>

The lower end of the range of capture velocities applies to substances of low toxicity and for locations where there are no draughts. The upper end of the range applies to toxic substances and for locations where draughts are likely.

5.1.2.5 Duct velocities

The transport or duct velocity needs to be sufficiently high to avoid the deposit of particles inside the ventilation ductwork. Some recommended minimum duct velocities for different types of contaminants are shown in the table below:

<table>
<thead>
<tr>
<th>Type of contaminant</th>
<th>Indicative duct velocity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gases and non-condensing vapours</td>
<td>No minimum value</td>
</tr>
<tr>
<td>Condensing vapours, fume and smoke</td>
<td>Up to 10 m/s</td>
</tr>
<tr>
<td>Dust from welding and cutting activities (e.g. plastic dusts, sawdust) fine dusts and mists</td>
<td>&gt; 12 m/s (average)</td>
</tr>
<tr>
<td>Low or medium density, low moisture content dusts (e.g. process dusts)</td>
<td>Up to 15 m/s</td>
</tr>
<tr>
<td>Dust from welding and grinding activities (shared ductwork)</td>
<td>18 m/s (minimum)</td>
</tr>
<tr>
<td>Process dusts (e.g. wood shavings, wood cutting machine, grinding dusts)</td>
<td>Approx. 20 m/s</td>
</tr>
<tr>
<td>Large particles, aggregating and damp dusts (e.g. metal turnings)</td>
<td>Approx. 25 m/s</td>
</tr>
</tbody>
</table>

5.1.2.6 Air sampling

Where appropriate, air sampling, including personal exposure monitoring should be performed to demonstrate that exposure is controlled.

5.1.3 Exhaust air

In absence of CERN rules, the Swiss regulation and guidelines [Ref. 7; Ref. 9], European and French regulation and standards [Ref. 6; Ref. 8] apply. To be in compliance with these regulations, standards and guidelines, the exhaust air potentially containing airborne contaminants shall be released into the atmosphere in accordance with the requirements mentioned below. These requirements apply to LEV systems which are installed in new buildings or facilities. For the modification of existing LEV systems or installation of new LEV systems in existing buildings, requirements shall be analysed case by case.

---

1 For welding operations using moveable capturing hoods, welding booths, downdraught tables etc. the minimum capture velocity should be 0.5 m/s at the point of welding/emission of fume [Ref. 5].
taking into account the quality of the exhaust air and facility/building constraints. The HSE Unit shall be contacted for advice on appropriate solutions.

5.1.3.1 **Quality of exhaust air**

The exhaust air shall be discharged to the outdoors so as to minimise exposure of people and the impact on the environment. Air treatment solutions (e.g. fabric filter or activated carbon filter, cyclone, electrostatic precipitator, wet scrubber) shall be installed whenever emission threshold limits are expected to be exceeded. The HSE Unit is available to provide assistance on the selection of adequate air treatment solutions and to define whether safety measures shall be carried out at the start of operation.

5.1.3.2 **Location of discharge**

The discharge point shall respect the following requirements:
- be above the roof of the highest section of the building and discharged upwards, so as to ensure an appropriate diffusion of emissions into the atmosphere;
- extend at least 2 m above the roof of the building to which it is attached. In some cases, the location of the discharge point might need to be at a greater height due to occupational health reasons;
- be at a minimum distance of 8 m from an adjacent building.

5.2 **Commissioning**

A commissioning report should be provided which contains:
- diagrams/photographs and a description of the LEV system including test points;
- description and results of the tests and measurements undertaken (see 5.1.1 and 5.1.2);
- any calculations performed;
- description of operator practice, including positioning and methods of working, to achieve maximum efficiency of the LEV system.

6 **CHECKING AND MAINTENANCE**

You should follow the guidance and schedule (e.g. daily/weekly/monthly) of routine checks in the operating manual for the LEV system, or in the absence of a manual, develop your own schedule of checks. An example checklist is provided in Annex I.

7 **THOROUGH EXAMINATION AND TEST (TEXT)**

All LEV systems at CERN (e.g. fume cupboards, glove boxes, small booths, walk-in booths, downdraught tables, fixed or moveable capturing hoods, canopy hoods) are subject to a thorough annual examination and test by a competent person and as such should be made known to the HSE Unit. All LEV systems will be given a unique identification number, which will be referenced in the test report and on the label displayed on the device (see 7.1 below).

The test procedure involves three stages:
1. A thorough visual examination (check that LEV is in efficient working order, in good repair and in a clean condition);
2. Measuring and examining the technical performance to check conformity with commissioning data (as required, those qualitative and quantitative tests described in chapter 5) and a check of any alarms fitted;
3. A judgement by the examiner on whether control of the worker’s exposure is adequate.

The examiner will decide whether the system is effectively controlling exposure to the substance which is hazardous to health. Any actions needed should be prioritised.

An example test report is shown in Annex II.
7.1 Labelling hoods

The examiner attaches a label to every hood/LEV system tested which indicates the result of the test and the date for the next control.

If the hood/LEV system has failed the test a pink label (see below) is used.

Criteria for failure:
No air flow;
Failure of an enclosing hood to contain the contaminant cloud;
Failure of a receiving hood to intercept or contain the contaminant cloud;
Failure of a capture hood e.g. capture zone cannot encompass the working zone.

7.2 Actions

The person responsible for the hood/LEV system should check the test report for any actions needed. They should follow the recommendations given in the report and arrange for any repair work or remedial actions to be carried out promptly.

If the device has failed the test it should no longer be relied upon as a control measure. The person responsible for the activity will need to provide suitable additional control measures, such as the use of respiratory protective equipment, until the actions have been resolved, and the device has been retested. In all such cases, the HSE Unit should be contacted for advice.

Depending on the reason for the failure of the test (e.g. ‘No air flow’) the hood/LEV system should be labelled as ‘Out of Action’ or “Hors Service” until the identified actions are resolved, and the device has been retested.

It may be that the design of the hood is at fault, and that it is not ‘fit for purpose’. In this case you should always seek competent advice from the HSE Unit, SMB-SE Group etc. before re-designing the system or purchasing a new LEV system.
Annex I

Example of Daily/Weekly checklist for an LEV System

General Checks

- No visible or obvious signs that the LEV is not working properly? E.g. odours, settled dust
- No unusual noises or vibrations?
- LEV has been thoroughly tested, with a test label that shows it is within date?

Instrumentation/filters

- Does the air indicator, if fitted, show the LEV is working properly?
- No warning lights indicating that filters are saturated

Fume Cupboards

- Is the height of the sash kept at or below the marked height (400 mm) at which the control is made?
- Fume cupboards are not being used to store chemicals?

Ventilation ducts

- No accumulation of settled dust in ventilation ductwork
**Annex II**

Example test report - Thorough Examination and Test (TExT)

---

**RAPPORT MAINTENANCE**
**CONTROLE STANDARD**
**TEST DE FUMEE**

---

**CONTROLE DE BRAS**
**ASPIRANT**

N°: 5012

---

|--------------|------------|------------|--------------------|

---

**SOCIÉTÉ CERN**
Adresse: Site de Meyrin
Dépt.: PH / UCM
Client: D3CERD
Tel: 

---

**VITESSES D’AIR**

Anémomètre de mesure et sonde: AMI 300 / FC300

<table>
<thead>
<tr>
<th>N°: 11121903 / 11126466</th>
<th>Calib: 12/11</th>
</tr>
</thead>
</table>

Diamètre tuyau en m: 0.15
Vue du diamètre d’aspiration et valeurs en [m/sec]

---

![Diagram](image)

Mise en service: service réparation

---

**CONTRÔLES TECHNIQUES GÉNÉRAUX**

Marquage OK
Dispositif d’équilibrage OK
Support mural OK
Grille de protection sous aspiration NA
Clapet OK
Lampe NA
Alarne NA
Longueur de détente OK
Matériaux de fabrication détente OK
Soufflets d’aspiration OK
État général Bon

Remarques/Défauts/Actions:
Régulation de la vitesse du ventilateur: 40 Hz.

---

<table>
<thead>
<tr>
<th>Test</th>
<th>V1</th>
<th>V2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitesse de l’air à 100%</td>
<td>8.5 m/s</td>
<td></td>
</tr>
<tr>
<td>Débit à 100%</td>
<td>D1</td>
<td>541 m³/h</td>
</tr>
<tr>
<td>Vitesse de l’air à distance de travail</td>
<td>V2</td>
<td>0.57 m/s</td>
</tr>
</tbody>
</table>

---

**ESSAIS AU FUMIGENE**

<table>
<thead>
<tr>
<th>Test</th>
<th>Oui</th>
<th>Non</th>
</tr>
</thead>
<tbody>
<tr>
<td>Presence zones mortes</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

---

**Date**

<table>
<thead>
<tr>
<th>Contrôle</th>
<th>Jour</th>
<th>Mois</th>
<th>Année</th>
</tr>
</thead>
<tbody>
<tr>
<td>22</td>
<td>6</td>
<td>2012</td>
<td></td>
</tr>
</tbody>
</table>