Industrial Ventilation Design Guidebook
Chapter 10
LOCAL VENTILATION

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LOCAL VENTILATION

Short definition:
Local Ventilation systems are used to transport contaminants or heat from the occupancy zone.
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Long definition:

Local Ventilation uses an air flow rate that is as low as possible, but sufficient to minimise the amount of airborne contaminants entering a specified volume or passing specified point(s). These are usually intended to be at the breathing zone of occupants. This minimisation of air flow can be achieved either by capturing (or containing) the airborne contaminant into an exhaust hood before it enters the workspace, by blowing non-contaminated air from a supply inlet through the volume to prevent the contaminant from entering the workspace, or a combination of those.
Local Ventilation Modes

**Fixed.** No changes to the system, except perhaps opening and closing of lids and doors, are possible. One example is the laboratory fume hood.

**Flexible.** The suction opening or supply device is placed inside a limited area or volume. The exhaust (or supply) opening and duct (or tube) is connected to the fan by moveable elbows or flexible tubes. One example is a wall mounted hood for welding exhaust.

**Mobile.** The exhaust (supply) opening may be placed almost anywhere inside a workroom. The whole system (exhaust/supply opening, duct, fan) is on wheels or a portable frame. Or a separate exhaust part (opening and short tube) is connected to a central duct system at many places. One example is a welding exhaust (with filter) on a small carriage and another is a centralized exhaust system for connection to car exhaust pipes. It also includes portable systems.
Figure 10.1. Principles for the three different ways of protecting a volume by using an exhaust hood (above), a supply inlet (middle), and a combined exhaust hood and supply inlet (below).
Description of each Local Ventilation system

General comments
Principle, including sketches and/or figures
Applicability of contaminant sources
Different forms and boundaries to other types
Relative location of supply and exhaust openings and source(s)
Location of worker and tools relative to exhaust and source(s)
Disturbances
Specific problems
Changing flow rates
Design equations and/or parameters
Evaluation procedures
Velocity distributions outside round (top left), round with flange (top right), and square (bottom) exhaust opening.
Principle for total enclosure

Principle for partial enclosure
The air shower principle creates a zone of clean air around the worker and pushes away the contaminant plume from the breathing zone.
Examples of principal arrangements of open unidirectional airflow benches.
A push-pull system is a combination of an exhaust and an inlet system.
A schematic representation of the Aaberg principle in a combined exhaust-supply system.
Principle for auxiliary air supply to a laboratory fume hood.
The Class III Biological Safety Cabinet is a combined exhaust-supply system. A: Glove ports with O-ring for attaching arm-length gloves to cabinet. B: Sash. C: Exhaust HEPA filter. D: Supply HEPA filter. E: Double-ended autoclave or pass-through box. Note: Connection of the exhaust to building exhaust system is required.
EVALUATION OF LOCAL VENTILATION SYSTEMS

The evaluation methods could be direct, e.g., measuring a containment index, or indirect, e.g., measuring pressure loss or velocity distribution.
Indirect methods are used to determine regulatory compliance. For example, specified minimum and maximum face velocities for laboratory fume hoods and static pressure (negative) inside enclosed hoods. Monitoring instruments can be connected to alarms.

Capture efficiency is the fraction of generated contaminant that is directly captured by the hood. This means measuring concentration of process-generated contaminant or a tracer material. Using contaminant requires instruments suited to each specific contaminant and its conditions. It is easier to use a tracer.

Simple evaluations by checking the air flow rates into the opening, presuming that many parameters have not changed since the detailed evaluation was done.

Static pressure loss for a hood can be used to monitor the flow rate into the hood. If the flow rate and the pressure loss were measured at the same time as the efficiency, the pressure loss can be used for monitoring hood performance.

Another simple way is to use smoke to visualize the air streamlines. It is sometimes possible to see how far an exhaust reaches by observing smoke movement.
<table>
<thead>
<tr>
<th></th>
<th>Exterior hoods</th>
<th>Enclosures</th>
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<tbody>
<tr>
<td><strong>Hood types</strong></td>
<td>Basic openings, Rim exhausts, LVHV, Receptor hoods, Special: Fit to machines</td>
<td>Booths, Laboratory fume hoods, Safety cabinets, Glove boxes, Storage cabinets, Built-in processes</td>
</tr>
<tr>
<td><strong>Evaluation procedures</strong></td>
<td>Capture efficiency, Capture velocity</td>
<td>Containment indices such as: Protection factor and similar. Leakage factor and similar. Pressure difference. Opening velocity.</td>
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</tbody>
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Thank you!

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