How to Ensure your LEV System Works

Evaluate your System

Local exhaust ventilation (LEV) systems are meant to capture airborne contaminants at the source of generation and remove them from the work area. When a LEV system does its job your workers are healthy and productive. But often LEV systems do not do their job. Why?

First, look at the number of components that must be working to ensure a LEV system is functioning properly. A LEV system consists of:

- hoods: for capturing the contaminant
  Q: Do your hoods capture the contaminant?

- ducts: for transporting the contaminant
  Q: Does the contaminant stay in the duct?

- air cleaner: for removing contaminants from the air stream
  Q: Does your air cleaner clean the air to the required efficiency?

- fan: to create airflow in the system
  Q: Does your fan provide adequate flow?

- stack: to discharge the air outside the workplace
  Q: Does your stack exhaust high enough?

- air make up system: to replace the air being exhausted
  Q: Is the AIR in your facility balanced?

Design for success

LEV systems that work are usually the ones that were designed specifically to meet the requirements of the job/process. In order to design an effective LEV system, first define what you want it to do.

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Know Your Contaminant

To design a LEV system you must know <u>all</u> about the contaminant you are dealing with and how it is used. For example, know the:

- physical state (is it a dust, mist, fume, gas or vapor?),
- contaminant's toxicity,
- applicable exposure limits,
- physical properties (boiling point, flash point, etc.),
- routes of worker exposure (inhalation, ingestion, skin contact),
- how, where and when the contaminant is being generated, and
- how the worker does their job.

1.0 *Hood design* -- A well-designed hood is the **most important** component of an effective LEV system. It must be:

- positioned so that it does not pull contaminated air through the worker's breathing zone,
- easy to use and not interfere with the job that the worker is trying to do, and
- positioned as close to the point of contaminant generation as possible.

NB: The further it is from the point where the contaminant is released into the air, the more airflow is required to capture it.

2.0 *Air volume and capture velocity* -- The air volume (cubic feet per minute) that must be exhausted by a LEV system is determined by:

- type of hood
- distance between the hood & the source of the contaminant
- velocity needed to capture the contaminant (Capture Velocity). Capture velocity for a hood is determined by the properties of the contaminant and how it is being generated. Examples of capture velocities are shown in Table 1.

RANGE OF CAPTURE VELOCITIES		
Condition of Dispersion of Contaminant	**Examples**	**Capture Velocity, fpm**
Released with practically no velocity into quiet air.	Evaporation from tanks, degreasing, etc.	50 – 100
Released at low velocity into moderately still air.	Spray booths; intermittent container filling; low speed conveyor transfers; welding; plating; pickling	100 – 200
Active generation into zone of rapid air motion.	Spray painting in shallow booths; barrel filling; conveyor loading; crushers	200 – 500
Released at high initial velocity into zone of very rapid air motion.	Grinding; abrasive blasting, tumbling	500 – 2000

In each category above, a range of capture velocity is shown. The proper choice of values depends on several factors:

Lower End of Range

1. Room air currents minimal or favourable to capture.
2. Contaminants of low toxicity or of nuisance value only.
3. Intermittent, low production.
4. Large hood – large air mass in motion.

Upper End of Range

1. Disturbing room air currents.
2. Contaminants of high toxicity.
3. High production, heavy use.
4. Small hood – local control only.

Table 1

3.0 *Transport velocity and duct size* -- Once a contaminant is captured by the hood it moves into the duct system. The velocity in the duct must be:

- sufficient to transport the contaminant through the LEV system
- the heavier the contaminant; the higher the velocity needed for transport

NB: Some examples of transport velocities for different contaminants are shown in Table 2.

4.0 *Make up air* -- Air will only be exhausted to the extent that air enters the workplace. If you don't provide make up air in the amount at least equal to the amount of air being exhausted, your LEV system will:

- not work properly,
- the workplace will be very drafty,
- humidity will build (Mold, Rust, etc.)
- doors will be difficult to open, and
- furnaces, heaters or other combustion equipment may back draft.

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Recommended Transport Velocities

Type of Pollutant	Recommended Transport Velocity (ft/min)
Gaseous gases	~ 1000 – 2000
Light particulate loading	~ 3000 – 3500
Normal particulate loading	~ 3500 – 4500

Table 2

5.0 *Streamlined airflow* -- LEV system should always use round ducts, because airflow is more uniform and streamlined, which makes the system more efficient and provides better transport for contaminants. The duct runs should be:

- as straight as possible;
- curves should be smooth and gradual;
- elbows should have a radius of 1.5 to 2.5 times the duct diameter;
- branch entries into the main duct should be at an angle between 30 - 45°;
- there should be no 90° entries; and
- all changes in size should be smooth and gradual.

6.0 *Stacks* -- A stack should discharge contaminated and/or exhausted air vertically upward and away from the building. Stacks should be:

- located as far from air intake units as possible to prevent reintroduction of contaminated air into the building
- 1.3 to 2 times the building height above the ground (2m above the highest peak is also a good rule of thumb)
- avoid exhausting air out of the sides of buildings

NB: The pressure of prevailing winds blowing into the exhaust can severely affect the performance of the LEV system.

7.0 *Fan selection* -- The fan you select for your LEV system should be based on the needs of the system. It should not only deliver the volume of air (in cubic feet per minute) necessary to capture the contaminant but be able to do so against the resistance in the duct system, also known as “Pressure drop” or TSP Total system pressure. The resistance to airflow is measured in inches of water. Static pressure losses in a LEV system are determined by the:

- size of the duct,
- roughness of the duct material,
- number and type of elbows, entries, and changes in size,
- type of air cleaner,
- type of hood,
- volume of air flowing in the system,
- stack design, and
- inlet losses.

It should be clear from this list that a fan cannot possibly be selected successfully until the system has been designed.

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8.0 *System installation* -- Insist that you get a system installed as designed, with:

- round ducts and smooth streamlined airflow,
- minimal use of a flexible duct (it is very rough),
- limit the use of dampers,
- ensure all joints are sealed,
- access doors installed for duct cleaning, and
- limit the use of grills and screens.

Fans will operate more efficiently if they are installed with a length of straight duct entering and leaving the fan. A rule of thumb is to provide a straight run of duct at least six duct diameters long on the entrance side of the fan and at least three duct diameters long on the exit side. After installing the system, measure to ensure that the LEV system delivers the airflow volume and velocity that is needed to do the job.

Keep it user-friendly

A LEV system should be easy for the worker to use. If the worker does not understand the reason for the system, or does not know how to use the system, or if it interferes with job performance, the LEV system is not going to work. So involve the worker in the entire process of designing, installing and starting up a new LEV system.

Maintain It

A LEV system is a mechanical system that must be maintained or it **will** fail over time. Some examples of failures that we have seen include:

- Fan not turned on,
- Fan turning in the wrong direction,
- Fan belt broken,
- Duct blocked from accumulated contaminant,
- Holes in duct,
- Hoods damaged or removed,
- Lack of make up air.

Inspect all components of the LEV system periodically to ensure it is operating properly. Scheduled maintenance should include:

- measurement of total airflow,
- duct velocity, and
- capture velocity for comparison with baseline measurements taken at the time of installation.