

Processes and sources and their control – Further details

Introduction

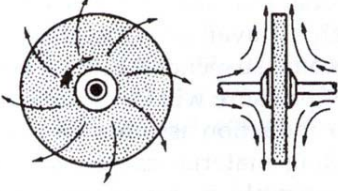
To effectively control exposure, local exhaust ventilation (LEV) hoods must be designed to match the way processes and sources emit airborne contaminant clouds. It follows that to apply a LEV effectively, you must understand processes and sources. The video-clips on this Webpage show some common processes and the sources they generate.

The following table:

- Identifies many common processes,
- Gives examples,
- Describes the mechanisms by which source contaminant-laden air is created and flows away from the process, and,
- Lists some control options.

Processes and sources

Process	Examples	Creation mechanism(s) and description	Possible modifications/ controls
Introduction			
Many common processes and sources are described. For each process examples are given, the mechanism(s) generating the contaminant and creating air movement are described and some possible process modifications and controls are listed.			
a. Rotating tools and parts	Orbital, belt and disc sanders. Disc cutters. Circular saws and routers. Lathes. Drills	Rotating motion creates a fan effect.	<ul style="list-style-type: none"> •Reduce rotational speed. •Enclose. •Strip off the "boundary layer" of still air close to the blade, moving with the rotating disc •Closely applied Low Volume High Velocity (LVHV) capturing hood

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	Abrasive wheels and polishers	<p>Air movement created may be a unidirectional air-jet if the rotating part is partially enclosed in, for instance, a guard. Or the source air may flow outwards radially in the plane of rotation</p> 	<ul style="list-style-type: none"> •Water suppression.
b. Hot (and cold) processes	Furnaces. Casting. Soldering, brazing and welding. Pouring liquid nitrogen	<p>Hot process and source; releases hot contaminant-laden air and heats air locally. Plume rises and expands by entraining workplace air. Cold process and source; Same mechanisms as for 'hot' but, in this case, the contaminant-laden plume sinks.</p> <p>To apply LEV control the approximate volume and flow rate of hot/cold air can be calculated or measured, for instance, using smoke to make the plume rise/fall visible.</p>	<ul style="list-style-type: none"> •Reduce temperature (hot processes) •Enclose process •Inhibit convection and entrainment of workroom air
c. Free falling, solids, liquids and powders	Falling liquid, powder or solid material. Conveyor transfer of powders/solids.	<p>Falling material induces a downward flow of air. If the material is a powder there will be some shearing off of powder-laden air at the edges of the falling stream.</p>	<ul style="list-style-type: none"> •Reduce height of fall •Enclose the falling material (reduces air entrainment) •Seal all gaps in enclosure •Apply air extraction(LEV) to enclosure
d. Displacement	Liquids, powders or solids being transferred into a container Stacking of flat sheets e.g. wood	<p>Materials will displace their own volume of air out of the container. If they have fallen from a height, the induced airflow will flow into the container and displace the same volume of air.</p> <p>A related release mechanism is the “bellows effect”</p>	<ul style="list-style-type: none"> •Minimise open area of container top •Minimise height of fall •Apply air extraction (LEV) to the container flow-rate sized to match the displaced air volume flow-rate

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	or slate	caused when two (usually) flat surfaces are brought together suddenly causing rapid displacement of air.	<ul style="list-style-type: none"> •Change process, for instance, <ol style="list-style-type: none"> 1. Slide flat sheets together 2. Or clean before stacking 3. Or minimise dust contamination in the first place
e. Spraying and blasting	Paint spraying. Abrasive blasting	<p>Compressed air pressure is used to induce and propel liquid or solid particles against surfaces to be painted or abraded. In the process the compressed air-jet, and the cone of moving liquid/solid particles, induce further air movement and create a cone-shaped jet. (Similar though differently shaped sources are produced by gas or liquid escaping under pressure)</p> <p>The 'throw' of a paint spray gun air-jet can be over 12 metres and the initial velocity, immediately in front of the air-cap can be >100 metres/second.</p>	<ul style="list-style-type: none"> •Reduce air pressure •Enclose the process •Undertake in a spray booth or room •Apply surface coating (e.g. paint) by less 'energetic' means e.g. brushing or rolling
f. Fracturing solids	Rock crushing (e.g. primary and secondary quarry rock or recycled building material crushing) Splitting (e.g. in slate making)	Pressure leads to 'brittle' fracture of solid with very local but explosive release of dust-laden air (dust cloud). Movement of material may create airflow, increase dust cloud size and creating directional contaminant cloud flow away from the process	<ul style="list-style-type: none"> •Enclose the process •Extract air from the enclosure •Keep rock, stone etc wet/damp
g. Impact and vibration	Powder covered sacks landing on a conveyor. Machinery vibration re-	Settled dust or split powder on a surface is re-suspended or propelled into the air by the physical impact or vibration applied to the contaminated surface. Badly dust contaminated clothing can behave in the same way. Once re-suspended where the dust-	<ul style="list-style-type: none"> •Eliminate or minimise impact and/or vibration •Eliminate or minimise surface contamination by, for instance, process or job re-design

Process	Examples	Creation mechanism(s) and description	Possible modifications/ controls
	suspending settled dust Deliberate striking of container	laden air moves to depends upon workroom air movement.	
h. Compaction	Crushing of waste material. Rolling up of used sacks	<p>The compaction action squeezes air out of the material or container creating dust/vapour clouds. In some case cases, induced heating occurs increasing the release of contaminant especially vapour. The direction of travel and size/shape of the contaminant cloud will depend on the shape and size of the material being compacted and the amount of air displaced.</p> <p>Compaction is similar to displacement and the mechanism by which airborne contaminant clouds are created are the same.</p>	<ul style="list-style-type: none"> • Minimise waste creation • Enclose compaction and apply extract ventilation
i. Handling	Sorting. Stacking. Carrying	Mechanisms will depend on what's handled. If covered in settled or spilt dust this may be re-suspended. If objects are stacked air-displacement may lead to further re-suspension. Carrying of dusty objects may lead to direct contamination of work-clothing and skin.	<ul style="list-style-type: none"> ▪ Minimise contaminant of objects before handling occurs ▪ Clean objects before handling ▪ Use handling aids ▪ Apply ventilation controls ▪ Use low dust-retention/release fabric for work clothing
j. Machining	Milling Turning Boring Drilling Cutting	Rotating and/or reciprocating parts create particles from the material being worked. These can be made airborne in metalworking fluid mist. If metalworking fluid is used to cool and lubricating (which most machining processes use) mist can be created. This	<ul style="list-style-type: none"> ▪ Increase fluid flow to increase cooling and reduce vaporisation ▪ Stop fluid flow during tool indexing ▪ Enclosure

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		<p>happens when metalworking fluid comes into contact with rotating, or reciprocating parts by splash and impingement of fluid jet on machining mechanism as it indexes tools. The mist is created mechanically in these cases. Fine fog can be created from condensation of liquid vapour, if material being worked gets sufficiently hot. True "fume" (solid aerosol) may be created if the metalworking fluid thermally degrades. Where rotating parts are involved, the fan effect may create directional airborne contaminant cloud movement.</p>	<ul style="list-style-type: none"> ▪ Full enclosure with extraction
k. Abrasion	Sanding Grinding Polishing Fettling	<p>Rubbing away a surface by friction. An abrasive is applied to a surface and rubs or abrades it. The action of the rough surface of the abrasive creates particles from the material to which it is applied. The degree to which the particles become airborne depends on the size range of the particles created, whether the abrasion is done wet or dry and the mechanism used to apply the abrasive. If, for instance, a hand-held rotary powered sander or grinder is applied dry significant amounts of airborne dust can be created. Also, in these cases, the rotary action of the tools will generate a strong directional movement to the contaminant cloud</p>	<ul style="list-style-type: none"> ▪ Reduce the need for abrasion by more exact manufacture ▪ Abrade wet rather than dry ▪ For powered hand-held tools built in LEV (often called Low Volume High Velocity or LVHV), if carefully and ergonomically designed can be effective ▪ A partial LEV enclosure (booth) although the wake effect and closeness of the process can dramatically reduce booth effectiveness
l. Sweeping	Sweeping up stone, wood or flour dust	<p>Sweeping of settled dust or spilt powder will disturb fine particles and make them airborne. The sweeping action will also create directional air movement and turbulence. The contaminant particle cloud created will</p>	<ul style="list-style-type: none"> ▪ Minimise leakage of the process and contamination of surfaces including the floor. ▪ Use another method of cleaning

Process	Examples	Creation mechanism(s) and description	Possible modifications/ controls
		flow into the sweeper's breathing zone and spread to other parts of the workplace.	<p>such as vacuuming or damp brushing</p> <ul style="list-style-type: none"> ▪ Don't use compressed air to clean off surfaces or parts!