ventilation control

for tool-manufacturing & resharpening shops

Field Research and Consultation Group
University of Washington

contents

preventing *hard metal exposure*

This booklet provides basic information on designing, installing, testing, and maintaining ventilation systems for hard metal–machining shops.

Working with hard metals can cause asthma and lung problems. These and other health disorders result from elevated exposures to harmful metals such as cobalt, cadmium, and chromium, which are released into the air when you work with tungsten carbide and stellite.

In 1996, the Field Research and Consultation Group studied hard metal exposure in Washington State. They learned that in shops with many machines close together, all operating at full capacity, workers received the highest exposures. Wet grinding, dry grinding, brazing, and welding tungsten carbide led to higher cobalt exposures.

Brazing and welding, but not other work, with stellite also led to higher cobalt exposures. Using metalworking fluids on tungsten carbide led to higher levels of airborne cobalt.

The best way to reduce exposure to hard metals is to use adequate local exhaust ventilation systems. Until exposures are kept below the state's allowable level by ventilation or other methods, workers must wear respirators.

understanding
local exhaust ventilation systems

Air, like water, flows along a path of least resistance. Barriers, friction, and turbulence can disrupt and decrease smooth flow. Local exhaust ventilation systems capture and remove contaminants in the air at their source. The goal in designing an exhaust ventilation system is to remove metal particulates and fumes before they reach the worker as smoothly and efficiently as possible.

A typical ventilation system (see illustration at right) contains:

hoods
Open from the ventilation system to capture contaminants into flowing air currents
Types: enclosing, nonenclosing

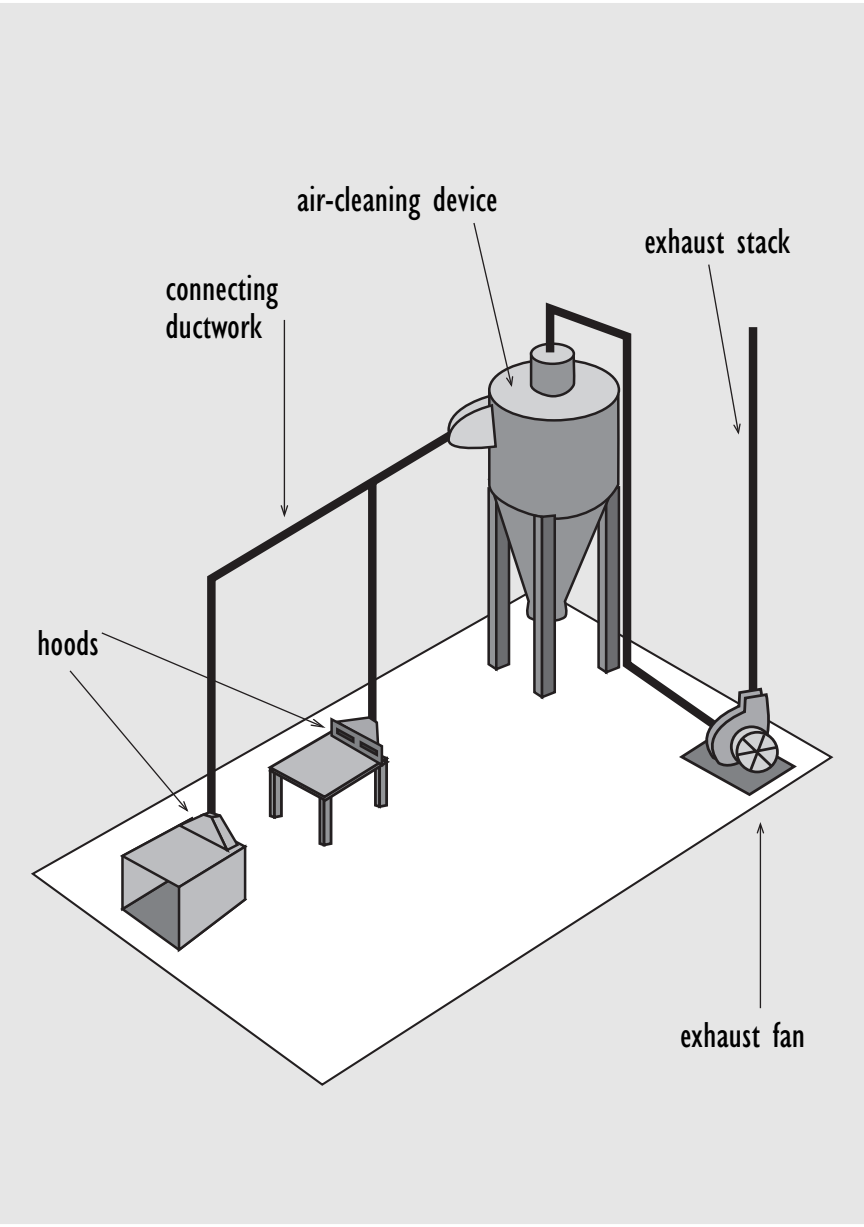
connecting ductwork
Carries air from all parts of the system

air-cleaning device
Captures and removes materials that have traveled through the ventilation system
Types: cyclone, filters, baghouse

exhaust fan
Provides the energy to draw air and contaminants into the hood and through the entire system

exhaust stack
Disperses the remaining air contaminants from the system to the outside atmosphere

supply air source
Provides air from outside the building to replace air that has been exhausted



ventilation system components

designing *good ventilation systems*

A ventilation system should be designed to move metal particulates and fumes away from the worker. It should be designed by a qualified design engineer. Certain factors and principles will assist the owner and operator in evaluating the system.

Enclose sources of dust as much as possible

Be sure that hoods are installed close to the source of dust, fumes, or mist, or they will not be effective

Avoid placing workers between exhaust and source of dust

Be sure that air flows through the ducts at high speed (3500–4000 feet per minute) to avoid clogging

Use a radial-blade fan because air upstream of the air-cleaning device is dirty, abrasive, and sticky

Select an appropriate air-cleaning device:

- cyclones remove coarse- to medium-sized wet or dry particles
- cloth filters (e.g., baghouses) remove medium to fine particles of dry dust only
- wet collectors are required for operations involving coolants

ventilation principles

The exhaust fan provides pressure differences and overcomes pressure losses.

Pressure differences move air through the system from an area of higher pressure to an area of lower pressure.

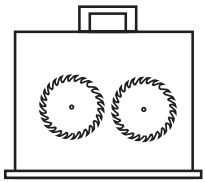
Pressure losses (energy lost through friction or turbulence) should be minimized to save on operating costs and improve fan efficiency.

installing

tips for building a system

Your ventilation system should be designed and installed with your production needs and expansion plans in mind. Here are some tips for a better job.

hoods

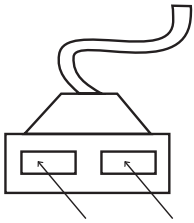


enclosing

Enclose the grinding operation as much as possible to reduce the airflow needed to control the dust

Make hoods convenient to use (transparent, with proper lighting, easy to open) (see photo on page 8)

nonenclosing

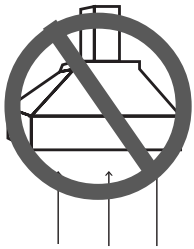


side

Locate and shape the hood so that the dust is pulled away from the operator

Place the hood as close as possible to the dust source

Locate the hood in the line of throw from the grinding wheel to catch the dust

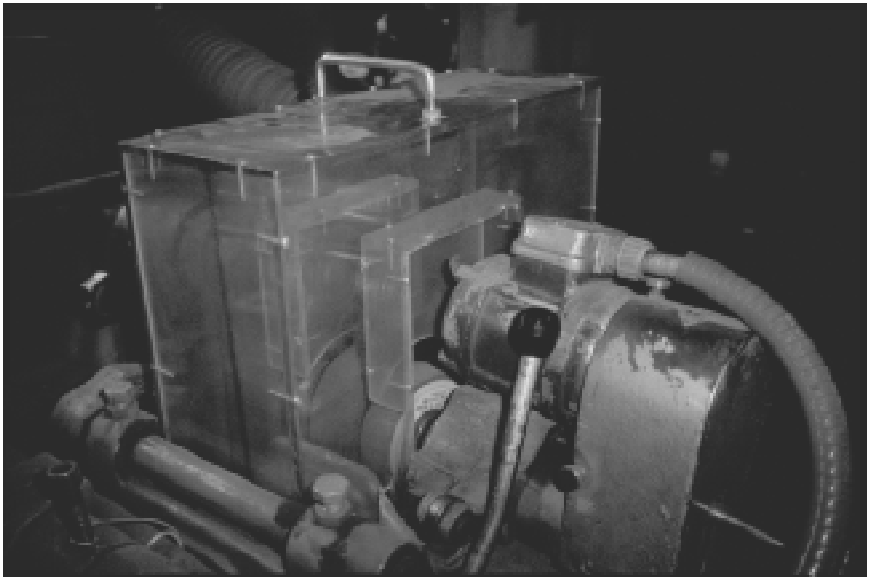


Avoid open ducts, which do not capture dust efficiently (see photo on page 1)

overhead or canopy

Avoid overhead canopy hoods, particularly for brazing operations, because workers are exposed to hot rising air that contains contaminants, fumes, and gases

band-saw enclosure (enclosing hood)



ductwork

reduce turbulence

Use straight, smooth, tight ducts

Choose duct diameters according to hood airflow and the speed needed to keep dust from settling

Avoid changing duct diameters except where required by branch entries

Minimize number of elbows

Avoid flexible tubing, whose resistance to airflow is very high

make ductwork easy to clean and maintain

Install duct cleanouts every 9–12 feet or use detachable duct sections

Add a pressure gauge to ductwork near the hood to measure suction in the duct

air-cleaning device

Install the air-cleaning device outside the work area to reduce noise

Do not recirculate used air back into the workplace

Install the air-cleaning device so that it is accessible for cleaning and maintenance

Maintain the air-cleaning device on a regular schedule

exhaust fan

Be sure that fan inlet and outlet ducts are straight (no elbows) and connected by flexible sleeves of canvas or rubber to reduce turbulence, vibration, and noise

Have electricians check proper fan rotation after wiring if the fan is not operating as well as expected

exhaust stack

Be sure that exhaust stack height and air speed are high enough to move the dust away from the building

Install a vertical stack

Do not use rain caps

supply-air source

Install a separate supply-air fan and heating unit to keep air pressure inside the building above the air pressure outside and ensure proper exhausting

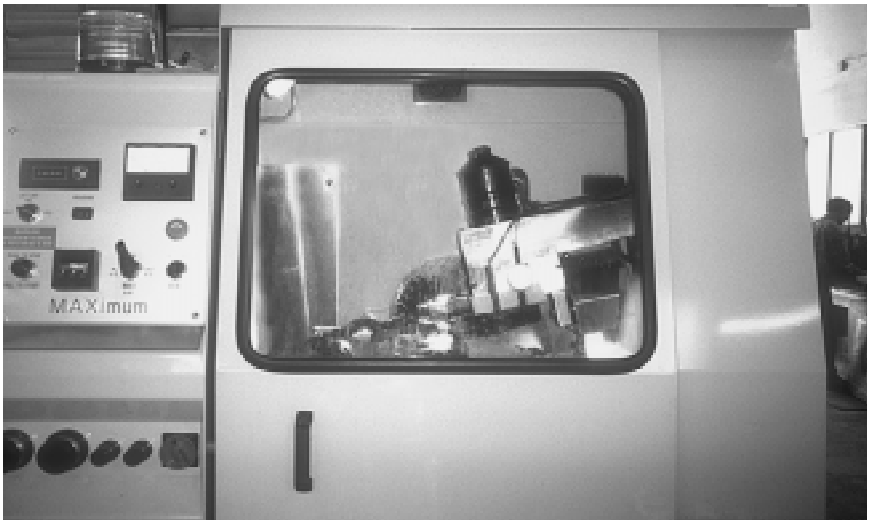
testing *your system's effectiveness*

Your ventilation system should be tested regularly to be sure it is working properly, to detect problems in the system, and to monitor the effects of any changes in ventilation or in production practices. The designer or installer should conduct the first, baseline, system test right after your system is installed. The installer should provide you with evidence that the system is operating according to its design specifications.

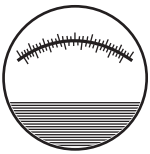
Periodic air samples for metal and dust should be taken by a qualified health and safety professional. These samples will help you verify whether the ventilation system is keeping worker exposures low. Have air samples taken whenever your production process or ventilation system changes.

Record the results of all systems tests.

enclosed-hood work station

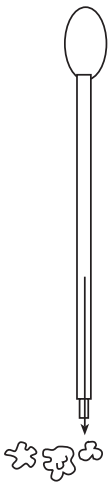


tests you can do yourself



visual inspections

Routinely, at least every week, look at your system for physical damage. Check for broken, corroded, or collapsed ducts and other components. If you have hoods, fans, or collectors with pressure gauges, mark the gauges for operating range and check the gauges regularly.



smoke tests

Use smoke tubes or tissue-paper strips to see if the hood is "catching" contaminants at the source. Smoke or tissue paper will also let you see the airflow patterns in and around the hoods. Smoke tubes can be obtained from a safety and supply company. If the smoke test shows that one or more hoods is not catching the smoke, check that

- All ducts are clear of rags and metal debris
- The fans are operating correctly
- The air-cleaning system is clean and working

If you cannot find the source of the problem, call a professional ventilation specialist: typically, engineers, industrial hygienists, or safety personnel.

maintaining *your ventilation system*

Ventilation systems require the same attention as machines and tools. Operators, maintenance personnel, and new employees should be trained in how the ventilation system works and how to maintain it properly. Shop management needs to put policies and procedures in place for ventilation maintenance.

elements of a ventilation maintenance program

- A written program on ventilation maintenance, developed and enforced by management
- Specific individual(s) designated to do maintenance
- Worker training in ventilation maintenance and operation
- Frequent visual inspections of ductwork, hoods, and fan
- Routine testing of the system's performance, especially whenever there is a change in ventilation or production
- Duct clean-out procedures
- Protective equipment worn during duct clean-out or other maintenance
- Process for handling workers' concerns about how the system is working
- Complete records of all inspections, training, and air sampling

what to look for in regular maintenance

Often, workers will be the first to notice a change in airflow at their work stations. They should therefore be prepared to identify potential ventilation problems:

- Damaged ducts (e.g., visible signs of wear and tear)
- Plugged ducts from accumulated dust or other objects
- Leaking ducts such as broken joints
- Worn or loose fan belt or other parts
- Dirty fan blades
- Clogged or dirty air cleaner
- Changes in pressure (check pressure gauge)

wet coolant system maintenance

There are special considerations for maintaining wet metal-working processes:

- Change coolants and clean tanks regularly
- Use barriers or guards to block coolant splashing
- Keep operator as far away as practical from mist or splashing
- Inspect hoods, duct seams, and ductwork for coolant leaks

resources *available to help you*

Resources are available to help you design, install, test, and maintain your ventilation system.

government

university of washington
The University of Washington's Field Research & Consultation Group does workplace assessments and evaluates ventilation at your site at no charge. Call (206) 543–9711.

occupational safety & health administration (OSHA)
State or federal OSHA agencies can help your company put together a safety and health program or analyze your existing program at no charge. They are listed in the blue government pages of your telephone book.

other

ventilation engineers
Look in the Yellow Pages or contact local engineering societies for assistance. Call Northwest Project Guide at (206) 230–8550 for engineer referrals.

vendors
Look in the Yellow Pages for industrial sheet-metal contractors. Other vendors are listed in the Yellow Pages under ventilating contractors, ventilating equipment, and ventilating systems: dust collectors.

industrial hygienists
Look in the Yellow Pages for industrial hygiene consulting companies if you need an assessment of possible exposures or an evaluation of your ventilation system.

references

for further information

Jeff Burton. 1996. *Industrial Ventilation Workbook.* American Industrial Hygiene Association (AIHA), Salt Lake City. This guidebook includes basic information on behavior of industrial air, problem characterization, hood and duct design, and other ventilation design issues. Call AIHA at (703) 849-8888 to order this workbook and for a catalog. $45.00.

Committee on Industrial Ventilation. *1991. Guide for Testing Ventilation Systems.* American Conference of Governmental Industrial Hygienists (ACGIH), Cincinnati, OH. Complete and easy to use for testing industrial ventilation systems. Call ACGIH at 513-742-2020 to place an order for this resource and for a catalog of other useful books. $8.00.

Committee on Industrial Ventilation. 1998. *Industrial Ventilation: A Manual of Recommended Practice,* 23rd ed. American Conference of Governmental Industrial Hygienists (ACGIH), Cincinnati, OH. This manual provides complete engineering requirements for the design, maintenance, and evaluation of industrial exhaust ventilation systems. $60.00.

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Kennedy S, Chan-Yeung M, Marion S, Lea J, Teschke K. 1995. Maintenance of stellite and tungsten carbide saw tips: respiratory health and exposure response evaluations. *Occup. Environ. Med.* 52:185–191.

Seixas N, Pappas G, Camp J, Sheppard L, Simcox N, Alcaraz X, Rajaraman, P. 1997. *Exposure Assessment and Health Effects in Hard Metal Tool Machining in Washington State.* Department of Environmental Health, University of Washington, Seattle.

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University of Washington
School of Public Health
and Community Medicine

Field Research & Consultation Group
Department of Environmental & Occupational Health Sciences
University of Washington
4225 Roosevelt Way NE, Suite 100
Seattle, Washington 98105