Checking Performance of Process Exhaust Systems

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Some two-and-a-half years ago the Health Maintenance Committee of this section undertook to develop a data sheet on the maintenance of local exhaust systems. The job is now about completed, with the help of the whole committee, and your program chairman has asked that we give you a preview of it.

Purpose

The purpose of the data sheet is somewhat different from that of most articles that have appeared on exhaust systems. What's made this possible has been the timely appearance in the last few years of outstanding books on the technical design of exhaust systems. Among these publications are:

1. *Manual of Industrial Ventilation* (1952)
   American Conference of Governmental Industrial Hygienists
2. *Industrial Health Engineering* (1947)
   A. D. Brandt
3. *Industrial Hygiene and Toxicology* (1948)
   Frank A. Patty, Ed. (Chapter 10—Ventilation, by W. N. Witheridge)
4. *Exhaust Hoods* (1952)
   J. M. DallaValle
5. *Accident Prevention Manual* (1951)
   National Safety Council (Chapter 21—Industrial Health Engineering)
6. *Ventilation*
   W. C. L. Hemeon — To be published
7. *Industrial Dusts* (2d edition)
   Phillip Drinker and T. F. Hatch — To be published
8. Design data published by numerous manufacturers, such as American Blower Corporation, American Air Filter Company, Buffalo Forge Company, Westinghouse, and others.

The first design and technical maintenance of exhaust systems falls in the lap of the plant maintenance or engineering department, and the above books handle these aspects thoroughly. Little has been written however, directly for the safety engineer. What are *his* responsibilities? What is *his* role, when the engineering phases are handled by the plant engineer?

This data sheet is written for the safety engineer. It does not cover detailed design, instrumentation or maintenance. It contains *only such background principles, and comments on popular fallacies, as are needed for* the safety man to work profitably with the engineer and department supervisor.

What Can Safety Engineer Do About Exhaust Systems?

1. *Air samples:* Exhaust systems that are meant to control a health hazard succeed or fail according to how well they keep the air contamination in the workroom below dangerous levels. Usually this can be determined only by air samples and analyses that actually measure the amount of the harmful agent in the air. Method used varies according to whether the material is silica dust or other toxic dust; vapor, as from a solvent or degreaser; fume, as from welding; gas; or even hot air—for the latter can be classed as a contaminant, and exhausted to the outdoors.

When the plant has no full-time industrial hygienist, as most plants do not, the safety engineer should arrange for these tests. They are his responsibility rather than that of the plant engineering department.

Such tests are *not* needed when the contaminant is not harmful, as with wood dust, lime, coal, and other nontoxic materials.

2. *Plan:* For existing exhaust systems the safety engineer should get a simple sketch of the layout. This need not be a working blueprint, or even to scale. An example of a simple line drawing is given in the data sheet. All that needs to be shown is the order in which branches come off the main ducts, diameters of all ducts, arrangement of fan and collector, size of fan and motor, and if possible, overall rate of air flow and static pressure as specified by the designer of the system.

FORM 1—Safety Engineer's Inspection Report

Test point	Condition of hood and branch (Battered? removed? plugged? repair?)	Static press. (inches water) Originally	Checked
A		2.1	
B		2.0	
C		2.5	
D		2.0	
E		1.9	
F		2.1	
G		2.2	
H		5.0	
J		8.0	
Filter resistance (J)-(H)		3.0	

Material collected since last check ________ lbs. Hours of operation ________ reg. Interval between shakings ________ hrs.

Comments of men, and Your comments (use back, if necessary): ________

3. *Test holes:* In each branch, near the hoods, at the collector intake, and at the fan intake, the safety engineer should have simple test holes, about 1/8" in diameter, drilled. These should be numbered serially with paint or tags, and on his sketch of the piping he should mark the approximate location of each hole, with its number.

4. *Portable U-tube:* He should then equip himself with a U-tube or water manometer. After connecting one leg of the manometer to a piece of rubber tubing, he can hold the other end of the tubing over each test hole in order and measure the static pressure or suction.

If the system is new, he should see that the plant engineering department "balances" the air flow from each branch—which means that the correct amount of air flow, as called for by the designer, is passing through each branch. If the contaminant is a health hazard, air samples, taken after balancing the system, will tell the safety engineer whether control of the air pollution has in fact been established. From then on, assuming no changes are made in the hoods, piping or process, he can be assured that the equipment is continuing to work right, if rechecks at the test holes give him the same static pressure readings as the initial ones.

Rechecks with the U-tube should be made regularly, probably at intervals of not over a month. He should have a mimeographed form to record permanently the current readings, so they can be compared with the initial readings. These suction rechecks make it unnecessary to take frequent air samples.

Certain other defects, which can be checked merely by looking should be noted: bent or battered hoods, new branches that may have been added, changes in the process, etc.

5. *Meaning of U-tube readings:* Knowing what the static pressures were when the system was properly balanced, changes from these values show if and where trouble develops.

For example: The increased reading in the first branch, with other readings remaining normal, shows something is plugging that branch between the test hole and hood.

A decreased reading in the branch would mean there is some obstruction farther up the branch, that is, between the test hole and the main duct or header.

Decreased readings in several branches and near normal readings would result if the header was partially plugged in branches nearer the dust collector when the header leading to the collector becomes plugged. There will be increased readings on both sides of the collector.

A partly plugged arrester would result in a decreased reading upstream and an increased reading downstream.

Decreased fan capacity due to slipping fan belt, dirty or worn blades, disjointed pipe between fan and arrester, or an open clean-out door would give the decreased suction readings throughout the system.

Thus relative changes in readings at different test holes can be used to track down the trouble.

Certain absolute values are important too. For example, although suction at a hood is