Air Pollution Sampling & Measurement

Instruction Manual

LaMotte

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HOW TO ESTABLISH A MEANINGFUL AIR MONITORING PROGRAM

To set up a program for monitoring air pollution there are two basic requirements. First, a means of collecting and analyzing the air sample is required. Second, a strategic plan for continuous sampling at a series of logical monitoring sites must be established. The recording of data over a period of time is important in observing the variations that take place at the monitoring sites.

EQUIPMENT REQUIREMENTS

Most of the sampling in air pollution studies is done with some type of vacuum equipment. The vacuum is required to draw an air sample through a chamber holding a special absorbing solution. The absorbing solution is chemically selective for a particular gas, and is held in a special glass bubbling tube called an impinger. Since gaseous pollutants differ chemically, the absorbing solutions are also different.

In order to make a quantitative test, a means to measure the amount of air that is drawn through the absorbing solution has to be known. This is done by the use of an adjustable flowmeter. A flowmeter is simply a device to measure the rate of flow of the air through the absorbing solution. For most air pollution studies the flowmeter is calibrated to measure the rate of flow in liters per minute (Lpm).

When a flowmeter is attached to the vacuum portion of the air sampling train, one can accurately monitor the amount of air which is pulled through the absorbing solution. A flowmeter with an adjustable flow device - like a needle valve - can be used to preset the vacuum pump to sample at a known rate. If one draws air through the absorbing solution at 2.0 Lpm for 10 minutes, then 20 liters of air have been sampled.

As one of the most important components of the air sampling train, the vacuum pump must meet certain requirements. If one is interested in taking air samples from outdoors, the vacuum equipment must be battery operated and completely portable. It should also possess a means for regulating the amount of air sampled. Vacuum equipment meeting these criteria would be useful for most applications. Air pumps that push the air through the pump first and then through the impinging equipment should be avoided. Proper sampling techniques require that the air sample be “sucked” through the impinger prior to its contact with the pump. The pump should have the ability to maintain a particular flow rate for a pre-determined time. Air sampling equipment should be completely portable, possess a regulating device for sampling at different rates, and be able to maintain a particular sampling rate for a known amount of time.

Impinger devices are available in various shapes and sizes. The simplest impinger device consists of a glass vial plus a stopper with a short glass tube and a longer glass tube. The long tube is immersed into the absorbing solution. Other types of impingers are more sophisticated and may meet the specifications set forth by the American Public Health Association or some other regulatory agency.

In principle, the inexpensive impingers and the precision impingers operate in a similar fashion. Some precision impingers have a fitted glass end which is immersed into the absorbing solution. This enables the impinger to disperse many minute bubbles. The smaller the bubbles, the more surface contact is permitted between the gas and absorbing solution and a higher efficiency of gas absorption results. A fritted glass bubbler of this description is used for nitrogen dioxide determinations. For other determinations, a plain glass bubbler assembly is used which usually has a 1 mm opening at the end for dispersing the air sample into the absorbing solution.

The individual chemical test modules used to analyze the absorbing solution after impingement are based upon established methods for testing air pollutants. For convenience and portability these testing units are furnished in compact carrying cases. All of the necessary apparatus and reagents needed to conduct a chemical analysis of the air are included within the testing outfit.

The reagent systems included in the testing units include an absorbing solution which extracts the chemicals from the atmosphere. In some systems a single indicator is added to the absorbing solution to cause a color reaction. In other systems, the absorbing solution is pre-treated before the indicator is added. The color reaction is measured in a visual comparator or an electronic colorimeter.

Visual comparators are devices for matching the color of the test sample to color standards of known value. Each comparator contains eight permanent color standards. The color standards have an index, numbered one through eight. The number refers to a calibration chart in the instructions for each test. After the recommended testing procedure is completed for a particular test, note which index gave the proper color match and refer to the calibration chart.

Regardless of whether the air pollution test equipment is used for testing air pollution levels in confined areas or for monitoring atmospheric pollutants in the field, significant results are obtained only if correct analytical techniques are used. Clean glassware and uncontaminated reagents are important for accurate results. Sampling apparatus should be checked periodically to insure proper operation.

Some of the reagents require special handling as they are capable of causing skin irritations. No chemical reagent should be taken internally, but if accidentally ingested, heed the antidote label on the bottle and contact a physician immediately. Reagents which are marked poison should be treated as such. Careful handling of all chemicals is a necessary part of chemical testing. Follow all instructions as outlined in the individual directions for each test.

ESTABLISHING A SAMPLING SITE

To establish a meaningful air pollution monitoring program, one must take a complete survey of the area and prepare a sampling map to select a sampling site. Consider which sources might be responsible for contributing to air pollution. Where are these sources? Determine whether pollution control devices are being used and whether these devices are operating correctly. Heavy industrial areas contribute significantly to the total pollution in an area. Determine what tests should be used to accurately monitor industrial emission.

When recording data on sampling, take into account meteorological data such as the prevailing winds, temperature inversions, rainfall and other factors which affect the dispersion of air pollutants. Try to set up a remote sheltered location away from the normal air pollution sources or a control for comparison purposes.

Another significant source of air pollution is the automobile. To familiarize you with how each car contributes to air pollution, check the emissions from a single car. Compare new cars with emission control devices to older cars with limited or no emission control devices. Determine what major pollutants are emitted from the exhausts of other internal combustion engines, e.g. lawn mowers. The exhausts from internal combustion engines are poisonous. Never work in confined areas without adequate ventilation. Work with proper supervision.

Locate the traffic laden roads of your community during rush hour. Compare the amount of pollution with the number of cars at different times. Compare results of tests to data compiled during non-rush hour traffic conditions. How may these pollutants be dispersed by meteorological conditions?

For classroom studies and to familiarize students with the chemical procedures it may be necessary to demonstrate the basic principles of collecting and measuring air pollution factors. Certain gaseous pollutants such as ammonia, chlorine, and total oxidants are easily demonstrated because of the simple chemical procedure involved and also because these gases are readily available as household or standard laboratory supplies — ammonia cleaners, bleach, hydrogen peroxide, etc.

Prior to any field trips, it is necessary to prepare a checklist of the components required for conducting an air pollution study. An inventory of the required chemical reagents should be compiled before taking the unit into the field for testing. The battery capacity for the sampling apparatus should be checked. A supply of reserve batteries might prevent an interruption in the middle of a sampling period. Plan in advance.

To record the results of air pollution investigations, one should include such items as the following: meteorological data — prevailing winds, temperature, atmospheric pressure, relative humidity; duration and time of sampling; location of sampling site; sampling and test procedure; and finally the concentration of the pollutant. Any observations which might adversely affect the result should also be noted.

After compiling data from a particular investigation, check results from previous surveys from your own or other schools, local health agencies, or state and federal monitoring programs.

AIR SAMPLING APPARATUS

AIR SAMPLING PUMP MODEL BD • CODE 1949

The Model BD Air Sampling Pump is designed especially for use with the LaMotte Air Pollution Test Equipment. Among the many features of the air sampling pump are an adjustable flowmeter, intake and exhaust connections, impinger holder, on-off switch, four "C" cell batteries and AC jack. For proper maintenance and to guarantee the life and usefulness of the air sampling pump, the following operating procedures are recommended.

INSTRUCTIONS

1. Check battery capacity by turning switch to the "ON" position. If the red LED on the front of the meter fails to come on, the batteries are too weak to operate the pump. Adjust flowrate to sample at 2.0 Lpm. If indicator float of flowmeter vibrates up and down with a deflection of more than 0.2 Lpm, or if air sampling pump cannot be adjusted to sample at 2.0 Lpm, replace batteries (see Battery Replacement). Alternatively the pump may be operated with an AC adapter (1744).

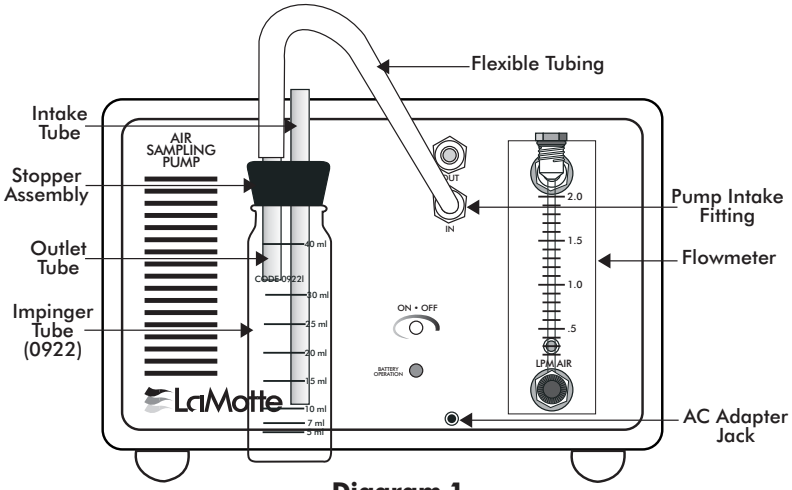


Diagram 1

2. Fill the impinging tube to the designated line with the absorbing solution. Insert stopper assembly, thereby immersing the long tube into the absorbing solution. Attach one end of the flexible tubing to the pump intake fitting. The other end of the tubing is attached to the short outlet tube of the General Purpose Impinger (0922) (Diagram 1). The outlet connection draws air from above the liquid in the impinger chamber. DO NOT connect to the inlet tube of the impinger which is below the surface of liquid. *Check to insure all connections are tight and that the tubing is correctly connected to the impinging tube before operating the pump.*

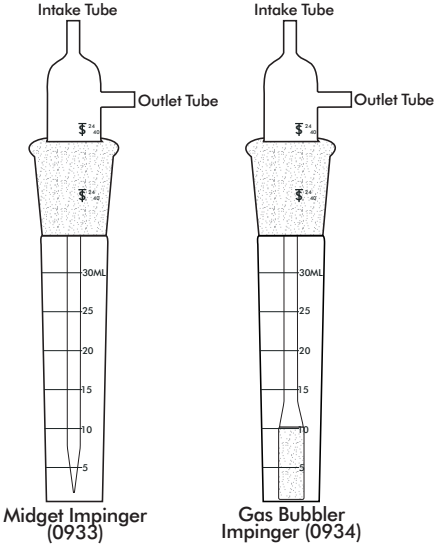


Diagram 2

NOTE: Several air sampling kits use the Midget Impinger (0933) or the Gas Bubbler Impinger (0934) instead of the General Purpose Impinger (Diagram 2). In Step 2, the flexible tubing from the pump is attached to the side outlet of the impinger. This is a tight connection which requires some care and patience to make. The outlet connection draws air from above the liquid in the impinger chamber.

3. Turn switch to "ON" position.

4. Adjust flowmeter to sample at the designated rate (according to instructions of testing unit). Turn knob clockwise to reduce flow, counterclockwise to increase flow. Do not unscrew or withdraw valve stem beyond threaded section except for maintenance. The flowmeter is read by aligning the reader's eye with the center of the black indicator float and the scale. Graduations on the scale are in 0.1 Lpm increments.

NOTE: To avoid introducing residue or foam into the pump a trap may be constructed by adding an empty impinger to the flexible tubing between the impinging tube with the absorbing solution and the pump intake fitting. Attach the flexible tubing leading from the impinging tube outlet to the intake of the empty impinger. Use an additional length of tubing to attach the outlet tube of the empty impinger to the pump intake fitting.

5. At the end of the sampling period, turn switch to the "OFF" position. Disconnect impinging apparatus and remove from holder.
6. The absorbing solution is then subjected to the testing procedure as outlined in the individual air pollution test instructions.

AC OPERATION

The Model BD Pump may be operated with an AC adapter (Code 1744) by plugging jack into designated receptacle.

BATTERY REPLACEMENT

Turn switch to the "OFF" position and remove panel. The battery holder and batteries are located under the panel. Remove old batteries and snap new batteries into battery holder making sure batteries are aligned properly to their positive and negative terminals as indicated. Misalignment of the batteries may result in permanent damage to the pump. After batteries have been replaced, return panel and secure by tightening the four corner screws.

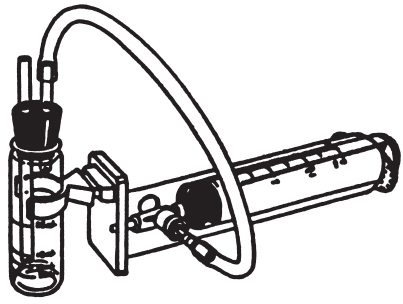
MAINTENANCE OF FLOWMETER

The only maintenance normally required is occasional cleaning of the flowmeter to assure reliable operation and good float visibility. Please contact LaMotte Company's Technical Service Department (800-344-3100 or www.lamotte.com) for instructions and assistance with disassembly and cleaning of the flowmeter.

STORAGE

To reduce the effect of possible variation introduced by the interval of collection and analysis, the time period should be kept as short as possible, and preferably of the same duration. The sample should be kept from exposure to heat and light. If the analysis cannot be made immediately after the sample collection, the sample may be stored at a low temperature.

HAND OPERATED SYRINGE PUMP MODEL LG • CODE 1947



This manually operated syringe pump is capable of drawing 50 cc of the test atmosphere through the impinging apparatus by one complete stroke of the syringe. The pumping mechanism relies upon the use of a special check valve which assures that a positive vacuum is formed on the upstroke of the syringe. The check valve also allows the expulsion of the air sample as the plunger is depressed.

Through the use of this mechanism a continuous sampling of the test atmosphere is obtained as the plunger of the syringe is manually pulled out and depressed.

A general purpose impinging apparatus is held in place by a special holder on the barrel of the syringe. The short plastic tube of the impinging apparatus is connected by flexible tubing to the intake connection of the syringe. As the syringe plunger is pulled out, air is drawn through the longer tube and bubbled into the absorbing solution. The vacuum formed on the upstroke of the plunger draws air from above the absorbing solution into the syringe chamber. When the syringe plunger is depressed, the air is forced through the outlet or exhaust of the check valve. After the syringe is in the downstroke position it is ready for another 50 cc air sample.

INSTRUCTIONS

1. Depress plunger to "0" position.
2. Remove stopper assembly from impinging tube and pour the designated amount of absorbing solution into the glass tube (refer to individual test kit instructions to determine what amount of absorbing solution is added to impinging apparatus).
3. Replace stopper assembly. Connect flexible tubing to short tube (outlet) of impinger assembly and to intake connections of syringe.
4. Begin to sampling the test atmosphere by completing one complete cycle (pulling out - depressing plunger). Twenty complete strokes on the syringe per minute is equivalent to sampling the air at one liter per minute (Lpm). Continue sampling until required volume of air has been sampled (refer to individual test kit instructions).

5. At the end of the sampling period, disconnect impinging apparatus and remove from holder. Test the absorbing solution as outlined in the procedures in the individual test kit instructions.

devices are being used and whether these devices are operating correctly. Heavy industrial areas contribute significantly to the total air pollution in an area.

CONVERSIONS

The individual air pollution test sets are calibrated with readouts in parts per million (ppm). To convert concentrations of gases and vapors from ppm by volume to mg/M^3 and vice versa at any given temperature and pressure, the following expression is useful:

$$C2\ (ppm) = \frac{C1 \times 24.450 \times T \times 760}{\text{mol. wt.} \times 298 \times P}$$

$$C1\ (mg/M^3) = \frac{C2 \times \text{mol.wt.} \times 298 \times P}{24.450 \times T \times 760}$$

C1 = Concentration of gas or vapor in mg/M^3

C2 = Concentration of gas or vapor in ppm

T = Absolute temperature in °Kelvin (°C + 273)

P = Absolute pressure in Torr of samples air stream (mm of mercury)

NOTE: It is usually necessary to convert the measured air flow to the temperature and pressure of air stream.

FLOW EQUIVALENTS

1 Cu Ft/Hr =	1 Lpm =
0.016 Cu Ft/Min	60 Lph
0.471 Lpm	0.035 Cu Ft/Min
28.317 Lph	2.118 Cu Ft/Hr
471.95 cc/Min	1000 cc/Min
28317 cc/Hr	60,000 cc/Hr
0.124 Gal/Min	0.264 Gal/Min
7.481 Gal/Hr	15.852 Gal/Hr

COMBINATION AIR POLLUTION TEST KITS

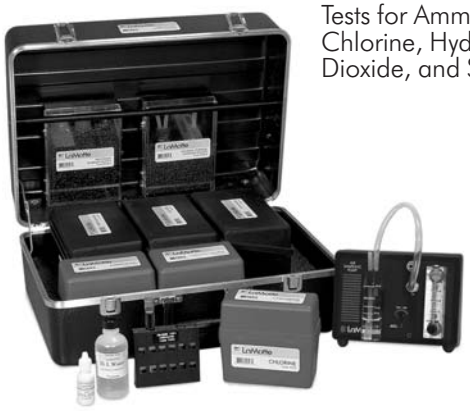
All of the testing methods used in each outfit follow the accepted procedures of the Environmental Protection Agency, which recommends collection of the gas in a special absorbing solution and the subsequent chemical analysis. Through the use of these methods, better quantitative results may be obtained than results acquired by gas indicator tubes or length of stain methods.

Each analytical method has been appropriately modified to make the entire outfit suitable for testing either field conditions or conditions in confined areas. Both precision impinging units and general purpose impinging units are furnished in the outfit.

AIR POLLUTION OUTFIT MODEL AM-61 • CODE 5959-01

Tests for Ammonia, Chlorine, Lead, Nitrogen Dioxide, Sulfur Dioxide, and Total Oxidants.

COMBINATION AIR POLLUTION OUTFIT MODEL AM-62 • CODE 5960



Tests for Ammonia, Carbon Monoxide, Chlorine, Hydrogen Sulfide, Nitrogen Dioxide, and Sulfur Dioxide.

INDIVIDUAL AIR POLLUTION TEST KITS

Each test set uses a standardized method of analysis and has been adapted for field use. Included are the standardized test reagents, the comparator equipment with permanent color standards, comparator tubes, instructions and case. Inexpensive reagent refill packages are available. Accessory equipment such as impingers and flowmeters are available separately.

Sampling pumps are not included in these kits.

DESCRIPTION	CODE
Ammonia in Air Kit	7735
Carbon Monoxide in Air Kit	7782
Chlorine in Air Kit	7973
Formaldehyde in Air Kit	6695
Hydrogen Sulfide in Air Kit	7671
Lead in Air Kit†	7440
Nitrogen Dioxide in Air Kit	7690
Sulfur Dioxide in Air Kit	7714
Total Oxidants in Air Kit	7738

*WARNING: Reagents marked with a * are considered hazardous substances. To view or print a Material Safety Data Sheet (MSDS) for these reagents see MSDS CD or our website. To obtain a printed copy, contact us by e-mail, phone or fax.

†Reagents in the Lead in Air Kit (7440) are banned for household use.

GENERAL PRECAUTIONS

A. Store in a cool, dry place to prolong reagent shelf life.
B. Read all instructions to familiarize yourself with the test procedure before you begin. Note any precautions in the instructions.
C. Read the label on each LaMotte reagent container prior to use. Some containers include precautionary notices and first aid information.
D. Keep all equipment and reagent chemicals out of the reach of young children.
E. Safety and first aid information for all LaMotte reagents is available in the United States, Canada, Puerto Rico, and the US Virgin Islands from Chem-Tel by calling 1-800-255-3924. For other areas, call 813-248-0585 collect to contact Chem-Tel's International access number. Each reagent can be identified by the four digit number listed on the upper left corner of the reagent label, in the contents list, and in the test procedures.
F. Avoid contact between reagent chemicals and skin, eyes, nose, and mouth.
G. Wear safety goggles or glasses when handling reagent chemicals.
H. Use the test tube caps or stoppers, not your fingers, to cover test tubes during shaking or mixing.
I. When dispensing a reagent from a plastic squeeze bottle, hold the bottle vertically upside-down (not at an angle) and gently squeeze it (if a gentle squeeze does not suffice, the dispensing cap or plug may be clogged).
J. Wipe up any reagent chemical spills, liquid or powder, as soon as they occur. Rinse area with wet sponge, then dry.
K. Thoroughly rinse test tubes before and after each test. Dry your hands and the outside of the tube.
L. Tightly close all reagent containers immediately after use. Do not interchange caps from different containers.
M. Avoid prolonged exposure of equipment and reagents to direct sunlight. Protect them from extremely high temperatures and from freezing.

PACKAGING & DELIVERY

Experienced packaging personnel at LaMotte Company assure adequate protection against normal hazards encountered in transportation. After the product leaves the manufacturer, all responsibility for its safe delivery is assured by the transportation company. Damage claims must be filed immediately with the transportation company to receive compensation for damaged goods.

LIMITS OF LIABILITY

Under no circumstances shall LaMotte Company be liable for loss of life, property, profits or other damages incurred through the use or misuse of their products.

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