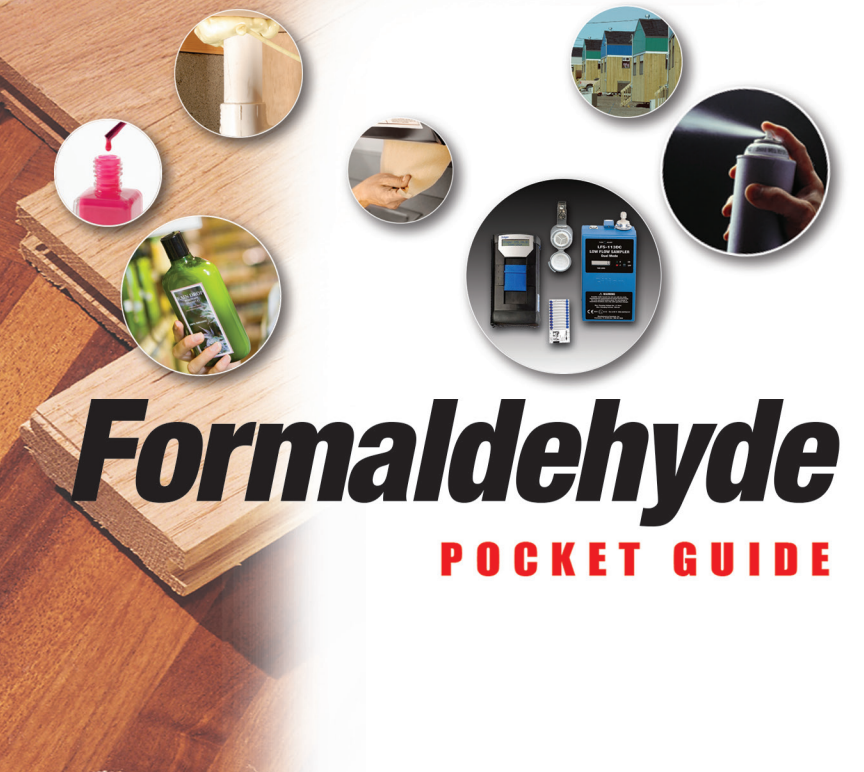

Formaldehyde

POCKET GUIDE

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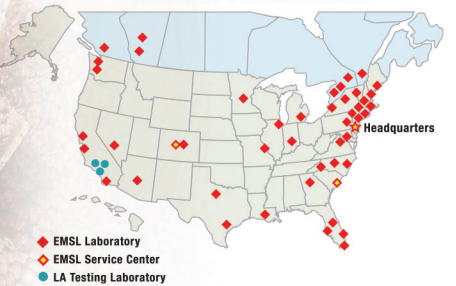
United States and Canada Locations



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Formaldehyde in Indoor Air

What is Formaldehyde?

Formaldehyde is a colorless, reactive, strong-smelling gas at room temperature. It is one chemical in a large family of chemical compounds called volatile organic compounds (VOCs). The term volatile means that the compounds vaporize or become a gas at room temperature. Formaldehyde can be manufactured as a liquid (formalin) or a solid (paraformaldehyde). Formaldehyde is an important industrial chemical used to make other chemicals and different types of products, such as: home furnishings, household cleaners, paints, textiles, landscape and yard products, medicinal and personal care products, and pesticides. Chemicals that are created with formaldehyde or have formaldehyde added to them include the following:

- Resins and lubricants
- Polyoxymethylene Plastics
- 1,4 - Butanediol
- Methylene Diphenyl Diisocyanate

Formaldehyde can be released into the air (off-gas) from materials and products made with it. Formaldehyde can also be released into the air by automobiles, cigarettes, and burning wood, kerosene or natural gas. It is also a naturally occurring substance.

Should You Be Concerned

Formaldehyde exposure may potentially cause a variety of symptoms and adverse health effects, such as eye, nose, throat, and skin irritation, coughing, wheezing, and allergic reactions. Long- term exposure to high levels of formaldehyde has been associated with cancer in humans and laboratory animals. Formaldehyde can affect people differently. Some people are very sensitive to formaldehyde at a certain level while others may not have any noticeable reaction to the same level. Formaldehyde is just one of several gases present indoors that may cause adverse health effects and illnesses. Many other gases, as well as respiratory illnesses (e.g., colds and the flu), can cause similar symptoms to those caused by formaldehyde.

What Levels of Formaldehyde Are Present in Consumer Environments

Formaldehyde is normally present at low levels, usually less than 0.03 parts per million (ppm), in both outdoor and indoor air. The outdoor air in rural areas has lower concentrations while urban areas have higher concentrations (due to sources such as automobile exhaust). Residences or offices that contain products that release formaldehyde into the air can have levels greater than 0.03 ppm.

Where is Formaldehyde Found?

Formaldehyde is found in:

- Resins used in the manufacture of composite wood products (i.e., hardwood plywood, particleboard and medium-density fiberboard)
- Building materials and insulation
- Household products such as glues, permanent press fabrics, paints and coatings, lacquers and finishes, and paper products
- Preservatives used in some medicines, cosmetics and other consumer products such as dishwashing liquids and fabric softeners
- Fertilizers and pesticides

It is a byproduct of combustion and certain other natural processes, and so is also found in:

- Emissions from un-vented, fuel burning appliances, like gas stoves or kerosene space heaters.
- Cigarette smoke.

What Affects Formaldehyde Levels in Indoor Air?

Formaldehyde levels in indoor air can vary depending on temperature, humidity, and air exchange rate within the indoor space. In addition, several studies have shown that, in the presence of ozone, formaldehyde levels increase; therefore, the outdoor and indoor ozone levels are also relevant. Formaldehyde levels in a residence may change with the season, day-to-day, and day-to-night. Levels may be high on a hot and humid day and low on a cool, dry day. Understanding these factors is important when one is considering measuring formaldehyde levels.

Chart Showing What Affects Formaldehyde Levels in Indoor Air

CATAGORIES	RESULTS
Formaldehyde Source	• Products with sealed surfaces or edges emit/release less • Products with larger surface areas or those treated with certain finishes (i.e., acid-cured) have potentially increased emissions. • Emissions generally decrease as the product ages
Temperature	• Increased emissions with increased temperature • Lowered emissions with lower temperature
Humidity	• Increased emissions with increased humidity • Lowered emissions with lower humidity
Air Exchange Rate *(Amount of outdoor air entering or leaving the indoor area)*	• Increased formaldehyde buildup with a decreased rate
Ambient Outdoor or Indoor Ozone Concentration	• Increased creation of formaldehyde in houses that ventilate with: *- Outdoor air on days with high levels of pollution (i.e., ozone-action days)* *- Portable or in-duct devices that intentionally emit ozone into the air or as a chemical by-product*

Sources of Indoor Formaldehyde Emissions

Historical Sources

Urea-formaldehyde foam insulation (UFFI)

During the 1970s, UFFI insulation was very popular, and many homeowners installed it to save energy. A substantial number of these homes had high levels of formaldehyde in the indoor air soon after installation; however, these levels decreased rapidly after the first few months and reached background levels a few years later. Recently, another urea-formaldehyde (UF) spray foam product has been used for insulation. It is technically classified as a UF material, but it is functionally different from UFFI. Previously, UFFI materials were made of liquid resins with more formaldehyde to maintain their shelf lives, which was directly responsible for the off-gassing issues associated with it. This recent UF spray foam product's liquid resin is produced by reacting controlled amounts of urea and formaldehyde and then drying the liquid to remove any VOCs, including free formaldehyde. Therefore, less formaldehyde would be expected to be released

Durable-press fabrics, draperies and coated paper products

In the early 1960s, several allergic reactions to formaldehyde were reported from the use of durable-press fabrics and coated paper products. Such reports have declined in recent years as industry has taken steps to reduce formaldehyde levels, and a recent investigation by the Government Accountability Office (2010) demonstrated only a small number of clothing items with low formaldehyde levels.

What are the Major Sources of Indoor Formaldehyde Emissions in Our Homes Today?

Measuring formaldehyde emissions from individual consumer products is difficult because a variety of products in the home can release formaldehyde or trap formaldehyde emitted from other sources. Products with greater emissions and larger surface areas in the home will most likely have a greater contribution to indoor air formaldehyde levels. Keep this in mind when prioritizing the different product types below. Also, not all brands within each product type contain formaldehyde.

Wood Floor Finishes:
Wet Commercial, Base and Top-Coat Floor Finishes

- May emit high levels of formaldehyde.
- Emissions decrease 24 hours after application.
- Finishes are not typically available to the consumer, but they can be (re-) applied by commercial floor contractors at residences or factories.

Pressed-Wood and Wood-Based Products

Pressed-wood (i.e., hardwood plywood, particleboard, and medium-density fiberboard (MDF)) and wood-based products, especially those containing UF resins, may be a significant formaldehyde source.

- Formaldehyde emissions from pressed-wood products have been reduced 80-90% from levels in the 1980's and earlier due to mandatory formaldehyde emission standards in California and national voluntary formaldehyde emission standards, which are described later in this booklet.
- Emissions decrease 6-10 months after initial testing.

Combustion

Cigarette smoke and the combustion of other materials, such as wood, kerosene, oil, natural gas, and gasoline, produce formaldehyde.

Wallpaper and Paints

- Moderate levels of formaldehyde initially following application.
- Levels formed during the curing process may be higher than after initial application.
- Emissions are sometimes still detectable 1-3 months following application.
- Some paints are now found with low-VOC formulations.

Other Materials

Formaldehyde can be created from the chemical reaction between ozone and other VOCs during the use of personal computers, laser printers, and photocopiers.

Re-Emitters

Because they are porous, products, such as carpets or gypsum board, do not contain significant amounts of formaldehyde when new. However, they may trap formaldehyde that is emitted into the air from other products and later release it into the indoor air.

Buck Libra (L-4) Pump w/Single Charger
#8706200
List Price: **$279.** USD

Gilian LFS-113 Standard Pump w/Single Charger
#8706211
List Price: **$865.** USD

Formaldehyde Emission Standards for Composite Wood Products

Rule Summary

On December 12, 2016, EPA published in the Federal Register a final rule to reduce exposure to formaldehyde emissions from certain wood products produced domestically or imported into the United States.

EPA worked with the California Air Resources Board to help ensure the final national rule is consistent with California's requirements for composite wood products.

The Formaldehyde Emission Standards for Composite Wood Products Act of 2010 established emission standards for formaldehyde from composite wood products and directed EPA to finalize a rule on implementing and enforcing a number of provisions covering composite wood products.

One year after the rule is published composite wood products that are sold, supplied, offered for sale, manufactured, or imported in the United States will need to be labeled as TSCA Title VI compliant. These products include: hardwood plywood, medium-density fiberboard, and particleboard, as well as household and other finished goods containing these products.

By including provisions for laminated products, product testing requirements, labeling, recordkeeping, and import certification, the final rule ensures that hardwood plywood, medium-density fiberboard, and particleboard products sold, supplied, offered for sale, imported to, or manufactured in the United States are in compliance with the emission standards.

The final rule also establishes a third-party certification program for laboratory testing and oversight of formaldehyde emissions from manufactured and/or imported composite wood products. To view this rule, visit: https://www.regulations.gov/document?D=EPA-HQ-OPPT-2016-0461-0001

Adverse Health Effects of Formaldehyde Exposure

The chart below shows some of the symptoms and potential adverse health effects of Formaldehyde exposure.

Formaldehyde exposure can cause a variety of symptoms and potential adverse health effects. A person's ability to smell a chemical odor, such as formaldehyde, does not always mean that the levels of the chemical are of concern or will cause an adverse health effect. Therefore, some people can smell formaldehyde before being adversely affected by it. The chart below shows some of the symptoms and potential adverse health effects of Fordaldehyde exposure.

Affected Area/Systems	Potential Adverse Health Effects
Eyes	• Stinging, burning, or itching • Excessive tearing
Nose or Throat	• Stinging, burning, or itching • Sore throat • Runny nose • Blocked sinuses • Sneezing • Cancer (human and laboratory animals)
Respiratory	• Chest tightness • Wheezing • Asthma
Skin	• Allergic contact dermatitis *- Skin rashes, blisters, and flaky dry skin*
Neurological	• Headaches • Mood changes (i.e., depression, irritability) • Insomnia • Attention deficit • Nausea • Impairments in dexterity, memory, and equilibrium

Do You Have Formaldehyde-Related Symptoms?

As discussed above, formaldehyde can induce several symptoms, such as watery eyes, runny nose, burning sensations in the eyes, nose, and throat, and headaches. These symptoms may also occur because of the common cold, the flu, or other pollutants that may be present in the indoor air. In general, if your symptoms lessen when you are away from the home or office but re-occur upon your return, they may be caused by indoor air factors including pollutants, such as formaldehyde.

Examine your environment. Ask yourself a few questions to determine if your symptoms may be related to formaldehyde exposure.

- Have the flooring or cabinets recently been refinished?
- Has remodeling occurred using pressed-wood products (i.e., wall paneling)?
- Have new cabinets, wall coverings, or furniture been installed?
- Has a wood-burning stove or other combustion source been used?
- Has an indoor air-cleaner that intentionally generates ozone been used?
- Have you recently worn new, unlaundered crease-, stain-, or static-resistant clothes?
- Do you or others smoke indoors?
- Has your house been tightly insulated recently for energy efficiency?

If the answer is yes to any of these questions and you have re-occurring symptoms as described above, you could have been exposed to formaldehyde. Therefore, you may want to contact your physician and/or state or local health department for further assistance.

How Do You Reduce *Existing* Formaldehyde Levels?

The choice of methods used to reduce indoor air formaldehyde levels is unique to each situation. The most common methods used include:

Remove formaldehyde-emitting products from your home

- Directly reduces formaldehyde levels
- Prevents other materials in the area, such as carpet and gypsum board, from absorbing and then re-emitting formaldehyde

Bring large amounts of fresh air into the home

- Increases ventilation by opening doors and windows and by using an exhaust fan(s) to air out indoor spaces.

Seal the surfaces of formaldehyde-emitting products that are not already laminated or coated

- Use a vapor barrier, such as some paints, varnishes, or a layer of vinyl or polyurethane- like materials
- Seal completely with a material that does not contain formaldehyde
- Many paints and coatings emit other VOCs when curing; therefore ventilate the area well during and after treatment

Install "manufactured-home," pressed-wood products

- Made with composites meeting the Ultra Low Emission Formaldehyde (ULEF) or No Added Formaldehyde (NAF) requirements; formaldehyde emission from NAF is less affected by increased temperature and humidity than ULEF.[1]

Additional specific advice can be obtained from your state or local health department, physician, or professional experts in indoor air quality.

[1] *NA-based resins are resins formulated with no added formaldehyde. ULEF resins are formaldehyde-containing resins formulated such that the formaldehyde emissions from composite wood products are consistently below applicable California emission standards.*

One method **NOT** recommended by CPSC is a chemical treatment with strong ammonia (28- 29% ammonia in water), which results in a temporary decrease in formaldehyde levels. ***This treatment is strongly discouraged because ammonia in this strength is extremely dangerous to handle.*** Ammonia may damage the brass fittings of a natural gas system, adding a fire and explosion danger.

How Do You Reduce Your *Exposure* to Formaldehyde?

CPSC, the Department of Housing and Urban Development (HUD), the Environmental Protection Agency (EPA), and other federal agencies have historically worked with pressed- wood and other formaldehyde-using industries to reduce the content and release of formaldehyde from their products. As discussed earlier, levels in some products that were historically high have been substantially reduced.

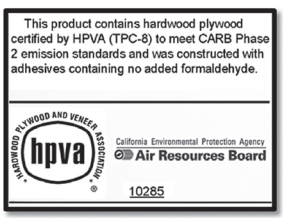
However, many people deliberately or unknowingly come in contact with other products that contain formaldehyde on a daily basis. For most people, a low-level exposure to formaldehyde will not produce any adverse effects. For sensitive people, however, the effects may be different. If you are sensitive to formaldehyde, you will need to avoid many of these everyday items to reduce the possibility of suffering from symptoms.

How to Reduce Exposure to High Levels of Formaldehyde

1. Installing wood floors or finishes that are not "acid-cured", which is a type of finish that is formaldehyde-based.
2. Installing pressed-wood products, such as particleboard, MDF, or hardwood plywood, for construction or remodeling of homes or for do-it-yourself projects that are labeled or stamped in compliance with the American National Standards Institute (ANSI) or California Air Resources Board Air Toxics Control Measure (CARB ACTM) criteria.

- Particleboard should conform to ANSI A208.1-2009 (label designated "-F18" or "-F09" (Grade D2) or "-F20," "-F18", or "-F09" (Grade D3)) or the CARB ACTM.*

- MDF should conform to ANSI A208.2-2009 (label designated with "-F21" or "-F11" for MDF > 8 mm thickness; "-F21"or "-F13" for MDF ≤ 8 mm thickness) or the CARB ACTM.*
- Hardwood plywood should conform to ANSI/HPVA HP-1-1994 or the CARB ACTM.*
- The Composite Panel Association (CPA) or Hardwood, Plywood, and Veneer Association (HPVA) stamps (examples below) also certify that products conform to the ANSI standards. These standards all specify lower formaldehyde emission levels.



- Installing furniture or cabinets that contain a high percentage of panel surface and edges that are laminated or coated. Unlaminated or uncoated (raw) panels of pressed wood products will generally emit more formaldehyde than those that are laminated or coated.
- Installing alternative products not made with urea-formaldehyde glues, such as wood lumber or metal.
- Installing "manufactured-home", pressed-wood products bonded with a phenol-formaldehyde resin system or other pressed-wood products made with composites meeting the ULEF or NAF requirements.

** These references should be consulted to confirm the information and standards cited herein are the most recent available.*

- Installing insulation that is not based on UF foam.
- Avoiding high household temperatures.
- Maintaining humidity in the house at 40-50% by:
  - Installing or using exhaust fans where moisture is generated
  - Using dehumidifiers in humid climates
  - Reducing moisture in crawlspaces or basements (i.e., constructing appropriate drainage or applying vapor barriers)
- Not using humidifiers or other products to add moisture to already humid air
- Washing durable-press fabrics before use and not choosing clothing and fabrics that are likely to contain formaldehyde, such as rayon, blended cotton, corduroy, wrinkle-resistant 100% cotton, shrink-proof wool, and heavy stiff fabrics.

Testing for Formaldehyde in Indoor Air

Should You Test?

It should not be necessary to measure formaldehyde in your indoor air if you reduce existing formaldehyde levels and do not introduce products that emit formaldehyde into your home. However, if you become ill following installation of a product that has been manufactured with formaldehyde, you should consult a physician to determine whether or not your symptoms might relate to indoor air quality problems. If your physician believes that you may be sensitive to formaldehyde, you may want to have the levels of formaldehyde measured.

There Are Three Basis Ways To Measure Formaldehyde In Indoor Air.

1. Indoor air professional

Indoor air quality (IAQ)-related issues can be complex and are often related to building design and function. Trained professionals can:

- Accurately sample for formaldehyde using a variety of methods (some which are not generally available to consumers)
- Control or account for complex factors (home closure, standard temperature/humidity and sample number/location/duration) that might affect formaldehyde levels
- Interpret the results
- Determine if additional sampling is necessary

When interviewing IAQ professionals, consider the following questions:

- Have they performed similar jobs, and what were the outcomes
- Will they include a written report with the data including recommendations
- Do they have client references with similar IAQ issues
- Do they have certifications and/or memberships in IAQ- related organizations and what do these certifications or memberships mean

2. Sampling kits

These kits provide a sample vial or badge (passive sampler) that must be opened and then attached to or hung in a representative area for a prolonged period of time (1 day or less). Following sample collection, the sampler is sealed and mailed to a lab for analysis. Currently, labs are available in the U.S. for analyzing passive samplers. As with IAQ professionals, sampling kits can vary in their ability to detect formaldehyde. In general, the buyer should consider the following questions before buying a sampler kit:

- Is the test based on a known method for assessing formaldehyde in air (i.e., NIOSH 2016)

- Has the sample been analyzed by a reputable laboratory? (Accreditation by the Industrial Hygiene Laboratory Accreditation Program (IHLAP) of the American Industrial Hygiene Association (AIHA)
- Participation in a Proficiency Analytical Testing (PAT) program collaboratively sponsored by AIHA and the National Institute for Occupational Safety and Health (NIOSH)?
- Does the test have a low detection limit (≤ 20-30 ppb)?
- Does the test have good accuracy (± 20 %)?
- Does the test have minimal interference from other chemicals, such as VOCs or ozone?
- Does the test include a detailed report with recommendations?
- Does the test include technical support?

3. Consumer Sampling and Analysis Kits

A combined sample and analysis test kit is available for formaldehyde that provides a one-time reagent and test protocol to analyze for atmospheric formaldehyde without sending the sample off to a lab. This combined kit requires the user to carefully follow instructions and is useful for short-duration exposures only. The accuracy of this combined sampling and analytical test kit is unknown. The buyer should consider the same questions above before buying combined sampler and analysis kits.

Formaldehyde Sampling

Use of Buck Libra L-4 Pump, Tubes and Universal Low-Flow Adapter (<1 lpm)

1) Review operating instructions for the Buck Libra L- 4 pump, in your kit.

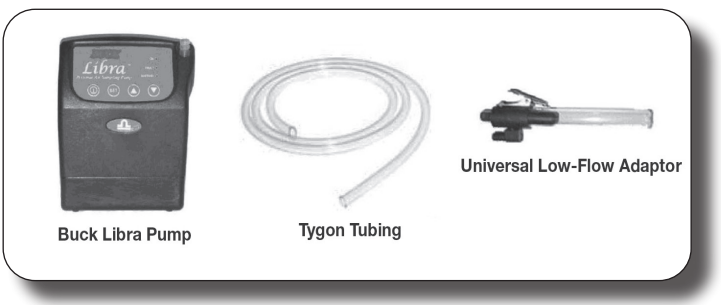
2) Charge and check out the pumps the day before sampling to ensure that the pump is fully charged prior to usage.

Note: Formaldehyde media is shipped cold and should be kept that way except during sampling period.

3) Place the cooler and ice pack in the freezer so they are ready to ship back.

4) DO NOT alter the charging apparatus as the battery may be damaged.

5) Assemble the equipment as shown below:



6) Assemble the sample train. The tubing attaches to the pump inlet, the low-flow adaptor attaches to the tubing; the clear tube shield is then unscrewed to access the tube fitting. The sorbent tube will then be inserted into the soft rubber tube fitting.

7) Immediately before sampling, break off the ends of the flame-sealed tube so as to provide an opening that is approximately half the internal diameter of the tube.

Note: Wear eye protection when breaking ends and do not use the charging inlet or the exhaust outlet of the pump to break the ends of the tube

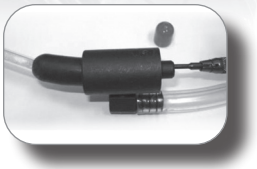
8) Insert the tube into the black rubber fitting on the low-flow adapter as shown, with the arrow pointing towards the tubing. The sorbent is close to one end of the tube, this is the end that should go towards the sampling pump. The tube shall be held or attached in an approximately vertical position with the inlet either up or down during sampling.

9) Turn the pump on (the LED light should turn on and you should hear the motor) – if it sounds like the motor is strained or frantic, you may have kinked the sample line or forgotten to break the ends off of the sorbent tube (see step # 7).

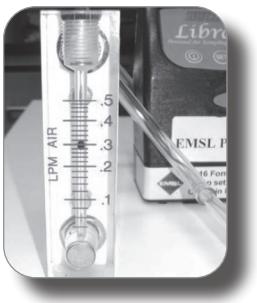
10) Insert the open end of the tube into the tubing connected to the top fitting of the rotameter (flowmeter).

Read the flowrate. It should be between 0.05 and 0.5 Liters per minute (lpm), the OPTIMAL flowrate is 0.3 lpm. If it is not at 0.3 lpm, carefully use a small screwdriver to adjust the flow using the screw on the low-flow adapter FIRST.

Note: This should be attempted prior to making an attempt to adjust the flowrate using the arrows on the front of the pump.



The adjustment arrows on the front of the pump should be used only after the following the steps outlined above. The pump flow can be adjusted by holding down the “SET” button and pressing the up or down arrow.



11) Place the pump in the area or on the person whose exposure level will monitored and document the time that the sampling began. If a personal sample, place the open end of the tube as close as feasible to the worker’s breathing zone. When taking area samples, note the position of the tube inlet on your notes.

Note: Do not let tube drop onto the ground or into liquids.

12) Periodically check to ensure that the pump is running. A sample in which the pump has failed and was left unattended during the sampling period will need to be discarded.

Note: It is important to ensure that the pump is operational for the entire duration of the sampling event.

13) When the sampling period is completed, stop the pump by pressing On/Off switch.

14) Document the time.

15) Take the tube out of the low-flow adapter and place a red cap on each end and label the tube using a folded label or piece of tape on the end cap ONLY.

16) Complete the Chain of Custody (COC). Indicate the analyte desired (in this case, formaldehyde), flowrate, sampling time in minutes, and the expected turnaround (TAT), etc. Put the tubes back into the cooler with the ice pack for shipment.

Note: If not shipping immediately, put the tubes, cooler, and ice pack in the freezer until you are ready to ship it overnight to EMSL.

17) Send the pumps and tubes back to EMSL for Laboratory Analysis.

Sources:
https://www.epa.gov/formaldehyde
https://www.cpsc.gov/s3fs-public/2.pdf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United States and Canada Locations