PCBs in Building Materials—Questions & Answers

July 28, 2015

Introduction

Based on the information available, the EPA believes that there was potentially widespread use of PCB-containing building materials in schools and other buildings built or renovated between about 1950 and 1979. This is an important issue because PCBs have been identified as probable human carcinogens and may cause a variety of non-cancer health effects.[1] Although the presence of PCBs in schools and other buildings may be a concern, the presence of PCBs alone is not necessarily a cause for immediate alarm. If PCBs are present or suspected of being present, EPA recommends the actions outlined in this document be taken by school administrators, building owners and building managers to reduce PCB exposures.

The specific questions and answers (Q&As) provided in this document are meant to help school administrators, building owners, managers and occupants better understand the types of building materials that may contain PCBs, the potential for building occupant exposure to PCBs, and how exposure to PCBs can be assessed and reduced. Information presented in this document is broadly applicable and serves as practical guidance meant to reduce potential exposure of building occupants to PCBs within a reasonable time frame and under exposure conditions expected in schools and other buildings.

School administrators, building owners and managers can take practical actions to reduce potential PCB exposures in buildings built or renovated between about 1950 and 1979. These include best management practices (BMPs) such as removing all PCB-containing fluorescent light ballasts (FLBs) from schools and other buildings since they can be a significant source of PCBs, improving ventilation, keeping surfaces clean to reduce dust that may contain PCBs, and improving building occupant hygiene (see Q&A #16). Due to building-specific factors, these practical actions may not always adequately reduce PCB exposure (see Q&A #25). Additional or more frequent cleaning, or other actions to identify and address PCB sources, may be warranted to reduce total PCB exposures. In such cases, the EPA recommends that school officials, building owners and managers consult with their EPA Regional PCB Coordinator and make decisions about appropriate action after thoughtful consideration of all available information and all legal requirements. After implementing BMPs or taking other actions in schools to address sources of PCBs, school administrators may want to consider conducting indoor air testing and comparing test results to the Exposure Levels for Evaluating PCBs in Indoor School Air (See Q&A #25 & 26) to assess PCB levels in indoor air. Only air testing can determine if PCBs are present in indoor air after BMPs and other actions have been implemented.

[1] https://www.epa.gov/pcbs/learn-about-polychlorinated-biphenyls-pcbs#healtheffects

The Exposure Levels for Evaluating PCBs in Indoor School Air provided in this Q&A document are based on potential exposure of school occupants over the course of a typical school year and are meant to keep total daily PCB exposure below the EPA life-time reference dose level for PCBs. These levels for indoor school air are not meant to be interpreted or applied as “bright line” or “not-to-exceed” criteria. Rather, measurements above these levels are intended to suggest the need for the further investigation of PCB sources in the school building and other actions to reduce exposure. If indoor air PCB concentrations persist above these levels in school buildings, school administrators should work in consultation with their EPA Regional PCB Coordinator to develop a plan to minimize exposures, including, as appropriate, plans to remove PCB-containing building materials. Note the Exposure Levels for Evaluating PCBs in Indoor School Air discussed in Section IV of this document were developed specifically for schools and cannot be directly applied to other buildings without adjustment of the underlying exposure assumptions (see Q&A #27, 28, 30 and 31).

This document is intended to be used as an informal reference and is not intended to be a summary of applicable PCB requirements. This document does not replace nor supplant the requirements of the Toxic Substances Control Act (TSCA) PCB regulations. Please refer to the regulations at 40 CFR part 761 for specific regulatory and legal requirements. You can also contact the appropriate EPA Regional PCB Coordinator if you have more questions concerning PCBs in building materials.

I. Potential Sources of PCB Exposure in Schools and Other Buildings

A. Overview

1. What are potential sources of PCBs in schools and other buildings?

Potential sources of PCBs in schools and other buildings built or renovated between about 1950 and 1979 include caulking used around windows, door frames, building joints, masonry columns and other masonry building materials. PCB-containing caulk may be present inside and on the exterior of the building as well as in surrounding surfaces. PCBs have been used in paints, mastics and other adhesives, fireproofing materials, and in the manufacture of some ceiling tiles and acoustic boards, among other products. PCBs may also be present in high intensity discharge (HID) lamp ballast capacitors and the capacitors of fluorescent light ballasts (FLBs) manufactured before 1979. The capacitors within the light ballasts in HID and fluorescent lighting fixtures serve to limit the amount of electrical current going to the lamp (e.g., tube or bulb). PCBs can emit into the air during normal use of these fixtures and if the ballast fails or ruptures. Building materials where PCBs were intentionally added during manufacture or application (called manufactured sources or also primary sources, such as the examples above) can lead to PCBs in indoor air. PCBs in the indoor air can then adsorb onto other surfaces and dust, which become secondary sources of PCBs (sources of PCBs where PCBs were not intentionally added to the material). These secondary sources may, in some cases, contribute to PCB concentrations in indoor air even after the manufactured sources are removed. PCBs from manufactured sources such as caulk may also contaminate adjoining materials, such as masonry or wood, through direct contact and create secondary sources.

2. How are building occupants exposed to PCBs in schools or other buildings?

PCB exposure to building occupants may occur through inhalation of PCBs that have off-gassed into the air from both manufactured sources and secondary sources. Building occupants may also be exposed to PCBs through the ingestion of PCB-containing dust and residues present on building surfaces transferred from hand to mouth. Building occupants may also experience direct dermal exposure to PCBs.

3. What are additional sources of PCB exposure to the general population?

Dietary intake and inhalation are the greatest sources of exposures to PCBs in the general population, although PCB concentrations in food have decreased. Together, these sources of PCBs generally result in background exposures that are significantly below the “reference dose” – or the amount of PCB exposure that EPA does not believe will cause harm (see Q&A #25 and #27). Indoor and outdoor air typically contain small amounts of PCBs. Most of the dietary intake comes from consumption of fish/seafood, meat, and dairy products. Some population groups or individuals with high fish/seafood consumption may experience higher dietary intake of PCBs than the general public.

B. Manufactured Sources of PCBs in School and Other Buildings

PCBs in Fluorescent Light Ballasts (FLBs)

4. Why are PCB-containing FLBs a concern?

PCBs are contained within the FLB capacitors and in the FLB interior potting material of old magnetic T12 lighting fixtures (see Q&A #5). The capacitor regulates the amount of electricity coming into the lighting fixture and the potting material serves to insulate the FLB and reduce the "humming" noise. Because all PCB-containing FLBs currently in use have exceeded their designed life span, it makes them susceptible to leaking or rupturing at any time which may lead to increased exposures to building occupants. Residues from these sources are difficult and costly to clean up. Additionally, intact PCB-containing FLBs may emit small amounts of PCBs into the air during normal use of the lighting fixture. For these reasons, EPA recommends all PCB-containing FLBs be removed from lighting fixtures. Note that EPA has limited data suggesting older HID ballast capacitors may be a source of PCB exposure. EPA recommends that school administrators and building owners consider removing and replacing HID ballasts that contain PCBs.

5. How do I know if my building has PCB-containing FLBs?

Any building built or renovated before 1979 (most uses of PCBs were banned in 1979) is likely to have PCB-containing FLBs if it has not undergone a complete lighting retrofit after 1979 (i.e., all light fixtures in the building are replaced with those manufactured after 1979). In some cases, PCB-containing FLBs that were manufactured before 1979 were stored and later used in some fluorescent light fixtures installed or repaired after 1979. Thus, some schools and other buildings built after 1979 that have not undergone a complete lighting retrofit could have PCB-containing FLBs. To determine whether your building has PCB-containing FLBs, conduct a visual inspection of the FLBs in a representative number (see https://www.epa.gov/pcbs/polychlorinated-biphenyl-pcb-containing-fluorescent-light-ballasts-flbs-school-buildings) of light fixtures (not just the tubes). Examining any available date of manufacture information is recommended.

The following criteria are provided to help identify FLBs that may contain PCBs:

- FLBs manufactured before July 1, 1979 may contain PCBs.
- FLBs manufactured between July 1, 1978 and July 1, 1998 that do not contain PCBs must be labeled "**No PCBs**" by the manufacturer.
- If an FLB is not labeled "**No PCBs**", it is best to assume it contains PCBs unless it is known to be manufactured after 1979.
- FLBs manufactured after 1998 are not required to be labeled but should not contain PCBs.

Note that PCBs are contained within magnetic T12 FLB capacitors and in the FLB interior potting material. Only the T12 magnetic FLBs (not T8 or T5 FLBs) may contain PCBs. The "T" designates the lamp that goes with the FLB as a "tubular" shape. The number after the "T" represents the lamp diameter in eighths of an inch.

6. What should I do if my building has PCB-containing FLBs?

EPA recommends removing all PCB-containing FLBs from schools and other buildings because these FLBs have exceeded their designed life span and are susceptible to leaking or rupturing in the future. Leaking PCB-containing FLBs left in place are a violation of the PCB regulations and must be removed. If there is staining or residues on light fixtures and/or on building surfaces that are attributable to prior PCB releases from the FLBs, the fixtures and surfaces must be cleaned or disposed of in accordance with 40 CFR part 761, subpart D. Consult with your EPA Regional PCB Coordinator to ensure that all relevant clean-up procedures are followed. Replacing old lighting systems with new, energy efficient systems will eliminate this potential source of PCBs. For more information on PCBs in FLBs, see https://www.epa.gov/pcbs/polychlorinated-biphenyl-pcb-containing-fluorescent-light-ballasts-flbs-school-buildings. (see also Q&A #17).

PCBs in Caulk

7. What is known about the use of PCBs in caulk?

PCBs were widely used in caulking and elastic sealant materials, particularly between about the 1950s through the 1970s. These materials were primarily used in or around windows, door frames, stairways, building joints, masonry columns, and other masonry building materials. PCBs were used in these building materials because of their properties as a plasticizer. PCBs have been detected in caulk in buildings, including schools, with concentrations ranging from below 50 parts per million (ppm) to greater than 440,000 ppm.

8. Why is caulk a potential source of PCB exposure?

If caulk contains PCBs, the PCBs may be released into the air through off-gassing. This may occur when the caulk is intact and undisturbed or if it is deteriorating. PCBs in the air originating from caulk can then be absorbed into other building materials, creating secondary sources which can then re-emit PCBs into the air (see Q&A # 13). PCBs in manufactured materials such as caulk may also move directly into adjoining materials, particularly porous materials such as wood, concrete, and other types of masonry. PCBs from exterior caulks may also leach into surrounding building materials and soil from precipitation and deterioration of the caulk, and from disturbances during renovations or construction.

9. How many schools and other buildings built or renovated between about 1950 and 1979 contain PCB-containing caulk?

EPA does not have much information on the prevalence of PCB-containing caulk in schools and other buildings. Based on the limited number of test samples gathered from different parts of the country, EPA believes that there was potentially widespread use of PCB-containing caulk in schools and other buildings built or renovated between about 1950 and 1979.

10. Is PCB-containing caulk present in housing structures?

In some instances, EPA found PCBs in large scale apartment complex buildings. However, the use of PCBs in residential building materials is not well documented.

PCBs in Paint and Coatings

11. Are PCBs present in paint used in schools and other buildings built or renovated between about 1950 and 1979?

PCBs may have been intentionally added to some specialty paints and coatings to improve their performance for use primarily in industrial and/or military applications (e.g., paints manufactured to endure thermal stress, vibration or corrosivity) but such specialty paints or coatings could have been used in some schools and other buildings built or renovated between about 1950 and 1979. PCBs intentionally added to specialty paints and coatings may occur in high concentrations. Although specialty paints or coatings were not typically used for interior or exterior decorative architectural uses, PCBs have been found in paint on walls in some schools and other buildings, so all interior and exterior decorative uses of PCB-containing paint cannot always be ruled out. PCBs in manufactured materials such as specialty paint may move directly into adjoining materials, particularly porous materials such as wood, concrete, and other types of masonry. PCBs, if present in exterior paints, may also leach into surrounding building materials and soil from precipitation and deterioration of the paint, and from disturbances during renovations or construction.

Other Potential Manufactured Sources

12. What are other manufactured sources of PCBs in building materials?

Besides caulk, paint and FLBs, other building materials or components may have been manufactured with PCBs. For example, window glazing, ceiling tiles, spray-on fireproofing, and floor finish containing PCBs have been found in some schools and other buildings. These other potential sources of PCBs and the extent of their use in schools and other buildings are not well characterized.

C. Secondary Sources of PCBs

13. What are examples of secondary sources of PCBs?

Secondary sources of PCBs are created when PCBs in manufactured sources move into other materials in schools and other buildings. Examples of secondary sources of PCBs include dust, paint, laminates, wood products, masonry, furniture foam, ceiling tiles, floor tiles, and carpet. There are two primary mechanisms for the movement of PCBs in schools and other buildings. First, PCBs are emitted from manufactured materials into the air inside schools and other buildings. PCBs in the air are then absorbed into other building materials, components, furnishings and dust. Second,

PCBs in manufactured materials such as caulk may move directly into adjoining materials, particularly porous materials such as wood, concrete, and other types of masonry. In schools with manufactured PCB sources, many different kinds of building materials have been found to have measurable levels of PCBs and are potential secondary PCB sources.

14. What do we know about PCB concentrations on interior building surfaces for schools and other buildings constructed or renovated using PCB-containing building materials?

Interior building surfaces (through residues and dust) are a potential source of non-dietary ingestion, dermal and inhalation exposure to PCBs. Available data indicate that when present, PCB concentrations on interior building surfaces can be variable from building to building and from room to room within the same building. Indoor dust is composed of multiple types of materials, potentially including deteriorating building materials, outside soils tracked into schools and buildings, and various kinds of organic matter. Measured values of PCBs in dust have ranged from less than 1 to 6,800 micrograms (one microgram is equal to one millionth of a gram) of PCBs per gram of dust. EPA recommends that interior building surface concentrations of PCBs be minimized through appropriate and frequent cleaning (see Q&A #16).

15. What do we know about PCB concentrations in the soils surrounding schools and other buildings constructed or renovated using PCB-containing building materials?

The soils surrounding schools and other buildings can be contaminated with PCBs originating from PCB-containing building materials, particularly from exterior caulks and sealants. In general, although not in all cases, measurements have indicated that higher concentrations of PCB-contaminated soils are found closest to the schools and other buildings.

II. Actions to Reduce PCB Exposure in Schools and Other Buildings

A. Best Management Practices (BMPs)

16. What are the BMPs to reduce PCB exposures in schools and other buildings?

Regardless of whether PCBs are known to be present, EPA recommends that all schools and other buildings built or renovated between about 1950 and 1979 implement the following practical actions to minimize potential building occupant exposure to PCBs:

- **Remove all PCB-containing fluorescent light ballasts (FLBs).** EPA recommends that non-leaking PCB FLBs be removed and retrofitted as part of lighting upgrades or as a stand-alone project. Leaking PCB FLBs must be removed as required under 40 CFR part 761, subpart D. The EPA recommends that an experienced contractor or properly trained facilities maintenance staff perform the removal, cleanup, and disposal of PCB-containing FLBs, light fixtures, and building surfaces. Consult with your EPA Regional PCB

Coordinator to ensure that all relevant cleanup procedures are followed. For the proper removal and disposal of PCB FLBs see: https://www.epa.gov/pcbs/polychlorinated-biphenyl-pcb-containing-fluorescent-light-ballasts-flbs-school-buildings.

- **Conduct the following best management practices listed below on a frequent ongoing basis to minimize potential exposures to PCBs**:
  - ✓ Ensure that ventilation systems are operating properly and are regularly inspected and maintained according to system manufacturer instructions and guidelines or ANSI/ASHRAE/ACCA Standard 180-2012—Standard Practice for Inspection and Maintenance of Commercial Building HVAC Systems. If system cleaning is needed, follow ANSI/ACCA Standard 6 – Restoring the Cleanliness of HVAC Systems (2007).
  - ✓ Clean inside schools and other buildings frequently to reduce dust and residue.
  - ✓ Use a wet or damp cloth or mop to clean surfaces.
  - ✓ Use vacuums with high efficiency particulate air (HEPA) filters.
  - ✓ Do not sweep with dry brooms or use dry cloths for dusting.
  - ✓ Wash hands with soap and water, particularly before eating.
  - ✓ Wash children's toys.

  For EPA's general school cleaning recommendations visit: http://www.epa.gov/iaq/schools/clean_maintenance.html

Due to building-specific factors, these BMPs may not always adequately reduce PCB exposure. In some cases, additional and more frequent cleaning or other actions to identify and address PCB sources may be warranted.

B. PCB Source Removal and Repair

17. What recommendations does EPA provide to school administrators or building owners on the proper removal and disposal of PCB fluorescent light ballasts (FLBs)?

EPA recommends that an experienced contractor or properly trained facilities maintenance staff perform the removal, cleanup and disposal of PCB-containing FLBs. Leaking PCB FLBs must be properly disposed of pursuant to the PCB regulations at 40 CFR part 761. Staining or residues on light fixtures and/or on building surfaces that are attributable to prior PCB releases from the FLBs must be cleaned (40 CFR section 761.61 or 761.79) or the contaminated building materials disposed of in accordance with 40 CFR part 761, subpart D. Consult with your EPA Regional PCB Coordinator to ensure that all relevant cleanup procedures are followed. EPA's recommended procedures for the proper removal of PCB FLBs are listed at: https://www.epa.gov/pcbs/polychlorinated-biphenyl-pcb-containing-fluorescent-light-ballasts-flbs-school-buildings.

18. Should PCB-containing building materials be removed during building repair and renovation activities?

Yes, EPA recommends that PCB-containing caulk and other PCB-containing building materials be removed during planned renovations and repairs (when replacing windows, doors, roofs, ventilation, etc.). Prior to removal, EPA recommends PCB testing for caulk and other building materials that are going to be removed to determine what protections are needed during removal and to determine proper disposal requirements. Where testing confirms the presence of PCBs at regulated levels in building materials, they must be disposed of in accordance with the PCB regulations at 40 CFR part 761, subpart D. In lieu of testing, caulk and other potentially PCB-containing building materials that are part of building repair and renovation activities may be assumed to contain PCBs at regulated levels and disposed of in accordance with 40 CFR part 761, subpart D.

19. What special procedures are needed when doing repairs or renovations that may disturb PCB-containing building material?

To ensure that PCB-containing building material does not contaminate surrounding surfaces when it is removed and disposed of, repairs that disturb PCB-containing building material, such as window removal and replacement, should be conducted by trained workers who use safe work practices to minimize dust and contain contaminated waste. EPA has developed guidance for minimizing exposures when conducting repairs and renovation activities, including cleaning the work area once the work is completed; see https://www.epa.gov/pcbs/steps-safe-renovation-and-repair-activities

Actions contractors should take include:

- Ensure workers are properly trained and are using gloves, eye goggles, skin protection and approved particulate breathing masks.
- In dusty work areas, have showers available and separate changing areas so that dust on clothing is not brought home.
- If working with solvents, provide respirators.
- Use heavy plastic sheeting to cover floors and other fixed surfaces like large appliances in the work area.
- Close and seal vents in the work area and turn off forced-air heating and air-conditioning systems.
- Regularly clean the work area using a HEPA vacuum and wet mopping.
- Properly dispose of personal protective equipment and cleaning material.

Building occupants should be notified of the PCB repair and renovation activities and be completely isolated from the parts of the building undergoing PCB repair and renovation activities to prevent exposure to PCBs. Additional steps, including physically isolating the work space with physical barriers and negatively pressurizing work areas may be necessary (see http://www.epa.gov/iaq/schooldesign/renovation.html). If complete isolation of the work space cannot be assured, school administrators and building owners should temporarily remove

occupants from the area of the building while the work is underway.

For additional guidance on protecting occupants during renovations or other construction activities, see ANSI/SMACNA 008-2008: IAQ Guidelines for Occupied Buildings Under Construction. The guidelines are available from the Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA) at www.smacna.org.

20. Can PCB-containing building materials be encapsulated to prevent the release of PCBs?

EPA has looked at the effectiveness of encapsulation (or sealing) techniques to prevent the release of PCBs. Based on laboratory research by EPA's Office of Research and Development, encapsulation was found to be most effective for interior surfaces that contain low levels of PCBs (i.e., up to several hundred parts per million). Encapsulation was not found to be effective for more than a short period of time in reducing air emissions from sources that have a high PCB content. Depending on the PCB reduction goal, the performance of the encapsulant and the conditions of the building, the upper limit of the PCB concentration for successful encapsulation may vary. Therefore, post-encapsulation monitoring may be an essential part of the encapsulation process. Building owners should consult EPA's research on this issue for more specifics (see http://nepis.epa.gov/Adobe/PDF/P100FA5L.pdf).

Encapsulation may be useful for the reduction of air emissions from secondary sources such as contaminated building materials under and around PCB-containing caulk or paint that has been removed. Because each site will present unique circumstances, please consult your EPA Regional PCB Coordinator regarding the application of encapsulation measures on a case-by-case basis. Additional details about EPA's research may be found at: https://www.epa.gov/pcbs/fact-sheets-summarizing-research-polychlorinated-biphenyls-pcbs-school-buildings

III.Assessment of PCBs in Schools and Other Buildings

A. Air Testing for PCBs

21. What should a school administrator do if there are concerns about possible exposure to PCBs in school indoor air?

As noted in Q&A #16, EPA recommends that all schools and other buildings built or renovated between about 1950 and 1979 implement Best Management Practices (BMPs) to minimize potential building occupant exposure to PCBs. After implementing BMPs, school administrators should consult with their EPA Regional PCB Coordinator to assess if there still may be the potential for PCB releases in their school and whether to consider testing indoor air for PCBs. If air testing is conducted, the test results should be evaluated using the Exposure Levels for Evaluating PCBs in Indoor School Air (see Q&A #25 & 26).

Each school is unique, which means that many factors should be considered when deciding whether and how to test the indoor air at a school. This decision should be made in consultation

with the EPA Regional PCB Coordinator and the decision makers should thoughtfully consider all available information, such as: school-specific conditions (e.g., building age, types of materials used in construction, layout, maintenance or renovation history), BMPs already implemented to address PCB sources (see Q&A #16), and available technical resources, costs, and public concerns.

While there are accepted analytical methods to measure PCBs in indoor air samples, there is no broadly accepted sampling protocol for testing PCBs in indoor air. Accordingly, EPA is unable to provide a generic recommendation on indoor air testing due to the many different school-specific situations encountered in designing a sampling plan. Development of an air testing plan should endeavor to be as representative as circumstances in the school allow and factor in school-specific conditions, which EPA believes school administrators are best positioned to identify in consultation with their EPA Regional PCB Coordinator. Only air testing can determine if PCBs are present in indoor air after BMPs and other actions have been implemented.

If school administrators decide to test school indoor air and find that PCB levels exceed the Exposure Levels for Evaluating PCBs in Indoor School Air (see Q&A #25), they should consult with their EPA Regional PCB Coordinator on appropriate next steps, such as the implementation of BMPs and whether manufactured sources (e.g., FLBs, caulk, paint) or secondary sources (e.g., paint, ceiling tiles) of PCBs should be investigated.

Furthermore, if PCB indoor air level exceedances persist, school administrators should work with their EPA Regional PCB Coordinators to develop a plan to minimize exposures (e.g., continue following the best management practices as indicated in Q&A #16, such as further cleaning of affected areas and optimizing ventilation) and investigate additional potential sources of PCB-containing building materials or expand air testing to identify the extent of the areas with air level exceedances.

See also Q&A #25 for additional information on the Exposure Levels for Evaluating PCBs in Indoor School Air.

22. Are there air sampling methods for determining the presence of PCBs in indoor air of schools and other buildings?

For determining the presence of PCBs in indoor air of schools and other buildings, EPA has two approved air sampling methods: Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air – Compendium Method TO-4A (high air volume) and Compendium Method TO-10A (low air volume). These two methods can be found respectively at:

http://www.epa.gov/ttnamti1/files/ambient/airtox/to-4ar2r.pdf and
http://www.epa.gov/ttnamti1/files/ambient/airtox/to-10ar.pdf

There are a number of factors to be considered when developing a building-specific sampling plan for testing the air. These include but are not limited to:

- Potential seasonal variations in the air concentrations due to changes in ventilation and temperature (e.g., windows may be open in the summer and closed in the winter);
- Whether the intent is to study worst-case or normal operating conditions within the building;
- The number of samples to be collected and their locations; and
- Whether the samples will be analyzed for individual types of PCBs: aroclors, homologues or congeners. Congeners are individual PCB chemicals; aroclors are specific mixtures of PCB congeners and homologues are a way of grouping PCB congeners by the number of chlorine atoms they have.
- To ensure that PCBs are accurately quantified, the type of PCB must be measured against the same type of PCB (Aroclors must be measured against a standard for that Aroclor, and an individual PCB congener must be measured against a standard for that congener).

For more information see: https://www.epa.gov/pcbs/polychlorinated-biphenyls-pcbs-building-materials#Test-Methods.

B. Interior Building Surfaces Testing for PCBs

23. How do I determine PCB levels on interior building surfaces?

There is currently no EPA method that is specific to sampling for PCBs in dust and residues on interior building surfaces. The most common approach for measuring PCBs on building interior surfaces is to sample a 100 cm^2 area by wiping with a solvent-wetted gauze material and analyze the gauze for PCBs. The surface wipe approach is specified for certain situations in the PCB spill clean-up regulations. Surface wipes collect PCBs bound to dust particles on surfaces and may also collect PCBs adhering to the material surface (residues). Hexane is the solvent specified in the PCB spill clean-up regulations (40 CFR section 761.123). In addition to collecting dust, hexane on the wipes is likely to extract PCBs adhering to materials. ASTM Method D6661-01 (2006) *Standard Practice for Field Collection of Organic Compounds from Surfaces Using Wipe Sampling* is also an available method for sampling surfaces for organics.

Bulk dust collection using a vacuum equipped with a filter is another approach for sampling indoor surfaces. A key challenge for bulk dust measurements is that surfaces often do not contain enough dust for accurate weighing or achieving adequate PCB analytical limits of detection.

C. Testing Building Materials for PCBs

24. How do I determine PCB levels in non-liquid building materials?

There are several laboratory methods for determining the presence of PCBs in non-liquid building materials such as caulk and paint. The laboratory should follow the recommended approach referenced in EPA's PCB regulations at 40 CFR part 761, such as method 3500B/3540C from EPA's SW-846, Test Methods for Evaluating Solid Waste for chemical extraction of PCBs and Method 8082 from SW-846 for chemical analysis. An alternative method

to those specified methods may be validated under 40 CFR part 761 subpart Q. To ensure that PCBs are accurately quantified, Aroclors must be measured against a standard for that specific Aroclor and an individual PCB congener must be measured against a standard for that specific congener.

IV. Exposure Levels for Evaluating PCBs in Indoor School Air

25. What are the Exposure Levels for Evaluating PCBs in Indoor School Air?

EPA calculated the Exposure Levels for Evaluating PCBs in Indoor School Air so that if children and adults breathed PCBs at or below those levels for the hours per day and days per year in which school is in session, those PCB exposures would not lead to risks of suffering adverse health effects. These calculations are based on the oral reference dose (RfD) of 20 ng PCB/kg body weight per day and are adjusted to reflect a typical school year (See Q&A #30). The Exposure Levels for Evaluating PCBs in Indoor School Air are based upon EPA's understanding of average exposure to PCBs from all other major pathways. These air levels were developed for all ages of children from toddlers in day-care to adolescents in high school, as well as for adult school employees. For background information on the potential health effects of PCB exposure, see https://www.epa.gov/pcbs/learn-about-polychlorinated-biphenyls-pcbs#healtheffects. These exposure levels should not be interpreted nor applied as "bright line" or "not-to-exceed" criteria, and may be used to guide thoughtful evaluation of indoor air quality in schools. Isolated or infrequent indoor air PCB measurements that exceed the exposure levels would not signal unsafe exposure to PCBs.

EPA advises that total exposure to PCBs from all sources be kept below the oral reference dose (RfD) of 20 ng PCB/kg body weight per day. This RfD is an estimate of a daily, lifelong, oral exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of harmful effects during a lifetime. The Exposure Levels for Evaluating PCBs in Indoor School Air maintain total PCB exposure below the RfD, considering other major pathways of PCB exposure. The level of PCBs that adults and children might be exposed to through pathways other than school indoor air was set equal to what is estimated to be average background PCB exposure for those pathways. Therefore, the values in the following table are only applicable to a school when one assumes that exposure to PCBs through pathways other than school indoor air are equal to average PCB background levels. School-specific exposure levels can be calculated if specific PCB data are available for one or more of the exposure pathways other than school indoor air. As shown in the table, for a typical school day, the Exposure Levels for Evaluating PCBs in Indoor School Air range from a low of 100 ng/m^3 for toddlers age 1 to <2 years and children 2 to <3 years, to a high of 600 ng/ m^3 for high school students, age 15 to <19 years. Values for each age group are provided in the table below.

Exposure Levels for Evaluating PCBs in Indoor School Air (ng/m^3)*

Assuming that PCB exposures through pathways other than school indoor air are equal to average background PCB exposures for those pathways, these indoor school-air concentrations should keep total PCB exposure below the oral reference dose of 20 ng PCB/kg-day.

Age 1 to <2 yr	Age 2 to <3 yr	Age 3 to <6 yr	Age 6 to <12 yr Elementary School	Age 12 to <15 yr Middle School	Age 15 to <19 yr High School	Age 19+ yr Adult
100	100	200	300	500	600	500

* **Note:** These exposure levels were derived to serve as health protective values intended for evaluation purposes. These levels should not be interpreted nor applied as "bright line" or "not-to-exceed" criteria. For further explanation, see Q&A #26 & #27. Exposure levels have been revised to reflect more recent data on dietary exposure and have been rounded to the nearest hundred ng/m^3.

26. How should the "Exposure Levels for Evaluating PCBs in Indoor School Air" be used?

After the implementation of the recommended BMPs or conducting other actions to reduce exposure, these exposure levels may be used to guide thoughtful evaluation of indoor air quality in schools. These exposure levels should not be interpreted nor applied as "bright line" or "not-to-exceed" criteria. Isolated or infrequent indoor air PCB measurements that exceed the exposure levels would not necessarily signal unsafe exposure to PCBs. When measured indoor school air PCB concentrations are above these exposure levels, the EPA suggests that school building administrators take further steps to reduce PCB exposure such as reviewing, reevaluating and adjusting BMPs or taking other actions to identify and address PCB sources.

Note, the earlier version of this document used the terminology "Recommended Public Health Levels for PCBs in Indoor School Air." The EPA revised that terminology to "Exposure Levels for Evaluating PCBs in Indoor School Air" because the Agency believes the revised terminology better reflects the intended purpose of these levels. For more information about the exposure assumptions used to calculate the Exposure Levels for Evaluating PCBs in Indoor School Air and how they might affect potential risk, see Q&As #27-31.

27. What pathways of exposure were considered when developing Exposure Levels for Evaluating PCBs in Indoor School Air?

The exposure pathways considered when developing the exposure estimates underlying the derivation of the Exposure Levels for Evaluating PCBs in Indoor School Air included several that can occur away from school: inhalation (indoor and outdoor), indoor dust ingestion,

outdoor soil ingestion, indoor dust contact, and total dietary ingestion. EPA also considered several kinds of exposures that can occur at a school: school building inhalation (indoor and outdoor), indoor dust ingestion, outdoor soil ingestion, and indoor dust contact. Average PCB concentrations in these media were used in developing the exposure estimates for each of the pathways other than school indoor air. Additionally, the underlying exposure estimates did not include direct ingestion of, nor direct contact with, potentially contaminated building materials because these are expected to happen infrequently and exposure estimates were developed to represent average PCB exposures over the course of a school year.

28. What are the limitations of EPA's exposure estimates used to derive the Exposure Levels for Evaluating PCBs in Indoor School Air?

The exposure estimates underlying the derivation of the exposure levels assume that 1) the PCB concentrations in environmental media (i.e., outdoor air, dust, soils) relevant to each exposure pathway are equal to the background concentrations of PCBs for those media and 2) children's and adults' contact rates for those media are what are expected to occur on average while in a school. Because PCB levels in environmental media are not well understood and may be variable depending upon school-specific conditions, the exposure levels should be used with consideration of the uncertainty in the underlying exposure estimates. School-specific exposure levels can be calculated if specific PCB data are available for one or more of the exposure pathways other than school indoor air. The Exposure Levels for Evaluating PCBs in Indoor School Air should not be used to estimate occupational exposure associated with non-school buildings or site clean-ups or for residential use.

29. Why are the Exposure Levels for Evaluating PCBs in Indoor School Air different for different age groups?

The Exposure Levels for Evaluating PCBs in Indoor School Air are estimated using different exposure assumptions and factors for different age groups. Children at different age levels and adults have different rates for the amount of air they breathe, foods they eat, and amount of dust and soil they contact and ingest. Some of these factors differ because of behavioral differences between age groups. For example, children have higher soil and dust ingestion rates than adults. Others factors differ because of physiological differences between children and adults. For example, the average body weight is lower for younger children than for older children and adults. Because the exposure levels are divided by body weight, younger children have higher dietary and inhalation exposures per unit body weight than older children and adults.

30. For exposure estimates, what assumptions is EPA making about the amount of time children spend in school?

EPA estimated exposure to PCBs in schools using established values for the number of days per year and the number of hours per day children and adults spend at school. Depending upon age, these values were 180 to 185 days per year, and 6.5 to 8 hours per day at school. However, exposure assessments can also be made with other values that reflect activities

specific for a given school or other type of building**.** Note, since the number of days per year for non-school buildings may be higher (e.g., 220 – 250 days per year), the Exposure Levels for Evaluating PCBs in Indoor School Air presented in Q&A # 25 cannot be directly applied to non-school buildings.

31. Are the Exposure Levels for Evaluating PCBs in Indoor School Air applicable to other types of buildings?

The Exposure Levels for Evaluating PCBs in Indoor School Air were developed specifically for schools and cannot be directly applied to other buildings without adjustment of the underlying exposure assumptions. For example, the assumptions were based on 180 to 185 days per year, and 6.5 to 8 hours per day spent in the school which are likely not applicable to an office or residential setting.

V. Research Studies

32. What research has EPA conducted?

EPA's research on PCBs in schools was designed to identify and evaluate potential sources of PCBs in order to better understand exposures to children, teachers, other school workers and other building occupants and to improve risk management decisions. EPA has investigated PCB-containing caulk and paint, as well as other potential sources of PCBs in schools. The results of this research could also be applied to buildings other than schools. Specifically, EPA's Office of Research and Development research results have:

- characterized potential sources of PCBs in schools (e.g., caulk, coatings, FLBs);
- showed that both intact (non-leaking) and leaking FLBs can emit PCBs into indoor air;
- characterized potential secondary sources of PCBs in school buildings;
- investigated the relationship of manufactured (primary) sources to PCB concentrations in air, dust, and soil;
- used models to estimate PCB exposures and exposure pathways in school buildings; and,
- evaluated methods for encapsulation and on-site treatment to reduce exposures to PCBs in caulk and other sources.

Read about the results of this research at https://www.epa.gov/pcbs/fact-sheets-summarizing-research-polychlorinated-biphenyls-pcbs-school-buildings.

VI. EPA's Enforcement Approach for PCB-Containing Building Materials

33. Does EPA intend to enforce the requirement that caulk ≥ 50 ppm and other PCB materials unauthorized for use be removed?

EPA regulations implementing the Toxic Substances Control Act (TSCA) prohibit the use of

PCBs in caulk and other building materials manufactured with PCBs at levels greater than or equal to 50 ppm, including the continued use of such materials that are already in place. EPA regulations also generally prohibit the continued use of other materials that are contaminated with PCBs by such manufactured sources. Although EPA does have enforcement tools that it can use as appropriate where the PCB concentration in the caulk or other materials is above the regulatory limit, EPA is most interested in ensuring that school districts and other building owners undertake the recommended actions to limit exposures to PCBs (see Q&A #16). EPA believes that enforcement may not be the most effective tool to reduce health risks when school districts and other building owners follow these recommendations. Thus, such buildings will in most cases be a low priority for enforcement. Nonetheless, EPA will not hesitate to act in situations where there are significant risks to public health that are not being addressed.