Technical Guidance for Determining the Presence of Manufactured PCB Products in Buildings and Other Structures

United States Environmental Protection Agency

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Preface

Manufactured polychlorinated biphenyl (PCB) products, are manufactured products containing PCBs in a non-liquid state. The United States Environmental Protection Agency (EPA) has prepared this technical guidance as a resource to assist property owners or operators, their contractors, and analytical labs in determining the presence of manufactured PCB products containing PCBs at concentrations greater than or equal to (≥) 50 parts per million (ppm) in buildings or other structures that are in use or planned for renovation or demolition. Certain sections of this technical guidance, such as those pertaining to the development of sampling plans, sample collection procedures, or analytical methods may also help inform environmental contractors and analytical laboratories hired by property owners and operators that are assessing a building or other structure.

In this technical guidance, the EPA presents a statistically-based sampling approach that can be used, along with records and documentation, to potentially determine the presence of PCBs in concentrations ≥ 50 ppm within a building or other structure. Please note that, if desired, this guidance, with the necessary modifications, can be applied to determine the presence of manufactured PCB products at a threshold other than 50 ppm. This document will use the general term "buildings" to include "other structures." This document is a companion to EPA's Fact Sheet on PCBs in Building Materials (Reference 1).

The use of manufactured PCB products containing PCBs at concentrations ≥ 50 ppm is not authorized under the Toxic Substances Control Act (TSCA) and the federal PCB regulations at Title 40 of the Code of Federal Regulations (CFR) part 761. If manufactured PCB products containing ≥ 50 ppm PCBs are found in buildings, they must be removed and disposed of as PCB bulk product waste in accordance with 40 CFR 761.62. Additionally, PCB-contaminated substrate in contact with manufactured PCB products containing ≥ 50 ppm PCBs may be regulated for cleanup and disposal.

Property owners or operators are responsible for complying with TSCA and the PCB regulations, including by managing and disposing of regulated PCBs in accordance with applicable requirements. In addition to these federal requirements, property owners or operators are also responsible for determining and complying with all other applicable federal, state, and local requirements. Individuals are encouraged to consult with their state or local environmental officials regarding any additional requirements that may apply.

This document is not intended to address building equipment containing liquid PCBs, such as fluorescent light ballasts and electrical equipment, or cleanup and disposal of contamination from spills or releases of liquid PCBs. Instead, please refer to the following:

- PCB regulations at 40 CFR part 761
- PCB spill cleanup and disposal guidance documents available on EPA's website at https://www.epa.gov/pcbs

Disclaimer

This document and two companion worksheets do not impose any legally binding requirements or obligations on EPA, states, or the regulated community, nor do they release any party from liability for any violation of TSCA or its implementing regulations. A property owner or operator may use the guidance provided in these materials to assess whether a building potentially contains manufactured PCB products. Discussion in this document of what users "should" or "need to" or "have to" do are not statements of legal obligation but, rather, technical instruction on how to follow the approaches described in this document. This document and two companion worksheets may not apply to a particular situation based upon the circumstances, and they do not preclude the use of other approaches.

Use of these materials does not guarantee that manufactured PCB products are not present in a building, nor does it create a defense against a violation under TSCA if that occurs.

Contents

I. PCB-Containing Materials

Note: All references are listed in Section IX (References) as well as linked throughout the text of this document.

Although PCBs are no longer commercially manufactured in the United States, EPA believes that there was widespread use of manufactured PCB products during building construction and renovation activities occurring between 1950 and 1979. In addition to manufactured PCB products, which contain PCBs in a non-liquid state, equipment containing liquid PCBs, such as fluorescent light ballasts, may be present in buildings constructed or renovated during this period.

Manufactured PCB products may be found throughout a building. For example, applied paints and caulks around windows and doors and within expansion joints have been frequently identified as manufactured PCB products. There may be an increased likelihood for the presence of manufactured PCB products in certain areas of a building, such as boiler rooms or other areas subject to high heat. The location and PCB concentrations of manufactured PCB products within a building can vary by material type and from item to item within materials of the same type. Even when manufactured PCB product is removed or replaced, PCB residues may be left behind and contaminate porous (e.g., concrete, brick) and non-porous (e.g., metal surfaces, smooth glazed ceramics) substrate materials that were in contact with the manufactured PCB product. These PCB residues may even migrate from the substrate materials previously contaminated by manufactured PCB products into newly installed replacement materials. The purpose of this technical guidance is to provide a resource to assist property owners or operators in determining if manufactured PCB products may be present in a building or structure and developing a building material characterization sampling plan to test such materials. The use of manufactured PCB products containing PCBs at concentrations ≥ 50 ppm is not authorized under the Toxic Substances Control Act (TSCA) and the federal PCB regulations at 40 CFR part 761. If manufactured PCB products containing ≥ 50 ppm PCBs are found in buildings, they must be removed and disposed of as PCB bulk product waste in accordance with 40 CFR 761.62.

The table below lists potential PCB-containing material types that may be present in buildings. This list includes materials frequently identified to be manufactured PCB product and equipment containing liquid PCBs, but it is not intended to be comprehensive. Other material types not listed here may contain PCBs based on their form or function or year and place of manufacture and installation.

Materials Potentially Containing Non-Liquid PCBs	Materials Potentially Containing Liquid PCBs
Paint, varnishes, lacquers	**Electrical equipment such as transformers or capacitors**
Non-conducting materials in electrical cables (such as plastic and rubber)	**Fluorescent light ballasts (which may contain liquid PCBs in the capacitor and non-liquid PCBs in the potting material)**
Rubber and felt gaskets	**Oil-filled electrical cable**
Coal-tar enamel coatings (e.g., pipe coating) and rust inhibitor coatings	**Hydraulic equipment**
Insulation material (including fiberglass, felt, foam, and cork)	**Heat transfer equipment**
Adhesives and tapes	**Extrusion fluids**

Caulk and grout (including putty, silicon, window glazing, and bitumen)	
Rubber isolation mounts, foundation mounts, and pipe hangers	
Plastic applications (including vinyl and PVC)	
Galbestos siding	
Mastics	
Acoustic ceiling and floor tiles	
Joint material (between structural joints on buildings, parking lot/sidewalk pads, etc.)	
Asphalt roofing and tar paper	
Synthetic resins and floor varnish	
Sprayed-on fireproofing	

If there is reason to suspect manufactured PCB products are present in building materials and the building is in use, there are several steps that may reduce potential exposure to building occupants until the building is fully characterized and any identified manufactured PCB products are abated. EPA's "PCB in Building Materials" website (Reference 2) provides information to property owners or operators on managing PCBs found in building materials to help minimize potential exposures to building occupants.

If there is reason to suspect liquid PCB use within building equipment, the equipment should be checked for leaks and the surrounding areas (e.g., concrete, steel surfaces) should be checked to determine if there is any evidence, such as visible staining, that the areas may have been impacted from the leaks. The use of building equipment containing liquid PCBs, such as fluorescent light ballasts and electrical equipment, and the cleanup and disposal of contamination from spills or releases of liquid PCBs, are regulated under the PCB regulations at 40 CFR part 761 but are not addressed in this document. The reader should consult the appropriate resources mentioned in the Preface.

II. Determine Potential Presence of Manufactured PCB Products in the Building

There is no visual standard for determining if manufactured PCB products are present in a building or structure, and a visual assessment alone is insufficient to determine the presence of PCBs. To determine if such products are present, sampling and laboratory analysis for PCBs are necessary. A property owner or operator may wish to consider the following steps in deciding whether to conduct testing, determine what types of materials to test, and develop a testing program.

Review Building Records

EPA recommends that the process of evaluating a building for the potential presence of manufactured PCB products begin with a review of historical records related to the construction, renovation, and maintenance of the building (e.g., caulk replacement, window replacement, stripping and repainting of surfaces). The property owner or operator may have documentation indicating that a specific material type within the building is not a manufactured PCB product or that the entire building itself does not contain manufactured PCB products. As noted above, EPA

believes that there was widespread use of manufactured PCB products during building construction and renovation activities occurring between 1950 and 1979. PCB production was banned in 1979 by TSCA (with some products and processes excluded from the ban by regulation), so available information showing that a building was constructed in the 1990s, for example, is a good indication that it likely would not contain manufactured PCB products.

Use of historical records related to building construction, renovation, or maintenance may include information about the types of materials used and may help identify building materials or areas of the building that do or do not contain manufactured PCB products. For example, records may indicate that all of the older electrical cables in a building have been replaced with modern PCB-free electrical cables. Alternatively, if records indicate that only a portion of the older electrical cables have been replaced, then the property owner or operator could exclude the newer wiring from the inventory of materials that may contain PCBs, described below. Even if records indicate that a potential manufactured PCB product, such as caulk, was previously replaced, residual PCBs from the original material could be present in surrounding substrates (e.g., concrete, brick), which could then contaminate the replacement material. In such a case, the property owner or operator may consider including the replacement material in the inventory of materials that may contain PCBs.

Compile an Inventory

In cases where the property owner or operator does not have any historical building records, or such records do not clearly indicate whether or not a specific material type is a manufactured PCB product, EPA recommends developing an inventory of each material type that the property owner or operator believes may contain PCBs.

EPA recommends performing an inspection of the building to look for suspected manufactured PCB products. The number of discrete items or square or linear feet of each material type present (e.g., the number of gaskets or the amount of caulk) and the location of each material type inside or exterior to the building should be determined by the inspection and noted on the inventory.

When compiling an inventory of suspected manufactured PCB product material types, consideration should be given to variances within a material type. For example, a building may contain various colors of paint or caulk within different areas (e.g., north, south, east, and west), different rooms, or on different floors, each with the potential to contain PCBs. Variation of other attributes, such as the condition of the materials (e.g., plasticity, degradation, brittleness, friability) should be considered. Note that PCBs in products such as paint and caulk can be heterogeneously distributed. A single building painted in the same color on all four exterior walls may show significant variation in PCB concentrations from wall to wall or even within the same wall (Reference 3). Therefore, varying PCB concentrations may be found within the same color of paint on the same wall.

Additionally, coatings applied to a surface over a specific area such as a wall (e.g., paint) or linearly to seal cracks (e.g., caulk), are examples of building materials that can be difficult to divide into individual, discrete items. Paint coverage may vary depending on the surface and application; however, one gallon of paint, as a rule of thumb, covers approximately 400 square feet. A property owner or operator may use other square footage values if supporting information is available. Using 400 square feet as an example, a property owner or operator may choose to treat every 400 square feet of similarly colored painted surface as one item when developing the number of painted items in the inventory. This does not mean a sample is recommended for every 400 square feet; however, it does mean that one may estimate the number of individual items available for sampling as the entire square footage

of painted surfaces divided by 400. For sampling of linear items such as caulk, EPA recommends using every 10 linear feet of similar color caulk as one item when determining the total number of caulk items in the inventory.

III. Building Fate

Once historical records are reviewed, visual inspection(s) performed, and an inventory developed, EPA recommends that the property owner or operator develop a building material characterization sampling plan that reflects the current and/or future use plan for the building. There are generally two paths that a property owner or operator may face: demolition and disposal, or renovation and continued use.

Demolition and Disposal

If the property owner or operator is planning to demolish the building and dispose of the resulting waste and does not have records clearly indicating that the building is unlikely to contain manufactured PCB products at regulated levels (i.e., ≥ 50 ppm), then sampling is recommended to determine whether protective measures, such as worker protection, are needed during demolition, to facilitate recycling of materials that do not contain or are not contaminated with PCBs (provided other contaminants, such as asbestos and lead-based paint, are not present), and to ensure PCB wastes are properly disposed of and controls are put in place to prevent a release of PCBs to the environment (References 4, 5, and 6). Alternatively, instead of sampling, the property owner or operator could choose to assume inventoried suspected manufactured PCB products contain ≥ 50 ppm PCBs and are regulated for disposal as PCB bulk product waste under § 761.62. Property owners or operators are responsible for complying with TSCA and the PCB regulations, including by properly managing and disposing of regulated PCBs, and for complying with any other applicable federal, state, and local requirements.

If the property owner or operator conducts sampling, they should test all inventoried suspected manufactured PCB product material types present in the building (see Section IV - Building Material Characterization Sampling Plan). If the material contains ≥ 50 ppm PCBs, it is regulated for disposal as a PCB bulk product waste (see §§ 761.3 and 761.62). The property owner or operator should also consider whether the material to which the manufactured PCB product containing ≥ 50 ppm PCBs is attached (i.e., substrate), such as wood, masonry, or brick, is regulated for cleanup and disposal, as PCBs may have leached into or onto those substrates from the manufactured PCB product.

If the property owner or operator intends to remove and dispose of the manufactured PCB products assumed or tested to contain ≥ 50 ppm PCBs together with any contaminated building substrates, they may designate and dispose of all the substrate materials coated or serviced with manufactured PCB products as a PCB bulk product waste without further testing of the substrate even if the manufactured PCB product becomes separated from the contaminated building substrates during demolition. The property owner or operator should document the decision to designate building materials as PCB bulk product waste at the time of designation for disposal (e.g., within the building demolition plan). For more information, see Reference 7.

If, however, the manufactured PCB products containing ≥ 50 ppm PCBs are no longer present or are no longer attached to the adjacent substrate at the time of designation for disposal (e.g., PCB-containing caulk or paint has already been removed from the substrate prior to the start of demolition), or if the property owner or operator intends to recycle the substrate, the substrate should be tested to determine if PCBs have leached into or onto the substrate. The extent of migration into the depths of the substrate and laterally away from the previously attached manufactured PCB product should be determined by sampling for the purposes of disposal or recycling. If PCBs are

present in the substrate, such that it meets the definition of a PCB remediation waste at § 761.3, it is subject to the cleanup and disposal requirements at § 761.61.

Additional Considerations - Dust and Stormwater Control

It is important to consider dust monitoring and control during demolition projects where manufactured PCB products are present to protect third parties and the environment. Regulatory requirements for the control of dust generated during demolition operations can arise from local or county ordinances or codes, state regulations, some federal regulations, and construction general permits issued by the EPA or states, see Reference 6. Additionally, EPA's 2022 Construction General Permit (CGP) contains PCB-specific requirements for certain building demolition activities. The CGP is a National Pollutant Discharge Elimination System (NPDES) permit issued under the authority of the Clean Water Act and associated regulations that regulates stormwater discharges from construction activities in those areas where EPA is the NPDES permitting authority. Such requirements include implementation of controls to minimize the exposure of PCB-containing building materials to precipitation and storm water (CGP Section 3.2). The CGP Fact Sheet (Reference 8) details a variety of controls that can be implemented to minimize the potential discharge of PCBs from demolition activities including constructing a containment area, covering the ground, and using tools that minimize heat and dust generation (pages 86-88 of the CGP Fact Sheet). Because these requirements are site specific, it is important to work closely with local and state environmental regulators as well as with any office that issues a demolition permit (if the project is located in an area where such permits are required), to determine the applicable requirements for the control of dust. For additional information, see Reference 6.

Renovation or Continued Use

If the property owner or operator is planning to renovate or continue to use the building and does not have records clearly indicating that the building is unlikely to contain manufactured PCB products at regulated levels (i.e., ≥ 50 ppm), then sampling is recommended to determine whether protective measures are needed during renovation activities, and to ensure PCB wastes are properly disposed of and controls are put in place to prevent a release of PCBs to the environment (References 4 and 5). Alternatively, instead of sampling, the property owner or operator could choose to assume inventoried suspected manufactured PCB products contain ≥ 50 ppm PCBs and are regulated for disposal as PCB bulk product waste under § 761.62. In this case, all manufactured PCB products assumed to contain ≥ 50 ppm PCBs must be removed from the building and disposed of in accordance with § 761.62. Property owners or operators are responsible for complying with TSCA and the PCB regulations, including by properly managing and disposing of regulated PCBs, and for complying with any other applicable federal, state, and local requirements.

If the property owner or operator conducts sampling, they should test all inventoried suspected manufactured PCB product material types present in the building (see Section IV – Building Material Characterization Sampling Plan). Material that contains ≥ 50 ppm is unauthorized for use and must be removed and disposed of as PCB bulk product waste under § 761.62. Depending upon the extent of such building materials identified, the property owner or operator may need to prioritize removal of manufactured PCB product building materials based on building occupancy, PCB concentration levels within the materials, location of the materials, and accessibility to building occupants and exposure risk. When removing manufactured PCB products in a phased approach, it may be necessary to install temporary controls to prevent releases from phases not yet addressed. For more information, see References 4 and 5.

If manufactured PCB products are assumed or tested to contain ≥ 50 ppm PCBs, the property owner or operator should determine if PCBs migrated from these materials to the surrounding porous and/or non-porous substrates and may require mitigation during renovation or for continued use of the building. The property owner or operator should test the substrate to determine if PCBs have leached into or onto the substrate to determine the extent of migration into the depths of the substrate and laterally away from the manufactured PCB product. If PCBs are present in the substrate, such that it meets the definition of a PCB remediation waste as defined at § 761.3, the substrate is regulated for cleanup and disposal in accordance with § 761.61, or alternatively, may be removed with the PCB-containing building material and disposed of as a PCB bulk product waste in accordance with § 761.62 (see Reference 7).

If removal of manufactured PCB products assumed or tested to contain ≥ 50 ppm PCBs and contaminated substrates is not feasible when the materials are identified in a building, the property owner or operator should work with the EPA Regional PCB Coordinator (see Section VII - Regional PCB Coordinators) to develop a plan to protect building occupants and manage such materials, along with any surrounding PCB-contaminated substrates, until they can be removed and disposed of in accordance with the PCB regulations.

Additional Considerations - HVAC

To help minimize potential exposures to PCB during building renovation, the HVAC system should be shut down and remain off until PCB abatement is complete. Abatement areas should be isolated from the HVAC system. Consider restoring the cleanliness of the building HVAC system using the latest Air Conditioning Contractors of America/American National Standards Institute (ACCA/ANSI) standards to remove buildup of particulate and debris which may adversely impact the indoor environment and performance of the system. Consider hiring contractors who specialize in cleaning ventilation systems, as they have specialized tools and training to ensure thorough cleanup. It is important to remember that not all ventilation system ducts can be cleaned. For example, some ducts are lined with fiberglass or other insulation, which can release fiberglass into building areas if damaged during cleaning. Also, flexible ductwork frequently has a porous inner surface and, in most cases, cannot be economically cleaned. For this reason, such ductwork should be discarded and replaced after the ventilation system is cleaned. For additional information, see Reference 5.

Additional Considerations - Dust and Stormwater Controls

When working on a renovation or repair job where manufactured PCB products are present, appropriate controls should be put in place to minimize spreading dust during the renovation and/or repair activity. The work area should be protected by constructing a containment area whenever potentially hazardous material is disturbed and could generate dust. For additional information related to dust control during renovation activities, see Reference 4.

EPA's 2022 Construction General Permit (CGP) contains PCB-specific requirements for certain construction activities. For example, if exterior building renovation is planned, the CGP may require implementation of controls to minimize the exposure of PCB-containing building materials to precipitation and storm water (CGP Section 3.2). The CGP Fact Sheet details a variety of controls that can be implemented to minimize the potential discharge of PCBs from demolition activities that may be useful controls. For example, constructing a containment area, covering the ground, using tools that minimize heat and dust, and many more BMPs are listed in pages 86-88 of the Fact Sheet.

Additional Considerations - Pre- and Post-Abatement Sampling

The property owner or operator should determine if indoor air and/or wipe testing prior to and/or after abatement is warranted. This may be necessary to address concerns about building occupant exposure via the inhalation pathway based on building construction details and features, cleaning practices, or the location of the identified manufactured PCB products. Additionally, such sampling can help determine if the controls put in place to prevent releases of PCBs during renovation were effective. Samples collected prior to abatement provide a site-specific baseline for comparison, which can be particularly useful at sites where manufactured PCB products are being removed in phases.

Wipe sampling can identify PCBs in settled dust, and air testing can determine if PCBs are present in indoor air. Each building is unique, which means that many factors should be considered when deciding whether and how to collect indoor dust and air samples. These factors include site-specific conditions, steps already implemented to address PCB sources, available technical resources, and public or building user concerns.

If the building is a school, the air test results may be compared to the Exposure Levels for Evaluating PCBs in Indoor School Air found at Reference 9. The Exposure Levels for Evaluating PCBs in Indoor School Air should not be used to estimate occupational exposure associated with non-school buildings or other sites or residential exposure. Property owners or operators may consider developing building-specific risk-based criteria for use at non-school buildings or other sites, or at schools where operational times are not typical (e.g., adults and children are in school more than 6.5 to 8 hours per day and/or 180-185 days per year).

For more information on safe PCB abatement and renovation activities, see References 4 and 5.

IV. Building Material Characterization Sampling Plan

Property owners or operators should develop a building material characterization sampling plan (sampling plan) to characterize inventoried suspected manufactured PCB product and/or substrates contaminated through contact with manufactured PCB product. Sampling plans should be robust enough to ensure that sufficient samples are collected of each suspected manufactured PCB product material type and the adjacent substrate to determine if PCBs are present. Applicable PCB regulations for managing and disposing of these materials may vary depending upon the PCB concentrations found.

In 2013, EPA issued a *Technical Guidance for Determining the Presence of Polychlorinated Biphenyls (PCBs) at Regulated Concentrations on Vessels (Ships) to be Reflagged* ("Ship Guidance") (Reference 10). The Ship Guidance describes the development of a statistically-based sampling plan using an inventory of potential manufactured PCB product material categories found on a ship. EPA recommends that a property owner or operator consider using the statistical approach to developing a sampling plan outlined in the Ship Guidance to determine the number and distribution of samples to collect from each inventoried suspected manufactured PCB product material type in a building. The statistical approach described below, based on the Ship Guidance, is provided as a resource to assist a property owner or operator with the development of a sampling plan for both discrete items such as gaskets and non-discrete items such as paint or caulk. Property owners or operators may consider using other sampling approaches to determine the presence of manufactured PCB products; EPA recommends statistically-based or

otherwise robust approaches. Reference 11 provides additional information on selecting sampling designs for new data collections.

The statistical framework used in the Ship Guidance is that of "acceptance sampling." In an "acceptance sampling" approach, items are considered in batches or lots. For the purposes of sampling suspected manufactured PCB product in a building, each category of suspected manufactured PCB product listed in the building inventory would be considered a separate lot. Examples of suspected manufactured PCB product categories include, but are not limited to, the items listed in the table provided in Section I of this document. The lot size is the sampling frame for a manufactured PCB product category, and it includes every item in that manufactured PCB product category that might contain PCBs; for example, the number of individual rubber gaskets found in the building would be the lot size for the rubber gasket category. A subset of the items in that manufactured PCB product category would be sampled and tested. The number of items to be sampled is the sample size. The sampling plan would consist of individual plans for each manufactured PCB product category listed in the building inventory that cannot be omitted from testing based on the building's records or some other information. Each manufactured PCB product category will have its own sample size in the sampling plan based on the manufactured PCB product category (lot) size, the level of statistical risk selected in the acceptance sampling approach, and the total number of manufactured PCB product categories to be tested. In the language of acceptance sampling, the sample size for each manufactured PCB product category is developed by selecting the probability for rejecting the manufactured PCB product category. This is done by selecting a ≥ 90%, ≥ 95%, or ≥ 99% probability of testing at least one item in the manufactured PCB product category that fails the test (i.e., contains PCBs above the desired threshold specification (e.g., 50 ppm, 1 ppm, or other concentration) if the true underlying proportion of PCB contaminated items is ≥ 10%, ≥ 5%, or ≥1%. The threshold specification is independent of the statistical assurance level used for the testing (i.e., the specification will not change the number of samples recommended for the material category to achieve the selected confidence levels). The Ship Guidance provides tables which have been adapted for use in this document to determine the number of samples to collect from each manufactured PCB product category depending on the selected probabilities and the total number of manufactured PCB product categories in the inventory to be tested. The building owner can select the degree of confidence that they desire to achieve. That level of confidence will correlate with the number of samples needed to reach that level of confidence. EPA recommends a property owner or operator consider the use of the building when selecting the degree of confidence. For example, if a building will be undergoing renovation for reuse as a residential space, a higher degree of confidence (e.g., 99%/1%) may be considered. For additional background on this acceptance sampling approach, see Appendix II of the Ship Guidance.

The property owner should distribute the number of samples required for the manufactured PCB product category across the number of locations where the material is present in the building (e.g., number of rooms). The property owner or operator can determine if the manufactured PCB product category is present such that samples may be evenly distributed across that manufactured PCB product category or, for non-discrete items such as painted surfaces, proportionally to the painted surface area present in different areas within the building for that manufactured PCB product category. There may be areas where the manufactured PCB product is inaccessible and cannot be sampled; these items are different from omitted items which are not sampled because they are shown through documentation to not contain PCBs. When selecting the sampling locations, if a selected location is known to be inaccessible for sampling, then the building owner or operator may randomly select another sample location. The number of inaccessible areas or items will not impact the number of samples recommended in the sampling frame.

The Ship Guidance describes how a sampling plan is developed using worksheets that walk a user through determining how many samples are needed for each suspect manufactured PCB product category identified on a ship. EPA has revised these worksheets for use in developing a building sampling plan. The revised worksheets are in Appendix A of this guidance, and an example of these worksheets used on a hypothetical building inventory is in Appendix B. Excel spreadsheets that mirror these worksheets are available at EPA's PCBs in Building Materials website. The spreadsheets are provided as a tool to assist in calculating the number of samples needed for a suspected manufactured PCB product category in a building.

EPA recommends that all sampling activities be conducted according to the requirements of a project-specific quality assurance/quality control (QA/QC) project plan. This plan should ensure that data of appropriate quality and quantity are available for their intended decision-making purposes. For additional information on developing Quality Assurance (QA) Project Plans, see Reference 15.

Composite Sampling

EPA recognizes that this statistical framework may result in the need to collect a relatively large number of samples to maintain a certain level of confidence in the result. In those cases, compositing of samples could be reasonably applied for certain material categories to limit the sampling costs incurred without compromising the degree of confidence resulting from the sampling.

Only material categories where multiple similar samples can be mixed and thoroughly homogenized should be used for composite sampling. Paint and caulk are the two material categories that EPA envisions being used in composite sampling. Different material categories (e.g., paints and caulks) or dissimilar materials within the same category (e.g., caulks of different colors) should not be composited together into one sample. However, EPA recognizes that there may be instances where it is difficult to separate colors when collecting a composite sample (e.g., multiple layers of different color paint on a surface). In such cases, sampling results should note that the samples represent multiple layers of paint.

In addition to the ability of samples from the material category to be mixed and homogenized, there are three other considerations for composite sampling:

- EPA recommends that no more than 9 samples (of the same material) be combined into one composite sample.
- The QA/QC project plan associated with composite samples should specify the practical quantification limit (PQL) to be achieved for the resulting data from a composite sample to be acceptable for use.
- When evaluating the results, EPA recommends that the result for each individual sample added to the composite be assumed to be the concentration of the composite sample multiplied by the number of individual samples. For example, if 9 individual samples were combined into one composite sample, and the analytical result of the composite sample is 12 ppm, then all 9 individual samples should be assumed to be 108 ppm (9 samples x 12ppm). This is a conservative approach, which does not reflect the true statistical probability of even one of the samples reaching the upper bound (108 ppm in the case of the example above). However, this conservative approach fits the purpose of this guidance, which is to determine the presence of manufactured PCB products in a building.

Composite sampling is discussed further in Section V.

Outdoor PCB Contamination & Potential Migration Considerations

Property owners or operators should be aware of the potential for ground surfaces surrounding buildings to become contaminated with PCBs originating from manufactured PCB products, particularly from exterior paints, caulks, and other sealants. In general, although not in all cases, PCB concentrations are highest in ground surfaces closest to the building. Stormwater and surface water runoff may transport PCBs to storm sewers or nearby surface water features (Reference 6). Property owners or operators should consider sampling nearby ground surfaces (e.g., soil, asphalt, concrete), runoff pathways, and sediment in storm sewers to determine if exterior manufactured PCB products have impacted those areas. 40 CFR part 761, subpart N provides a method which may be used for sampling such areas or for assessing the sufficiency of existing sampling data.

V. Sample Collection Procedures

For the various sample types listed below, sufficient sample volume should be collected to ensure the laboratory can measure the concentrations of PCBs at levels required by the PCB cleanup and disposal regulations at 40 CFR part 761, with additional volume available for laboratory QA/QC requirements. EPA recommends that the property owner or operator contact the laboratory to discuss the necessary requirements for each sample type.

Bulk solid samples

Bulk solid samples include such materials as caulks and paints or soils which are adjacent to a building where exterior manufactured PCB products were present. Bulk solid sampling typically includes removing a small portion of the potentially contaminated material for analytical testing. For example, a caulk sample would be the quantity of caulk needed by the laboratory for analytical testing. Only the caulk should be included in the final sample and not other adjacent substrate materials, such as wood or concrete, which may skew the sample analysis results. Section V.C. of the Ship Guidance (Reference 10) contains sample collection procedures for various categories of non-liquid suspected manufactured PCB products such as paint and caulk.

To composite individual samples of paint and caulk, identify which individual samples will be grouped into one composite sample. Compositing should be done by the laboratory rather than in the field. Additional information on composite sampling is provided in Section IV above. Sample preparation is discussed further in Section VI.

A property owner or operator may wish to save extra material from each of the individual samples that were combined into the original composite sample should testing of the individual samples be desired. For example, if a composite sample result exceeds the desired threshold criteria (e.g., 50 ppm), the individual samples that comprised the composite sample could be tested to determine which individual samples exceed the threshold criteria.

When soil samples are collected, consider whether the PCBs are on the soil surface or if they could be located deeper in the soil. An example of when PCBs might be on the soil surface would be if fragments of weathered caulking from the exterior of the building were deposited on undisturbed soil surfaces. Alternatively, PCBs could be located deeper in the soil, in locations such as landscaping areas where the soil surface has been disturbed or where new soil has been added. PCBs may also be located at deeper depths in poor drainage areas where surface water, soils, and sediments collect.

Non-porous surface samples

If the surface being sampled is smooth and impervious, such as a metal substrate that was adjacent to a caulk seam, a wipe sample can be collected to determine if the surface is contaminated with PCBs. A standard wipe test, as specified in § 761.123, uses a 10 centimeter (cm) by 10 cm template (or equivalent template that equals 100 cm^2) to outline the sample area and a gauze pad or glass wool that has been saturated with hexane to collect the sample. The hexane-saturated wipe is used to thoroughly swab the area inside the 100 cm^2 template. Care must be taken to assure proper use of the sampling template, as the sample results will be based on the 100 cm^2 sample area (i.e., micrograms (µg) per 100 cm^2). 40 CFR part 761, subpart P provides sample site selection procedures which may be used for large, nearly flat surfaces and for small or irregularly shaped surfaces.

Porous surface samples

Because PCBs can migrate into substrate materials that are porous surfaces (e.g., brick, masonry, concrete, or wood), surface wipe sampling is not adequate to characterize the PCB concentration of porous surfaces. Instead, core samples of the top 0.5 to 2 cm of the porous surface should be collected on a bulk basis (i.e., ppm). For these porous surface samples, an adequate sample (as determined by the laboratory) should be removed for analysis. Tools such as chisels, drills, and saws can be used to collect the sample, taking care to minimize dust generation (References 4, 5, 13).

The samples should be collected from the top 0.5 cm to 2 cm of the surface closest to the likely source of PCB contamination. For porous surfaces where the likely source of PCB contamination has been removed, such as masonry with open joints where caulk was located adjacent to bricks, sampling should be focused on the brick surfaces to which caulk was previously attached. Alternatively, consider removing the bricks which were located adjacent to the manufactured PCB product materials and disposing of them as PCB remediation waste.

A Standard Operating Procedure (SOP) suitable for collection of a porous matrix sample for PCB analysis is available at the link found at Reference 12.

For additional information on how to test for PCBs and characterize suspect materials, see Reference 13.

Indoor air samples

Samples should be collected, extracted, and analyzed by EPA Method TO-4A or TO-10A (Reference 14). Sufficient sample volumes, as referenced in the EPA Methods, should be collected to provide a minimum laboratory reporting limit for Total PCBs that is below the risk-based indoor air level appropriate to the use and exposure scenarios for the building. While these are accepted analytical methods to measure PCBs in indoor air samples, there is no broadly accepted sample design protocol for collecting PCB samples in indoor air. Accordingly, EPA is unable to provide a generic recommendation on indoor air sample design due to the many different building-specific situations encountered in designing a sampling plan. Development of an air sampling plan should endeavor to be as representative as circumstances allow and factor in site-specific conditions, which EPA believes property owners or operators are best positioned to identify in consultation with their EPA Regional PCB Coordinator.

VI. Analytical Methods for Building Materials

In this section, EPA provides an overview of the EPA methods for PCB analysis suitable for determining the presence of PCBs in various building materials. Some of the information will be more relevant to owners/operators and other

information to their contractors and labs performing the sample collection, preparation, and analysis. This section is not meant to be comprehensive, and EPA references the appropriate source or method in each relevant section.

For analysis of samples, only laboratories that follow approved EPA analytical methodology and that have QA/QC management programs should be used. Some states maintain publicly available databases of laboratories accredited for specific analytical methods. For more information, see Reference 15.

The EPA SW-846 publication, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, specifies the maximum allowed time from the point of collection to extraction and analysis of organic samples. After a sample collection, the laboratory will extract the PCBs from the collected sample. After a sample has been collected, there are no sample holding time limits prior to extraction for any of the PCB sample matrices listed in SW-846 (Reference 16, Table 4-1).

EPA recommends the use of Methods TO-4A or TO-10A for air samples (Reference 14).

All samples should be analyzed by EPA SW-846 Method 8082A (Reference 17) for Aroclors 1016, 1221, 1232, 1242, 1248, 1254, 1260, 1262, 1268 and reported as Total PCBs (PCB_{tot}). Please see Method 8082A in SW-846 for a complete discussion on applying this analysis to PCB congeners.

Clean Water Act Method 1668C may be used with approval from EPA to quantify the 209 PCB congeners should it be preferred based on the formulation of PCBs present in the material being analyzed per § 761.1(b)(2). This method is not one of the determinative methods in the PCB regulations, but it may be appropriate in certain situations. This method has very low detection limits and is more likely to experience laboratory background contamination which could lead to data interpretation problems. The validation study for Method 1668C also does not include soil or sediment matrices and does not identify how to report total PCBs. For use on matrices other than water, biosolids, and tissue, the method requires verification of precision and recovery by running tests on a reference matrix. The reference matrix must simulate, as closely as possible, the sample matrix under test (see also 40 CFR Part 761, Subpart Q). For more information, see Reference 18.

In general, EPA SW-846 Method 8082A recommends that both extracts from solid samples and aqueous samples for PCB analysis be analyzed within 40 days of extraction; however, PCBs are very stable in a variety of matrices and Method 8082A notes that this timeframe is a recommendation. EPA recommends that property owners or operators and their environmental consultants discuss this with the laboratory to meet the lab's requirements on the timeline from sample collection to extraction and analysis.

Sample Preparation

For samples of materials such as paint and caulk, laboratories often require advanced notification of the sample submission for laboratory preparation. The laboratory should adequately homogenize solid samples for analysis by chopping, grinding, or cutting the sample into small pieces to increase the surface area available for extraction. If compositing samples, the laboratory should ensure that the composite sample is equally representative of all the individual samples being composited (i.e., equal parts by mass of each individual sample are used to make up the composite sample).

Paint and caulk textures can vary from dry and flaky samples to samples that remain pliable and are not easily homogenized for analysis. Use the most effective technique possible for sample homogenization to achieve the desired particle size.

Flexible Caulks and Paints

Approaches for homogenization of flexible paints or flexible caulks, to help make the sample amenable to grinding, include:

- cutting or shredding
- adding anhydrous sodium sulfate to the sample
- cold temperature techniques such as freeze drying, dry ice-assisted grinding, liquid nitrogen shatter box mills, or cryomilling.

Such homogenization techniques can be used in lieu of or in addition to the use of a mortar and pestle or other grinding technique (Reference 19 - Section 7.1.4; Reference 20 - Section 8.1.2.4).

Dry Caulks and Paints

Dry, brittle caulk and dry paint can be treated similarly for sample homogenization. Grinding by using a mortar and pestle is a commonly used technique (Reference 20 - Section 8.1.2.4).

Sample Extraction

EPA has no specified holding time limit for solid samples to be extracted for PCB analysis. However, EPA recommends that the property owner or operator consult with the laboratory to meet the laboratory's requirements for the timeline from sample collection to extraction.

EPA recommends the use of EPA SW-846 Method 3540C - Soxhlet Extraction (Reference 19), Method 3541 – Automated Soxhlet Extraction (Reference 23), Method 3545A – Pressurized Fluid Extraction (Reference 24), and Method 3546 Microwave Extraction (Reference 25), for the chemical extraction of PCBs from solid samples. [1] The PCB regulations also allow for Method 3550C (Reference 21) for wipe samples only. In addition, other extraction methods may be used, if they are validated under Subpart Q of 40 CFR part 761.

Note that Method 3540C requires the use of methylene chloride or 10:1 toluene/methanol as the extraction solvent for all materials other than soils/sediments or aqueous sludge samples. The property owner or operator should also be aware that Method 3540C for solid samples can be problematic for many laboratories, either because this extraction method is not done regularly, or because the material does not work well in the extraction. As a result, laboratories often have to implement corrective actions or method modifications to improve efficacy. Therefore, before testing, EPA recommends that the property owner or operator discuss these issues with the intended laboratory to ensure it can perform this PCB extraction on solid samples to meet QA/QC objectives and requirements. Methods TO-4A and TO-10A provide extraction methods for air samples (Reference 14). All air samples should be extracted within one week after collection and stored at < 4°C until extracted.

[1] On 29 August 2023, EPA finalized regulatory changes that include expanding the available options for extraction and determinative methods used to characterize PCB wastes (88 FR 59662, https://www.federalregister.gov/documents/2023/08/29/2023-17708/alternate-pcb-extraction-methods-and-amendments-to-pcb-cleanup-and-disposal-regulations).

Extract Cleanup

Many of the solid material categories contain contaminants that can cause interference during the analysis. PCB extracts often need to undergo a cleanup method to remove these contaminants. This is dependent on the analytical method chosen to detect and quantify PCBs. For some analytical methods, the extraction method alone may be sufficient and additional cleanup steps may not be required. Other analytical methods may require additional cleanup steps. EPA SW-846 Method 3600C provides general guidance on the selection of cleanup methods that are appropriate for PCBs (Reference 22). These include Method 3630C (Silica Gel Cleanup), Method 3620C (Florisil Cleanup for the separation of analytes from interfering compounds through chromatographic techniques), and Method 3665A (Sulfuric Acid/Permanganate Cleanup for extract solvent exchange and acidic treatment). Methods TO-4A and TO-10A include sample cleanup steps for PCBs in ambient air (Reference 14).

VII. Handling, Storing, and Disposing of Wastes

Manufactured PCB products and PCB impacted substrates generated during demolition or renovation activities may be disposed of as PCB bulk product wastes or PCB remediation wastes, depending on the type of waste. Additional information on how to dispose of these materials can be found under Abatement Step 3 at Reference 5.

VIII. Regional PCB Coordinators

Please consult with your EPA Regional PCB Coordinator should you have additional questions. A list of Regional PCB Coordinators for your location may be found here: EPA PCB Program Contacts.

IX. References

1. **EPA Fact Sheet: PCBs in Building Materials – Determining the Presence of Manufactured PCB Products in Building Materials or Other Structures.** https://www.epa.gov/pcbs/pcbs-building-materials-determining-presence-manufactured-pcb-products-buildings-or-other
2. **EPA PCB in Building Materials Main Website:** https://www.epa.gov/pcbs/polychlorinated-biphenyls-pcbs-building-materials
3. **NVL Labs (2013), Rainier Commons Work Plan,** https://www.epa.gov/sites/default/files/2017-12/documents/pcb-rainier-commons-work-plan-rev072013.pdf
4. **Steps to Safe Renovation and Repair Activities:** https://www.epa.gov/pcbs/steps-safe-renovation-and-repair-activities
5. **Steps to Safe PCB Abatement Activities:** https://www.epa.gov/pcbs/steps-safe-pcb-abatement-activities
6. **Managing Stormwater and Dust at Demolition Sites:** https://www.epa.gov/large-scale-residential-demolition/managing-stormwater-and-dust-demolition-sites
7. **Polychlorinated Biphenyl (PCB) Guidance Reinterpretation:** https://www.epa.gov/pcbs/polychlorinated-biphenyl-pcb-guidance-reinterpretation
8. **2022 Construction General Permit (CGP) – Fact Sheet** https://www.epa.gov/system/files/documents/2022-01/2022-cgp-final-fact-sheet.pdf
9. **Exposure Levels for Evaluating PCBs in Indoor School Air:** https://www.epa.gov/pcbs/exposure-levels-evaluating-polychlorinated-biphenyls-pcbs-indoor-school-air
10. **Technical Guidance for Determining the Presence of Polychlorinated Biphenyls (PCBs) at Regulated Concentrations on Vessels (Ships) to be Reflagged:** https://www.epa.gov/pcbs/polychlorinated-biphenyls-pcbs-ships#TechGuidance
11. **Resources for Planning New Data Collections:** https://www.epa.gov/quality/resources-planning-new-data-collections#sam
12. **Standard Operating Procedure for Sampling Porous Surfaces for Polychlorinated Biphenyls (PCBs):** https://www.epa.gov/pcbs/standard-operating-procedure-sampling-porous-surfaces-polychlorinated-biphenyls-pcbs
13. **How to Test for PCB and Characterize Suspect Materials:** https://www.epa.gov/pcbs/how-test-pcbs-and-characterize-suspect-materials
14. **Test Methods for PCBs in Buildings:** https://www.epa.gov/pcbs/polychlorinated-biphenyls-pcbs-building-materials#Test-Methods
15. **Guidance for Quality Assurance Project Plans, EPA QA/G-5:** https://www.epa.gov/quality/guidance-quality-assurance-project-plans-epa-qag-5
16. **Chapter Four of the SW-846 Compendium: Organic Analytes:** https://www.epa.gov/hw-sw846/chapter-four-sw-846-compendium-organic-analytes
17. **SW-846 Test Method 8082A: Polychlorinated Biphenyls (PCBs) by Gas Chromatography** https://www.epa.gov/hw-sw846/sw-846-test-method-8082a-polychlorinated-biphenyls-pcbs-gas-chromatography
18. **Method 1668C – Chlorinated Biphenyl Congeners in Water, Soil, Sediment, Biosolids, and Tissue by HRGC/HRMS** https://www.epa.gov/sites/production/files/2015-09/documents/method_1668c_2010.pdf
19. **SW-846 Test Method 3540C: Soxhlet Extraction:** https://www.epa.gov/hw-sw846/sw-846-test-method-3540c-soxhlet-extraction

20. **Standard Practice for Preparation of Dried Paint Samples by Hotplate or Microwave Digestion for Subsequent Lead Analysis, ASTM E1645−21.** https://www.astm.org/e1645-21.html
21. **SW-846 Test Method 3550C: Ultrasonic Extraction:** https://www.epa.gov/hw-sw846/sw-846-test-method-3550c-ultrasonic-extraction
22. **SW-846 Test Method 3600C: Cleanup:** https://www.epa.gov/hw-sw846/sw-846-test-method-3600c-cleanup
23. **SW-846 Test Method 3541: Automated Soxhlet Extraction:** https://www.epa.gov/hw-sw846/sw-846-test-method-3541-automated-soxhlet-extraction
24. **SW-846 Test Method 3545A: Pressurized Fluid Extraction (PFE):** https://www.epa.gov/esam/method-3545a-sw-846-pressurized-fluid-extraction-pfe
25. **SW-846 Test Method 3546: Microwave Extraction:** https://www.epa.gov/hw-sw846/sw-846-test-method-3546-microwave-extraction

X. Appendix A – Example Blank Worksheets

Worksheet Instructions

General: Excel spreadsheets that mirror these worksheets are available at EPA's PCBs in Building Materials website. These spreadsheets do much of the calculation referenced in the instructions below, including sample size determination in lieu of using the tables from the Ship Guidance, found here. For any assistance in modifying the Excel tools for a scenario outside the categories or limits here, please contact the Office of Resource Conservation and Recovery PCB Team at ORCRPCBs@epa.gov.

Sampling Plan Cover Sheet – General information and conclusion proportion/probabilities

a. Complete the Building/Project Name, Owner, Date of Construction, Persons Developing the Sampling Plan, and Date the Sampling Plan was Completed.
b. Determine the Desired Conclusion, 'X', which is the threshold specification (e.g., 50 ppm, 1 ppm, or other). The threshold specification is independent of the statistical assurance level used for the testing (i.e., the specification will not change the number of samples recommended for the material category to achieve the selected confidence levels).
c. Decide on the Conclusion Probability, 'Y', which is the probability that the sampling plan will detect PCBs in concentrations ≥ 'X' (e.g., 90%, 95%, or 99%).
d. Decide on the Conclusion Proportion, 'Z', which is the underlying proportion of items that could contain PCBs in concentrations ≥ 'X' ppm. Used in conjunction with Conclusion Probability to determine the number of samples needed to meet the following desired conclusion: "The probability that this sampling plan would detect PCBs in concentrations ≥ 'X' is at least 'Y' if the true underlying proportion of materials containing them were greater than or equal to 'Z' (e.g., 10%, 5%, or 1%).

1. Sampling Plan Worksheet 1 – Identify Categories Omitted from Testing:
    a. This worksheet is intended to help you quickly eliminate categories from needing sampling where there is available data or information about the PCB content of every item in that category. Categories where some items may have PCBs and others may not are evaluated on Worksheet 2.
    b. List all of the inventoried suspect manufactured PCB product categories present in the building and check off the types that are determined to be omitted from sampling based on the reasons listed in Columns A-D (e.g., records show some materials in the building recently tested negative for PCBs). In the tables, manufactured PCB product is referred to as MPP. The categories in the example tables below are examples of common building materials and may not reflect the categories for a particular sampling site.
    c. Count the number of categories (rows) that do not have a checkmark. That is the number of suspect manufactured PCB product categories to test (NCT). The spreadsheet that accompanies this guidance will calculate the NCT for you, but this value should be verified for accuracy.

2. Sampling Plan Worksheet 2 – Items That May Contain PCBs:

a. This worksheet is intended to refine the suspect manufactured PCB product categories to eliminate discrete items that are documented not to have PCBs from the need to sample (e.g., PCBs not detected in existing analytical samples).
b. In Column E, list the total number of items in each suspect manufactured PCB product category. For non-discrete material types inventoried in linear or square feet, convert to a discrete number of items based on the supporting information for coverage of material (e.g., 1 gallon of paint covers 400 ft^2; a property owner may choose to treat every 400 square feet of similarly colored painted surface as one item of paint when developing the discrete number of painted items in the inventory).
c. If any of the items in Column E can be omitted from sampling (e.g., using existing analytical samples), write that number in Column F.
d. If any items in Column E can be omitted due to documented year and place of manufacture or installation, write that number in Column G.
e. Subtract Columns F and G from E to determine the size of the population of items in each suspect manufactured PCB product category that may contain PCBs above the desired threshold concentration. The number in Column H is the size of the sampling frame (i.e., the lot size for a manufactured PCB product category which includes every item in that manufactured PCB product category that might contain PCBs) and the size of the population from which testing will occur. This column is calculated automatically by the accompanying spreadsheet.

3. Sampling Plan Worksheet 3 – Calculate Sample Sizes to Support Conclusion:
    a. Divide H by E and record the ratio in Column I. This is the proportion of items in the suspect manufactured PCB product material category for which there is no available data or information about the PCB content of the items.
    b. In Column J, use Tables II-1 to II-14 from the Ship Guidance to determine the number of samples based on the NCT from Sampling Plan Worksheet 1. The tables from the Ship Guidance include calculations for NCT up to 14, and the Excel spreadsheet will calculate the sample size for NCT up to 18. The sample sizes corresponding to a Y% conclusion probability and Z% conclusion proportion are entered in Column J. If the sample size noted in the table is “ALL,” then write “ALL” in Column J. If the sample size in the table exceeds the number in Column E, then write “ALL” in Column J and test all of the items. This indicates that for that suspect manufactured PCB product material category, all items should be tested (i.e., census testing). If the coversheet in the spreadsheet tool is completed with the conclusion probability and the conclusion proportion, spreadsheet column J will automatically update with the sample size based on the statistical distribution.
    c. Multiply the number in Column J by the number in Column I. If the result is a whole number, record it in Column K. If the result is not a whole number, round it up to the next whole number and record it in Column K. (This is the step that gives credit for results already obtained via available data or information for the suspect manufactured PCB product material category. The only items that remain to be tested are those for which there is no available data or information about the PCB content of the items in the suspect manufactured PCB product material category.)

4. Sampling Plan Worksheet 4 - Revise Sample Sizes Downward Due to Censuses:

a. In order to account correctly for sampling uncertainty in multiple suspect manufactured PCB product categories, the worksheets make a statistical correction for testing across multiple suspect manufactured PCB product categories and to provide the desired level of confidence. The NCT is reduced by the number of suspect manufactured PCB product categories where all items should be tested.
b. Column L identifies those suspect manufactured PCB product categories where all items will be tested. Enter a checkmark here if J is “ALL” or if K > H or if K is close enough to H that you wish to test all items in H to reduce the number of suspect manufactured PCB product categories for sampling (NCS). Column L in the spreadsheet will auto-populate with an “X” if K=H.
c. The NCS is the NCT minus the number of suspect manufactured PCB product Categories for Census Testing (NCC = number of checkmarks in Column L). Column M then uses the resulting NCS and Ship Sampling Table II- “NCS” to determine the final sample size for the suspect manufactured PCB product category. This column is automatically calculated in the spreadsheet based on a statistical distribution.

Sampling Plan Cover Sheet

Building/Project Name:
Owner:
Date of Construction:
Persons Developing the Sampling Plan:

Date the Sampling Plan Was Completed:

Desired Conclusion: *"The probability that this sampling plan would detect PCBs ≥ X ppm is at least(select a value for probability: e.g., 90%, 95%, or 99%) if the true underlying proportion of materialscontaining them were greater than or equal to (select a proportion: e.g., 10%, 5%, or 1%)."*

Write the Conclusion Probability here (e.g., 90%, 95%, or 99%): Y

Write the Conclusion Proportion here (e.g., 10%, 5%, or 1%): Z

Sampling Plan Worksheet 1 – Identify Categories Omitted from Testing

	Omitted from PCB Testing			
	In each row, place a checkmark in columns A-D if appropriate.			
	There is noneof this material in the building.	Every item is documented to have PCB concentrations <X ppm.	Every item can be assumed to have PCB concentrations < X ppm due to documented year and place of manufacture or installation.	Every item can either be documented or assumed to have PCB concentrations <X ppm.
Suspect MPP[2] Category	A	B	C	D
Paint, varnishes, lacquers				
Non-conducting materials in electrical cables				
Rubber/felt gaskets				
Coal-tar enamel coatings and rust inhibitor coatings				
Insulation material including fiberglass, felt, foam, and cork				
Adhesives and tapes				
Caulking and grout				
Rubber isolation mounts, foundation mounts, and pipe hangers				
Plastic applications (vinyl and PVC)				
Galbestos siding				
Mastics				
Acoustic ceiling and floor tiles				
Structural joint material				
Asphalt roofing and tar paper				
Synthetic resins and floor varnish				
Sprayed on fireproofing				
Other materials				

Count the number of categories (rows) that do not have a checkmark. That is the Number of MPP Categories to Test (NCT). Copy it into the appropriate location on Worksheet 3._____(NCT)

[2] Manufactured PCB Product

Sampling Plan Worksheet 2 – Items That May Contain PCBs ≥ X ppm

	Not Omitted from PCB Testing			
	Cross Out Rows That Have A Checkmark on Worksheet #1			
	<u>Population:</u> Total number of items in this suspect MPP category in the building.	Number that aredocumented to have PCB concentrations <X ppm.	Number that can be assumed to have PCB concentrations < X ppm due to documented year and place of manufacture or installation.	<u>Sampling Frame:</u> Total number of items in this suspect MPP category that cannot be documented or assumed to have PCB concentrations <X ppm. (H = E - F - G)
Suspect MPP Category	E	F	G	H
Paint, varnishes, lacquers				
Non-conducting materials in electrical cables				
Rubber/felt gaskets				
Coal-tar enamel coatings and rust inhibitor coatings				
Insulation material including fiberglass, felt, foam, and cork				
Adhesives and tapes				
Caulking and grout				
Rubber isolation mounts, foundation mounts, and pipe hangers				
Plastic applications (vinyl and PVC)				
Galbestos siding				
Mastics				
Acoustic ceiling and floor tiles				
Structural joint material				
Asphalt roofing and tar paper				
Synthetic resins and floor varnish				
Sprayed on fireproofing				
Other materials				

Sampling Plan Worksheet 3 – Calculate Sample Sizes to Support Conclusion

	Sample Size for PCB Testing		
	Cross Out Rows That Have A Checkmark on Worksheet #1		
	Proportion of items in this suspect MPP category for which results are not currently known (I = H / E)	Sample SizeBased on NCT (Ship Guidance Table II-NCT starts on page 90)	Preliminary expected number of suspect MPP items that will need to be tested (K = J x I)
Suspect MPP Category	I	J	K
Paint, varnishes, lacquers			
Non-conducting materials in electrical cables			
Rubber/felt gaskets			
Coal-tar enamel coatings and rust inhibitor coatings			
Insulation material including fiberglass, felt, foam, and cork			
Adhesives and tapes			
Caulking and grout			
Rubber isolation mounts, foundationmounts, and pipe hangers			
Plastic applications (vinyl and PVC)			
Galbestos siding			
Mastics			
Acoustic ceiling and floor tiles			
Structural joint material			
Asphalt roofing and tar paper			
Synthetic resins and floor varnish			
Sprayed on fireproofing			
Other materials			

Copy Number of Categories to Test (NCT) from Worksheet 1: _____

Sampling Plan Worksheet 4 – Revise Sample Sizes Downward Due to Censuses

	Sample Size for PCB Testing	
	Cross Out Rows That Have a Checkmark on Worksheet #1	
	Enter a checkmark here if J is "ALL" or if K > H or if K is close enough to H that you wish to test all items in H to reduce thenumber of suspect MPP categories for sampling (NCS)	Sample sizebased on NCS (Ship Guidance Table II-NCS)
Suspect MPP Category	L	M
Paint, varnishes, lacquers		
Non-conducting materials in electrical cables (such as plastic and rubber)		
Rubber gaskets		
Felt gaskets		
Coal-tar enamel coatings (e.g., pipe coating) and rust inhibitor coatings		
Insulation material including fiberglass, felt, foam, and cork (not including electrical cable insulation, but including sound deadening felt)		
Adhesives and tapes		
Caulking and grout (including putty, silicon, window glazing, and bitumen)		
Rubber isolation mounts, foundation mounts, and pipe hangers		
Plastic applications (including vinyl and PVC)		
Galbestos siding		
Mastics		
Acoustic ceiling and floor tiles		
Structural joint material		
Asphalt roofing and tar paper		
Synthetic resins and floor varnish		
Sprayed on fireproofing		
Other materials		

Copy Number of suspect MPP Categories to Test (NCT) from Worksheet 1: ____
Count the checkmarks in column L
The sum of checkmarks is the Number of suspect MPP Categories for Census Testing (NCC): _____
Subtract NCC from NCT; this is the Number of suspect MPP Categories to Sample (NCS): ____

XI. Appendix B – Example Building Scenario

A property owner plans to renovate a multiroom and multilevel building. The property owner wishes to determine the presence of manufactured PCB products by testing. The building owner is interested in knowing whether PCBs are present greater than or equal to a threshold of 50 ppm.

Step 1 – Review Building Records

A review of the building history and available building records show that the building was constructed in 1960 and underwent renovations in certain areas in the late 1980s.

Step 2 – Compile Inventory

The property owner performs a walkthrough of the building to conduct a visual inspection and develops an inventory that identifies all building materials that could potentially be manufactured PCB product (Table 1) or could be contaminated from contact with PCB containing material. In the tables, manufactured PCB product and potentially contaminated product are referred to as "MPP." The suspect manufactured PCB product categories are grouped by those materials that were evaluated to be similar and likely to be homogenous based on available information. The inventory columns provide additional descriptive information for each suspect manufactured PCB product category including color, number of rooms containing the material, approximate total quantities of the material by the individual number of units (discrete), in total linear feet, or total square footage. The inventory also notes whether enough information is available in the building records to confidently exclude the suspect manufactured PCB product category from the need to sample (e.g., known post-1979 manufacture).

Table 1 – Building #101 Inventory

Suspect manufactured or contaminated PCB product Category	Color	Floor	Number of Rooms	Approximate Total Quantity	Units	Documented Post-1979 Manufacture, Installation, or not present (Exclude)
Suspended Ceiling Tile A	White	Multiple	14	1475	Sq Ft	No
Gypsum Wall Board A	White	Multiple	19	6359	Sq Ft	No
Carpet Mastic	Brown	Multiple	8	3239	Sq Ft	No
Thermal System Insulation	Yellow	Multiple	12	25	Discrete	No
Spray-On Insulation	Beige	Multiple	11	2903	Sq Ft	No
Vinyl Floor Tile	Gray	Multiple	17	5556	Sq Ft	Yes
Mastic	Gray	Multiple	17	3276	Sq Ft	No
Paint	Beige	Multiple	65	24,800	Sq Ft	No
Covebase	Black	Multiple	22	53	Sq Ft	Yes
Suspended Ceiling Tile B	White	Multiple	42	16645	Sq Ft	Yes
Replacement Window Caulking	White	Multiple	38	1441	Lin Ft	No

Flue Connector	White	2nd	2	15	Discrete	No
Adhesive	Light Green	Multiple	7	832	Sq Ft	No
Sink Undercoating A	Tan	Multiple	2	6	Discrete	No
Suspended Ceiling Tile C	White	2nd	4	701	Sq Ft	No
Sink Undercoating B	Gray	Multiple	4	16	Sq Ft	Yes
Fire Stop Caulk	Red	Multiple	3	135	Lin Ft	No
Gypsum Wall Board B	White	Multiple	16	2532	Sq Ft	Yes
Expansion Joint Caulking	Gray	Multiple	25	455	Lin Ft	No
Dust Seam Sealant	Gray	3rd	1	3	Sq Ft	Yes

The property owner also created a table (Table 2) to provide additional descriptive information on the inventoried suspect manufactured PCB product categories. This table contains information that can be used to perform a conversion of linear or square foot inventoried suspect manufactured PCB product categories to represent discrete items for the purposes of sampling. It also provides descriptive information on the adjacent substrate materials.

Table 2 – Material Descriptive Information

Material Category	Material Description	Substrate Type
Suspended Ceiling Tile A	4 ft^2 square tile	-
Gypsum Wall Board A	Standard 4’ x 8’ Wallboard	-
Carpet Mastic	Assume 200 ft^2 per gallon coverage	Concrete
Thermal System Insulation	Mudded pipe joint insulation	Metal
Spray-On Insulation	Assume 200 ft^2 per insulation kit	Concrete
Vinyl Floor Tile	9” dark gray with white streaks	Concrete
Mastic	Assume 30 ft^2 per gallon coverage	Concrete
Paint	Oil Based (400 ft^2 coverage per gallon)	Concrete
Covebase	4” black (original)	Concrete
Suspended Ceiling Tile B	4 ft^2 Deep Fissures	-
Replacement Window Caulking	Metal casing to Concrete (assume 10 linear ft per discrete item)	Metal and Concrete
Flue Connector	Duct Seam Sealant	Metal
Adhesive	Assume 100 ft^2 per gallon coverage	Concrete
Sink Undercoating A	Metal sink to formica counter	Metal to Formica
Suspended Ceiling Tile C	8 ft^2 tile	-
Sink Undercoating B	Metal sink to soapstone counter	Metal to Soapstone
Fire Stop Caulk	Metal door frames (assume 10 linear ft per discrete item)	Metal
Gypsum Wall Board B	Newer, type 2	-
Expansion Joint Caulking	Concrete Masonry Unit (CMU) to CMU (assume 10 linear ft per discrete item)	Concrete

Dust Seam Sealant	Metal ductwork	Metal

Step 3 - Develop Sampling Plan

The property owner decides to perform statistical acceptance sampling. The property owner desires that the probability that the sampling plan will detect PCBs is at least 95% if the true underlying proportion of materials containing them were greater than or equal to 5%. The property owner determines the number of samples needed from each suspect manufactured PCB product category to achieve that desired conclusion using the worksheets presented in Appendix A and the *Sample Sizes for Sampling Plans* Tables from the Ship Guidance (Appendix II.F).

Step 4 – Determine Distribution of Samples and Perform Testing

Table 3 presents the sample sizes determined from the worksheets versus the number of adjusted individual items in the suspect manufactured PCB product category calculated in Column E of worksheet 2. The property owner should distribute the number of samples required for the suspect manufactured PCB product category across the number of locations where the material is present in the building (e.g., number of rooms). Using the Suspended Ceiling Tile in Table 3 as an example, if the 14 rooms each contain an equal number of tiles, the 77 samples can be equally distributed between the 14 rooms (77 ÷ 14 = ~ 6 samples per room).

Table 3 – Sample Size per Suspect manufactured PCB product Category

Suspect manufactured PCB product Category	Number of Rooms	Approximate Total Quantity	Units	Adjusted Individual Items	Number of Samples from Worksheets	Floor
Suspended Ceiling Tile A	14	1475	Sq Ft	184	77	Multiple
Gypsum Wall Board A	19	6359	Sq Ft	199	77	Multiple
Carpet Mastic	8	3239	Sq Ft	16	16	Multiple
Thermal System Insulation	12	25	Discrete	25	25	Multiple
Spray-On Insulation	11	2903	Sq Ft	15	15	Multiple
Mastic	17	3276	Sq Ft	109	77	Multiple
Paint	65	24,800	Sq Ft	62	53	Multiple
Replacement Window Caulking	38	1441	Lin Ft	144	77	Multiple
Flue Connector	2	15	Discrete	15	15	2nd
Adhesive	7	832	Sq Ft	8	8	Multiple
Sink Undercoating A	2	6	Discrete	6	6	Multiple
Suspended Ceiling Tile C	4	701	Sq Ft	88	62	2nd
Fire Stop Caulk	3	135	Lin Ft	14	14	Multiple
Expansion Joint Caulking	25	455	Lin Ft	46	40	Multiple

Sampling Plan Cover Sheet

Building/Project Name: *Building #101*
Owner: *James Shew*
Date of Construction: *1960*
Persons Developing the Sampling Plan: *ABC Consultants*

Date the Sampling Plan Was Completed: *October 2021*

Desired Conclusion: *"The probability that this sampling plan would detect PCBs ≥ 50 ppm is at least95% if the true underlying proportion of materials containing them were greater than or equal to 5%."*

Write the Conclusion Probability here: (e.g., 90%, 95%, or 99%): **95%**

Write the Conclusion Proportion here: (e.g., 1%, 5%, or 10%): **5%**

Sampling Plan Worksheet 1 – Identify Categories Omitted from Testing

The property owner lists the inventoried suspect manufactured PCB product categories from Table 1 and, in Column C, checks off the types that the property owner has determined to exclude from sampling based on building records.

	Omitted from PCB Testing			
	In each row, check one (A-D) if appropriate			
	There is noneof this material in the building.	Every item is documented to have PCB concentrations <50 ppm.	Every item can be assumed to have PCB concentrations < 50 ppm due to documented yearand place of manufacture or installation.	Every item can either be documented or assumed to have PCB concentrations <50 ppm.
Suspect MPP Category	A	B	C	D
Suspended Ceiling Tile A				
Gypsum Wall Board A				
Carpet Mastic				
Thermal System Insulation				
Spray-On Insulation				
Vinyl Floor Tile			√	
Mastic				
Paint				
Covebase			√	
Suspended Ceiling Tile B			√	
Replacement Window Caulking				
Flue Connector				
Adhesive				
Sink Undercoating A				
Suspended Ceiling Tile C				
Sink Undercoating B			√	
Fire Stop Caulk				
Gypsum Wallboard B			√	
Expansion Joint Caulking				
Dust Seam Sealant			√	

Count the number of categories (rows) that do not have a checkmark. That is the Number of suspect MPP Categories to Test (NCT). Copy it into the appropriate location on Worksheet 3. 14 (NCT)

Sampling Plan Worksheet 2 – Items That May Contain PCBs

In Column E, the property owner lists the total number of items in each suspect manufactured PCB product category. For non-discrete suspect manufactured PCB product categories where the total number of items listed in Table 1 were in linear or square feet, the example shows the calculation made to convert to a discrete number of items based on the information presented in Table 2. Because none of the suspect manufactured PCB product categories listed can be further eliminated from sampling based on available PCB information (Columns F & G), the total number of items is carried over to Column H.

	Not Omitted from PCB Testing			
	Rows That Have No Checkmark on Worksheet #1			
	Population: Total number of items in this suspect MPP category in the building.	Number that are documented to have PCB concentrations <50 ppm	Number that can be assumed to have PCB concentrations < 50 ppm due to documented year and place of manufacture or installation.	Sampling Frame: Total number of items in this suspect MPP category that cannot be documented or assumed to have PCB concentrations <50 ppm. (H = E - F - G)
Suspect MPP Category	E	F	G	H
Suspended Ceiling Tile A	1475 ft^2 ÷ 4 ft^2/tile = 184			184
Gypsum Wall Board A	6359 ft^2 ÷ 32 ft^2/board = 199			199
Carpet Mastic	3239 ft^2 ÷ 200 ft^2 = 16			16
Thermal System Insulation	25			25
Spray-On Insulation	2903 ft^2 ÷ 200 ft^2 = 15			15
Mastic	3276 ft^2 ÷ 30 ft^2 = 109			109
Paint	24,800 ft^2 ÷ 400 ft^2 = 62			62
Replacement Window Caulking	1441 ft ÷ 10 ft = 144			144
Flue Connector	15			15
Adhesive	832 ft^2 ÷ 100 ft^2 = 8			8
Sink Undercoating A	6			6
Suspended Ceiling Tile C	701 ft^2 ÷ 8 ft^2 = 88			88
Fire Stop Caulk	135 ft ÷ 10 ft = 14			14
Expansion Joint Caulking	455 ft ÷ 10 ft = 46			46

Sampling Plan Worksheet 3 – Calculate Sample Sizes to Support Conclusion

In Column I, the proportion of total items where PCB presence is unknown could be adjusted if some of the materials from Worksheet 2 would have been further eliminated from sampling consideration based on available PCB information. Since no such adjustment could be made, the proportion is 1 (or 100% of total items have unknown PCB content).

In Column J, the property owner uses Tables II-1 to II-14 from the Ship Guidance Appendix II-F to determine the number of samples based on the Number of Categories to Test (NCT) from Sampling Plan Worksheet 1. For NCT = 14, Table II-14 is used and the sample sizes corresponding to a 95% conclusion probability and 5% conclusion proportion are entered in Column J. Because the proportion in Column I is 1, the same sample size is carried through to Column K. Note that the sample size from Table II-14 is larger than the total number of material items available for some material types like the spray on-insulation (i.e., Column K is greater than Column H). This indicates that for that material type, all items should be tested (i.e., census testing).

	Sample Size for PCB Testing		
	Cross Out Rows That Have A Checkmark on Worksheet #1		
	Proportion of items in this suspect MPP category for which results are not currently known (I = H / E)	95%/5% Sample SizeBased on NCT = 14 (Ship Guidance Table II-14)	Preliminary expected number of suspect MPP items that will need to be tested (K = J x I)
Suspect MPP Category	I	J	K
Suspended Ceiling Tile A	184/184 = 1	85	85
Gypsum Wall Board A	199/199 = 1	85	85
Carpet Mastic	16/16 = 1	28	28
Thermal System Insulation	25/25 = 1	28	28
Spray-On Insulation	15/15 = 1	28	28
Mastic	109/109 = 1	85	85
Paint	62/62 = 1	42	42
Replacement Window Caulking	144/144 = 1	85	85
Flue Connector	15/15 = 1	28	28
Adhesive	8/8 = 1	28	28
Sink Undercoating A	6/6 = 1	28	28
Suspended Ceiling Tile C	88/88 = 1	67	67
Fire Stop Caulk	14/14 = 1	28	28
Expansion Joint Caulking	46/46 = 1	42	42

Copy Number of Categories to Test (NCT) from Worksheet 1: 14

Sampling Plan Worksheet 4 – Revise Sample Sizes Downward Due to Censuses

In order to account correctly for sampling uncertainty in multiple categories of materials, the Worksheet 4 instructions have the property owner make a correction for testing across multiple categories and to provide the desired level of confidence. The NCT is reduced by the number of suspect manufactured PCB product categories where all items should be tested. Column L identifies those suspect manufactured PCB product categories where all items will be tested. The Number of Categories to Sample is the NCT (14) minus the number of census testing categories (7). Column M then uses the NCS of 7 and Table II-7 in the Ship Guidance to determine the sample size for the category.

	Sample Size for PCB Testing	
	Deleted Rows That Have A Checkmark on Worksheet #1	
	Enter a checkmark here if J is "ALL" or if K > H or if K is close enough to H that you wish to test all items in H to reduce the number of suspect MPP categories for sampling (NCS)	Sample sizebased on NCS = 7 (Ship Guidance Table II-7)
Suspect MPP Category (Discrete Units)	L	M
Suspended Ceiling Tile A (184)		77
Gypsum Wall Board A (199)		77
Carpet Mastic (16)	√	16
Thermal System Insulation (25)	√	25
Spray-On Insulation (15)	√	15
Mastic (109)		77
Paint (62)		53
Replacement Window Caulking (144)		77
Flue Connector (15)	√	15
Adhesive (8)	√	8
Sink Undercoating A (6)	√	6
Suspended Ceiling Tile C (88)		62
Fire Stop Caulk (14)	√	14
Expansion Joint Caulking (46)		40

Total Samples: 562

Copy Number of Categories to Test (NCT) from Worksheet 1: 14

Count the checkmarks in column L; the sum is the Number of Categories for Census Testing (NCC): 7

Subtract NCC from NCT; this is the Number of Categories to Sample (NCS): 7