

Guideline

Waste management

Identifying and managing equipment containing polychlorinated biphenyls (PCBs)

This guideline provides information on how to identify equipment containing PCBs and determine the surface concentration of PCBs. It also provides guidance to people who are involved in maintaining or demolishing equipment containing PCBs.

Background

PCB is the common term for the chemical polychlorinated biphenyl. PCBs can harm our health and, if they contaminate the environment, can stay there for many years. PCBs range in appearance from colourless oily liquids to more viscous, darker fluids or can be resins ranging in colour from yellow to black, depending on the chlorine content. Imports of PCBs to Australia have been banned since 1986.

The major use of PCBs in the electrical industry has been as an insulating fluid inside transformers and capacitors. Transformers and capacitors range in size from very large transformers used by electrical supply businesses and heavy industries containing several thousand litres of PCBs, to small capacitors used in farming equipment and on commercial premises which may only contain several millilitres of PCBs.

In the 1950s, 60s and 70s, capacitors containing PCBs were installed in equipment including fluorescent light fittings, ceiling fans, dishwashers, clothes dryers, electric motors, vacuum pumps, air conditioners and small washing machines. Electrical equipment manufactured in Australia since then is unlikely to contain PCBs.

Experience shows that most capacitors in small electrical equipment contain almost pure PCBs, whereas a majority of the larger transformers contain predominantly non-scheduled PCBs. However, some transformers contain scheduled PCBs and a small number of relatively smaller transformers contain concentrated PCBs. All testing for PCBs must be undertaken by a specialist National Association of Testing Authorities (NATA) registered laboratory www.nata.asn.au.

PCBs released into the environment do not readily break down and can accumulate in fatty tissues of animals. This longevity, and their affinity for any fatty tissue, can result in PCBs concentrating through the food chain. The most commonly observed symptom in people exposed to high levels of PCBs is a condition known as chloracne. It is a severe, persistent, acne-like rash. Very high exposure to PCBs may also cause liver damage and damage to the nervous system, resulting in numbness, weakness and tingling in the arms and legs. It is possible that PCBs may cause cancers.

Because of their hazardous nature, the Commonwealth Government moved to better manage PCBs through the *Polychlorinated biphenyls management plan revised edition - April 2003* (the Plan). The provisions of the Plan have been incorporated into Queensland legislation as Part 5C of the Waste Reduction and Recycling Regulation 2011, administered by the Department of Environment and Science (DES). The Plan is available at www.scew.gov.au/resource/ephc-archive-anzecc-reports.

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PCBs are also classified as a persistent organic pollutant under the Stockholm Convention and are identified for international action because of their persistence, bioaccumulation, long-range dispersion and toxicity.

Definitions

PCB material is '**scheduled**' if:

- the **concentration** of PCBs in the material is at least 50 mg/kg
- the **material** contains at least 50g of PCBs.

PCB material is '**concentrated**' if:

- the concentration of PCBs in the material is at least 100,000 mg/kg
- **the** material contains at least 50g of PCBs.

Non-scheduled PCB material means any material containing PCBs at levels below the threshold concentration (50 mg/kg) or threshold quantity (50g) and above the concentration level considered as PCB-free (2 mg/kg).

Material is 'PCB-free' if it is not PCB material.

Equipment is 'PCB-free' if:

- there is no PCB material in the equipment other than on the surface area of the PCB contaminated metal in the equipment
- the PCB contaminated metal in the equipment does not have a coverage of PCBs on its surface area of more than 1mg/m².

Identifying equipment containing PCBs

The management requirements for owners of equipment depend on the concentration and quantity of PCBs contained within equipment. Therefore, a simple and accurate determination of the "PCB status" is the first step in fulfilling the owner's responsibilities. There are three basic methods for the identification of PCB-containing electrical equipment:

Age of equipment — if the equipment was produced after 1979 or imported after 1986 then the equipment should be PCB-free. This is because imports of PCBs to Australia have been banned since 1986.

Use of available documentation — The *Identification of PCB-containing capacitors* handbook contains the name, product code and PCB status of electrical components. This handbook is aimed at electricians and electrical contractors, emergency service personnel, the waste management industry, and people involved in demolishing, refurbishing or maintaining older buildings and plant. This free handbook is available at www.scew.gov.au/resource/ephc-archive-anzecc-reports.

It should be noted that even if equipment is not listed, it may still contain PCBs. If there is any doubt as to whether equipment contains PCBs, submit a sample to a NATA-accredited laboratory for PCB analysis (www.nata.asn.au).

Sampling — if there is only very limited information available on the status of a piece of electrical equipment or other material likely to be contaminated with PCBs, the most appropriate way to determine the PCB status is to send a small sample of the material (e.g. dielectric fluid from the equipment) to a NATA-accredited laboratory to determine whether or not it contains PCBs. It is the responsibility of the owner of the equipment to appropriately

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identify the PCB status of the equipment. Caution should be exercised when sampling from small pieces of equipment to prevent spillage.

Statistical sampling

A statistical sampling technique must be used when it is not practical to sample all equipment that may contain PCBs due to the risk of:

- **compromising** the continued use of the equipment; or
- **producing** unsafe conditions or unacceptable risks.

Subgrouping

PCBs are expected to be randomly spread throughout the equipment population, but in time exist as clusters due to contamination at the time of manufacture or through subsequent maintenance practices.

To achieve a realistic picture of the extent of concentrated or scheduled PCB material, it is necessary to divide the population of possible PCB-containing equipment into subgroups based on equipment type, manufacturer and age.

Members of each subgroup should be tested according to the sample size (described below) and classified into two classes based on the probability of occurrence of one percent or more of concentrated or scheduled PCB material in each group.

Equipment manufactured after 1985, which was not subjected to the possibility of cross contamination from maintenance practices, will not require testing for PCBs.

Sample size

Sample sizes will depend on the selected group size. The variation of sample size with group size is presented in table 1. From figure 1, the exact number of required samples may be obtained.

Table 1: Sample size for equipment groups

Group population	Number to sample	Group population	Number to sample
≤ 95	All	700	245
96-100	95	800	250
200	155	900	255
300	190	1000	260
400	210	2000	275
500	225	5000	290
600	235	> 10,000	300

(">" indicates greater than) ("≤" indicates less than or equal to)

Where applying this statistical approach to your sampling program is not practicable, all equipment can be removed without testing and taken to an licensed treatment / disposal facility.

Calculation of probability

The probability of finding concentrated or scheduled material in each subgroup is calculated by dividing the number of equipment or items of plant found to contain concentrated or scheduled PCB material by the number of samples taken for that subgroup and expressed as a percentage.

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$$\% PCB = \frac{n}{N} \times 100$$

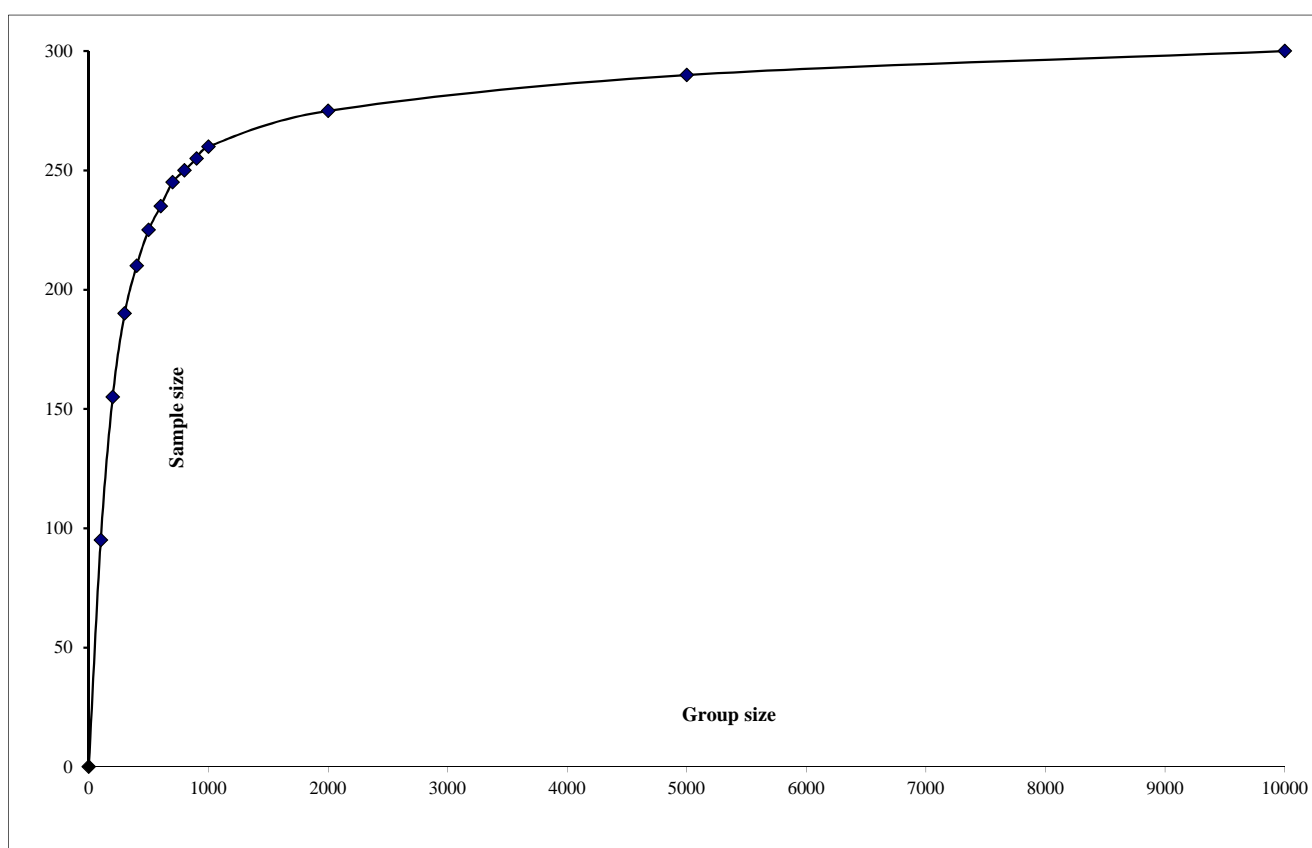
Where:

%PCB = percentage of units containing concentrated or scheduled PCB material

n = number of sampled units found to contain concentrated or scheduled PCB material

N = number of units sample

Figure 1: Plot of sample size with variation of group size



If one percent or more of concentrated or scheduled PCB material is found in the number sampled, then action must be taken as follows.

- **Less than one percent concentrated or scheduled material** — the remaining untested equipment in the subgroup must be tested for PCB content at time of repair, decommissioning or disposal
- **Greater than one percent concentrated material** — the remaining untested equipment in the subgroup must be tested before the year 2002
- **Greater than one percent of scheduled material** — the remaining untested equipment in the subgroup must be tested before the year 2008.

How to determine the surface concentration of PCBs

In order that equipment can be disposed of or recycled as 'PCB-free', the amount of PCB retained on the surface of any equipment after removal of oil and draining must be less than 1 mg/m^2 for non-porous material. If this limit is exceeded, the solid materials must be treated to reduce the concentration below this limit so that the material can be regarded as 'PCB-free'.

The amount of PCB retained in porous material or on non-porous contaminated metal can be directly measured using solvent extraction or the wipe test, respectively. It can also be directly estimated for equipment that has contained transformer mineral oil by applying retention factors to the results of the original concentration of PCB in the oil phase.

All PCB testing must be carried out by a NATA (National Association of Testing Authorities) laboratory accredited for PCB testing (www.nata.asn.au).

Direct measurement

Suitably qualified personnel should conduct the following tests.

Non-porous material (wipe test)

A wipe test may be performed on non-porous components, such as:

- bare copper leads
- tank steel
- structural/frame members
- bushings
- fins (internal).

To determine PCB surface concentration on core laminations, a section of the core must be dismantled and the amount of material determined by a wipe test or by repeated solvent washing. It is not sufficient to test the outer layers only.

1. Prepare absorbent material (cotton wool or gauze pads) by solvent (soxhlet) extraction to remove any interfering compounds.
2. Choose a suitable high purity solvent such as hexane, heptane or isooctane that is free from interferences for gas chromatography/electron capture detector (GC/ECD) analysis.
3. Prepare a clean solvent-washed glass sample jar to collect solvent washings and swabs. The sample jar must have a solvent-resistant lid, preferably metal or PTFE¹ lined.
4. Measure the area of solid material to be sampled and mark boundaries with pencil or chalk. An area of at least 100 square centimetres (10cm x 10cm) is required.
5. Hold a portion of the absorbent material in clean metal laboratory tongs or a nitrile-gloved hand. Soak a portion of the absorbent material in the chosen solvent and swab the measured area. Use horizontal and vertical strokes to ensure adequate surface coverage. Rinse the absorbent with a minimum of solvent into the sample jar.

¹ Note: PTFE is polytetrafluoroethylene and commonly called Teflon.

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6. Repeat the swabbing and rinsing process, replacing the absorbent as necessary, until no trace of oil remains in the sample area.
7. Place used swabs in the sample jar and seal. Label the jar and consign it to a NATA accredited laboratory for analysis.
8. Analyse the recovered solvent for PCB content and calculate the surface concentration as mg PCB/m².

Porous material

1. Select a sample of porous material for testing. Approximately 5 to 10 grams are required. If the porous material has been taken from equipment/plant that has been solvent washed, then porous material not directly in contact with the solvent must be selected (e.g. between conductor turns).
2. Extract the PCB via a soxhlet and analyse for PCB content.
3. Express the result as mg PCB per kg of porous material (i.e. ppm).

Direct estimation

The amount of PCB retained on surfaces and in porous material may also be determined by the use of retention factors or limits. These factors relate the amount of PCB in the bulk oil to the amount of PCB expected to be retained in the various components of the electrical equipment after draining for a preset time.

The retention factors will vary for different equipment components e.g. non-porous metal components, core laminations, cellulosic materials, and paper wrapped or covered materials. The retention factors will also be influenced by the preparation method of equipment (e.g. drainage process and time).

Industry may assess the retention characteristics of particular types of equipment and provide the results of assessment to the Department of Environment and Science for consideration of the proposed retention factors for the equipment type.

Managing equipment containing PCBs

Within one year of equipment being permanently removed from operational use (section 41ZQ of Waste Reduction and Recycling Regulation 2011):

- for equipment containing concentrated PCB material, the owner must give the equipment to a licensed treatment facility for treatment so the equipment becomes PCB-free;
- for equipment containing scheduled PCB material (not concentrated PCB material), the owner must treat the equipment so the equipment becomes PCB-free, or the owner must give the equipment to a licensed treatment facility so the equipment becomes PCB-free;
- for equipment containing non-scheduled PCB material, the owner must treat the equipment so the equipment becomes PCB-free; or give the equipment to a licensed treatment facility for treatment so the equipment becomes PCB-free; or give the equipment to a licensed disposal facility.

Recycling metal from electrical equipment containing PCBs

Large electrical units such as transformers contain a significant amount of recyclable metal and therefore present a valuable resource that should be utilised. However, workers at such recycling facilities must be protected from exposure to PCBs through dermal contact with contaminated metal surfaces.

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Metal from electrical equipment may be recycled at a licensed metal recycler if the metal is considered to be PCB-free. For equipment containing low level PCBs, it is possible that the unit may only require draining to be considered PCB-free. However, higher levels of contamination may require more advanced treatment techniques.

Handling PCBs

PCB containing equipment is unlikely to pose a health risk, unless it becomes damaged and leaks. The *Advisory standard for hazardous substances* (1998) should be consulted when handling PCBs. It provides information on the management of a range of hazardous substances in the workplace. It is available from the Queensland Local Government Toolbox website www.lgtoolbox.qld.gov.au/Pages/Home.aspx.

Depending on the situation, protective material could become regulated waste and should be disposed of accordingly.

Storing PCBs

Operating a facility for receiving and storing wastes containing PCBs is an environmentally relevant activity (ERA 62 — Resource recovery and transfer facility operation) under the Environmental Protection Regulation 2008 and requires an environmental authority from DES. When equipment containing PCBs is removed temporarily for repair or permanently from service, it should be stored with caution.

PCB-containing equipment (capacitors, ballasts, etc.) should be placed in a polyethylene bag that should then be placed in dangerous goods approved (DGA) drums. These drums are sealable, open-head, epoxy-lined, export-quality steel drums. This container should be maintained in a good order (that is, no visible signs of damage or corrosion). If some of these materials are leaking, the container should be partially filled with an absorbent material, such as commercial absorbent, kitty litter or a diatomaceous earth. The plastic wrapped leaking components can then be placed in the container.

Drums containing scheduled and non-scheduled PCB waste and any large components should have one hazard label attached to the side of the drum or large component. The labelling of the containers must comply with the *National code of practice for the labelling of workplace substances* (1994).

Additionally, this label should contain the following information:

- Class 9
- PCB
- an indication of concentration (scheduled/non-scheduled PCB).

If PCBs cannot be transported immediately for disposal, all containers must be stored in an area that prevents any discharge of the PCBs to the environment. Note that as PCBs have a very low vapour pressure, they give off negligible vapours at room temperature, enabling storage in occupied buildings under appropriate conditions.

Drums of PCB waste and any large components should be stored in a way which protects the environment. The following provides guidance on how drums should be stored:

- on an impermeable floor, such as concrete
- away from heat sources
- away from any flammable liquids and food storage areas
- in a place with no drainage outlets

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- in an area not prone to flooding
- in an area away from other chemicals and batteries
- in a place that is protected from access by unauthorised persons
- in a place that is protected from weathering and other external agents
- in an area bunded in accordance with any relevant Australian Standard
- in a roofed area (liquid scheduled PCB waste)
- in a place that has adequate access for inspection of all drums.

If more than 10kg of PCBs in scheduled PCB material requires storage, DES must be notified of the quantity, location and type of material.

Liquid PCBs drained from large electrical components should be placed in separate drums and not placed in drums with equipment containing PCBs. Separate drums should be used to contain liquid PCBs from different sources to limit the potential for mixing concentrated PCBs with more dilute PCB material.

Note that the material containing PCB should be disposed of as soon as possible. If stored for an extended period, containers should be raised off the floor to avoid corrosion of the bottom of the container.

Treatment and disposal of PCBs

Treatment and disposal of wastes containing PCBs are environmentally relevant activities (ERA 55 or 61 for treatment and 60 for disposal) under the Environmental Protection Regulation 2008 and require an environmental authority from DES. The environmental authority may include conditions relating to the form and concentration of PCBs that may be accepted at the facility.

Supporting information

Australia and New Zealand Environment and Conservation Council, 1997. *Identification of PCB-containing capacitors*.

Australia and New Zealand Environment and Conservation Council, 2003. *Polychlorinated biphenyls management plan revised edition – April 2003*.

Department of Employment, Training and Industrial Relations (DETIR), 2003. *Advisory standard for hazardous substances*.

National Occupational Health and Safety Research Council (NOHRC), 1994. *National Code of Practice for the Labelling of Workplace Substances [NOHSC:2012(1994)]*.

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Disclaimer

While this document has been prepared with care it contains general information and does not profess to offer legal, professional or commercial advice. The Queensland Government accepts no liability for any external decisions or actions taken on the basis of this document. Persons external to the Department of Environment and Science should satisfy themselves independently and by consulting their own professional advisors before embarking on any proposed course of action.

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Enquiries:

Permit and Licence Management
Ph: 1300 130 372 (select option 4)
Fax: (07) 3330 5875
Email: palm@des.qld.gov.au

Version history

Version	Effective date ^[1]	Description of changes
1.00	04/02/2016	First published. This amalgamates the content of three guidelines (EM2348, EM2349 and EM2350) into one document.
1.01	15/06/2018	Document rebranded to align with machinery of government changes
2.00	01/07/2019	Updated for the Environmental Protection (Waste ERA Framework) Amendment Regulation 2018

^[1] This is the date approved, not the date published.