# Handbook on PCBs in Electrical Equipment

## Chapter 2 Identification and Labelling of PCB Equipment





### *2.1 Introduction*

In this handbook, PCB equipment means electrical equipment that was designed to use PCBs. PCB equipment includes PCB transformers and PCB capacitors.

### *2.2 Identification of PCB Transformers*

Transformers are manufactured in a variety of shapes and sizes and are either dry-type or liquid-filled. An example of a liquid-filled transformer is shown in Figure 1. In transformers containing dielectric fluid, the fluid also serves as a heat exchanger; heat from the windings is transferred to the casing. If the heat transfer capacity of a transformer casing is not sufficient, cooling tubes or fins can be added. These operate like a car radiator. Most larger transformers are characterized by these tubes or fins.

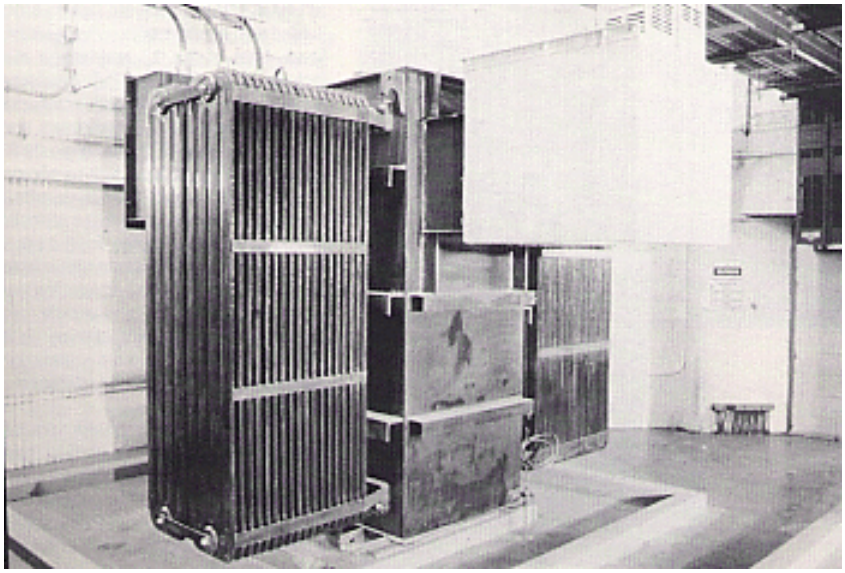

**Figure 1 Liquid-filled Transformer**
**Pad-mounted**
may contain askarel

Transformers can be found in a number of locations (Figure 2), i.e.:

a. Indoors
   i. mounted on a wall or column,
   ii. in an electrical room or fenced enclosure,
   iii. within fire-proof vaults, and
   iv. in mines and underground vaults.
b. Outdoors
   i. on a roof,
   ii. on a concrete pad, and
   iii. on a utility pole.

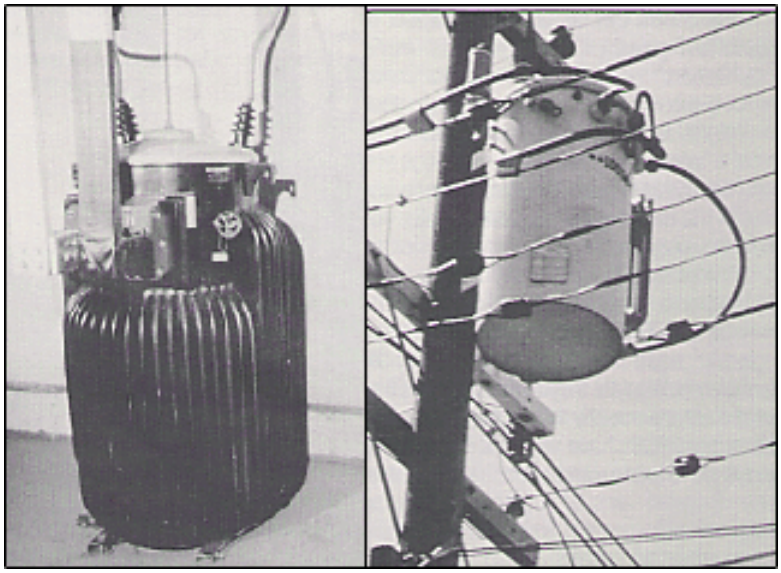

**Figure 2 Typical Transformer Locations**

Indoor liquid-filled transformers must be nonflammable unless they are installed in a fireproof vault approved by the electrical inspection authorities. PCBs have very low flammability and were considered ideal for use in indoor

liquid-filled transformers. Consequently, transformers of the type installed indoors prior to 1979, in locations other than fireproof vaults, often contain PCBs.

Not all transformers contain PCBs; the following procedures can be used to determine which transformers contain PCBs and which ones do not. First, a liquid-filled transformer may or may not have a conservator tank (see Figure 3). Any transformer that was manufactured in North America with a conservator tank was *not* designed to use PCBs and probably contains mineral oil. Second, a transformer's nameplate, attached to the outside of the transformer casing, should be checked for information about the fluid content. If the type designation on the nameplate starts with the letter 0, such as ONS, ONAN, ONWF, etc., the transformer is filled with mineral oil. If the type designation on the nameplate starts with the letter L, such as LNAN, LNAF, LNWF, etc., the transformer is filled with nonflammable or flame-retardant liquid. Most of the "L" transformers manufactured before 1979 are PCB transformers. Some of the "L" transformers manufactured before 1979 and all "L" transformers manufactured in or after 1979 were originally filled with flame-retardant liquid such as silicone or other alternative non-PCB fluids described in Chapter 4 of this handbook. Some nameplates specify the brand of cooling liquid inside the transformer. If one of the brand names listed in Table 1 appears on the nameplate, the transformer contains PCBs. Sometimes the nameplate does not provide information on the fluid content, in which case the manufacturer or Environment Canada can be contacted for additional information.

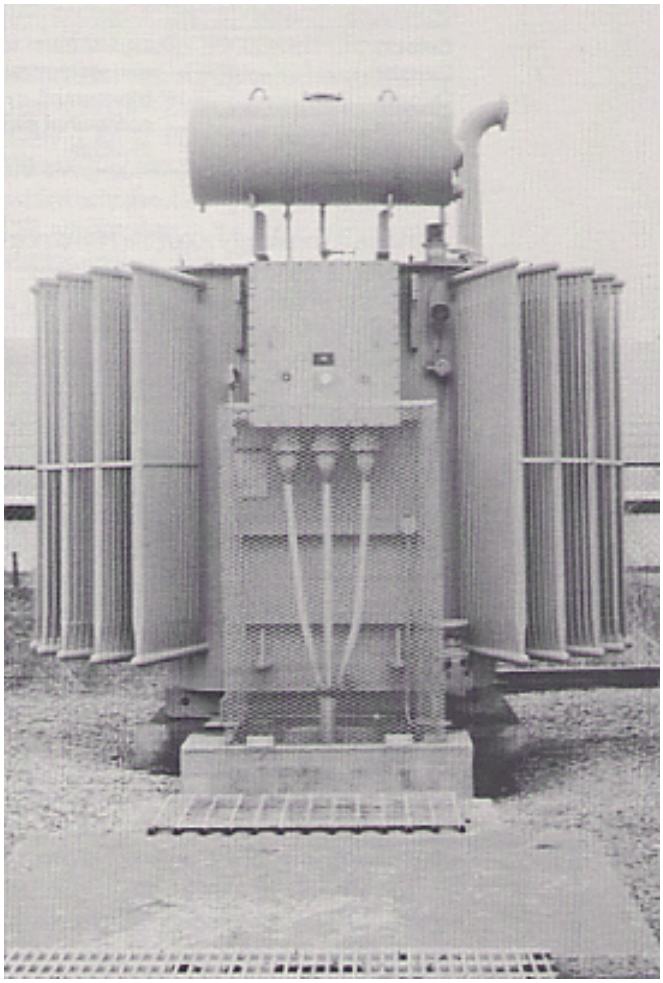

**Figure 3 Liquid-filled Transformer with Conservator Tank**

Askarel can be distinguished from other fluids, such as mineral oil, by physical characteristics. The most obvious difference is the strong odour of askarels, due primarily to the tri- and tetrachlorobenzenes (TTCBs) contained in them. Physical characteristics useful in the identification of askarels are listed in Table 2; however, a proper laboratory test is the best way to obtain positive confirmation.

### Table 2 Physical Characteristics of Askarel

| | |
|---|---|
| **Colour** | crystal clear to pale yellow |
| **Density** | denser than water |
| **Odour** | bitter smell |
| **Texture** | somewhat slippery |
| **Vapours** | invisible |

Used askarel does not usually have the same appearance as new askarel. It can become contaminated with dirt, moisture, black carbon particles (from arcing) and pieces of insulation from inside the equipment. Contamination

degrades the performance of askarel and clouds or darkens its appearance.

## 2.3 PCB-contaminated Mineral Oil Transformers

Mineral oil-filled transformers were not designed to use PCBs but many of them have been found to be contaminated with PCBs in concentrations exceeding 50 ppm. Several possible explanations have been advanced to account for this finding:

i. transformer plants producing both PCB and non-PCB transformers may have used common filling equipment for both;
ii. askarel may have been used as a make-up fluid for mineral oil-filled equipment; or
iii. equipment may have been used for servicing both askarel and mineral oil transformers without proper cleaning.

PCB-contaminated mineral oil transformers are not the focus of this handbook. However, they are subject to regulations which also apply to PCB transformers. The Chlorobiphenyl Regulations No. 3 (Release) prohibit the release of PCBs in quantities exceeding 1 g per day from any transformer manufactured in or imported into Canada prior to July 1, 1980, and in concentrations above 50 ppm for transformers manufactured or imported after that date. Provincial regulations and control criteria might also apply to out-of-service or stored PCB-contaminated mineral oil transformers.

If there is uncertainty about the PCB concentration of a mineral oil-filled transformer, a sample should be taken for analysis (it may be necessary to acquire professional services for the removal of transformer fluid samples). Field test kits can be used to determine whether or not a sample of mineral oil contains PCBs in a concentration greater than a specified amount, such as 50 ppm. Many of these kits are easy to use and give quick results, employing a simple colour transformation that indicates whether PCBs are present in a concentration greater or less than the specified amount. These kits should only be employed as a preliminary screening tool. Samples that test positive with a kit should be sent to a laboratory for confirmatory analysis using gas chromatography.

Treatment technologies have been developed to reduce or eliminate PCB contamination in dielectric fluids such as mineral oil. Several processes for the treatment of contaminated mineral oil have been introduced commercially. These processes are mobile and are designed for either on-line continuous or batch treatment. Additional information can be found in the "*Manual for the Management of Wastes Containing Polychlorinated Biphenyls*" (Environment Canada, 1987).

## 2.4 Identification of PCB Capacitors

Capacitors have a number of uses, including:

i. power factor correction, to achieve more efficient operation of AC induction motors, furnaces and other inductive loads;

ii. starting aid for single phase motors;
iii. surge protection for both electronic and power equipment, such as large motors;
iv. voltage regulation for power lines; and,
v. lamp ballasts for fluorescent and high intensity discharge light sources.

Capacitors vary in size considerably, from the size of an ice cube to much larger than a refrigerator. They can often be recognized by the letters kVar stamped on their nameplates. These letters indicate the electrical rating of a capacitor which most often falls within the 5 kVar to 200 kVar range.

Capacitors can be found in both indoor (Figure 4) and outdoor locations, usually installed in cool, dry areas to allow for efficient operation. Capacitors located outdoors are usually enclosed in a weatherproof welded, steel housing of rectangular construction. Capacitors may be found in a variety of locations within a building:

i. in the plant area, wired to bus bars feeding a row of motors or electric welders;
ii. wired to the electrical terminals of AC motors (if 30 horsepower or larger), electric welders and induction furnaces;
iii. connected to motor control centre panels; and
iv. connected to the main service cables inside the electrical room.

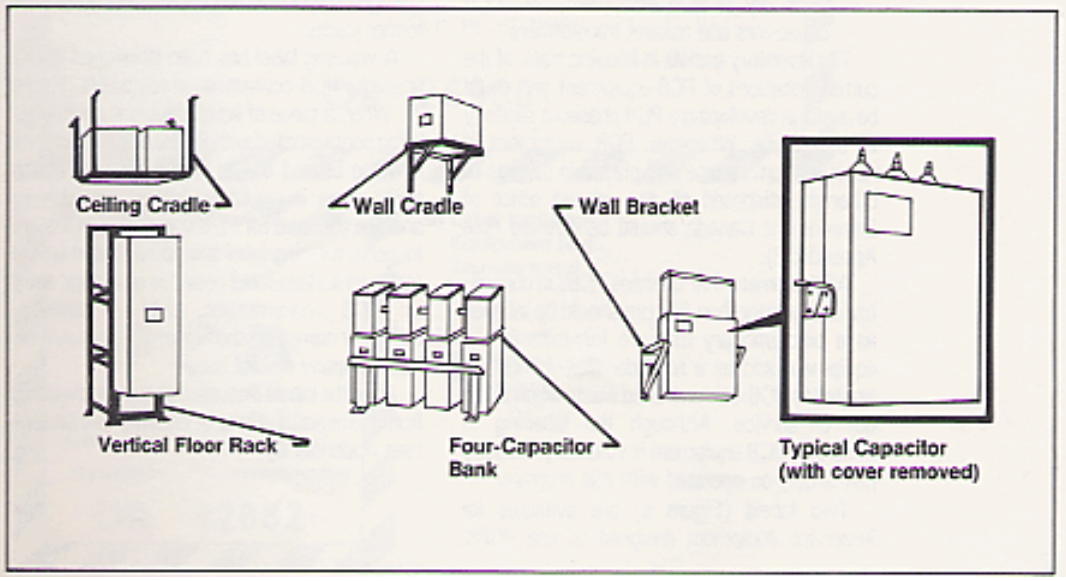


**Figure 4 Typical Indoor Capacitors**

Practically all liquid-dielectric AC power capacitors manufactured between 1930 and 1977 contain PCBs. In general, capacitors contain much smaller amounts of PCBs per unit than transformers. A PCB capacitor measuring 10 cm x 10 cm x 25 cm would contain approximately 1 kg of PCBs and even the largest (200 kVar) power factor correction capacitor contains only about 80 kg of PCBs. Most of the PCBs are absorbed in the paper or other solid dielectric material. Non-PCB capacitors manufactured after 1978 are often marked: "No PCBs" or "Non-PCB Capacitor". Capacitors containing the dielectric fluids WEMCOL, FARADOL 100, DIELEKTRO II or DPO (as specified on nameplates) do not contain PCBs. All other AC power capacitors

must be assumed to contain PCBs. Capacitors, unlike transformers, are usually hermetically sealed and analysis of the fluid for PCB content is not practical.

PCB capacitors found in lamp ballasts constitute a special case because of their small size and relative inaccessability. These capacitors are usually encapsulated in an asphalt-type compound in a steel enclosure installed inside the lighting fixture. Ballasts for high intensity discharge lamps are often mounted remotely from light fixtures. A typical capacitor utilized in a fluorescent lamp ballast contains only about 25 g of PCBs. PCB capacitors in high intensity discharge lamps contain significantly more, usually about 300 g. Since 1978, fluorescent lamp ballasts have been manufactured without PCB capacitors. Environment Canada's "Identification of Fluorescent Lamp Ballasts Containing PCBs" (1986) provides useful information for evaluating ballasts.

## *2.5 Labelling of PCB Equipment*

Environment Canada has developed a labelling system for PCB equipment in order to:

i. provide immediate identification of PCB equipment; and
ii. facilitate the development of a national inventory of PCB equipment, i.e., PCB capacitors and askarel transformers.

The inventory assists in keeping track of the current locations of PCB equipment and could be useful in developing a PCB phaseout strategy in the future. Whenever PCB equipment is removed from service and placed in storage or otherwise disposed of, the nearest office of Environment Canada should be notified (see Appendix B).

All equipment that contains PCBs in concentrations greater than 50 ppm should be labelled as a precautionary measure for users of the equipment and as a reminder that it must be treated as PCB-contaminated waste when taken out of service. Although the labelling of in-service PCB equipment is voluntary, industry has largely co-operated with this program.

Two labels (Figure 5) are available for in-service equipment designed to use PCBs.

These labels are serialized and have individual registration numbers at the bottom. The label shown in Figure 5a measures 15 cm x 15 cm and should be used on askarel transformers. The label shown in Figure 5b measures 7.6 cm x 7.6 cm and should be used for labelling capacitors. Where a number of capacitors are found together, such as in a capacitor bank, one label may be used for the entire group regardless of the size of the individual capacitors; however, when a capacitor is removed from the bank for disposal it should be labelled. Equipment that contains PCB capacitors, e.g., radio transmitters and fluorescent lamp ballasts, does not have to be labelled. Labelling is advised, however, if the capacitors in such equipment are accessible and large enough to be labelled.

**Figure 5 Serialized Labels for PCB Equipment**


**Figure 5a) Label for Large Equipment (e.g., Transformers)**


**Figure 5b) Label for Small Equipment (e.g., Capacitors)**

A non-serialized version of the 15 cm x 15 cm label is available (Figure 6) and should be used as a general warning label and placed in a clearly visible position at entrances to locations where PCB equipment is found. Such locations, most often containing drums of waste, include fenced storage compounds, electrical rooms and transformer vaults.


**Figure 6 Unserialized PCB Warning Label**

A warning label has been developed specifically for PCB-contaminated equipment (Figure 7). When a piece of equipment is suspected of being contaminated with PCBs, and if an activity is to be carried out to which the regulations apply, then it would be highly advisable to analyse the fluid for PCB content. If PCBs are found, a warning label should be placed on the equipment. This label provides space for entry of: PCB concentration, date of analysis, company name and the signature of an authorized company official.


**Figure 7 Warning Label For Pcb-Contaminated Equipment**

All of the labels discussed above are available from the regional offices of Environment Canada (see Appendix B).