



EPA-305-X-04-002

Polychlorinated Biphenyl Inspection Manual

August 2004

Office of Compliance
Office of Enforcement and Compliance Assurance
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue, NW (MC 2224-A)
Washington, D.C. 20460

<http://www.epa.gov/compliance/resources/publications/monitoring/manuals.html>

Chapter Four

Equipment-Specific Information

	<u>Page</u>
4.0 Equipment-Specific Information	4-1
4.1 Transformers	4-1
4.1.1 Background	4-1
4.1.2 Transformer Locations	4-2
4.1.3 Maintenance and Repair of PCB Transformers	4-5
4.1.4 Manufacturers and Trade Names	4-7
4.2 Capacitors	4-9
4.2.1 Background	4-9
4.2.2 Locations	4-10
4.2.3 Maintenance and Repair	4-10
4.2.4 Manufacturers and Trade Names	4-10
4.3 Other Electrical Equipment	4-12
4.4 Hydraulic Systems	4-12
4.4.1 Background	4-12
4.4.2 Manufacturers and Trade Names	4-13
4.5 Other PCB Equipment	4-13
4.5.1 Fluorescent Light Ballasts	4-13
4.5.2 Heat Transfer Systems	4-14
4.5.3 Natural Gas Pipelines	4-15
4.5.4 Electric Motors	4-16
4.5.5 Electromagnets	4-16
4.5.6 Products Containing PCBs	4-16

Tables

Table 4-1. Estimate of the Number of Registered Transformers by Industry Sector 4-4
Table 4-2. Transformer Manufacturers and PCB Fluid Trade Names 4-8
Table 4-3. Capacitor Manufacturers and PCB Fluid Trade Names 4-11
Table 4-4. Hydraulic Fluid Manufacturers and Trade Names 4-13
Table 4-5. TSCA Disposal Requirements for Fluorescent Light Ballasts 4-14
Table 4-6. Heat Transfer Fluid Manufacturers and Trade Names 4-15

4.0 Equipment-Specific Information

An inspector may encounter several types of PCB-containing equipment during a PCB inspection. This equipment consists chiefly of five major categories: transformers, capacitors, other electrical equipment, hydraulic systems, miscellaneous (e.g., fluorescent light ballasts, heat transfer systems), and other equipment. This chapter provides the inspector with general information on these major categories of regulated PCB equipment for which EPA authorizes certain activities (e.g., servicing and/or use), in accordance with Section 6(e) of TSCA.

For each type of PCB equipment discussed, this chapter provides information on the typical economic sectors using the equipment and a list of manufacturers and trade names. This chapter also includes information on inspections relating to specific equipment and the risk of contamination from exposure to such equipment.

The sections below summarize those regulations pertaining only to activities authorized for the specific equipment. Section 761.30, "Authorizations" describes these authorization provisions. General regulatory requirements (e.g., provisions concerning disposal and storage, marking, and recordkeeping) also apply to authorized uses of such equipment. Inspectors should refer to Chapters Three and Four as well as the regulations when preparing to conduct inspections.

Each section in this chapter contains a list of manufacturers and trade names used for PCBs or materials containing PCBs. Appendix E contains a comprehensive listing of PCB manufacturers and the trade names they used for PCB materials.

4.1 Transformers [§761.30(a) and (b)]

4.1.1 Background

Transformers increase or decrease the voltage level of an electric current. Electrical transformers are often filled with a dielectric liquid that increases the resistance of the unit to arcing and acts as a heat transfer medium, helping to cool the coils. Today, most transformers are filled with mineral oil or silicone.

PCBs are chlorinated fire-resistant fluids that meet the definition established in the National Electrical Code (NEC) for askarel, the generic name for non-flammable synthetic chlorinated hydro-carbons used for insulating media. Askarel transformers, containing 40 to 60



Figure 4-1. Two PCB Transformers.

percent PCBs, with the remainder of the fluid being chlorobenzenes, were manufactured in the United States from 1929 to 1978. Askarel transformers were made in a variety of sizes, containing from three to 3,000 gallons (average 235 gallons) of liquid. They were generally used in locations where flammability was a concern. Many mineral oil transformers may have been contaminated with PCBs through servicing or at the time of manufacturing. Figure 4-2 shows an oil filled transformer and a non-oil filled transformer.

The regulations define *PCB* and *PCBs* as any chemical substance that is limited to the biphenyl molecule that has been chlorinated to varying degrees or any combination of substances which contains such substances. The regulations define a *PCB Transformer* as any transformer containing 500 ppm PCBs or greater. *PCB-Contaminated Transformers* contain PCBs at concentrations greater than or equal to 50 ppm and less than 500 ppm. The inspector should be aware that the PCB concentration of transformer bushings may differ from the transformer.

The inspector should note that regulations pertaining to railroad transformers are separate from those relating to other transformers. Therefore, the information pertaining to railroad transformer regulations, as well as to maintenance, repair, and inspection of railroad transformers, is presented separately, later in this chapter.

4.1.2 Transformer Locations

As of August 28, 1998, owners/operators of PCB Transformers in use, or in storage for reuse, must register those transformers with EPA. Owners/operators of a transformer who failed to register in 1998 are still required to register. This registration is a one-time requirement. When an owner/operator of a company removes PCB Transformers from service and disposes of them, it need not update its original registration. EPA has developed a database of the registered PCB Transformers (the PCB Transformer Registration Database) which can be accessed at www.epa.gov/pcb/data.html. Based on a simple analysis of the company names in the October 2001 version of this database, the industries listed in the table below registered the most transformers. The inspector should use the information below only as a general guide to which industries commonly have PCB Transformers, as opposed to an exact count of the transformers in use. Some owners of PCB Transformers may not have registered, while others incorrectly registered.

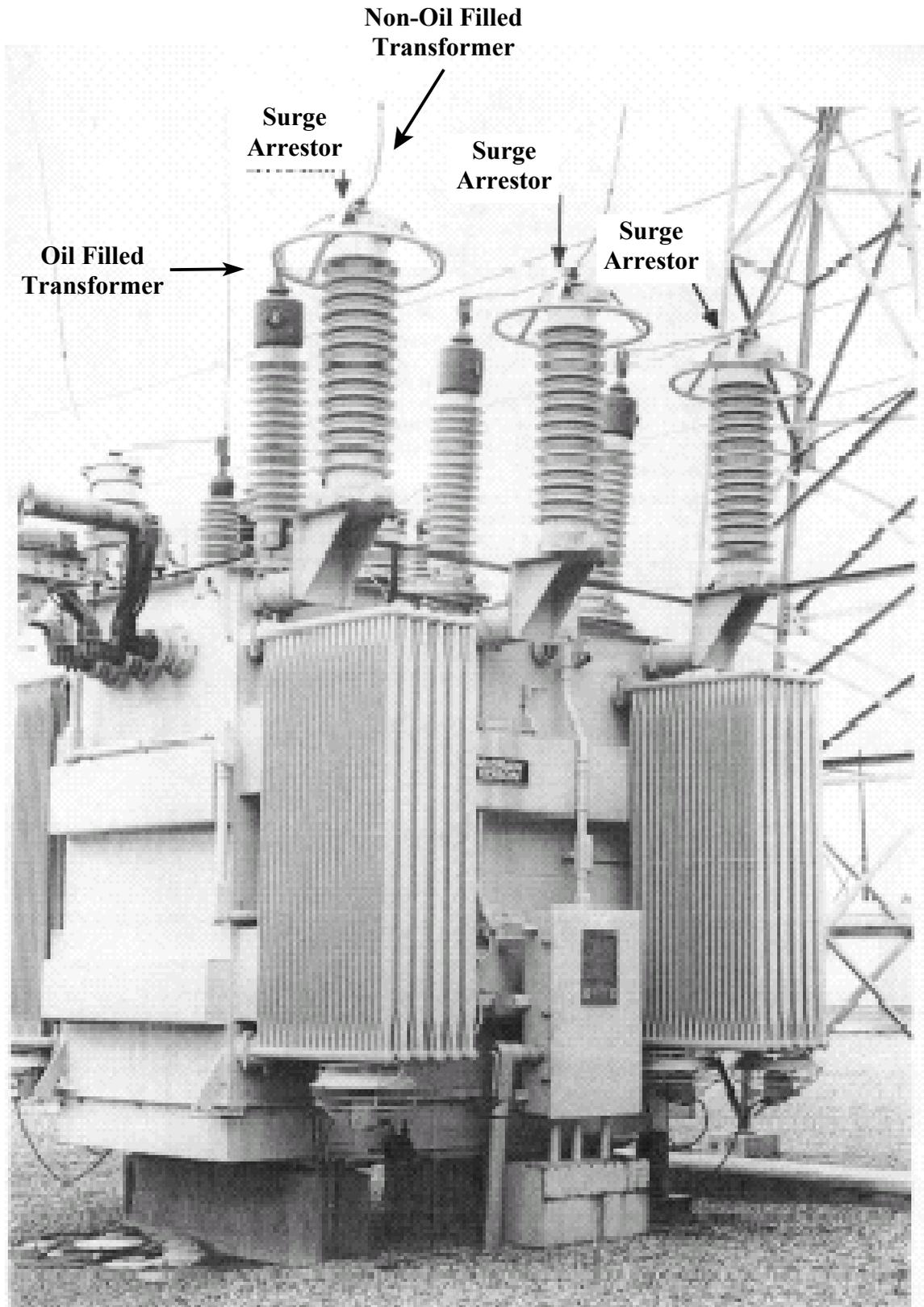


Figure 4-2. Oil filled and non-oil filled transformers.

Table 4-1. Estimate of the Number of Registered Transformers by Industry Sector

Industry Sector	Number of Registered Transformers
Utilities	10,644
Steel	1,968
Federal	1,805
Metal	1,292
Automotive	1,063
Paper and Paper Products	391
Tire and Rubber	344
Mining	340
Education	308
Transportation	287
Textiles	221
Durable Goods	215
Chemicals and Polymers	208
Cement and Concrete	179
Non-Federal Government	164
Fertilizer and Allied Products	150
Glass	135
Pharmaceutical	113
Oil/Gas/Refinery	111
Building Materials	102
Other	1,814
Grand Total	21,854

PCB Transformers are in use in a wide variety of locations, often including:

Utilities

- PCB Transformers can be found in:
 - Distribution substations
 - Generating facilities (including coal, gas, and nuclear facilities).

Mines

- Transformers are usually located within the power substation that supplies electricity to the entire mine. (See Appendix F for more information regarding the use and distribution of PCBs in underground mines and training and safety issues for inspectors visiting mines.)

Industrial and Other Sectors

- Industries with high-power requirements or equipment are likely to have PCB Transformers. Likely locations of PCB Transformers include:
 - In electrical substations
 - Inside, around, or on top of buildings
 - In powerhouses that generate and distribute electrical power throughout the facility
 - In underground vaults.
- Transformers can also be found in the broadcasting industry.

Commercial Buildings

- PCB Transformers often are used inside commercial buildings to meet fire code restrictions or to reduce fire insurance premiums. Most commercial building owners contract the servicing of their transformers to transformer maintenance and repair companies. However, commercial building owners may not own PCB Transformers. The electric utility providing service to the building often owns such units. The inspector should determine who owns and is responsible for the unit.
- Neon signs may also contain PCB Transformers and may be found on old or abandoned commercial buildings or in scrap yards.

Railroads and Subways

- Railroad companies used PCBs in on-board transformers in electric locomotives and self-propelled cars in service in the Northeast Corridor (Washington to Boston). The transformers reduce the high voltage current from overhead lines. Subway systems used PCB Transformers to distribute power to subway cars. Transformers are generally underground.

4.1.3 Maintenance and Repair of PCB Transformers

PCB Transformers (both railroad and others) require periodic maintenance and repair, which may be handled by facility staff or by independent contractors.

- Independent firms may contract to maintain and repair transformers for all types and sizes of industries, including small firms (e.g., commercial buildings).
- Maintenance divisions of larger industries may operate facilities to maintain and repair transformers. These divisions occasionally service transformers for other firms.

Maintenance operations take place both onsite (at the operating location of the equipment) and offsite (at a special shop or facility operated by the firm or by the contractor).

- Onsite maintenance and repair may involve considerable handling of PCBs, including:
 - Transport of items such as waste liquids and contaminated rags to storage or disposal.
- Offsite maintenance may occur in specific facilities used only for transformer maintenance or in shops that handle other maintenance as well. The handling includes:
 - Removal of the transformer from the operating site
 - Transport of damaged or leaking equipment
 - Transport of waste to storage or disposal site
 - Reinstallation of repaired equipment.

PCB Transformer Maintenance

PCB Transformers (excluding railroad transformers, which are discussed below) require service periodically and repair when out-of-order. Maintenance includes:

- Sampling fluid to test dielectric strength
- Topping off fluid (historically a source of PCB contamination)
- Replacing gaskets, bushings, insulators, etc., which may involve partial draining of the unit
- Removing and filtering the dielectric liquid and refilling the unit
- Removing PCB liquid and refilling with replacement dielectric fluid
- Generating waste liquid, contaminated rags, equipment, etc., which must be disposed of in accordance with the regulations.

Railroad Transformer Maintenance

Railroad transformers require additional and more frequent maintenance because of their unique installation and operating circumstances:

- On-board transformers are subject to severe conditions (high loads, cramped space) and require a high level of maintenance.
- Pumps circulate oil containing PCBs through the transformers, where the oil absorbs heat, to a series of finned radiators which dissipate the heat.
- Transformers and the cooling apparatus located in the undercarriage are subject to damage from objects dislodged from the roadbed. Inspectors should be aware that leaks can cause exterior surfaces to become contaminated.

Maintenance frequently takes place in repair pits, which can become severely contaminated with PCBs. Operations are similar to those listed for other PCB Transformers, but include additional activities, such as:

- Repairing/replacing circulating pumps and damaged, leaking cooling systems and radiators
- Dismantling/disconnecting cooling systems filled with PCB fluids
- Decontaminating the system and equipment surfaces.

4.1.4 Manufacturers and Trade Names

Many manufacturers of PCB askarel liquid identified the substance by a trade name. PCBs have been used since 1929, and many of the early manufacturers have gone out-of-business.

**Table 4-2. Transformer Manufacturers and
PCB Fluid Trade Names**

Transformer Manufacturer	PCB Fluid Trade Name
Allis-Chalmers	Chlorextol
American Corporation	Asbestol
Cornell Dubilier	Dykanol
Electro Engineering Works	
Envirotech Buell	
ESCO Manufacturing Company	Askarel*
Ferranti-Packard Limited	Askarel*
General Electric	Pyranol
H.K. Porter	
Helena Corporation	
Hevi-Duty Electric	Askarel*
ITE Circuit Breaker Company	Non-flammable Liquid
Kuhlman Electric	Saf-T-Khul
Maloney Electric	
Mitsubishi	Kennechlor, Santotherm
Monsanto (fluid only)	Aroclor
Niagara Transformer Corporation	Askarel*, EEC-18
Power Zone Transformer	EEC-18
Research-Cottrell	Askarel*
Standard Transformer Corporation	
Uptegraff Manufacturing Company	
Van Tran Electric	
Wagner Electric	No-Flamol
Westinghouse	Inerteen
-----	Nepolin

* Generic name for non-flammable insulating liquids.

Note: There may be other manufacturers and PCB fluid trade names that are not listed.

4.2 Capacitors [§761.30(l)]

4.2.1 Background

Capacitors regulate the flow of electric current. PCBs were the dielectric fluid used in approximately 95 percent of U.S.-produced, liquid-impregnated capacitors manufactured prior to 1978. The regulations require that all capacitors be disposed of as a PCB Capacitor except when a specific capacitor is known not to contain PCBs based on a label or nameplate, manufacturers' literature, or chemical analysis. To assist in this determination, EPA regulations required all non-PCB, large low voltage capacitors, small capacitors, and fluorescent light ballasts manufactured between July 1, 1978, and July 1, 1998, must bear a "No PCBs" label [§761.40(g)].

There are two general types of capacitors containing PCBs: (1) capacitors built into electrical equipment, such as fluorescent lights, televisions, and small motors, which are smaller in size; and (2) capacitors used as separate units in electrical power distribution systems, which are larger in size (see Figure 4-3).

The PCB regulatory program under TSCA defines three types of PCB Capacitors in 40 CFR 761.3:

- A small capacitor contains less than 1.36 kg (3 pounds) of dielectric fluid.
- A large high voltage capacitor contains 1.36 kg (3 pounds) or more of dielectric fluid and operates at 2,000 volts (AC or DC) or above.
- A large low voltage capacitor contains 1.36 kg (3 pounds) or more of dielectric fluid and operates below 2,000 volts AC or DC.



Figure 4-3. Six large high voltage capacitors.

4.2.2 Locations

The following is a list of likely locations, by economic sector, of capacitors. Within these sectors, the capacitors may be located almost anywhere.

Electric Utilities

- Capacitors are usually located in distribution substations.

Manufacturing

- Capacitors are:
 - Located in banks or individually.
 - Located in underground pump stations.
 - Used for power factor correction on motor control circuits and as part of the circuitry of electric induction furnaces.
 - Used for power correction or startups of large motors as used commonly with water pumps for large air conditioning systems or lift stations.
 - Used for startup of any large motor associated with manufacturing (e.g., drills, saws).

Subway Systems

- Large capacitors are used:
 - In conjunction with underground transformers.
 - On subway cars.

Mines

- Capacitors are:
 - Usually located within the power substation that supplies electricity to the entire mine
 - Located underground in skid-mounted or wheel-mounted power centers or individually
 - Often installed in control boxes for large electrical motors.

4.2.3 Maintenance and Repair

Facilities replace rather than repair non-functioning capacitors. Short-circuiting units can rupture and leak.

4.2.4 Manufacturers and Trade Names

Several companies manufactured PCB Capacitors in the United States from 1929 until 1978. Many of the manufacturers identified the PCB dielectric liquid by trade name. The following list of manufacturers and trade names is not necessarily complete and, therefore, should be used only as a guide.

Table 4-3. Capacitor Manufacturers and PCB Fluid Trade Names

Capacitor Manufacturer	PCB Fluid Trade Name
Aerovox	Hyvol
Axel Electronics	
Capacitor Specialists	
Cornell Dubilier	Dykanol
Electrical Utilities Corporation	Eucarel
Electromagnetic Filter Company	
Federal Pacific	Non-flammable liquid
General Electric	Pyranol
Jard Corporation	Clorphen
McGraw Edison	Elemex
Monsanto (fluid only)	Aroclor, Capacitor 21, MCS 1489
P.R. Mallory & Company	Arclor B
R.F. Interonics	
Sangamo Electric Company	Diaclor
Sprague Electric Company	Clorinol
Tobe Deutschmann Labs	
Universal Manufacturing Corporation	Askarel*
Westinghouse	Inerteen
York Electronics	

* Generic name for non-flammable insulating liquids.

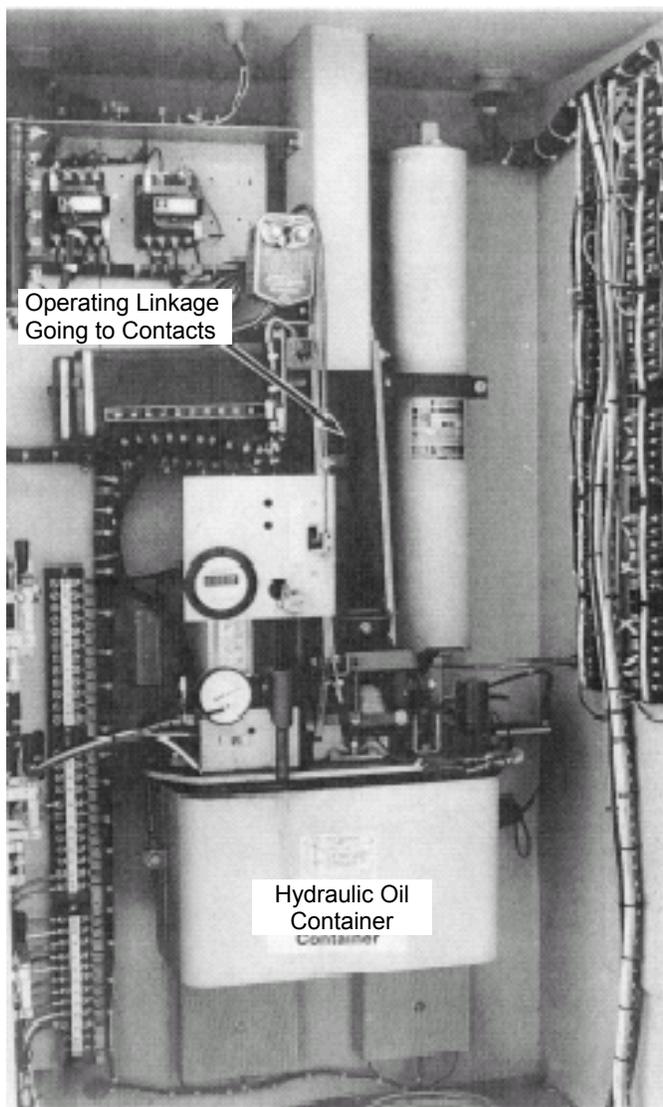
4.3 Other Electrical Equipment [§761.30(h) and (m)]

Other PCB-Contaminated Electrical Equipment includes circuit breakers, reclosers, voltage regulators, switches (including sectionalizers and motor starters), and electromagnets. The inspection guidelines are similar to those for capacitors. Figure 4-4 shows a circuit breaker system and location where PCB-contaminated oil may be found.

4.4 Hydraulic Systems [§761.30(e)]

4.4.1 Background

Hydraulic systems are machines that operate by the force exerted by pressurized and confined liquid. Many steel manufacturing and die casting plants used PCBs in hydraulic systems to reduce fire hazards on machines that handled hot metals. These systems included hydraulic systems for metal dye casting equipment, trim presses, induction hardening machines, heat treating furnaces, forge furnaces, and forge presses. The PCB regulations authorize the use of hydraulic systems containing PCBs below 50 ppm. Owners drained and flushed hydraulic systems in an attempt to reduce PCB contamination. However, systems may still be contaminated with residual PCBs that remained after refilling with non-PCB fluid. Hydraulic systems normally leak several times their capacity each year because the fluid is often pressurized to several thousand pounds per square inch causing the system to leak at connection joints and piston rings.



4.4.2 Manufacturers and Trade Names

The following list of hydraulic fluid trade names may not contain all trade names. PCBs have been used since 1929, and many of the early manufacturers have gone out-of-business.

Table 4-4. Hydraulic Fluid Manufacturers and Trade Names

Manufacturer	Hydraulic Fluid Trade Names	
Monsanto	Pydraul A-200	Pydraul 230
	Pydraul A-200-B	Pydraul 230-A
	Pydraul AC*	Pydraul 280
	Pydraul AC-A*	Pydraul 312
	Pydraul AC-28	Pydraul 312-A
	Pydraul F-9	Pydraul 540
	Pydraul F-9-A	Pydraul 540-A
	Pydraul 135	Pydraul 540-B
	Pydraul 135-A	Pydraul 625
	Pydraul 150	Pydraul 625-A
	Pydraul 150-A	Turbinol 153
	Santovac 1	Santovac 2

* These were reportedly used as lubricating fluids in some natural gas pipelines as well.

4.5 Other PCB Equipment

4.5.1 Fluorescent Light Ballasts

Light ballasts are the primary electric components of fluorescent light fixtures and are generally located within the fixture under a metal cover plate. The PCBs are located in the light ballasts' small capacitor or in the potting material, the insulating material inside the ballast. Since 1978, EPA has required manufacturers of fluorescent light ballasts to mark ballasts that do not contain PCBs with the statement "No PCBs." Inspectors should assume that light ballasts contain PCB small capacitors if they were manufactured before 1978 or do not have a "No PCBs" statement. Table 4-5 indicates the disposal requirements for fluorescent light ballasts. Please note that after July 1, 1998, fluorescent light ballast manufacturers are no longer required to mark fluorescent light ballasts with the statement "No PCBs."

Table 4-5. TSCA Disposal Requirements for Fluorescent Light Ballasts

PCB Capacitor	PCB Potting Material	Labeling, Transportation, and Manifesting for Disposal	Disposal Reference in §761	Disposal Options
"No PCBs" label		Not regulated under TSCA.	N/A	Not regulated under TSCA.
None*	< 50 ppm	Not regulated under TSCA.	N/A	Not regulated under TSCA.
Intact and non-leaking or none*	≥ 50 ppm	-Is a PCB bulk product waste. -No labeling is required. -Manifesting is required for disposal in accordance with §761.62(a); is not required under §761.62(b); may be required under §761.62(c).	.50(b)(2)(ii) .62(a)-(c)	-TSCA incinerator** -TSCA/RCRA landfill Alternate Destruction Method. -Decontamination (§761.65(d) storage may be required). -Coordinated approval. -State-approved landfill (leach test required). -Risk-based approval.
Intact and non-leaking	< 50 ppm	No labeling or manifesting required.	.50(b)(2)(i) .60(b)(2)(ii)	Dispose as municipal solid waste (§761 Subpart D options).
Leaking	< 50 ppm or ≥ 50 ppm	-Disposal as PCB bulk product waste. -No labeling is required. -Manifesting is required for disposal in accordance with §761.62(a); may be required under §761.62(c).	.62(a) or (c)	-TSCA incinerator* -TSCA/RCRA landfill Alternate Destruction Method- -Decontamination (§761.65(d) storage may be required). -Coordinated approval. -Risk-based approval.

* "None" means that the capacitor contains no PCB's or was manufactured after 1978.

** A TSCA incinerator is one approved by the Regional Administrator or by the Director of NPCD to handle TSCA waste.

Source: www.epa.gov/pub/guidance.html (EPA PCB Website)

4.5.2 Heat Transfer Systems [§761.30(d)]

Heat transfer systems use fluids of high heat capacity to remove unwanted heat or to transfer heat from one place to another within a system. They are commonly used to provide heat in chemical manufacturing where temperatures greater than that provided by steam are needed. Heat transfer systems in certain applications used PCBs as a heat transfer fluid. Heat transfer

systems that contained PCB fluid were refilled with non-PCB fluid approximately 90 percent of the time. Despite this refilling, most systems contained residual PCBs. Leaks usually occur through pump motor seals.

Inspectors of facilities using PCB heat transfer fluid should ensure that all systems are below the 50 ppm limit by checking records or sampling (if it is safe to sample). Inspectors should also review disposal records such as manifests for PCB-contaminated fluid drained from the systems to determine if the facility properly stored the fluids for disposal or disposed of the fluids by incineration and visually check for PCB contamination and current releases of PCBs on site due to prior spills or disposal of the PCB fluids.

The following is a list of heat transfer fluid manufacturers although it may not contain all trade names. PCBs have been used since 1929, and many of the early manufacturers have gone out-of-business.

Table 4-6. Heat Transfer Fluid Manufacturers and Trade Names

Manufacturer	Heat Transfer Fluid Trade Names
Geneva Industries	Monsanto FR-1
Monsanto	Therminol FR-0 Therminol FR-2 Therminol FR-LO Therminol FR-3 Therminol FR-1

4.5.3 Natural Gas Pipelines [§761.30(i)]

A number of gas pipeline companies used PCBs as a working fluid in their compressors between 1950 and the early 1970's. There are several sources of PCBs associated with natural gas transmission pipelines. The use of PCBs in turbine compressors leaked PCBs (Aroclors 1221, 1242 and 1248) into the transmission pipelines and contaminated the existing natural gas pipeline liquids (water and condensate). The condensate fraction consists of heavier hydrocarbons that may be ignitable, BTEX (benzene, toluene, ethyl benzene and xylenes) and naphthalenes. The PCB contamination spread to other interconnected pipeline systems. The improper disposal of PCB contaminated condensate into open pits, via spills and venting caused significant contamination at natural gas companies such as Texas Eastern and Transwestern compressor stations. The historical use of waste oils, contaminated with PCBs, to "fog" or lubricate the old pipelines and use (probably minor) of a Rockwell plug valve sealant/grease containing PCBs (Aroclor 1268) also contaminated existing natural gas pipeline condensate. The use of PCBs (Aroclors 1221, 1242, 1248 and 1254) in reciprocating air compressors and associated blowdowns resulted in onsite surface soil and wastewater drainage system PCB contamination. This use did not result in transmission pipeline PCB contamination. This occurred at Texas Eastern, Tenneco, Columbia Gas, Texas Gas and other companies.

Current regulations (761.30(i)) authorize the use of PCBs in natural gas pipelines at concentrations of less than and greater than 50 ppm PCBs under certain conditions. These (761.30(i)) are the rules that now govern the PCBs that still remain in the various natural gas transmission pipelines. The old PCB/Compliance Monitoring Program (CMP) was terminated when this rule was promulgated in 1998. Additional NGP information and details of the 1981 and 1996 PCB CMP are found in Appendix G of this manual.

4.5.4 Electric Motors

In the late 1960s and early 1970s, Reliance Electric for Joy Manufacturing Company manufactured electric motors that contained PCBs. Liquid-filled motors were used because they were smaller and lighter than air-cooled motors. Manufacturers chose a PCB mixture for the liquid because it was non-flammable, provided adequate lubrication, and possessed the best overall combination of electrical properties, chemical stability, and cost.

Mining machine electric motors used on certain underground continuous loaders built by Joy contain PCBs as a coolant fluid in the large cutting head motors and traction motors. Previous versions of the regulations established a deadline of January 1, 1982, for phasing-out the use of these motors. The current regulations [§761.30(c)] allow the use of PCB-containing mining equipment only under 50 ppm.

Submersible well pump motors manufactured before 1979 may contain up to five ounces of PCB dielectric fluid in their capacitors. PCBs may leak out of these submersible well pump motors during normal wear-and-tear or when the pump suddenly fails due to lightning strikes or electrical failures or shorts. Appendix H contains the manufacturer's models and serial numbers of some of the submersible pump units that contain PCBs.

4.5.5 Electromagnets [§761.30(h)]

Regulations prohibit servicing, including rebuilding, of PCB electromagnets with a PCB concentration of 500 ppm or greater that requires the removal of internal components.

4.5.6 Products Containing PCBs

Other products that may contain PCBs include:

- Investment casting wax
- Carbonless copy paper
- Resins
- General sealants and coatings, including windshield sealant and silo sealant
- Lubricants, including bridge bearings and additives to transmission fluids
- Paint, including marine paint
- Electrical cable insulation
- Gaskets
- Roofing materials.

Blank Page