

# CLOR·N·OIL™

PCB Screening Kit

U.S. EPA  
Method  
9079

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**DEXSIL®**

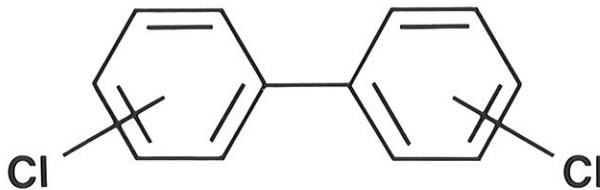
# DEFINITIONS

PCB stands for "polychlorinated biphenyl" and is classified as a chlorinated hydrocarbon. PCB is made by attaching one or more chlorine atoms to a biphenyl molecule. PCB was used primarily as electrical insulating fluid in transformers, capacitors, and other electrical apparatus. PCB has a heavy oil-like consistency, is very stable, and exhibits low electrical conductivity. As well, PCB has a low water solubility, low vapor pressure, low flammability threshold, and high heat capacity, all of which made PCB an obviously stable insulating fluid in high energy electrical equipment.

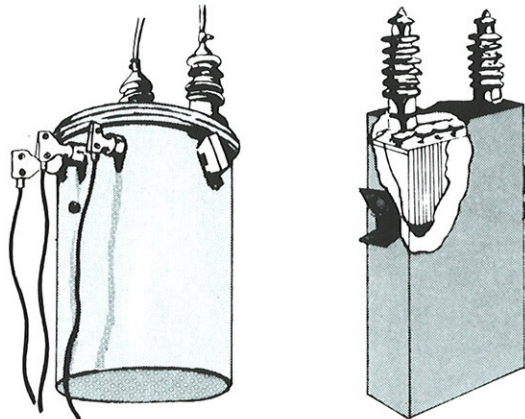
PCB was marketed under various trade names including:

Abestol	Elemex
Adkarel	Eucarel
Aroclor	Hyvol
Aroclor B	Inerteen
Askarel	No-Flamol
Chlorextol	Pyranol
Clorphen	Saf-T-Kuhl
Diactor	Sanotherm
Dykanol	

Askarel is the most common name used to refer to PCB and is often used to mean any combination of PCB and chlorinated benzenes.



PCB is formed by joining from 1 to 10 chlorine atoms to a biphenyl molecule.



PCB is extremely stable, non-conductive, and exhibits low flammability; which made it an ideal electrical insulating and heat transfer fluid.

# EPA REGULATIONS

Environmental Protection Agency (EPA) regulations limit the concentration of PCB in electrical insulating fluid to less than 50 parts per million (ppm) wt/wt basis. Equipment containing fluid with a PCB concentration between 50 and 500 ppm is considered to be "PCB contaminated," while equipment containing fluid with a PCB concentration greater than 500 ppm is considered to be a "PCB item." Any oil or equipment containing a concentration of PCB greater than 500 ppm must have been removed from food and feed facilities by October 1985. By December 1985 all transformers containing greater than 500 ppm must have been registered with local fire personnel, and by October 1990, the use of PCB transformers with high secondary voltages ( $\geq 480$  V) was prohibited.

The EPA has determined that PCB poses a health risk to humans because of its uncommonly stable molecular structure. Once introduced into the environment, PCB will not break down into other chemicals and therefore allows any potential health hazards to persist for indefinite periods of time. The EPA has ruled that PCB is "toxic and persistent."

The most immediate health hazard to humans occurs when PCB is burned at low temperatures and creates the highly toxic chemical, dioxin. In contact with the human body, PCB also has the potential for developing chloracne, a disfiguring, though reversible, skin illness. Animal research also suggests the probability of reproductive disorders, developmental toxicity, and the formation of tumors (oncogenicity).

# ABOUT THE KIT

The Clor-N-Oil PCB Screening Kit was developed by the Electric Power Research Institute (EPRI) in response to the U.S. EPA's decision to restrict the use of, and eventually remove from service, all electrical equipment containing PCB contaminated insulating fluid. Research for the kit was funded by EPRI and performed by General Electric Company of Pittsfield, Massachusetts, and Dexsil Corporation of Hamden, Connecticut. Dexsil manufactures and markets the Clor-N-Oil kit. By using the kit as a comprehensive screening test of all suspect transformers, utilities and other users are able to eliminate up to 90% of costly laboratory analysis that is normally required.

In addition to significant cost savings, the Clor-N-Oil Kit offers immediate, on-site results in less than five minutes when equipment needs repair or when site cleanup

involves fluid spills of an unknown PCB level. Although the Clor-N-Oil Kit does not eliminate the need for all laboratory analysis, it can significantly reduce the number of samples which must be sent to the lab. The kit has been used extensively throughout the U.S. and Canada, as well as in Europe, South America, and the Far East. Four different test levels for the Clor-N-Oil kit are currently available – 20 ppm, 50 ppm, 100 ppm, and 500 ppm. Each kit is used in the same way – the end point for each has been adjusted so that it turns color at the proper level. The kit involves a "go, no-go" type of test where the result is either positive or negative – for instance, the Clor-N-Oil 50 kit will reveal whether a sample is above or below 50 ppm, but will not tell whether a sample contains 70 or 80 ppm. When the kit registers under 50 ppm, however, the darker the color, the closer the sample is to zero.

# CLOR-N-OIL™ ADVANTAGES

## Test Samples at 20, 50, 100 or 500 ppm :

Four different Clor-N-Oil kits are available to test at either 20, 50, 100, or 500 parts per million.

## It's Easy to Use:

The Clor-N-Oil screening kit involves a simple procedure that can be performed by anyone in the field, lab, or maintenance shop. No

calibrations are required as all reagents are pre-measured in crushable glass ampules.

## It's Quick:

With Clor-N-Oil, the entire testing procedure takes less than four minutes from the time the oil sample

is taken from the electrical apparatus to the time results are obtained.

## It's Convenient:

Since no instruments are required, tests can be performed immediately, on site. The 2 oz. kit can be stored in

any lab or field vehicle for quick access on short notice when emergency testing is required.

## It's Safe:

All Clor-N-Oil reagents are self-contained within the kit. After pipetting the oil sample into the pre-marked reaction tube, no measuring

or pipetting of reagents is required — no reagent or other chemical ever comes into contact with the person using the kit.

## It's Inexpensive:

Using the PCB Screening Kit, the analysis can be accomplished at a

fraction of the cost of laboratory analysis.

# COST ANALYSIS

Regular systematic testing of all company-owned or operated transformers can be very expensive if the testing method used is gas chromatography (GC). The Clor-N-Oil kit can save up to 70% of the total cost of GC testing, as well as alleviate downtime while waiting for GC analysis results.

One major utility has successfully used the kit to test and screen over 100,000 suspect transformers. Of all those tested to date, approximately 93% have tested negative (below 50 ppm PCB) eliminating the need for further testing. At this rate, use of the Clor-N-Oil kit will result in savings of between 1.4 and 3.7 million dollars for every 100,000 transformers tested.<sup>1</sup>

EPA regulations require that any PCB spill be treated as contaminated if the actual PCB concentration is not known. Clean-up costs for such leakage can run as high as \$10,000 per spill. Virginia Electric and Power Company estimates a yearly savings of \$124,000 by using the Clor-N-Oil kit to determine, on site, the PCB level of any leaking or damaged transformer. Such on-site testing allows for quick determination of

contaminated or non-contaminated fluids resulting in carefully informed decisions regarding cleanup procedures, saving Virginia Electric considerable expense in cleanup and litigation fees.<sup>2</sup>

Much of the savings realized by the Clor-N-Oil kit is found in the time saved in the sampling and testing process. Because the Clor-N-Oil kit is extremely portable and inexpensive, several kits can be kept on site at service shops, substations, and in company vehicles. In the event of a spill or other emergency situation, a kit is usually in close proximity and the test can be completed within a matter of minutes. If the kit is not used, and a laboratory test must be run, a sample from the unit in question must be sent to a laboratory and then run on a gas chromatograph. This process takes at least an hour, and very often results are not reported for three or four days. During this time, the spill area must be roped off because the oil must be considered contaminated until it has been shown otherwise. This very often results in having to keep customers off line and crews on location for longer than is necessary.

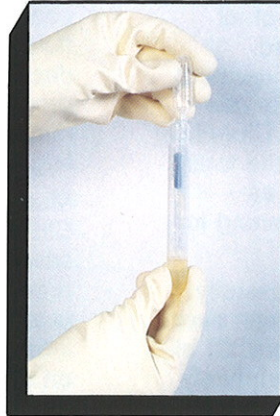
<sup>1</sup> "Clor-N-Oil Test Kit as a PCB Screening Tool," *Proceedings: 1985 EPRI PCB Seminar*, pp 4-7 to 4-14, EPRI CS/EA/EL-4480.

<sup>2</sup> "Quick and Easy Field Testing for PCBs: Clor-N-Oil," EPRI "First Use" #4ZZZF, Dec. 1984.

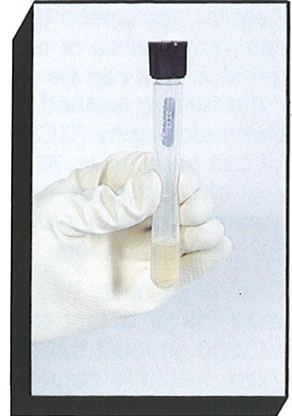
# STEP BY STEP

## Step 1

Unscrew black cap from the first tube. Using the plastic pipette, fill the tube with exactly 5 ml of transformer oil (to 5 ml line on tube). Replace the black cap securely.



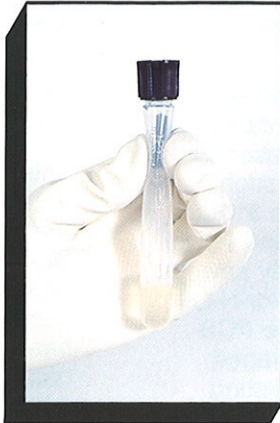
Step 1



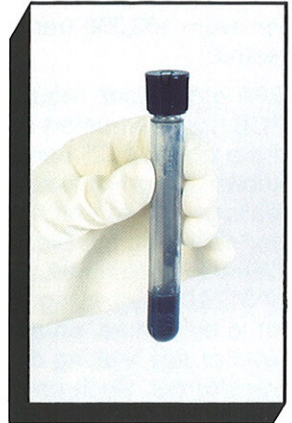
Step 2

## Step 2

Break the colorless ampule (lower) in the black-capped tube by compressing the sides of the tube. Shake for ten seconds. Break the gray ampule (top) and shake for ten seconds. (Be sure that the colorless ampule is broken first, the gray one second.) Allow to react for one minute, shaking intermittently. Place the tube in holder in the box.



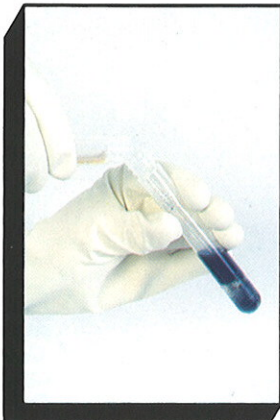
Step 2a



Step 2b

## Step 3

Keep black tube in holder. Remove the caps from both tubes and pour the clear solution from the white-capped tube into the black-capped tube. Replace the black cap and shake the tube for ten seconds. Vent the tube by unscrewing the black cap 1/2 turn. Tighten cap securely and shake for ten seconds more. Vent tube again and tighten cap securely. The oil should no longer appear gray.



Step 3



Step 3a

# DIRECTIONS

## Step 4

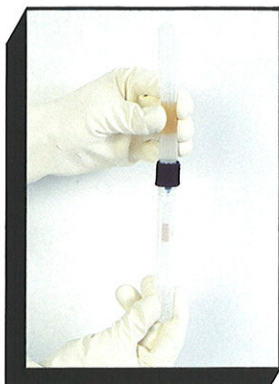
Turn the black-capped tube upside down, allow the solution to settle for two minutes. If the yellowish oil layer (5 ml) is below the clear buffer layer (7 ml), stop the test since the oil is primarily pure PCB. If the yellowish oil layer is on top of the clear water layer, position the black tube over the white tube, carefully flip open the black nozzle (keep nozzle pointed away from operator) and dispense exactly 5 ml of the buffer solution into the white-capped tube (to 5 ml line on the white tube). Replace the white cap securely and close the nozzle on the black cap.



Step 4 If oil layer is on bottom, STOP test.



Step 4a If oil layer is on top, continue test.



Step 4b



Step 4c

## Step 5

Break the colorless ampule (bottom) in the white-capped tube, shake for ten seconds. Break the colored ampule (top), shake for ten seconds, and observe color.



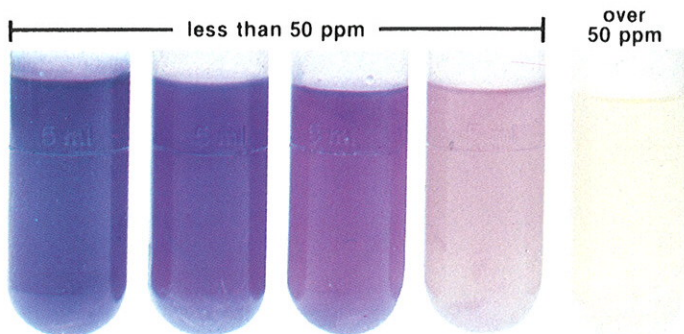
Step 5



Step 5a

## Step 6

If the solution is purple, the oil sample contains less than 50 ppm PCB. If it is yellow or colorless, it may contain more than 50 ppm PCB and should be tested further by a PCB specific method. Disregard any color which may develop in a thin layer of oil on top of the solution.

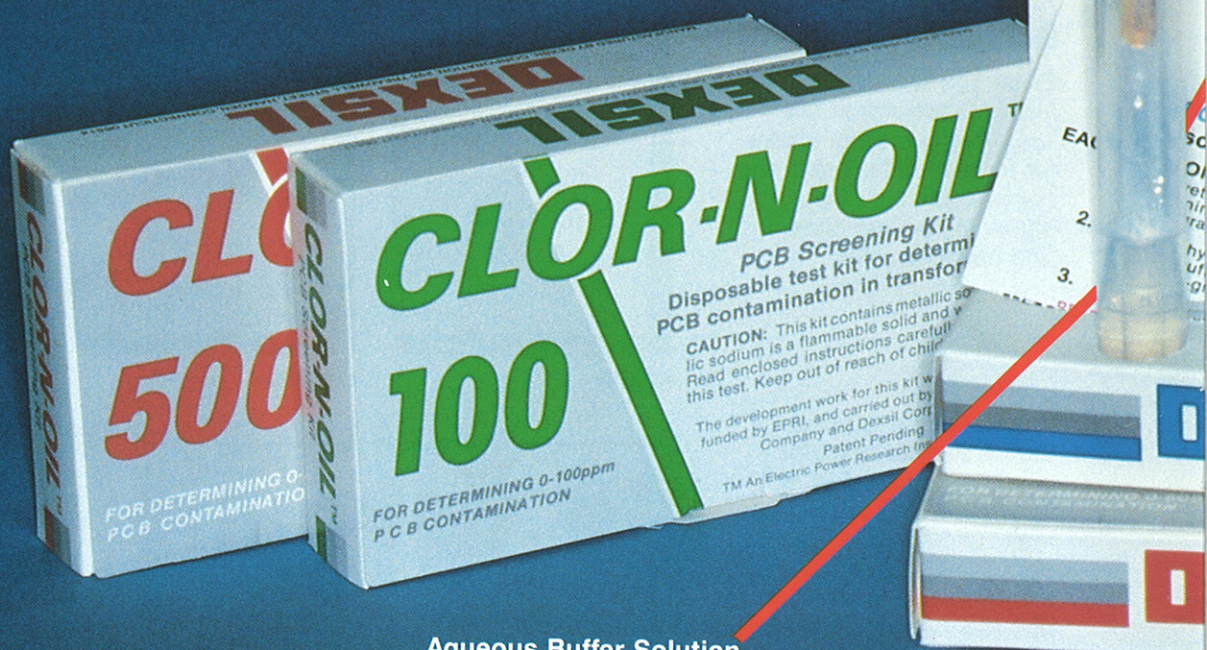
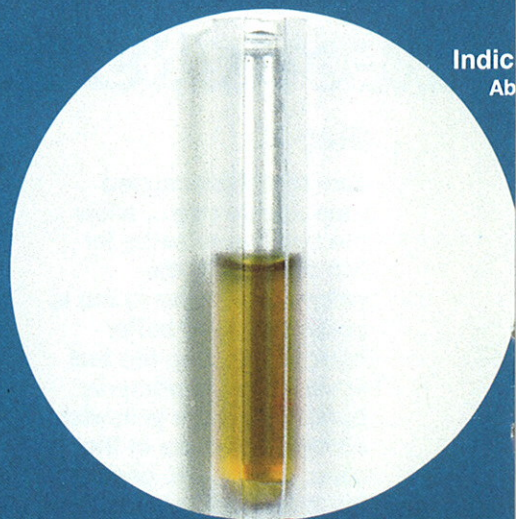


# PCB SCREENING KIT

## Each Kit Contains:

1. A polyethylene test tube with a black dispensing cap containing a colorless ampule (bottom) and a gray ampule (top).
2. A polyethylene test tube with a white cap containing 7 ml of buffer solution, a clear ampule (bottom) and a red-green ampule (top).
3. A disposable polyethylene pipette for obtaining the oil sample.
4. A comprehensive set of instructions.

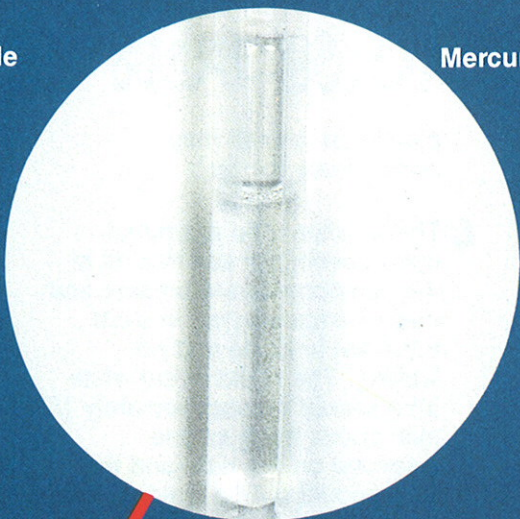
Check expiration date on the end of box.



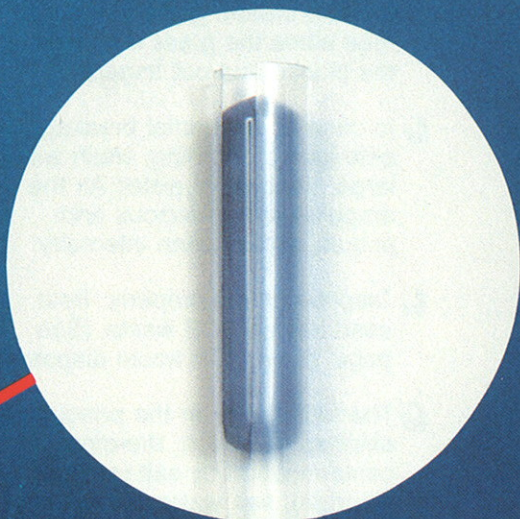
**Aqueous Buffer Solution**  
½ inch above 5 ml. line



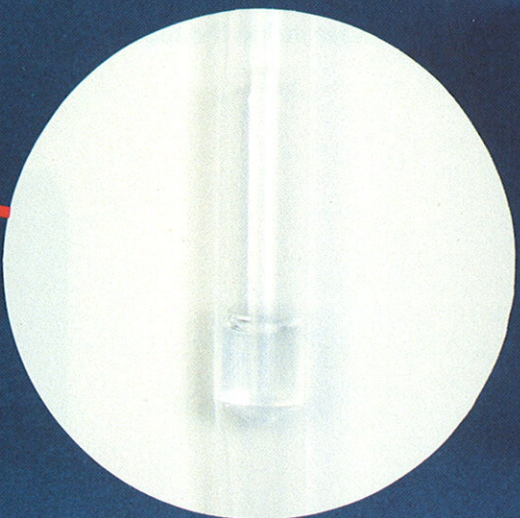
**Mercuric Nitrate Ampule**  
About half full



**Mercuric Nitrate Ampule**  
About 2/3 full



**Sodium Ampule**  
Not full but usually coats ampule to appear full



**Catalyst Ampule**  
About 1/4 full



INSTRUCTIONS FOR  
**CLOR-N-OIL™ 50**  
B Screening Kit  
Screening test for transformer

**CONTAINS:**

ethylene tube with a black dispensing cap  
and a colorless ampule (bottom)  
and a colorless ampule (top).

ethylene tube with a  
clear solution.

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# SUGGESTIONS FOR USING

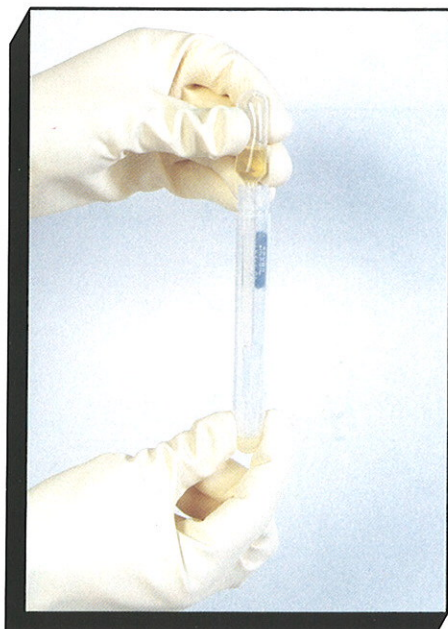
- Wear rubber gloves and safety glasses.
- When crushing glass ampules, press firmly in the center of the ampule **once**. Never attempt to recrush broken glass in the test tube since the glass may sever the plastic and cut fingers.
- In case of accidental breakage onto skin or clothing, wash with large amounts of water. All the ampules are poisonous and should not be taken internally.
- Dispose of kits properly. Treat used kits as PCB waste. (See page 13 on PCB waste disposal.)
- The test works on the principle of chloride detection, therefore, contamination by salt (sodium chloride), sea water, perspiration, etc., will give a false positive result and require further testing in the laboratory.
- Never touch the ampules, the holder inside the tube, or the pipette tip, as salt may contaminate the test.
- The kit should be examined upon opening to see that all of the components are present and that all ampules (two in each tube) are in place and not leaking. The liquid in the white tube should be approximately 1/2 inch above the 5 ml line inscribed on the tube and the tube should not be leaking. The ampules are not supposed to be completely full.
- The Clor-N-Oil test will not work on a sample that contains water. If, in step 2, the tube loses its gray color, the sample probably contains water and the test should not be run. Another sample may be tried if the oil is dried first.
- Freezing of the buffer solution does not damage the kit, but the solution should be completely melted before running the test.

Before using a kit, make sure that the expiration date has not passed.



# THE CLOR-N-OIL™ TEST KIT

- ❑ Perform the test in a warm, dry area with adequate light. In cold weather, a truck cab is sufficient. If a warm area is not available, step 4 of the directions should be performed while warming the tube in the palm of the hand.
- ❑ When drawing oil into the pipette, do not submerge tip too deeply into the oil sample. This will cause the pipette to drip.
- ❑ When inserting the pipette into the black tube, insert it all the way to the 5 ml line. This prevents oil from getting on the tube walls and reagent holder and allowing too much oil into the tube.
- ❑ Always crush the clear ampule in each tube first. If this has not been done, stop the test and start over using another complete kit. A false negative may result and allow a contaminated sample to pass without detection.
- ❑ Check expiration date on the end of the box. If kits have expired (more critical when kits are stored at higher temperatures) you will start to notice a greater number of false positive results. For instance, a sample that actually contains about 30 ppm PCB may show greater than 50 when tested with an outdated Clor-N-Oil kit. An expired kit will not give a false negative result.
- ❑ Remember that the kit is designed to test only transformer oil of petroleum origin. It may work on other fluids, but please check with Dexsil before using the kit on anything but transformer oil.
- ❑ A video tape showing how to take a sample and use the kit in the field is available from Dexsil. Please contact Dexsil if you feel that your company could make use of this video.



**Make sure the pipette is inserted to the 5ml line so that excess oil does not accumulate on the sides of the tube.**

# TECHNICAL APPROACH

The Clor-N-Oil PCB Screening Test is based on the detection of the total concentration of chlorine in an oil sample. Since all PCB contains some chlorine and the amount of chlorine is directly proportional to the amount of PCB, then the PCB concentration in a given sample can be indirectly measured by determining the total chlorine concentration.

During the testing process, the chlorine atoms are stripped away from the PCB through the action of sodium and a catalyst. The chloride ions are then introduced into a water buffer solution and reacted with a carefully controlled amount of dissolved mercuric nitrate. A color indicator, sensitive to mercuric ions, is then added. If there are more mercuric ions than chloride ions, the free mercuric ions react with the indicator resulting in a purple color, indicating less than 50 ppm PCB. If the number of chloride ions is equal

to or greater than the number of mercuric ions, then all the mercuric ions are associated with the chloride ions and there are no mercuric ions free to react with the color indicator, thus, no purple color can develop. The result is a pale yellow or colorless solution revealing the presence of greater than 50 ppm PCB.

Since the exact amount of mercuric nitrate is known, it is easy to determine if the concentration of chloride ions is above or below the preset endpoint dictated by the mercuric nitrate. Once the amount of chlorine is known, one has a good indication of the amount of PCB present in the sample. When a positive reading has been obtained with the Clor-N-Oil testing procedure, the oil sample should be further tested by a PCB specific method, usually gas chromatography, in order to determine the exact amount of PCB present in the sample.

ASKAREL TYPE	% PCB IN ASKAREL			% CHLORINATED BENZENES		COMPONENT RATIOS		PCB CONCENTRATION AT 21 PPM CHLORINE (point where Clor-N-Oil gives positive result)
	1260	1254	1242 (1016)	Trichloro-benzene	Tetrachloro-benzene	PCB/Askarel	Cl/PCB	
1) TRANSFORMER ASKARELS (ASTM D2283)								
A	60			40		0.60	0.99	21
B	45			40	15	0.45	1.34	16
C			80	15	5	0.80	0.57	37
D		70		30		0.70	0.79	27
E			100			1.00	0.42	50
F	45			40	15	0.45	1.27	17
G	60			40		0.60	0.92	23
2) CAPACITOR ASKARELS (ASTM D2233)								
A			100			1.00	0.42	50
B		100				1.00	0.54	39
C		75		25		0.75	0.73	29
D			(100)			1.00	0.42	50

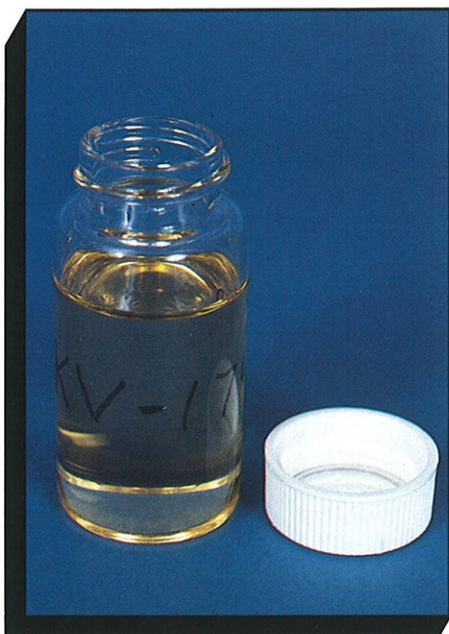
# Suggested Sampling Procedures

Accepted sampling procedures should be followed when taking an oil sample from a piece of electrical equipment or container for use with Clor-N-Oil or GC testing methods.

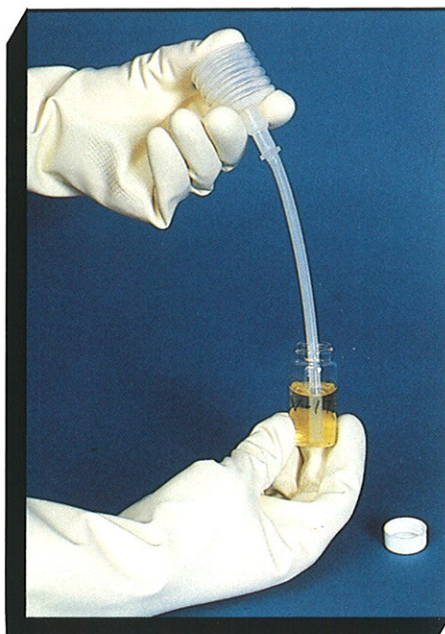
Test samples should be taken from a spot which is representative of the entire piece of equipment. Although PCB is generally evenly dispersed throughout the oil, there may be other interfering compounds which collect either at the top or bottom of the oil container.

Because water adversely affects both the Clor-N-Oil test and the GC test, it is recommended that the sample not

be taken from the bottom of the container since water is heavier and collects there. If possible, the sample should be taken a few inches below the surface of the oil. This will minimize the chances of contaminating the sample with water or other compounds that are unrepresentative of the whole. If the sample must be taken from the bottom of the unit, remove at least a quart of fluid before the sample to be tested is taken. When the sample is taken, make sure that the fluid is of consistent viscosity and color. If the oil does not appear homogenous, continue removing fluid until it does.



Samples should be stored in clean glass vials with either foil or Teflon<sup>®</sup>-lined caps.



Dexsil can provide both sample vials and a 20ml capacity pipette for taking samples from electrical equipment.

# Waste Disposal

EPA regulations regarding the disposal of waste oil fall into three categories: Oils containing less than 50 ppm PCB (Non-PCB), oils containing between 50 ppm and 500 ppm PCB (PCB Contaminated), and oils containing greater than 500 ppm PCB (PCB Fluid).

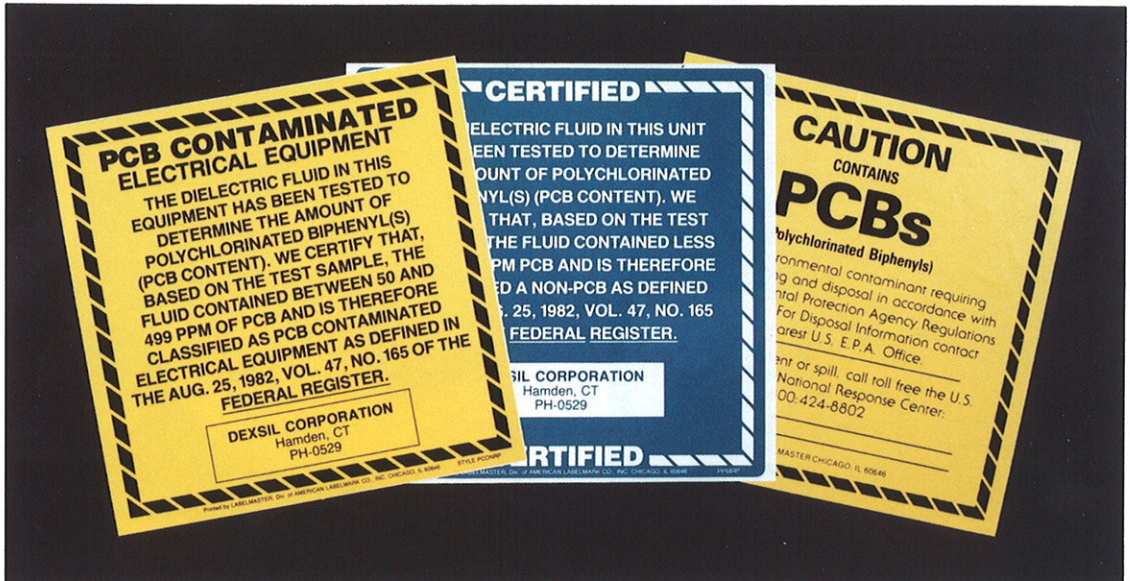
1. There are no regulations governing the disposal of transformers and oils containing less than 50 ppm PCB except that such oils may not be used as a coating, sealant, dust control agent, or pesticide carrier and may not be sold for re-use.
2. Transformers and oils containing between 50 ppm and 500 ppm PCB must be packaged and stored in a certified chemical

waste landfill, incinerated in high temperature boilers or incinerated in an EPA-approved high temperature incinerator.

3. Transformers and oils containing greater than 500 ppm PCB must be disposed of only by incineration in an EPA-approved high temperature incinerator.

Used Clor-N-Oil kits should be disposed of as PCB contaminated waste. Although any PCB has been broken down during the course of the chemical reaction, oil residue remaining in the extraction pipette may contain some concentration of PCB.

For additional information on PCB regulations, consult your regional EPA office or see 40 CFR Part 761.



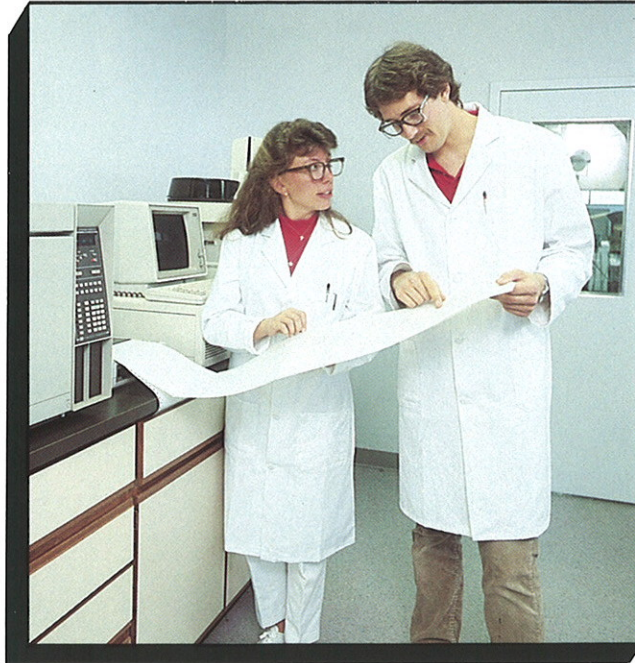
# GAS CHROMATOGRAPHIC ANALYSIS

Dexsil offers Gas Chromatographic analysis as an important follow-up to Clor-N-Oil. Once an oil sample has been screened with the Clor-N-Oil test, negative samples (less than 50 ppm) can be tagged and eliminated from concern. However, positive results (indicating greater than 50 ppm) often need to be tested by a PCB specific method, such as gas chromatography (GC), in order to determine actual PCB type and specific concentration.

Because the Clor-N-Oil kit is based on a total chlorine analysis, a positive result may occur when the sample is contaminated with

chlorinated sources other than PCB. A supplementary GC analysis will verify either the presence of PCB or the presence of some other chlorinated compound.

The Dexsil laboratory is able to perform GC analysis on oil, water, soil, or wipe samples at a discount to Clor-N-Oil users. The laboratory also possesses GCMS capability for samples which may be partially degraded or which may contain compounds that are structurally similar to PCBs. Please write or call Dexsil for additional information about all our laboratory services.



**Dexsil's gas chromatography laboratory performs analysis on oil, water, soil and wipe samples at a discount to Clor-N-Oil users.**