AROCLOR

Aroclor is Monsanto's brand name for a series of 3 capacitor impregnants composed of chlorinated diphenyl. The 3 grades are:

Aroclor 1242

(Commercially known as trichlorodiphenyl)

This grade now predominates and is used exclusively in many countries. It is the most economically attractive grade and is essential for capacitors installed outside in colder climates.

Aroclor 1248

(Commercially known as tetrachlorodiphenyl)

This grade continues to be used to a small extent, although it is less economic than Aroclor 1242.

Aroclor 1254

(Commercially known as pentachlorodiphenyl)

Although this grade was the first to be used in the capacitor industry, it has now been almost entirely superseded by Aroclor 1242.

These 3 grades of Aroclor are classified as 'capacitor askarels'. The term 'askarel' is defined by the American Society for Testing and Materials (ASTM) as 'a generic term for a group of nonflammable chlorinated hydrocarbons used as electrical insulating media'.

Aroclor was first used in the U.S.A. in 1929 and is now extensively used by the capacitor industry throughout the world. Monsanto has been producing Aroclor at its Newport (U.K.) plant since 1951.

Aroclor has been used in impregnated paper capacitors since its introduction into the industry. In more recent years its use has been extended to capacitors in which polypropylene film forms part of the dielectric.

Although most of the Aroclor impregnated capacitors operate at power frequency, some are used—with water cooling—at high frequencies, and some—with suitable additives—in d.c. circuits.

Advantages of Aroclor

1. Capacitors having the least volume and mass per unit of reactive power can be built.
2. Raw materials costs can be reduced because of this higher efficiency.
3. Labour costs can be reduced because smaller windings are required and plant throughput is increased.
4. Overload security is provided by uniform permittivity of impregnant and paper.
5. Long lasting capacitors result from high stability and resistance to oxidation.
6. Reduced fire hazard.

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The information, recommendations and suggestions made herein are offered in the light of prevailing legislation and on the basis of present scientific information (1972) available to Monsanto.

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TOWOLDMON0021270
WATER_PCB-00005739

Specified Properties of Aroclor

PROPERTY	TEST METHOD	UNIT	AROCLOR 1242	AROCLOR 1248	AROCLOR 1254
Appearance	ASTM D1702	—	Clear liquid free from suspended matter or sediment.		
Colour	ASTM D1702	APHA	50 max.	50 max.	50 max.
Density	ASTM D1810 and ISO/R649	g/cm³	1.380 to 1.390 at 20°C	1.450 to 1.470 at 20°C	1.470 to 1.490 at 90°C
Refractive Index at 20°C	ASTM D1807	—	1.6250 to 1.6270	1.6305 to 1.6325	1.6380 to 1.6400
Kinematic Viscosity	ASTM D445	cSt	55 to 71 at 20°C	3.4 to 4.5 at 90°C	7 to 10 at 90°C
Flash point	ASTM D92	°C	170 min.	190 min.	None to BP
Fire point	ASTM D92	°C	None to BP	None to BP	None to BP
Pour point	ASTM D97	°C	−18 max.	−6 max.	+12 max.
Neutralization Number	Monsanto	mg KOH/g	0.01 max.	0.01 max.	0.01 max.
Inorganic Chlorides	ASTM D1821	ppm Cl	0.05 max.	0.05 max.	0.05 max.
Hydrolyzable Chlorides	ASTM D2441	ppm Cl	1.0 max.	1.0 max.	1.0 max.
Water Content	ASTM D1533	ppm	30 max.	30 max.	30 max.
Resistivity at 100°C, 500V after 1 minute	Monsanto	Tαcm	2* min.	2 min.	2 min.
Dissipation Factor at 100°C, 50 Hz	Monsanto	%	2* max.	2 max.	2 max.
Relative Permittivity at 100°C, 50 Hz	Monsanto	—	4.7 to 4.9	4.5 to 4.8	4.15 to 4.35

*The value given in the table applies to bulk deliveries. For deliveries over long distances in drums the dissipation factor is increased to 4%, maximum, and the resistivity decreased to 1 Tαcm, minimum.

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Non-specified Properties of Aroclor

(Typical values are given for information only)

PROPERTY	UNIT	AROCLOR 1242	AROCLOR 1248	AROCLOR 1254
Mean coefficient of expansion over temperature range 20 to 90 °C *	10^{-4}/°C	6.8	6.8	6.6
Mean specific heat capacity over temperature range 20 to 90 °C	J/g°C	1.269	1.190	1.128
Thermal conductivity at 28 °C	W/m°C	0.1005	0.0988	0.0959
at 81 °C		0.0979	0.0967	0.0925
Vapour Pressure at 90 °C	10^{-3} torr	10	4	1.4
Surface tension at 20 °C	dyne/cm	45.3	44.2	—
at 25 °C		—	—	48.4

*Calculated from the formula $\beta = \frac{\ln(\rho_1/\rho_2)}{\Theta_2 - \Theta_1}$ where ρ_1 = density at temperature Θ_1, ρ_2 = density at temperature Θ_2

Storage, Handling and Disposal of Aroclor

Caution

Aroclor contains POLYCHLORINATED BIPHENYLS (PCB's) which some studies have shown may be persistent, an environmental contaminant and, possibly, injurious to certain forms of bird, aquatic and animal life.

Drums

Inside storage is recommended to prevent contamination of the product by water. If the drums have to be stored outside they should be stacked on their sides to prevent water accumulating around the bungs and being breathed into the drum during severe ambient temperature changes.

Drum storage areas should be organised so that any leakages are collected for safe disposal.

Partially emptied drums should not be left open to the air.

Bulk

The supply of Aroclor in bulk tank car loads, offers many advantages to medium and large volume users, compared with drum deliveries. Unloading, storing and transferring to the production unit is safer, easier, faster and cheaper. Material losses due to spillage and incomplete emptying of drums are eliminated. The possibility of product contamination during handling is greatly reduced.

Even where storage and handling facilities are not at present available, the economics of bulk handling may quickly pay for the tanks and piping systems required.

A booklet indicating the type of system necessary for the efficient handling of Aroclor in bulk is available from Monsanto.

As soon as a changeover to bulk delivery is contemplated, experienced Monsanto personnel will be available for site discussions regarding the most efficient type of installation for the particular location and an offloading procedure appropriate to that particular installation.

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Handling Precautions

Arcolor drums and containers carry the following label which gives general instructions for handling:

IMPORTANT **CHLORODIPHENYLS (42%-54%) (or 60%) (PCB)**

This product contains POLYCHLORINATED BIPHENYLS (PCB's) which some studies have shown may be persistent, an environmental contaminant and, possibly, injurious to certain forms of bird, aquatic and animal life.
PREVENT ANY ENTRY INTO THE ENVIRONMENT THROUGH SPILLS, LEAKAGE, DISPOSAL, VAPOURISATION, RE-USE OF CONTAINERS OR OTHERWISE.
SPILLS, LEAKAGES AND WASTE PRODUCT MUST BE COLLECTED.
Use of this product must be restricted to applications which can be controlled so that entry into the environment does not occur and to applications in which it cannot come into contact with food, animal feedstuffs or pharmaceuticals.
HARMFUL SUBSTANCE IF TAKEN INTERNALLY OR IF IN PROLONGED CONTACT WITH THE SKIN.
CAUSES IRRITATION OF SKIN AND EYES.
DURING SHIPMENT AVOID SPILLS AND LEAKAGE INTO INLAND WATERWAYS AND THE SEA.
Store away from food, animal feedstuffs and pharmaceuticals.
Keep container tightly closed.
Do not eat or smoke when using.
Avoid breathing vapours, mist or fumes.
Do not wear contaminated clothing.
Wash product from skin with soap and water.
Wash eyes by flushing with water.

In addition to the foregoing we can add that:

1. Animal toxicity tests (small mammals) indicate that acute oral toxicity is low but that acute dermal toxicity may be moderate.
2. When handling the fluid minimise contact with the skin and wash any off with soap and water. People with sensitive skins should wear gloves resistant to chlorinated solvents or apply a silicone hand cream.
3. Should Arcolor accidentally splash or be rubbed into the eyes, they should be rinsed thoroughly with water for a few minutes. It is suggested that all operators be provided with safety glasses as Arcolor will cause pain if it gets into the eyes.
4. Elementary rules of hygiene should be applied—such as not smoking, eating or drinking during handling and contaminated clothing should be discarded.
5. Arcolor should be handled at ambient temperatures in well ventilated areas. If hot Arcolor has to be handled, a respirator with an active carbon canister should be worn.

Disposal of empty drums and waste Arcolor

Empty drums should not be re-used for anything except scrap Arcolor. Unwanted empty drums should be disposed of by a specialised waste disposal contractor familiar with PCB's who will crush the drums and bury them on an approved toxic dump in accordance with local regulations. Handling of Arcolor in bulk will minimise the problems associated with handling of drums. Waste Arcolor should be disposed of by special high temperature incineration at 1000°C minimum with a residence time of 1.5 seconds or longer or alternatively by a method conforming to local regulations.

Care must be exercised during such disposal and the ultimate use of Arcolor to avoid pollution, particularly of sewers and waterways.

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