numerical standard for all of the United States. The principal considerations which support the case-by-case approach rather than the proposed single across-the-board approach are as follows:

(a) It is my understanding that the United States capacitor industry is now committed to the use of Aroclor 1016.

(b) There is a significant difference (3 fold or more) between Aroclor 1016 and the more chlorinated Aroclors 1254 and 1260 in persistence/bioaccumulation.

(c) The most technically reliable bases for bioaccumulation criteria are the averages of existing observations. These are:

Aroclor 1016	14,225 (nominal water concentration) */ 30,700 (measured water concentration) */
Aroclor 1242	64,000 **/
Aroclor 1254	194,000 **/

(d) The more conservative approach used in the EPA Criteria Document of selecting the highest reported value from laboratory studies (but then modified by ignoring the

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*/ See Exhibit E.

**/ See Exhibit F.

apparently anamalous data) produce the following bioaccumulation criteria:

Aroclor 1016	50,000 (nominal water concentration) 73,300 (measured water concentration) [**]
Aroclor 1242	107,000 [**]
Aroclor 1254	307,000

(e) Using these data, the appropriate water criteria to avoid exceeding the 5 ppm FDA limit on food for human consumption would then be:

(i) for the average case:

	BIOCONCENTRATION CRITERIA	WATER CRITERIA
Aroclor 1016	14,225 [*]	0.35 ug/l
	30,700	0.16 ug/l
Aroclor 1242	64,000 [**]	0.078 ug/l
Aroclor 1254	194,000 [**]	0.026 ug/l

(ii) for the conservative case:

	BIOCONCENTRATION CRITERIA	WATER CRITERIA
Aroclor 1016	50,000 [*]	0.1 ug/l
	73,300 [**]	0.068 ug/l
Aroclor 1242	107,000 [**]	0.046 ug/l
Aroclor 1254	307,000	0.016 ug/l

There is for both of these approaches a built-in 3-4 fold safety factor in that these criteria are designed to keep residues in whole fish at or below 5 ppm, whereas on the average, the portion of fish normally eaten

[*] See Exhibit E.

[**] See Exhibit F.

EXHIBIT C

BIOCONCENTRATION FACTOR FOR AROCLORS 1016
AND 1254 BY SHEEPSHEAD MINNOW ADULTS */

NOMINAL WATER CONCENTRATION ug/l	CONCENTRATION FACTOR# AROCLOR 1016	1254
0.10	8,400	22,000
0.32	4,700	30,000
1.00	8,700	25,000
3.20	10,500	15,000
10.00	———	NA
	$\bar{X}$ 8,000	23,000

Ratio Aroclor 1254 to 1016 = 2.8:1

#Exposure time 28 days

*/ Hansen, David J., Steven C. Schimmel and Jerrold Forester. 1975. Effects of Aroclor 1016 on embryos, fry, juvenile and adults of sheepshead minnows (Cyprinodon variegatus). Trans. Amer. Fish. Soc. 104(3):583-586.

Hansen, David J., Steven C. Schimmel and Jerrold Forester. 1973. Aroclor 1254 in eggs of sheepshead minnows: effect on fertilization, success and survival of embryos and fry. In: Pro. 27th Ann. Conf. Southeastern Associate of Game and Fish Commissioners.

EXHIBIT D: COMPARISON OF BIOACCUMULATION FACTORS OF AROCLORS 1016, 1242 and 1254.

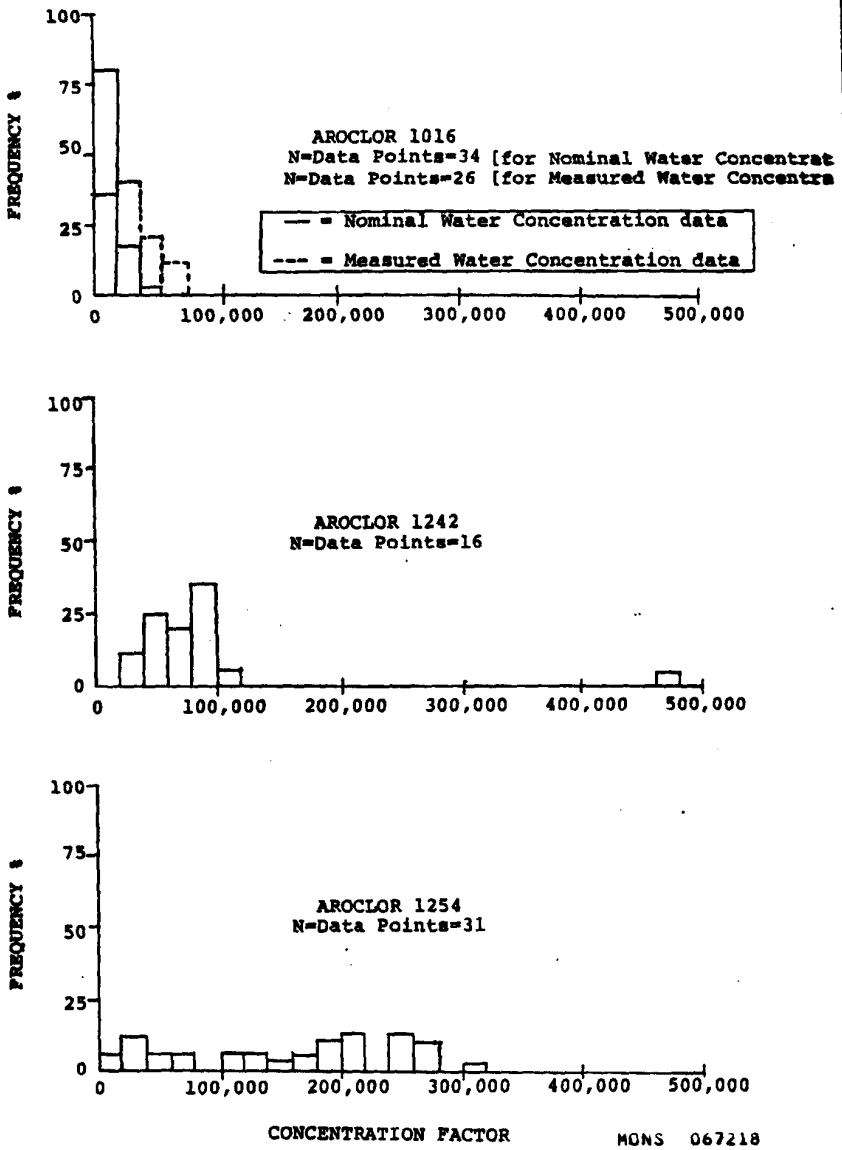

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EXHIBIT E

BIOCONCENTRATION OF AROCLORS 1016 AND 1254 IN SHEEPSHEAD MINNOWS, PINFISH AND FATHEAD MINNOWS

ORGANISM	LIFE STAGE	NOMINAL WATER CONCENTRATION ug/l	CONCENTRATION FACTOR 1016	CONCENTRATION FACTOR 1254	MEASURED WATER CONCENTRATION 1016 ug/l	MEASURED WATER CONCENTRATION 1254 ug/l	CONCENTRATION FACTOR 1016	CONCENTRATION FACTOR 1254
Sheepshead[a/] 1/ Minnow	Juvenile	0.10	23,000		ND			
	Adult	0.10	8,400	22,000	ND	0.09		24,000
	Fry	0.32	2,500		ND			
	Juvenile	0.32	28,000		ND			
	Adult	0.32	4,700	30,000	ND	0.14		68,000
	Fry	1.00	4,900		0.46		10,700	
	Fry	1.00	5,900		0.29		20,300	
	Juvenile	1.00	11,000		0.46		23,913	
	Juvenile	1.00	10,000		0.29		34,500	
	Adult	1.00	12,000		0.46		26,100	
	Adult	1.00	5,400	25,000	0.29	0.39	18,600	64,000
	Fry	3.20	6,900		1.40		15,700	
	Fry	3.20	8,100		1.00		26,000	
	Juvenile	3.20	25,000		1.40		56,400	
	Juvenile	3.20	17,000		1.00		54,000	
	Adult	3.20	14,000		1.40		32,900	

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BIOCONCENTRATION OF AROCLORS 1016 AND 1254 IN SHEEPSHEAD MINNOWS, PINFISH AND FATHEAD MINNOWS

ORGANISM	LIFE STAGE	NOMINAL WATER CONCENTRATION ug/l	CONCENTRATION FACTOR 1016	CONCENTRATION FACTOR 1254	MEASURED WATER CONCENTRATION 1016 ug/l	MEASURED WATER CONCENTRATION 1254 ug/l	CONCENTRATION FACTOR 1016	CONCENTRATION FACTOR 1254
Sheepshead Minnow (cont.)	Adult	3.20	6,900	15,000	1.8	1.1	22,000	44,500
	Fry	10.00	3,800		5.5		6,900	
	Fry	10.00	5,700		3.4		16,800	
	Juvenile	10.00	23,000		5.5		41,800	
	Juvenile	10.00	22,000		3.4		64,700	
	Adult	10.00	10,000		5.5		18,200	
	Adult	10.00	11,000		3.4		32,400	
	Juvenile				15.		73,300	
	Fry				15.		13,300	
	MEAN DATA FOR ADULTS		$\bar{X}$ 8,000	$\bar{X}$ 23,000				
Pinfish[aa/] [2/]		0.10	24,000		ND			
		1.00	11,000		0.8		13,750	
		10.00	17,000		3.0		55,300	
		1.00	17,000		0.9		18,900	
		3.20	20,000		2.5		26,000	
		10.00	17,000		7.0		24,300	
		32.00	19,000		13.0		47,700	

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BIOCONCENTRATION OF AROCLORS 1016 AND 1254 IN
SHEEPSHEAD MINNOWS, PINFISH AND FATHEAD MINNOWS

ORGANISM	LIFE STAGE	NOMINAL WATER CONCENTRATION ug/l	CONCENTRATION FACTOR 1016	CONCENTRATION FACTOR 1254	MEASURED WATER CONCENTRATION 1016 ug/l	MEASURED WATER CONCENTRATION 1254 ug/l	CONCENTRATION FACTOR 1016	CONCENTRATION FACTOR 1254
Pinfish (cont.)		10.00	11,000		6.8		16,300	
		32.00	3,000 3/		21.		5,000 3/	
		100.00	2,000 3/		59.		3,500 3/	
Fathead Minnow	***/	13.00 4/	50,000 4/		10.0 4/		50,000 4/	
TOTAL			X̄ 14,225	X̄ 23,000			X̄ 30,700	

1/ Exposure time 28 days.

2/ Exposure time 42 days except at concentration factors 3,000 and 2,000 where 33 and 18 days respectively.

3/ These circled values appear to be unusually low anomalies and have not been included in computation of average or range of bioaccumulation factors for Aroclor 1016. See original publication for probable reason for these anomalies.

4/ Steady state attained in one week; Exposure time 32 days.

Veith's 50,000 concentration factor for 1016 is reported for both the nominal and the measured water concentration data; it is uncertain how the data should be properly reported, given the different water concentration values measured in the experiment over time. The dose rate was reported at 13 ppb, and measured values at the end of the experiment were approximately 10 ppb. Veith reports the 50,000 concentration at the measured 10 ppb levels; rather than recalculate a lower concentration factor for the nominal water concentration of 13 ppb, the 50,000 factor is repeated for purposes of this analysis.

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BIOCONCENTRATION OF AROCLORS 1016 AND 1254
IN SHEEPSHEAD MINNOWS, PINFISH AND FATHEAD MINNOWS

REFERENCES

*/ Hansen, David J., Steven C. Schimmel and Jerrold Forester. 1975. Effects of Aroclor 1016 on embryos, fry, juvenile and adults of sheepshead minnows (Cyprinodon variegatus). Trans. Amer. Fish. Soc. 104(3): 583-586; Hansen, David J., Steven C. Schimmel and Jerrold Forester. 1973. Aroclor 1254 in eggs of sheepshead minnows: effect on fertilization, success and survival of embryos and fry. In: Proc. 27th Ann. Conf. Southeastern Associate of Game and Fish Commissioners.

**/ Hansen, David J., P.R. Parrish and J. Forester. 1974. Aroclor 1016: toxicity to uptake by estuarine animals. Environmental Research 9(3):363-373.

***/ Veith, Gilman D. and L. Kiwus. 1975. Uptake of Aroclor 1016 by fish. I. Laboratory bioaccumulation studies with fathead minnows. Unpublished report, U.S. Environmental Protection Agency, Environmental Research Laboratory, Duluth, Minn. (cited as Reference 338 in EPA Criteria Document, at page 295).