Monsanto

FROM (NAME & LOCATION): P. G. Benignus-St. Louis

DATE: February 1, 1974

SUBJECT: ELECTRONIC COMPONENTS, INC. BRIDGEPORT, CONN. (Capacitors)

REFERENCE:

TO: C. Paton
B2SC

cc: H. S. Bergen
T. L. Gossage
R. H. Munch
W. R. Richard
P. L. Slayton (w/o Att.)
J. G. Bryant (w/o Att.)

Mr. Ray Clark, General Manager
Mr. Glenn Rayno, Tech. Director

Monsanto Representatives: J. G. Bryant
P. G. Benignus

Subj: Comparative Evaluation of Aroclor 1016, MCS 1489 and MCS 1475

Glen Rayno

The studies made by EC are very informative. These life tests were supervised by Glen Rayno, formerly with GE at Hudson Falls. During a good number of years, over half of the very large amount of capacitor life testing done by GE was under his supervision. Through all of this, he has developed expertise on judgement based on Insulation Resistance values. He places much less credence on power factor values. Glen Rayno and Gene Cox monitored and put to commercial practice every important development at Hudson Falls, dating back to about 1960. This includes the epoxide and plastic film developments.

Ray Clark

Years ago Ray managed the engineering of GE's ballast capacitor operation at Ft. Edward. The comparative studies of our dielectric fluids by these people are very helpful, both from the standpoint of capacitor performance and realistic economics. Complete technical data is attached for Drs. Munch and Richard.

A comparative brief summary in general terms is:

IN - 10 REV. 1/72

I. Comparative Values of the Capacitors

	Power Factor 100C	Insulation Resistance 100C
Aroclor 1016	Good - stable	Good - stable
MCS 1489	Not quite as good as Aroclor 1016, but rated good - stable	Good - stable
MCS 1475	Not good and unacceptable stability	Not good and unacceptable

Electronic components feel certain that MCS 1489 can be used without trouble to replace Aroclor 1016

But their results from their MCS 1475 capacitors are judged to be unacceptable.

II. Economic MCS 1489 vs. Aroclor 1016

Based on 31.5¢/lb. vs. 20.5¢/lb. for Aroclor 1016, EC gave us a detailed breakdown of savings relative to paper, foil, winding labor, Aroclor, and cans. The following summarizes this in terms of cents for each general type capacitor.

Capacitor Types	Their Importance To EC's Business	Price of Capacitors	Savings-Cents per Capacitor	Savings- % Per Capacitor
Fluorescent ballast 3.95/.05 nf-330V	90% of EC Bus. 20M units/year	$0.40 to $0.80	0.28 cents	0.5%
Motor-run room air conditioner 15 nf-370V	Small	$0.90 to $1.80	3.87 to 4.81	3.2%
Mercury vapor lighting - HLD-24 nf-440V 35 nf 280V	Small	$2 to $3	8 to 16	5.0%
Motor-run central air conditioning 35 nf-370V 35 nf-440V	Small	$3 to $4	10.5 to 22.5	5.0%

EC's COMMENTS

1. 90% of EC's business is fluorescent ballast. In this category the saving is only about 1/4 of one cent per capacitor. When the saving is so small it can be lost, easily. They would not adopt MCS 1489 unless saving of 0.75 to 1.0 cent per capacitor could be assured.

2. In the other categories the saving is readily apparent but EC are small (10%) in these areas.

3. While EC would not adopt MCS 1489 at 31.5¢/lb., they raised the interesting question -- "Since they must themselves incorporate the epoxide additive, could we sell them the DK enhancement additive? This would allow EC to incorporate it to maximum advantage in the different areas."

4. EC discussed in some detail an economic squeeze of serious consequences in their particular operation. They keenly feel that they must save 5 cents per capacitor. They believe this possible by going to a dry-film unit. However, they hold interest in our MCS 1489 "concept" as the only means to off-set the dry-film approach.

5. EC cannot see how they (EC) can make an all PPL film-liquid impregnated (Aroclor) unit, economically. They believe that one must make his own film (like GE) to do this.

6. EC want to stay with PCB units because they are stable and they do not burn. They fear that especially an ester type unit is not stable and they fear not having had experience with other non-PCB fluids relative to possible burning hazard.

   They are aware of the import of the PCB ecological-water pollution matter now up in Washington.

7. As the Government makes EC liable, they would not go with our hydrocarbon base fluid unless the Government approved it from the safety point of view. Room air conditioners are near curtains. When GE had instability (blow-up epedemic) with PCB units prior to epoxide additives, there were air conditioner fires to a serious extent and concern; not due to Aroclor fluid burning but due to flammable materials around the failed unit. EC worry that non-PCB capacitors not proved as stable as 1016 would repeat this problem and greatly intensify it.

EC offer to work with Monsanto to investigate the potential problems of flammability regards non-PCB capacitors in conditioners and lighting probed in in a practical end-use way -- not as a laboratory experiment.

8. EC would be pleased, in any event, to life test our best hydrocarbon based candidate.

Paul Benignus

P. G. Benignus

/bi

Savings Available for 1489 vs. 1016 (1/29/74)
1489 @ 31.5¢ vs. 1015 @ 20.5¢/lb.
VARIANCES -5/C

Figures in brackets is cents saving per capacitor

	Capacitor	Foil	Paper	Winding Losses	Aroclor	Can	Teflo
Fluorescent ballast, big vol. Make 20M units/yr. Capacitor costs $0.40-$0.80	1.9-600	(.48)	(.87)	(.01)	.85	—	(.51)
	3.95/.05-330	(.60)	(.52)	(.03)	.87	—	*(.28)
	4.2/.075-525	(.85)	(1.88)	(.83)	1.95	—	(1.61)
Motor-run, room air conditioner $0.90 to $1.80	5-370 (STD. CAN)	(.92)	(1.68)	(.10)	1.29	—	(1.41)
	5/16" SHORTER CAN	(.92)	(1.68)	.06	.98	(1.65)	(3.21)
	15-370 (STD. CAN)	(3.24)	(5.46)	(.50)	5.33	—	(3.82)
	3/8" SHORTER CAN	(3.24)	(5.46)	—	3.89	—	(4.81)
Mercury vapor lighting HID $2 to $3	17.5-280 (STD. CAN)	(2.90)	(5.05)	(.21)	4.16	—	(4.00)
	3/8" SHORTER CAN	(2.90)	(5.05)	(.21)	2.98	—	(5.18)
	24-440 (STD. CAN)	(7.19)	(11.14)	(.39)	8.94	—	(9.72)
	1/2" SHORTER CAN	(7.19)	(11.14)	(.17)	6.99	—	(11.51)
	3/4" SHORTER CAN	(7.19)	(11.14)	—	5.70	(4.79)	(17.42)
	35-280 (STD CAN)	(5.90)	(9.95)	(.43)	7.93	—	(8.35)
	3/4" SHORTER CAN	(5.90)	(9.95)	.27	4.87	(5.38)	(16.09)
Motor-run central air conditioning $3 to $4	35-370 (STD. CAN)	(7.76)	(12.71)	(.27)	10.36	—	(10.38)
	1/2" SHORTER CAN	(7.76)	(12.71)	(.18)	8.04	(9.44)	(22.55)
	35-440 (STD. CAN)	(10.72)	(16.84)	(.69)	13.31	—	(14.24)
	1/2" SHORTER CAN	(10.72)	(16.84)	(.19)	9.59	—	(17.15)

*Would not convert @ 1/4 cent saving

MONS 029120

Rayon, 3.95 u/ 330 Volts 350 V max
Tested at 440 Volts and 150 c

Subject: Monsanto Samples as of 1000 AM [illegible]

1489 PF 100°C			1489 IR 100°C		
	[illegible]	1651 hrs	Initial	[illegible]	1651 hrs
.47	.45	.48	20	32	16.5
.47	.47	.50	15	28	15.5
.43	.40	.44	19	30	16
.43	.42	.43	19	24	21
.47	.46	.46	18	28	22
.42	.37	.42	21	22	21
.46	.45	.54	19	30	15
.46	.45	.55	17	24	13.5

1489 NO FAILURES AFTER 1651 hrs

PF 100°C			1016 IR 100°C		
	[illegible]	1651 hrs	Initial	1131 hrs	1651 hrs
.36	.36	.39	mig/hmt 35	35	28
.36	.37	.36	36	35	23.5
.35	.35	.28	37	39	31
	[illegible] @ 48 hrs Indeterminate		41	made a bad capacity failed in 48 hrs [illegible]	
.32	.33	.38	41	39	25
.36	.35	.42	43	40	28
.32	.33	.34	42	40	28
.31	.31	.35	47	42	32

MONS 029121

1016 1 (ONE) FAILURE AFTER 1651 hrs

1475 PF 100°C		1475 IC 100°C	
Initial	496 hrs.	Initial	496 hrs.
.50	.32	12	14
.83	Thermal @ 371 hrs.	10	✓
.48	.72	12	8.5 ✓
.49	Indeterminate @ 371 hrs.	11	✓
.20	.80	14	7.8 ✓
.56	.76	12	8.0 ✓
.58	.60	11	11.5
.49	.55	12	9.5 ✓

2 Failures @ 371 hrs.

IR below 10 meg ohms terminal to terminal 1 min charge 500 V DC indicates Job King the [illegible] 1/27/74 will fail

Reyno said 1475 not in same ball park with 1016 and 1489

MONS 029122

Mr. Rayns;

Subject: Electrical and Chemical test run on Monsanto Samples 1489 and 1475 in comparison to Monsanto 1016.

8 capacitors of 3.95/05 of 330 vac impregnated with MCS 1489 have been on life test for approximately 1131 hrs, along with 8 capacitors of same rating impregnated with 1016 aroclor from our regular production. They are running at 100°C and 440 vac.

1131 hrs. Recheck 100°C 1489.			1131 hrs. Recheck 100°C 1016		
	P.F.	IR (Meg Ω)		P.F.	IR (Meg Ω)
1.	.45	32	1.	.36	38
2.	.47	28	2.	.37	35
3.	.40	30	3.	.35	39
4.	.42	24	4.	.33	39
5.	.46	28	5.	.33	39
6.	.37	22	6.	.35	40
7.	.43	30	7.	.33	40
8.	.48	24	8.	.32	42

Testing numbers 1 thru 8
1475 [illegible] on test 12/6/73

Bob King
12/6/73

MONS 029123

Monsanto Samples.

1489

Resistivity 335×10^9
Power Fact. 0.56
Hydroscopic Stability .213
Thermal Stability .091
Free Chlorides .017
Dielectric Constant 5.8

1475

Resistivity 110×10^9
Power Fact. 0.68
Hydroscopic Stability .284
Thermal Stability .098
Free Chloride .026
Dielectric Constant 1.6

Tests of [illegible] 6.5 cc of 230 VAC
[illegible] with 1.0% by weight and
.35% by weight of additive.

GR Cap. 25°C pf	Lo-Voltage-Bridge P.F. 25°C 60Hz %	P.F. /100. 60Hz %	OIL RES 25°C	GR BRIDGE I.R 300V ½ min CHARGE 25° C	Read-Megs 100° C	Schering Bridge - Rated Vol Cap 25°C pf	Cap 100°C pf	P.F. 25°C %	Pr
4.11/.046	.4	.45	[illegible]	3050	35	4.1081	3.8993	.46	.36
4.14/.0469	.4	.5	[illegible]	2875	36	4.1302	39371	.46	.36
4.13/.0465	.35	.4	[illegible]	3200	37	4.1096	3.9015	.42	.35
4.11/.0474	.32	.4	[illegible]	3500	41	4.1024	3.9122	.45	.37
4.14/.049	.32	.5	[illegible]	3150	41	4.1348	3.9415	.45	.36
4.04/.0473	.3	.45	[illegible]	2950	43	4.0273	3.826	.42	.36
4.12/.0435	.35	.45	[illegible]	2875	42	4.108	3.9089	.46	.36
3.91/.0417	.35	.35	[illegible]	2725	47	3.883	3.6936	.39	.31
4.07/.05	.4	.5	[illegible]	2425	44	4.0562	3.8435	.42	.36
4.13/.045	.33	.4	[illegible]	2400	38	4.1167	3.9115	.45	.36
4.15/.0421	.35	.5	[illegible]	2000	36	4.1463	3.9382	.46	.38
3.91/.042	.3	.35	[illegible]	2500	42	3.8843	3.6947	.36	.34
4.07/.0494	.32	.45	[illegible]	2650	38	4.075	3.8245	.45	.37
4.13/.0494	.4	.4	[illegible]	2500	41	4.1159	3.9159	.42	.36
4.14/.046	.4	.45	[illegible]	2700	39	4.1277	3.9285	.42	.36
4.19/.045	.4	.45	[illegible]	2300	36	4.1736	3.9737	.42	.36

Not meaningful

Abnormal Readings on Dielectric Absorption (Checked some Tettona Units, these were abnormal readings
Foxboro Tester Manufacturer.

Tettona Units

1	188/36	8
2		6
3		7 3[illegible]

MONS 029125

TEST RUN ON 395/[illegible] of 330 VAC
IMPREGNATED WITH MCS 1429 ADDITIVE
AND .35% by weight of ADDITIVE.

GR Cap 25°C µf	Lo-Voltage-Bridge P.F. 25°C 60Hz %	Lo-Voltage-Bridge P.F. 100°C 60Hz %	Diel Abs 25°C	GR Bridge I.R. 300V ½ min charge ½ min Read - Meg Ω 25°C	GR Bridge I.R. 300V ½ min charge ½ min Read - Meg Ω 100°C	Scheering Bridge-Rated Voltage Cap 25°C µf	Scheering Bridge-Rated Voltage Cap 100°C µf	Scheering Bridge-Rated Voltage P.F. 25°C %	Scheering Bridge-Rated Voltage P.F. 100°C %
4.59/.0555	.6	1.1	* 36/23	3000	20	4.5635	4.3612	.63	.47
4.57/.0486	.6	.9	60/24	2700	15	4.5612	4.3464	.64	.47
4.55/.0521	.55	.9	75/47	2500	19	4.5325	4.3351	.61	.43
4.48/.0475	.52	.9	81/44	2300	19	4.4587	4.2558	.60	.43
4.63/.0576	.57	.85	45/32	2200	18	4.6047	4.4064	.61	.47
4.36/.0487	.5	.8	42/44	2150	21	4.3378	4.1472	.57	.42
4.52/.051	.61	1.0	48/26	1700	19	4.4929	4.3038	.62	.44
4.66/.0568	.59	.95	37/46	1750	17	4.6295	4.4251	.64	.46
4.64/.0486	.58	.9	40/50	1800	17	4.6136	4.409	.64	.47
4.65/.0464	.58	1.0	51/54	1725	17	4.6171	4.4118	.62	.47
4.55/.051	.55	.9	51/74	1900	20	4.5268	4.3336	.56	.44
4.37/.0487	.6	.8	100/56	1875	20	4.3553	4.1587	.62	.42
4.56/.051	.55	.85	100/26	1700	21	4.5352	4.3362	.59	.42
4.52/.05	.5	.9	45/30	1700	22	4.4281	4.2867	.51	.42
4.56/.0473	.55	.95	95/51	1750	19	4.5292	4.3377	.58	.44
4.6/.0497	.6	.95	100/40	2000	18	4.5677	4.3744	.62	.44

MONS 029126

Test Run on 275/50 of 330 mc impregnated with mix MTS 63x/6x and .35 % by weight of additive

GR Cap 25°C wf	Lu - Voltage Bridge Pf. 25° 60 Hz %	Pf. 100° 60 Hz %	DF Bridge 25° C	GR Bridge IR 300 1 min charge 1 min load - Megohms 25° C	100° C	Schering Bridge - Cap 25° C wf	Cap 100° C wf	Power Factor Pf. 25° %	Pf. 100° %
3975/.043	1.0	1.0	68	1650	12	3.9608	3.7907	.641	.8C
4.2/.0441	1.0	1.1	42	1450	10	4.2137	4.104	.789	.8E
41/.051	.9	.95	37	1900	12	4.1012	3.9352	.717	.9
422/.0472	.8	.9	28	1675	11	4.2342	4.0775	.787	.5
404/.0432	.85	.95	28	1700	14	4.0502	3.917	.768	.2
4.22/.0461	.8	.9	20	1675	12	4.2023	4.0425	.681	.5
427/.0494	.9	1.0	30	1300	11	4.2745	4.1307	.766	.5
424/.047	.95	1.2	58	1750	12	4.2271	4.0559	.729	.4
3.99/.0422	.8	.9	31	1600	14	3.9879	3.8367	.534	.5
407/.0437	1.0	1.0	44	1625	15	4.0634	3.9295	.713	.5
411/.0468	.95	.85	58	1925	12	4.113	3.9757	.790	.6
425/.0487	.9	1.0	60	1350	12	4.25	4.0931	.737	.5
416/.0458	.95	1.1	62	1275	11	4.18	4.0836	.936	.6
4.12/.053	.95	1.1	60	1300	12	4.1319	3.9763	.835	.6
422/.0465	.95	.95	60	1250	13	4.221	4.060	.690	.4

Leaky Area

Units started out bad and stayed bad — The only sample of 1470 gave manual breakdown at 1489 and held it to 1500.

MONS 029127